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SINTEF REPORT

TITLE

ARKTRANS
The Norwegian system framework architecture for multimodal transport systems supporting freight and passenger transport

Version 5.0

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ABSTRACT

The four transport modes, road, sea, air and railway, have identical needs and challenges with respect to freight and passenger transport related to the use of information and communication technology (ICT). They also see much of the same shortcomings related to the transport preparation and planning, transport services, information services, handling of dangerous goods, etc.

ARKTRANS, the Norwegian system framework architecture for multimodal freigth and passenger transport, provides a harmonized view upon the transport domain that will contribute to new and improved solutions. The first versions of ARKTRANS were established in a research project. The current version is established in a follow-up project managed by ITS Norway. Norwegian transport authorities and stakeholders representing all transport modes (road, sea, air and railway) have contributed to the work.

ARKTRANS specifies:

- A reference model describing the sub-domains of the transport domain
- Roles of the stakeholders in the transport domain
- A functional view that specifies and structures the functionality needed within the sub-domains
- A behavior view describing scenarios and interactions between the sub-domains
- An information view describing conceptual information models for freight transport and multimodal route information
- Technical aspects

KEYWORDS	ENGLISH	NORWEGIAN
GROUP 1	ICT	IKT
GROUP 2	Transport	Transport
SELECTED BY AUTHOR	System Architecture	Systemarkitektur
	Multimodal	Multimodal
	Freight and passenger transport	Gods- og passasjertransport

Preface

ARKTRANS is the Norwegian system framework architecture for multimodal freight and passenger transport. The work on ARKTRANS was established by Norwegian transport authorities. A pilot study was done in 2001, and this work resulted in the first version of ARKTRANS . The overall structuring of the work was done by identifying the sub-domains of the ARKTRANS reference model.

The research project, co-funded by the Research Council of Norway, was started in January 2002 and ended in 2004. The project participants were the Public Road Administration, the Norwegian Coastal Administration, Avinor (the Norwegian civil aviation administration), the Norwegian National Rail Administration, the Norwegian State Railways, the Federation of Norwegian Transport Companies, Telenor, and the ERGO Group. They all contributed to the work by providing input, by participating in work groups, and by commenting on preliminary results. The work would have been impossible without their knowledge about the transport domain. SINTEF has been responsible for the coordination and management of the project, and they have also established the architecture. In January 2003, 2004 and 2005 version 2.0 , 3.0 and 4.0 of ARKTRANS were issued respectively.

After the research project, ITS Norway took the responsibility for further development of ARKTRANS, and this version, ARKTRANS version 5.0, is established based upon founding from the Norwegian Ministry of Transport and Communications and the Norwegian Public Road Administration. For more information see www.arktrans.no or www.its-norway.no.

In addition to the project participants mentioned above, other stakeholders in the transport domain have contributed to the work by participating in working groups. These groups have been crucial to the establishment of the overall parts of the architecture. We would like to acknowledge the Norwegian Hauler’s Association, CargoNet, Norsk Reiseinformasjon, Trafikanten in Oslo and Akershus, Trafikanten in Møre og Romsdal, SAS Braathens AS, and the FARGIS Forum. We also want to acknowledge Kay Fjørtoft, MARINTEK, and Per Lillestøl, SINTEF, in this respect. Others stakeholders have also contributed, but they are too many to be mentioned here.

ARKTRANS is used in several projects, among others the MultiRIT research project that will develop new and improved travel information services based on ARKTRANS. The work in the research projects as well as in other projects using ARKTRANS will provide input to the further work on refining the framework.

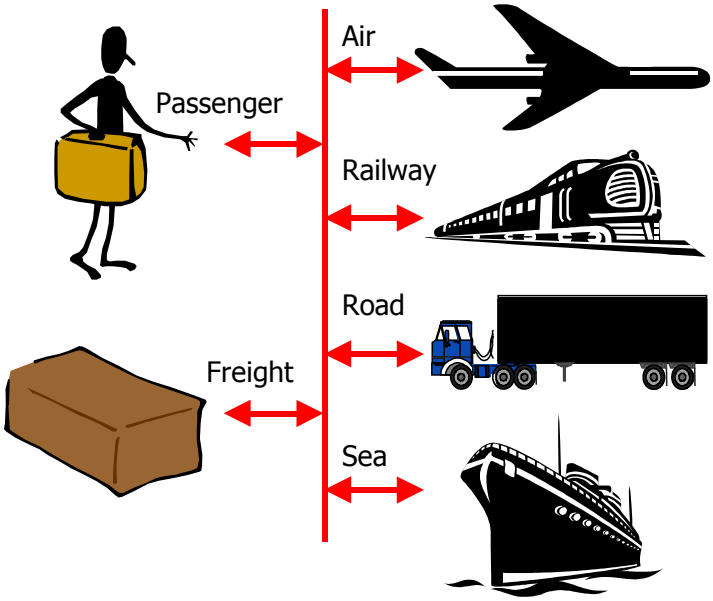
TABLE OF CONTENTS

Abbreviations

ACID	Atomicity, Consistency, Isolation, and Durability
AIS	Automatic identification System
API	Application Programming Interface
ATA	Actual Time of Arrival
ATC	Automated Traffic Control
ATD	Actual Time of Departure
ATM	Automated Teller Machine
ATP	Actual Transport Preferences
B2B	Business-to-Business
BCF	Business Collaboration Framework
BOD	Business Object Document
BPEL	Business Process Execution Language
BPEL4WS	Business Process Execution Language for Web Services
BPML	Business Process Modelling Language
BPSS	Business Process Specification Schema
BTP	Business Transaction Protocol
CEFACT	Centre for Trade Facilitation and Electronic Business
CEN	The European Committee for Standardization
COTS	Commercial Off-The-Shelf
CPP	Collaboration Protocol Profile
CPPA	Collaboration-Protocol Profile and Agreement Specification
D2D	Door-to-Door
DAML-S	DARPA Agent Mark up Language for Services
DBMS	DataBase Management System
DDA	Disability Discrimination Act
DFD	Data Flow Diagrams
ebMS	ebXML Messaging Specification
ebXML	Electronic Business using eXtensible Markup Language
EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange For Administration, Commerce, and Transport
EDS	Electronic Data Systems
EMS	Emergency Medical Services
ER-diagram	Entity-Relationship diagram
ETA	Estimated Time of Arrival
ETD	Estimated Time of departure
EU	European Union
GSM	Global System for Mobile Communications
GTP	General Transport Preferences
IATA	International Air Transport Association
ICF	International Classification of Functioning
ICT	Information and Communication Technology
ID	Identity/Identifier
IIOP	Internet InterOperability Protocol
ISO	International Standards Organization
ITS	Intelligent Transport Systems and services
JAR-OPS	Joint Aviation Requirements Operation
LAN	Local Area Network
LE	Large Enterprise
MFAG	Medical First Aid Guide
MIG	Message Implementation Guidelines
MIME	Multipurpose Internet Mail Extensions
MS	Message Service

MSH	Message Service Handler
NCSU	North Carolina State University
NOIE	National Office for the Information Economy
OAGi	Open Applications Group
OAGIS	Open Applications Group Integration Specification
OASIS	Organization for the Advancement of Structured Information Standards
PT	Public Transport
RFID	Radio Frequency Identification
RMI	Remote Method Invocation
RM-ODP	Open Distributed Processing – Reference Model
RPC	Remote Procedure Call
RUP	Rational Unified Process
SAML	Security Assertion Markup Language
SME	Small & Medium Enterprise
SMS	Short Message Service
SMTP	Simple Mail Transfer Protocol
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
SQL	Structured Query Language
SSIM	Standard Schedules Information Manual
TC	Technical Committee
TCC	Traffic Control Central
TIC	Traffic Information Central
TRIDENT	Transport Intermodal Data sharing and Exchange NeTworks
TRIM	Transport Reference Information Model
TRP	Transport Routing & Packaging
UD	Universal Design
UDDI	Universal Description, Discovery and Integration
UIC	Union Internationale des Chemins de Fer (International Union of Railways)
ULD	Unit Load Device
UML	Unified Modelling Language
UMTS	Universal Mobile Telecommunications System
UN	United Nations
VHF	Very High Frequency
VIP	Very Important Person
VTS	Vessel Traffic Services
W3C	World-Wide-Web Consortium
WHO	World health Organization
WS	Web-services
WSCI	Web Service Choreography Interface
WSCL	Web Service Conversation Language
WSDL	Web-services Definition Language
WSEL	Web service Endpoint Language
WS-I	Web Service Interoperability Organization
WWW	World-Wide-Web
XACML	eXtensible Access Control Markup Language
XML	Extensible Markup Language

1Introduction



ARKTRANS is the Norwegian system framework architecture for the transport sector. ARKTRANS is the result of a comprehensive study of all transport modes (road, sea, rail and air). The framework architecture is harmonised across all transport modes, meaning it is a multi modal architecture. ARKTRANS is also harmonised across freight and passenger transport. The pursuance of the work with ARKTRANS is ensured by ITS Norway. See www.arktrans.no or www.its-norway.no for more information.

1.1Background and Motivation

The current traffic situation is dominated by severe problems mainly related to road transport, like congestions, a high number of casualties, and air pollution. Increased use of other transport modes, preferably rail and sea, will improve the situation . However, most departure and destination points are not located next to ports or rail terminals, and a door-to-door transport operation involving sea or rail transport will in most cases require a multimodal transport chain. A multimodal transport chain will always involve many actors, and the establishment and management of such chains usually require a considerable amount of coordination and information exchange. It is the belief that such chains can become more competitive by means of interoperable ICT solutions . Planning of such chains, as well as coordination and information exchange, and detection of deviations and incidents can be automated or supported in a more efficient way. Delays in one part of a chain may for example be reported in time and enable corrective actions in the remaining chain.

Openness and interoperability are prerequisites for the desired solutions. Systems and services from different vendors, and systems that are owned or operated by different stakeholders must be able to interact. It has also been important to develop a framework architecture which can embrace both existing and planned information systems. A system framework architecture for the transport domain may arrange for such solutions, and may also benefit the society in general. Safety and efficiency can be promoted , and the system framework architecture may also arrange for new and improved services.

1.1.1Multimodality

ARKTRANS is multimodal in the sense that the framework is common and harmonized for all the transport modes, road, sea, air and rail. There are of course differences between the transport modes. However, the similarities are more conspicuous, especially at an overall conceptual level. Thus, the ARKTRANS approach is to harmonise and coordinate whatever can be harmonised and coordinated into a common system framework architecture. Necessary variations are not introduced until specifications of the more detailed parts of the architecture.

An alternative to the ARKTRANS approach would be to establish separate architectures for each transport mode. However, it is our belief that such an approach will complicate the establishment

of optimal multimodal transport solutions. Interfaces will have to be defined between the separate architectures. Empirically, the establishment of such interfaces or gateways will require a lot of effort, and they will also cause problems due to unforeseen differences in the separate architectures. By establishing a common framework architecture, the establishment of ITS solutions that will promote multimodal transport is more likely to happen. System interoperability, efficient information flows, coordination across transport modes, etc. will be supported in a more adequate way.

1.1.2Harmonisation of Freight and Passenger Transport

In addition to being multimodal and harmonised across all transport modes, ARKTRANS also harmonises freight and passenger transport. Such a harmonisation is, as far as we know, not done in previous work on system architectures for the transport domain, but many similarities between freight and passenger transport legitimate a closer coordination. Freight and passenger transport are to a large extent performed by the same types of transport means, on the same transport networks and between the same endpoints, and a freight unit and a travelling person are example more or less equal from a conceptual point of view.

The need for a harmonisation is very obvious with respect to the fleet management part, but passenger transport preparation and planning also is quite similar to freight transport preparation and planning. The need for on-board support and control and updated information about for example traffic conditions will also very much be the same for both freight and public transport.

1.1.3Complexity

The transport sector is very comprehensive and it encompasses a large number of actors and activities. Figure 1 below shows a simplified picture of the transport sector. Transport Users book transport services from Fleet Operators. Fleet Operators manage their fleet and follow up the specific transport operations performed by the Transport Means and their Crew. The Fleet Operators also have to provide the Transport Users with relevant information about the status of the transport operation (delays, etc.). Before and during the transport operations the transport infrastructure comprised by the Transport Network and the Terminals have to be consulted. Information about traffic conditions is received; booking of services (customs, loading/unloading, etc.) is done, etc.

ARKTRANS focuses on the coordination of multimodal transport as well as on the improvement of services for freight and passenger transport. These issues represent an enormous potential with respect to efficiency. Thus, the establishment of a harmonised system framework architecture for multimodal freight and passenger transport is a necessity.

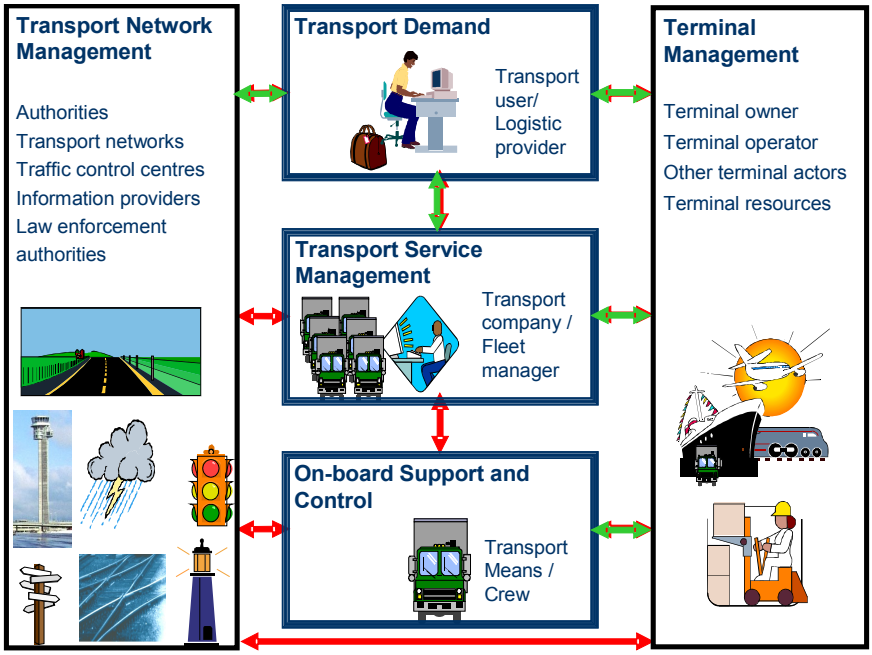


Figure 1 The Transport Sector

1.2Objectives

ITS, *Intelligent Transport Systems*, are ICT (information and communication technology) systems for the transport domain. The objective of ARKTRANS is to establish a system framework architecture that provides a framework for the design, implementation and operation of ITS for multimodal transport of freight and personnel. The framework shall promote safety, efficiency and environmental friendly transport. This shall lead to a platform for:

- New and improved services for planning and management of multi modal transport chains
- Improved traffic control and better dissemination of relevant traffic information
- More efficient information flows between ITS solutions
- Harmonisation of ITS solutions across transport modes for freight and personnel transport

To achieve these objectives we have to:

- Establish a system framework architecture
- Build on existing results and coordinate the work with ongoing international work
- Disseminate results and knowledge about the results
- Support the initiation of projects where ARKTRANS will be used as template
- Test and evaluate the resulting architecture in cooperation with other projects

1.3System Framework Architecture

A *System Framework Architecture* is a generic specification of ICT solutions for a product family or for a set of systems belonging to a specific domain or sector, in the case of ARKTRANS the transport sector. The conceptual and logical parts of the system framework architecture should preferably be valid even through changes in technology. The architecture will define functionality, information, and interfaces in such a way that integration and interoperability is enabled. It should be possible to combine and replace system components developed according to the system framework architecture. The architecture must of course also contain technical specifications denoting how solutions shall be realised. However, it should be possible to substitute these parts as new technologies are developed.

A *System Architecture* is however the basis for the development of a more specific ICT solution that more or less may be established by means of a system framework architecture. The system framework architecture can be used as a template. A customisation will probably be required

(adding new functionality, selection among optional parts of the system framework architecture, etc.). However, the relations towards its surroundings (information exchange, etc) must be according to the system framework architecture to ensure interoperability and conformance to superior requirements. In that way system components from different vendors can operate together, as long as they stick to the requirements defined in the system framework architecture.

The system framework architecture, as ARKTRANS, can be looked upon as a development plan for an area stating the overall requirements to the building and defining the surroundings and infrastructures, while the system architectures can be looked upon as the detailed drawings of each of the buildings in that area. The buildings should be according to the requirements stated in the development plan.

1.3.1Content

The content of a system architecture or a system framework architecture partly depends on the software engineering framework used. Several software engineering frameworks are available. Most of them state that different aspects of the system must be specified. The ISO RM-ODP framework identifies a wide set of relevant viewpoints, while the Converge guidelines for transport system architectures operates with a more limited number of what they call architectures . The frameworks also give guidelines with respect to the specification process, but the specification techniques are not focused. Converge is used in other transport projects, and the framework is known to several actors.

For ARKTRANS the use of RM-ODP versus the use of Converge are more or less equivalent. However, the number of viewpoints in Converge is a bit too limited. Thus, we have selected the viewpoints we need from either framework.

One of the main decisions to be taken was whether an object oriented or a structural breakdown approach should be taken in the development of ARKTRANS. Due to the comprehensiveness of the transport domain, we decided to use both. We organised the transport domain into sub-domains (in a reference model) and decomposed each sub-domain by means of a functional breakdown. The result is a functional hierarchy providing a structure and a terminology for the overall functionality. However, as the overall functionality was decided upon, we used oriented system specification methodologies to specify information, interactions and dependencies.

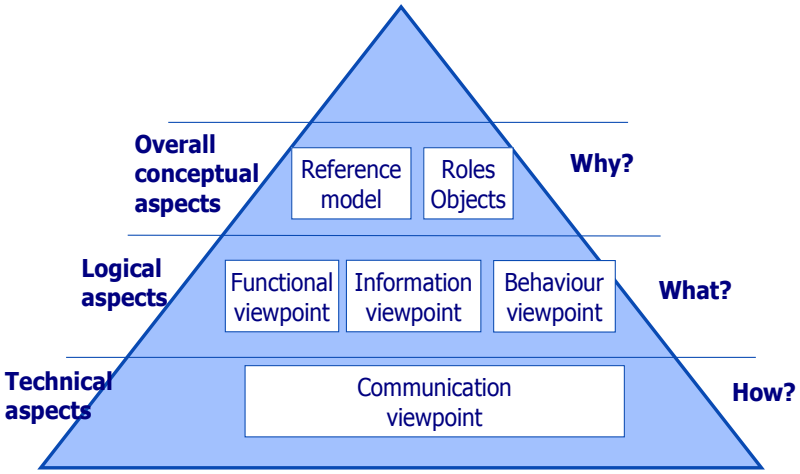


Figure 2 The ARKTRANS content

Converge is not up to date with respect to an object oriented system specification approach. Thus, we have customised the methodology to such an approach.
The content of ARKTRANS is, as shown in Figure 2, a reference model and several viewpoints, each focusing on different aspects of ITS:

- Reference model that defines the overall concepts by dividing the transport domain into sub-domains
- Roles of the stakeholders in the transport domain and objects of relevance are defined
- Functional viewpoint describing the logical functionality and structure of the sub-domains of the reference model
- Behaviour viewpoint describing process scenarios and overall information flows
- Information viewpoint describing the structure, relations and content of information elements as well as the information content that is exchanged between sub-systems
- Communication viewpoint specifying technical requirements to interfaces, and communication solutions

1.3.2The Work Process

The work on ARKTRANS has been challenging for many reasons:

1. Comprehensiveness: The transport domain is very wide and encompasses a large number of actors with quite different roles and objectives. The actors also represent different transport modes. Thus, the architecture has to capture a large number of user needs.
2. Harmonisation: ARKTRANS is harmonised across transport modes as well as personnel transport and freight transport. Even though the similarities are most conspicuous, ARKTRANS has to cope with differences with respect to terminologies and working procedures, different use of technical solutions, different level of maturity, different standards, etc.
3. User involvement: The need for ARKTRANS has to be communicated to many actors in an intelligible way, and the actors must be able to influence on the results. Preferably, actors should also feel ownership to the results.
4. Sufficient level of details: ARKTRANS is not a system architecture for a specific system, but a system framework architecture for a domain. Thus, details about the inner parts of systems are not of interest. Focus is on interoperability and integration.
5. Conceptual model: Despite of the focus on interoperability, technical specifications of interfaces are not enough. A common understanding of the transport domain with respect to roles, overall functionality, information, organisation and relations are also prerequisites. Such grounding will give a context on which the interoperability can arrange for new and improved services.

The following has been done to cope with these challenges:

- Much of the work has been based on inputs from working groups. Stakeholders from relevant parts of the transport domain have been participating in the working groups.
- We have not started from scratch. The work has been based on available results from other projects, both projects working on architectural issues and projects that have developed solutions. User requirements captured by other projects, e.g. the KAREN project , and functionality specified by others are used.
- Software engineering methodologies and specification techniques has been used as the basis for the architecture specification process (see below).
- The transport domain is organised into manageable sub domains.
- The work has been and will be iterative. Preliminary results will be tested in demonstrators and presented for user reference groups. Gained experience will be considered during the further development of the architecture.

Both Converge and RUP have inspired the development process, but adjustments are done. Use case techniques specified by the Object Management Group have been used to capture user requirements and to specify functionality (denoted in the functional view). However, the scenarios specified in the use cases are at a very high level, as the framework architecture does not deal with the detailed functionality in specific systems. The results from the use cases are denoted in UML swim lane diagrams . Examples in Converge, and also KAREN and the National ITS

Architecture uses DFD (Data Flow Diagrams). However, in ARKTRANS the interactions between different sub-domains are focused and not the internal data flows within the system components. Thus, the swim lanes are considered to be more suited. In addition the functionality is described in prose. In the current version ER-diagrams are used to describe the conceptual information models.

1.3.3Deployment

ARKTRANS is a framework that defines some sort of best practice with respect to ITS solutions. By means of ARKTRANS, individual transport systems can be designed to link together and to create an integrated environment. Thus, the performance, usefulness, safety and efficiency of transport can be improved. Each individual system provides one or more functions[1], and the functions can be linked and combined to create multi-functional systems.

The objective of ARKTRANS is to provide a stable basis for ITS solutions. Flexible systems must be built upon stable architectures. ARKTRANS supports the development of systems by providing a tool for a proper integration and cooperation between systems. The architecture specifies requirements in order to make such interaction and cooperation possible.

The ARKTRANS system framework architecture may contribute to the objectives mentioned above in many ways, e.g.:

- The establishment of a common comprehension of the transport domain
  The overall parts of ARKTRANS define concepts and relations that together contributes to the establishment of a common picture of the transport domain for all transport modes and for freight as well as for personnel transport (common sub-domains, common terminology for roles, functionality, etc.)
- Improved interoperability between ITS solutions
  ICT solutions that are realised according to the architecture can exchange information and operate in a coordinated way (information exchange according to a common specification, system components with defined functionality, systems that can collaborate with other systems, etc.)
- Definitions and check lists that simplify the specification of new ITS solutions and the purchasing of existing system components
  New transport solution can be specified by referring to requirements defined in ARKTRANS, and available systems or system components (e.g. COTS) can be specified by referring to the same requirements (ARKTRANS will be a template, solutions can be evaluated with respect to ARKTRANS, etc.)
- Deploying national ITS architectures can be challenging as reported from for instance Sweden and Italy . The European deployment of the KAREN architecture is also addressing the challenges of deploying the architecture . ARKTRANS will take into account all experiences with deployment.

1.4Status and Report content

The establishment of ARKTRANS is an iterative process, and the progress on selected parts of the architecture depends on whether input from other (more practical) projects is available or not. Thus, parts of the architecture may be more mature than other parts. The content and status with respect to the different parts of the architecture is:

- The reference model that divides the transport domain into sub-domains is specified in Chapter 4
- The roles of the stakeholders in the transport domain are specified in Chapter 5. The roles are strictly related to the sub-domains of the reference model. The role information is updated continuously as the work on the architecture goes on. New knowledge about roles and stakeholders are documented.

[1] Functions combined to meet a user need are known as *service*s

- The functional view that specifies the functionality in the sub-domains of the reference model is specified in Chapter 6, 7, 8, 9 and 10.
- The behaviour view that specifies the process scenarios and the overall information flow is specified in Chapter 11. The specifications are just examples. Such processes may be carried out in many ways. However, the examples help to identify the required interactions. The specifications will be further refined later.
- The information view describes conceptual information models for route and travel information in Chapter 12. Other information models are documented electronically. URLs are available in Chapter 13 and 14. In Chapter 15 the content of route and travel information messages are described.
- The technical aspects are described in Chapter 16. Technologies and possible solutions that arrange for interoperability between ITS solutions are discussed. The specifications are preliminary and will need further details and clarifications.

2Norwegian Summary

ARKTRANS er utviklet som den nasjonale referansearkitekturen for IKT-løsninger innen multimodal gods- og persontransport. Grunnlaget for det arbeidet som presenteres i denne rapporten ble lagt i ARKTRANS Forprosjekt og i versjon 2.0, 3.0 og 4.0 av ARKTRANS som ble etablert i et Forskningsrådsprosjekt. Etter avslutningen av forskningsprosjektet ble videreutviklingen av ARKTRANS finansiert av Samferdselsdepartementet og Vegdirektoratet. ITS Norway har stått bak denne videreutviklingen, og denne rapporten, ARKTRANS versjon 5.0, beskriver rammeverket slik det forelå ved utgangen av 2005.

Forprosjektrapporten foreligger i sin helhet på norsk, men erfaringen fra forprosjektet tilsa at ARKTRANS bør dokumenteres på engelsk. Denne rapporten er derfor skrevet på engelsk. De mest tungtveiende grunner for dette er behovet for å kunne utveksle informasjon prosjekter og initiativer utenfor Norge. I tillegg kommer behovet for å bruke samme terminologi som andre, og for å kunne dra nytte av andres arbeid.

2.1Bakgrunn

Etatene for de fire transportformene vei, sjø, bane og luft, representert ved Statens Vegvesen ved Vegdirektoratet, Kystverket, Jernbaneverket, NSB AS og Avinor AS hadde før oppstarten av ARKTRANS etablert et godt samarbeid om multimodal transporttelematikk etter initiativ fra Samferdselsdepartementet. Det ble etablert en såkalt Nettverksgruppe med representanter fra de fem institusjonene og Samferdselsdepartementet. Arbeidet i Norge er samordnet med en nordisk nettverksgruppe og arbeidsgruppe for transporttelematikk nedsatt av Nordisk Ministerråd og Nordisk Embetsmannskomité for Transport (NET).
De fire etatene så vel som transportutøverne og transportbrukerne har svært sammenfallende behov og utfordringer innenfor fagfeltet transporttelematikk . Det er et stort potensial for synergi-effekt av et nært og praktisk samarbeid på tvers av ulike roller og ulike transportmodi. Det var imidlertid, før oppstarten av Nettverksgruppen, gjort lite for å få til en samordning. På initiativ fra Nettverksgruppen ble temaet behandlet i seminarer og i diskusjon med fagpersoner fra forskningssiden resulterte dette i en felles oppfatning om at den mest effektive angrepsmåte var å starte arbeidet med en systemarkitektur for transportområdet. ARKTRANS Forprosjekt startet opp høsten 2000. Forprosjektet resulterte så i oppstarten av et forskningsrådsprosjektet i 2002. Deltaker i forskningsrådsprosjektet var Vegvesenet ved Vegdirektoratet, Kystverket, Jernbaneverket, Avinor AS, NSB AS, Ergo Group, Telenor FOU og Transportbedriftenes Landsforening. Hovedprosjektet ble ledet av SINTEF. I tillegg kom en større referansegruppe som ga et uvurderlig bidrag til spesifikasjonen av ARKTRANS.
Eierskapet til ARKTRANS er etter forskningsrådsprosjektets slutt ivaretatt av ITS Norge. Se ellers www.arktrans.no og www.its-norge.no for mer informasjon.

2.2Problemstillinger

ARKTRANS Forprosjekt frembrakte god oversikt over relevante problemstillinger samt innsikt i nasjonale og internasjonale resultater og aktiviteter som er av betydning for det videre arbeidet med en multimodal systemarkitektur. Blant annet. kan vi nevne følgende forhold som gjør at for-bedringspotensialet er stort:

1. Det er i stor grad den samme informasjonen og de samme tjenestene som etterspørres av myndighet, tjenesteyter og bruker - uavhengig av transportmodus, men det er dårlig samordning av systemer og lite effektiv informasjonsflyt:
    - Informasjon kan ikke sendes elektronisk mellom aktører og transportformer. Samme informasjon må registreres manuelt mange ganger i løpet av en transportkjede, både hos brukere, transportutøvere og myndigheter.
    - Feilregistreringer oppstår på grunn av gjentagne manuelle registreringer, ulik terminologi og dårlig samordnede systemer.

- Håndteringen av farlig gods er for dårlig. Det er liten eller ingen overlevering av relevant informasjon fra en transportmodus til en annen, og mellom aktører.
- Sporing av gods, farlig gods inkludert, gjøres i liten grad og ikke i det hele tatt på tvers av transportmodi og aktører
- Kontroll med transport som utføres av en kjede med utøvere er dårlig. Statusinformasjon er svært lite tilgjengelig underveis.

2. Det er et problem at informasjon som kan forbedre sikkerhet og effektivitet ikke er tilgjengelig, eller den utnyttes dårlig ved planlegging og gjennomføring av transport, for eksempel:
   - Informasjon om meteorologiske forhold, tilstanden til transportnettet (veier, farleder, baner, korridorer) og forhold ved trafikken (kødannelser, ulykker, osv.) er til en viss grad tilgjengelig, men etablering og dynamisk oppdatering av slik informasjon kan bedres i vesentlig grad, og informasjonen må formidles og presenteres på måter som egner seg for de ulike aktørene og den jobben de utfører (for eksempel værprognoser på kart til flåteoperatører som planlegger ruter, bruk av informasjon om trafikkforhold, værforhold og forhold ved transportnettet ved rute- og tidsplanlegging, melding om gjeldende værforhold og forhold ved trafikken og transportnettet via talemeldinger til førere av transportmidler, osv.) .
   - Ruteinformasjon og trafikkdata (avgangs- og ankomsttider, forsinkelser, forventet ankomst, osv.) som formidles gjelder i stor grad kun for én aktør eller én transportform. Informasjon fra ulike transportutøvere og ulike transportformer kan ikke kombineres slik at det gis et samlet bilde av transportoppdrag (person eller gods) som omfatter flere etapper og flere transportutøvere/transportmodi.
3. Flere aktører er involvert i både gods- og persontransport, og det er mange av de samme problemstillingene knyttet til begge former for transport. Gode løsninger for en av transportformene bør derfor kunne utnyttes av den andre. Blant annet kan vi nevne at følgende likhetstrekk ikke er utnyttet til effektivisering og samordning
   - Problematikken rundt flåtestyring og planlegging er lik for mange former for godstransport og persontransport. Bestillinger skal mottas, bruk av personell og ressurser skal planlegges, ruter skal velges, tidsplaner legges, osv.
   - Behovet for førerstøtte og kjøretøykontroll er sammenfallende, blant annet vil man underveis i transporten ha behov for informasjon om trafikkforhold, meteorologiske forhold og forhold ved transportnettet, og man vil overvåke viktige forhold ved transportmiddelet. ARKTRANS innser dog at det på dette området er mange modale, internasjonale standarder som man *må* forholde seg til innenfor hver transportmodus.
   - Operatører må ofte forholde seg til ulike administrative systemer mot gods- og persontrafikk, selv om de selv benytter samme transportmiddel og/eller terminal for å avvikle denne transporten.

2.3FoU-utfordring

Gode IKT-løsninger kan gi sikrere transport av personer og gods og bidra til en effektivisering. En utvikling av ITS-løsninger som samvirker på tvers av transportmodi og aktører er derfor nødvendig. Dersom man skal få til dette, må man blant annet beskrive aktører, funksjonalitet, informasjon og informasjonsutveksling. Området er stort og komplekst, og det skal fungere som en helhet. Det må derfor beskrives på en presis og formell måte i form av en systemarkitektur som kan fungere som et rammeverk for løsningene. Selve utarbeidelsen av denne systemarkitekturen er en utfordring med hensyn på blant annet disse forholdene:

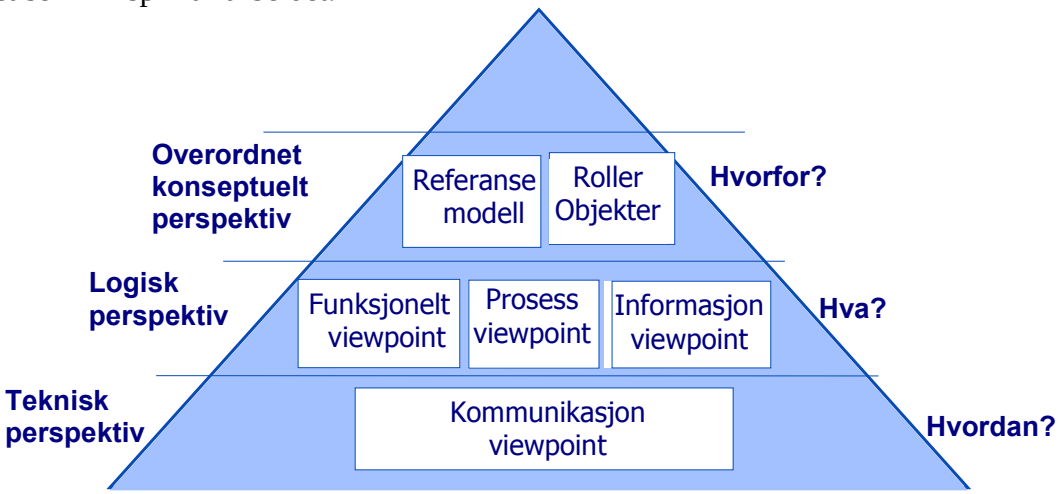
- Man må forholde seg til eksisterende resultater og bruke disse der det er hensiktsmessig. De eksisterende resultatene er til dels svært omfattende og detaljerte, men de forholder seg i hovedsak til kun en transportmodus, og de er ikke samordnede. Noe av utfordringen ligger derfor i å lage løsninger som har konseptuelle modeller som gjelder alle transportmodi og som gjenbruker og bygger videre på eksisterende resultater på en hensiktsmessig måte.

- Det skal etableres et felles begrepsapparat for hele transportdomenet. Brukere og utøvere fra ulike transportmodi og med ulike roller skal få et felles ”bilde” av transportområdet og termer som gjør at de bedre skal kunne utveksle ideer samt diskutere og velge løsninger som gir gevinster og synergi.

I tillegg til det multimodale aspektet er det også en utfordring å få til en samordning av persontransport og godstransport. Tidligere arbeid med arkitekturer for transportdomenet har behandlet disse områdene separat, men det er en kjensgjerning at gods- og passasjertransport i stor grad involverer de samme aktørene, det skjer ved hjelp av de samme kjøretøyene, utføres på den samme infrastrukturen og går mellom de samme endepunktene. Likheten er kanskje tydeligst når det gjelder flåtestyring, men planlegging av persontransport har også likhetstrekk med planlegging av godstransport. Grensesnittet mot for eksempel systemer for førerstøtte og transportmiddelkontroll samt ulike typer informasjonsleverandører vil også være svært likt ved både gods og persontransport.

2.4Arbeidsmetodikk og resultater

Arbeidet med ARKTRANS er gjennomført i henhold til metoder og teknikker fra fagfeltet ”software engineering. Det er tatt utgangspunkt i de overordnede retningslinjene fra, IEEE 1471-2000 , og det er blant annet benyttet innspill fra Converge , RUP og RM-ODP . KAREN/FRAME og US Architecture . Metodene som er benyttet, og de perspektivene (“viewpoints”) som er spesifisert, er imidlertid modifisert noe da utarbeidelsen av et rammeverk som ARKTRANS avviker noe fra tradisjonell programvareutvikling. Eksisterende resultater og standarder er benyttet som innspill til arbeidet.



Figur 3 Innholdet i ARKTRANS

Figur 3 viser innholdet i ARKTRANS. Ulike perspektiver på transportområdet er beskrevet. Et overordnet konseptuelt perspektiv avklarer hvorfor man trenger de løsningene som systemarkitekturen omfatter. En *referansemodell* deler transportområdet inn i delområder og avgrenser omfanget av arkitekturen. Hvert delområde forholder seg til aktører og organisasjoner, som fyller gitte *roller*, og det er *objekter* som inngår i helhetsbildet (for eksempel godsenheter, transportnette, utstyr, osv.).

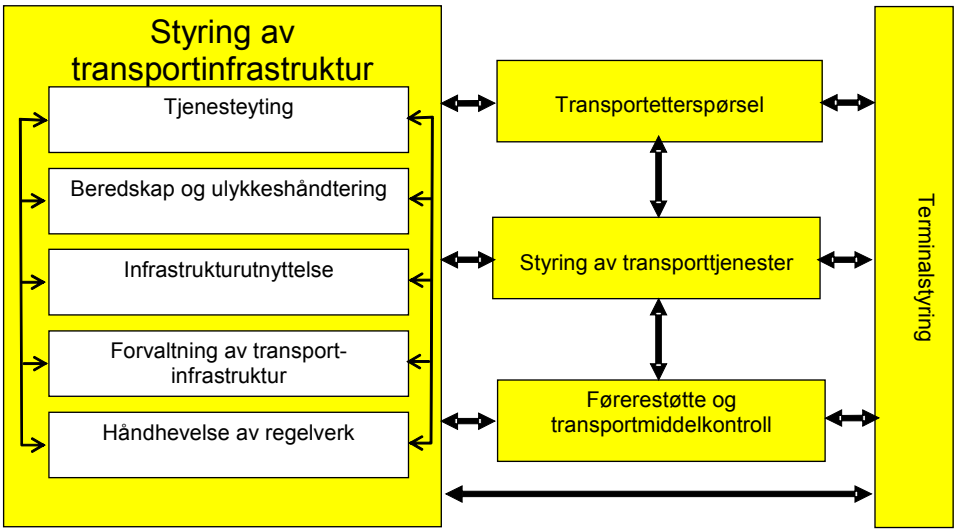
Et logisk perspektiv angir hva løsningene skal gjøre. Nødvendig funksjonalitet og informasjon som det er behov for spesifiseres. I tillegg gis en beskrivelse av hvordan de delene av transportområdet opptrer i forhold til hverandre (i arbeidsprosesser), blant annet ved at de utveksler informasjon.

Det er lagt vekt på at ARKTRANS så langt som mulig skal spesifiseres på en teknologiuavhengig måte, slik at man lettere kan tilpasse seg skiftende teknologier, men teknologi for realisering må selvfølgelig angis slik at konkrete løsningene kan spesifiseres. Et teknisk perspektiv beskriver hvordan løsningene kan realiseres.

Innspill til arbeidet er i stor grad hentet inn i ulike arbeidsgrupper hvor representanter fra alle transportformene har jobbet sammen. Det er også avholdt arbeidsmøter på tvers av arbeidsgruppene for koordinering

Gjennom studier av relaterte arbeider og tilbakemeldinger fra internasjonale kontakter er det klart at ARKTRANS i internasjonal sammenheng i er unik. Det eksisterer ingen andre rammeverk som samordner transportformene på en tilsvarende måte. Den multimodale forankringen hos transportetater, transportbrukere og transportutøvere, som er oppnådd gjennom bredt sammensatte multimodale arbeidsgrupper, er også i særklasse.

2.4.1Referansemodell og roller



Figur 4 - ARKTRANS Referansemodell med dekomponering av delområdet Styring av Transportinfrastruktur

Referansemodellen er vist i Figur 4. Modellen er strengt rollesentrert. En rolle er kun relatert til ett av områdene i modellen. Norske rollebegreper er angitt i tabellene i Kapittel 5. Et hjernekart i Vedlegg A gir en oversikt over rollene.

Delområdene i referansemodellen har veldefinerte mål og ansvarsområder:

- Transportetterspørsel støtter transportbrukerne eller de som representerer disse (reisebyrå, speditører, osv.) ved planlegging, bestilling og oppføling av både person- og godstransport.
- Styring av transporttjenester støtter flåteoperatøren ved planlegging, forberedelse og gjennomføring av flåteoperasjoner for både person- og godstransport. Ruter, timetabeller, ressursbruk osv. håndteres. Både faste ruter og mer ad hoc-preget transport håndteres. Transportoperasjonene overvåkes, og transportbrukerne informeres om status.
- Førerstøtte og transportmiddelkontroll skjer lokalt på selve transportmiddelet. Besetningen støttes under gjennomføringen av transportoppdraget (hva skal transporteres hvor, statusrapportering, osv.). Selve førerjobben støttes også (navigasjon, relevant informasjon om trafikkforhold, osv.). Fører, last, passasjerer og selve transportmiddelet overvåkes, og aksjoner tas dersom avvik eller hendelser oppstår.
- Styring av transportinfrastruktur håndterer forhold knyttet til selve transportnettet (veier, farleder, jernbanelinjer, luftkorridorer, signaleringsutstyr). Myndighetenes oppgaver på bl.a. trafikkavvikling og sikkerhet så vel som tjenestetilbydere som f.eks. tilbyr informasjonstjenester støttes.
- Terminalstyring støtter koordinering og utførelse av det som skjer på terminaler (havner, godsterminaler, holdeplasser, osv.).

Delområdene i referansemodellen kommuniserer med hverandre og utveksler informasjon og tjenester. Funksjonalitet i to delområder kan f.eks. representere hver sin side i en såkalt ”business-to-business”-prosess. Området Transportetterspørsel kan f.eks. bestille transporttjenester, mens den andre siden representert ved området Styring av transporttjenester vil motta og prosessere ordren. Funksjonalitet i et av delområdene kan også være basis for funksjonalitet i andre delområder. Sporingsinformasjon som etableres av teknologi på transportmiddelet (området Førerstøtte og transportmiddelkontroll) kan f.eks. støtte flåteoperatørens sporing av transportmiddelet i delområdet Styring av transporttjenester. Videre kan slik sporingsinformasjon oversendes transportbrukeren i området Transportetterspørsel i form av oppdatert statusinformasjon.

2.4.2Funksjonelle modeller

Delområdene i referansemodellen defineres videre ved hjelp av funksjonell dekomponering i funksjonsmodellene. Strukturen er dokumentert i form av ”hjernekart” som viser hvordan de ulike funksjonene er brutt ned og organisert, se Vedlegg B. I tillegg er den ulike funksjonaliteten tekstlig beskrevet i denne rapporten. Alle de funksjonelle modellene ansees å være godt kvalitetssikret blant deltakerne i prosjektet.

2.4.3Prosessvinkling

På bakgrunn av roller og funksjonelle modeller, er det utformet ulike scenarioer som belyser hvordan funksjonaliteten i praksis kan benyttes. Scenarioene identifiserer informasjon som må flyte mellom de ulike delene av referansemodellen. Scenarioene er beskrevet ved hjelp av såkalte ”swim lanes”, eller svømmebanediagrammer. (se diagrammene i kapittel 11). Resultatene er gjennomgått og diskutert på arbeidsgruppemøter. Dette har også bidratt til en kvalitetssikring av de funksjonelle modellene, men scenariene er ikke komplette og absolutte. Et scenario er kun et eksempel på hvordan en arbeidsprosess kan være. Scenariene bør utvides og bearbeides videre i samarbeid med prosjekter som utdyper de ulike problemstillingene.

2.4.4Informasjonsmodeller

Den informasjonen som deles mellom delområdene i referansemodellen er beskrevet ved hjelp av konseptuelle informasjonsmodeller. Disse er beskrevet eller de er referert i kapittel 13, 14 og 15.

2.4.5Tekniske aspekter

Tekniske aspekter knyttet til utveksling av informasjon er beskrevet i kapittel 16.

2.5Mer informasjon

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3English Summary

ARKTRANS is the Norwegian system framework architecture for multimodal ITS (Intelligent transport Systems and Services) supporting freight and passenger transport. The work on ARKTRANS is established by Norwegian transport authorities and is so far co-funded by the Research Council of Norway. Links are established to relevant national and international activities to achieve maximum input.

3.1Motivation and Background

ARKTRANS is a joint effort by Norwegian transport authorities: the Public Road Administration, the Norwegian State Railways, the National Rail Administration, Avinor, and the Norwegian Costal Administration; and also representatives for transport users and providers of transport services. The stakeholders to a large extent see identical needs and challenges with respect to all transport modes and to intermodal transport, for example shortcomings related to the transport preparation and planning, the coordination of transport services, information flow, handling of dangerous cargo, etc.

Harmonization of freight and passenger transport is, as far as we know, not done in previous work on system architectures for transport. The accomplishment of freight and passenger transport is more or less the same, and a harmonisation is possible at a conceptual level.

ARKTRANS addresses the coordination and harmonisation of services for multiple transport modes as well as services for freight and public transport. This issue represents an enormous potential with respect to efficiency. A multimodal system framework architecture for freight and passenger transport will arrange for such a harmonisation.

3.2Results

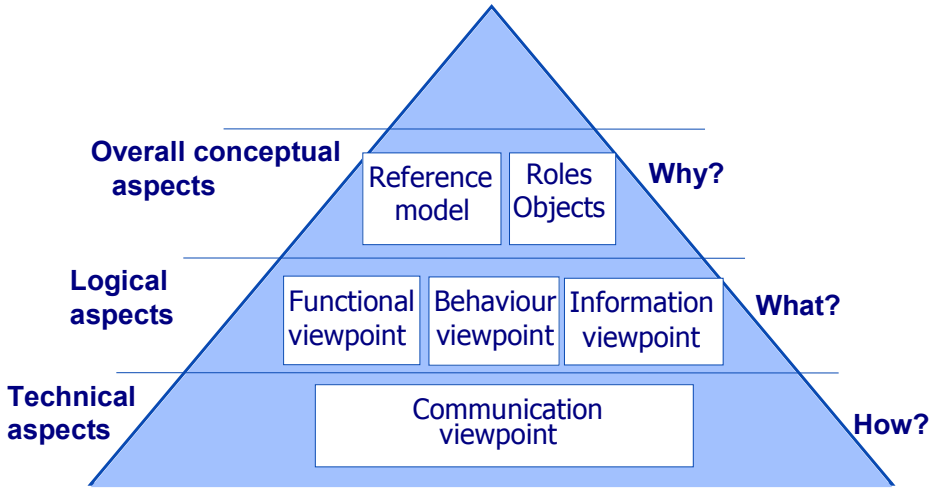

Figure 5 The ARKTRANS content

The content of ARKTRANS is, as shown in Figure 5, a reference model, roles and several viewpoints, each focusing on different aspects of ITS.

3.2.1Reference Model

The ARKTRANS reference divides the transport domain into five manageable sub-domains.

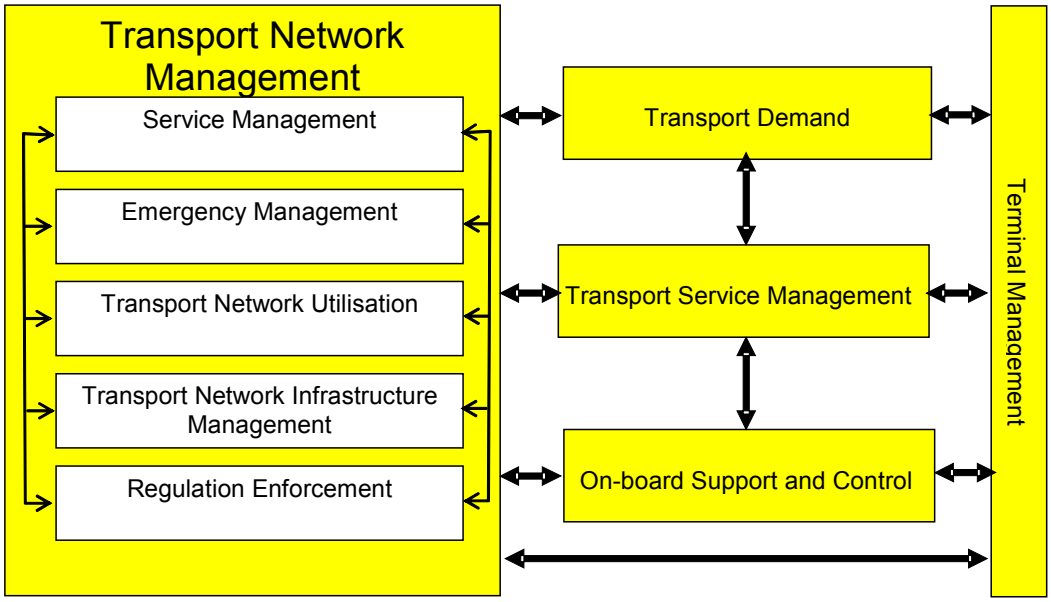

Figure 6 ARKTRANS Reference Model and upper level functional decomposition of Transport Network Management

Each sub-domain has well defined objectives and responsibilities towards its surroundings:

- The *Transport Demand* sub-domain supports the transport demands for both freight and passenger transport. This involves pre-trip preparation and planning as well as transport order initiation and follow-up of simple as well as more complex transport chains.
- The *Transport Service Management* sub-domain handles planning and preparation of fleet operations as well as fleet management for both freight and passenger transport. Routes and timetables are planned. This includes predefined routes as well as dynamic planning depending on transport demands to enable the optimal transport scheduling. The transport operations are monitored and controlled by means of interactions with the On-board Support and Control sub-domain.
- The *On-board Support and Control* sub-domain supports the transport of freight or personnel on-board the transport means. The driver and the operation of the transport mean as well as freight and passengers may be monitored. On-board equipment presents information to the driver and supports the driver with respect to the fulfilment of the transport operation, navigation, reporting, etc. On-board incident handling is also an important issue.
- The *Transport Network Management* sub-domain provides functionality related to the transport network (roads, fairways, railroads, lanes, etc) and the safety and efficiency of the traffic flow. The sub-domain encompasses functionality that supports optimal transport network utilisation by means of traffic control and incident handling, transport network infrastructure management including establishment and distribution of information about the transport network, emergency management, regulation enforcement, and various services like information services offered to the users of the transport network
- The *Terminal Management* sub-domain is related to terminals where goods and passengers are transferred between transport means that may represent different transport modes. The sub-domain includes planning and preparation of terminal operations as well as the management of ongoing operations.

The sub-domains communicate with each other, and they exchange information and provide services to each other. The functionalities in two sub-domains may represent the two sides in a business-to-business interaction. E.g. the Transport Demand sub-domain will order transport services, while the other side represented by the Transport Service Management sub-domain will accept and process the orders. Functionality provided by one sub-domain may also be the basis for functionality in other sub-domains. E.g. tracking information collected by tracking technology on-board the transport means (On-board Support and Control) may support management and tracking

of fleet resources in the Transport Service Management sub-domain. Further on, such tracking information can be passed to the Transport Demand sub-domain and provide the transport user (a consignor, consignee, etc.) with status information and tracking information for the cargo on its way towards its destination.

3.2.2Roles and objects

ARKTRANS also defines a set of roles (defined by multi modal terms), and the sub-domains in the Reference Model relate to these roles. E.g. a Transport User (e.g. a consignor who wants to send some cargo) is supported by functionality provided by the Transport Demand sub-domain, a Transporter (a freight carrier company) is supported by functionality in the Transport Service Management sub-domain, a Driver is supported by the On-board Support and Control sub-domain, Authorities operates through the Transport Network Management sub-domain, and a Terminal Operator is supported by functionality provided by the Terminal Management sub-domain. An overview of the roles in ARKTRANS id provided in a mind map in Appendix A.

ARKTRANS also defines a set of objects that are important in the transport domain. These are transport units, transport network, equipment etc.

3.2.3Functional View

The functional view specifies the functionality related to the sub-domains of the reference model. The breakdown structure of the functionality is depicted in the mind maps in appendix B. The structure and the textual specification of the functionality are established in working groups with representatives form stakeholders in the four transport modes.

3.2.4Behaviour View

The behaviour view specifies how the transport domain is working with respect to interactions between actors. Scenarios are used to illustrate work processes embracing several sub-domains as shown in UML swim lanes in chapter 11. The interactions are described.

3.2.5Information View

The information view specifies information that is shared between the sub-domains of the reference model. Conceptual information model are described or referred in chapters 12, 13, 14 and15.

3.2.6Technical Aspects

Technical aspects like the realisation of interactions and information exchange is to some extent described in Chapter 16.

3.3More Information

Further development of ARKTRANS is managed by ITS Norway.

WEB-pages: http://www.arktrans.no/
(so far mainly in Norwegian. However, some English information is available)

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4ARKTRANS Reference Model

The transport domain is so extensive and complex that a division into manageable sub-domains is a necessity. The ARKTRANS reference model defines 5 such sub-domains and visualises the overall need for interoperability. The following issues are stressed:

- *Simplicity*: The reference model contributes to the establishment of a common conceptual model of the transport domain in the minds of transport stakeholders.
- *Stability*: The reference model shall last through changes in user needs, user requirements and technology.
- *Independence*: The reference model is independent of organisational issues as well as the physical realisation of the ITS solutions.

The reference model defines the overall concepts for multimodal transport of freight and passengers, and by its simplicity, the reference model is an overall conceptual model of the transport domain and transport issues. It is easy to map activities, projects, systems and stakeholders into the model, and the model simplifies the communication about transport issues. The sub-domains and the relations defined in the reference model are further specified in the logical aspects of the ARKTRANS: the functional view, the behaviour view, and the information view.

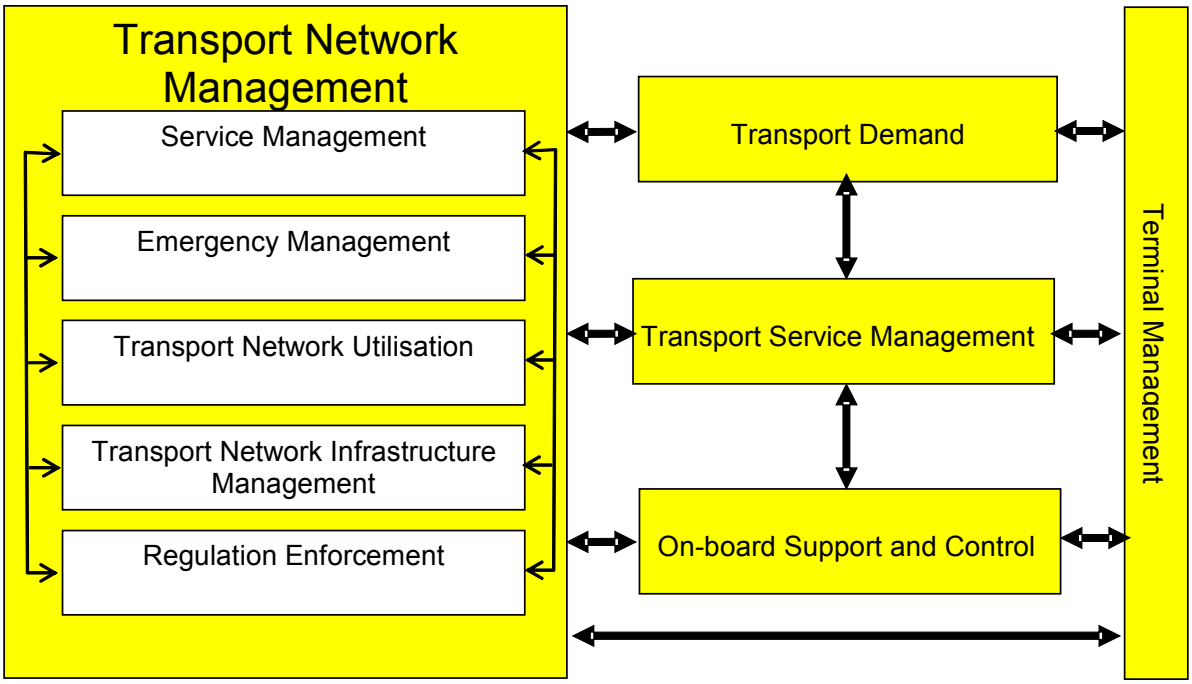


Figure 7 ARKTRANS Reference Model

4.1The Sub-domains of the ARKTRANS Reference Model

The reference model divides the transport domain into manageable sub-domains and defines necessary interactions as shown in. Each sub-domain relates to:

- A defined set of roles associated to the sub-domains – see specifications in Chapter 5
- Objectives – as seen from the associated roles
- Responsibilities – as seen from the other parts of the reference model

The functionality provided by the sub-domains is further specified in the functional view of ARKTRANS (see Chapter 6, 7, 8, 9 and 10). The relations represent interactions that are described in the behaviour view in Chapter 11.

1.1.1Transport Network Management

The Transport Network Management sub-domain addresses those parts of the transport infrastructure that support and control the traffic flow along the transport networks (roads, fairways, railways, air corridors). Passenger and freight terminals also are important parts of the transport infrastructure. However, the management of terminals is a part of the Terminal Management sub-domain (see 4.1).

The Transport Network Management sub-domain mainly addresses the flow of transport means, safety and security. The traffic is a result of freight and passenger transport. Such transport is of vital importance to our society, and the sub-domain addresses the planning and management of this traffic so that it can be accomplished as efficient, safe, secure and environmentally friendly as possible. A wide spectre of tasks must be supported, such as traffic management during normal traffic conditions, the management of specific events or situations, incident handling, emergency management, transport network planning and management, the provision of proper information services, regulation enforcement, and so on. Some of these tasks are traditionally handled by public administrations or by authorities.

The Transport Network Management sub-domain also addresses how to ensure that the transport is accomplished a way that is to the best of the society. Regulations, enforcements, information services and other services that have a positive effect are focused.

The objectives of the sub-domain are:

1. To arrange for safety of persons and properties that are involved in or affected by traffic
2. To arrange for efficient traffic flows
3. To arrange for sustainable transport services with respect to environmental issues
4. To arrange for the availability of information and supportive services that contributes to the planning and accomplishment of safe, efficient and environmentally friendly transport.
5. To arrange for mobility by supporting planning, establishment and maintenance of transport networks which optimise the benefits of investments and provide the required capacities and qualities
6. To arrange for the establishment of transport services that provide the required capacities, routes, schedules and qualities (these services will however be established and operated as a part of the Transport Service Management sub-domain)
7. To support incident handling, emergency preparedness and planning, and the management of emergency situations
8. To manage information about hazardous goods in such a way that incidents and emergencies involving such cargo can be managed in a proper way
9. To enforce laws and regulations, including operative control, security issues, and management of registries, licences, customs, fee collection and statistics

Responsibilities of this part of the transport domain are as follows:

- To provide traffic control that optimise efficiency and safety
- To provide information services and other services that support transport planning as well as efficient and safe accomplishment of transport
- To establish and maintain transport networks that benefit the society
- To handle foreseen and occurred incidents in a proper way
- To provide guidelines or requirements for public transport with respect to capacities, routes, service level and fees
- To manage emergency situations in a proper way
- To accomplish fee collection and regulation enforcement as efficiently as possible

1.1.2Terminal Management

The Terminal Management sub-domain addresses terminals where goods and passengers enter or leave the transport means, as well as where they may be transferred between different transport means. Terminal operations are planned and carried out, terminal resources are allocated, and so on. The Terminals may also provide additional services like security controls, travel information, restaurants, etc. The transport means that are visiting the terminal may represent different transport modes.
As indicated by a relation on Figure 7, coordination and information exchange between the Terminal Management and the Transport Network Management sub-domains may be required. The movement of transport means in the transport networks (roads, air corridors, railways and fairways) is a Transport Network Management issue. For road transport and freight transport by trains the handover between the sub-domains is defined by the physical area of the terminal. However, railway tracks through passenger terminals are defined to be a part of the transport network. For air traffic, the terminal manages the movements and the manoeuvring of the airplanes from the taxing area to the gate. The terminal is also managing internal movements between stop points (gates). However, the Transport Network Management sub-domain handles the landings and the take offs. For sea transport, the docking of vessels is a Terminal Management issue. However, the movement of vessels that are entering or leaving the dock area are managed by the Transport Network Management sub-domain as such movements are considered to be a part of the traffic flow.

The objectives are:
1. To support the overall planning of the terminal operations.
2. To manage the internal movements of transport means between stop points (gates, quays, etc.) within the terminal area
3. To utilise terminal resources as efficiently as possible
4. To provide cost-effective terminal operations by accomplishment of an effective internal logistic. This counts for transfer between transport means as well as transits involving breaks
5. To handle the Transport Items (cargo or passengers) according to regulations and agreements
6. To avoid damages
7. To handle dangerous cargo in a trusted way

Responsibilities are:
- To provide information about the available terminal services and resources
- To provide electronic services for booking of terminal services and resources
- To provide efficient terminal operations that minimise the time consumptions and costs. This especially counts for the transfers of cargo and passengers between transport means, also between transport means from different transport modes
- To ensure the required coordination and information exchange with the Transport Network Management sub-domain
- To register and report deviations according to agreements
- To provide depot services

1.1.3Transport Demand

The Transport Demand sub-domain supports transport preparation and planning, transport booking, and follow-up for freight as well as passenger transport. Functionality needed by transport users who want to travel or to send cargo, as well as functionality needed by those who are organising the transport on behalf of the transport user (travel agency, forwarding agent, logistics provider) is provided. Transport chains of variable complexity that may include several transport modes are defined and managed.
The transport user and those who are organising the transport need much of the same functionality. Transport users have traditionally requested transport services through travel agencies and logistics providers, or by means of human contact with the transport companies

involved in the transport chain. However, in the long term, electronic services will probably to a large extent support the transport user and enable self-service. This is partly about to happen for fragmented parts of the transport market (route information and booking of travel services as well as portals for freight transport are available on the Web). However, there are as far as we know no formal agreements on standards. Harmonised solutions are necessary. In that way multimodal transport services can be provided to the transport user in a more efficient way.

The objectives of the sub-domain are:
1. To provide administrative services for preparation, planning and establishment of a transport chain (ordering, information management, etc.)
2. To support the establishment of a transport plan by enabling the use of predefined preferences and templates
3. To support the definition of the preferred transport chain
4. To support the execution of the transport chain (information exchange towards the transport companies, authorities and service providers as well as coordination)
5. To support the follow up of the transport chain and to support corrective actions in case of deviations
6. To support the termination of a transport chain in such a way that experience gained can be reused

The responsibilities of this part of the transport domain are
- To order the required transport services
- To provide stakeholders involved in the transport chain with the required information about the transport items (cargo or travellers)
- To issue the required documents and accomplish the necessary information exchange towards transport companies, terminal stakeholders, authorities and other stakeholders involved in the transport chain
- To follow up the transport plans in such a way that that necessary actions are taken towards other stakeholders in the transport chain in case of deviations.

1.1.4Transport Service Management

This sub-domain addresses the management and provision of transport services that is accomplished by a transport company or a fleet manager. The transport business is administrated; strategical, tactical and operational planning and preparation of fleet operations are done; and on-going transport operations are managed.
The main purpose is to be able to plan and accomplish transport services based on actual and foreseen demands from the Transport Demand sub-domain, as well as on available infrastructures and resources provided by the Transport Network Management and Terminal Management sub-domains. Routes and timetables are to be planned. This includes predefined routes as well as dynamic planning depending on traffic conditions and transport demands. Optimisation of routes, time schedules and resource usage as well as safe, efficient and environmentally friendly transport are aimed. The maintenance of transport means and equipment on-board the transport means must be co-ordinated with the fleet operations.
The transport operations are monitored and controlled by interactions with the transport means and the crew (the On-board Support and Control sub-domain). Information about traffic flow conditions etc. may be received from the Transport Network Management sub-domain. The exchange of information with the Transport Demand sub-domain shall support effective accomplishment of the whole transport chain that may include fleet operations managed by several transport companies.

The objectives of the sub-domain are:
1. To accomplish transport services as efficient, safe and environmentally friendly as possible
2. To enable the most optimum routes and time schedules
3. To enable the most optimum use of resources

4. To monitor and control ongoing transport operations
5. To co-ordinate the maintenance of transport means and on-board equipment with the ongoing fleet operations
6. To disseminate information about services that can be provided

Responsibilities of this part of the transport domain are:
- To provide information about the transport services that can be provided
- To provide transport services according to orders and regulations
- To monitor and control ongoing transport operations
- To provide required feedback about the status of transport tasks as well as alerts and other information that may support the management of the transport chain
- To accomplish the required information exchange with authorities and terminals
- To provide the transport means and their crew with information about the transport tasks as well as information that may support the accomplishment of the transport operation

1.1.5On-board Support and Control

The On-board Support and Control sub-domain addresses functionality on-board the transport means that supports security, safety and efficiency. On-board equipment should provide the crew with information and support the fulfilment of the transport operation as well as information and functionality that supports the operation of the transport means. On-board equipment should also communicate with the other sub-domains whenever this is necessary.
The driver and the operation of the transport means as well as the freight and the passengers may be monitored, and incidents are handled.

The objectives of the sub-domain are:
1. To promote safety and efficiency by providing information and support to the crew
2. To support the accomplishment of the transport operation
3. To control the operation of the transport means in such a way that dangerous situations can be detected and if possible avoided
4. To monitor the driver in such a way that dangerous situations can be detected and if possible avoided
5. To monitor the passengers and the cargo in such a way that damage and irregular or dangerous situations can be detected and if possible avoided
6. To inform the crew about dangerous or irregular situations and possible damage

Responsibilities of this part of the transport domain are:
- To support the accomplishment of the transport tasks
- To inform the fleet manager about status and deviations
- To inform the fleet manager about certain dangerous or irregular situations and possible damage
- To inform the traffic control centre about certain dangerous or irregular situations
- To inform the terminal about deviations

4.2Relations Towards and Between the Sub-domains

ARKTRANS defines a set of roles defined by multimodal terms, see Chapter 5, and each sub-domain in the reference model has a relation towards a set of these roles. E.g. a Transport User is supported by functionality provided by the Transport Demand sub-domain, a Transporter (a freight carrier company) is supported by functionality in the Transport Service Management sub-domain, a Driver is supported by the On-board Support and Control sub-domain, Authorities operate through the Transport Network Management sub-domain, and Terminal Actors are supported by functionality provided by the Terminal Management sub-domain.
The sub-domains also relate to each other, and they exchange information and provide services to each other. The functionalities in two sub-domains may represent two sides in a business-to-

business interaction. E.g. the Transport Demand sub-domain will order transport services, while the other side represented by the Transport Service Management sub-domain will accept and process the orders.
Functionality provided by one sub-domain may also be the basis for functionality in other sub-domains. E.g. tracking information collected by tracking technology on-board the transport means (On-board Support and Control) may support the management and tracking of fleet resources in the Transport Service Management sub-domain. Further on, such tracking information can be passed to the Transport Demand sub domain and provide the Transport User (a consignor, consignee, etc.) with status and tracking information for the cargo on its way towards its destination.

4.3ARKTRANS Deployment

ARKTRANS may be deployed in many ways. The conceptual and logical aspects of ARKTRANS will provide concepts and knowledge that explains the transport domain. The specifications can be used when solutions of services are planned, purchased and developed. The technical aspects of ARKTRANS provide specifications that enable interoperability.

1.1.6Functionality in ITS solutions

Each sub-domain of the ARKTRANS reference model encompasses functionality that may be combined into systems and services that are used by the stakeholders possessing roles related to the sub-domains. The functions that are building blocks for such systems and services are specified in the functional view of ARKTRANS (see chapters 6, 7, 8, 9 and 10).

ARKTRANS may be used as a functionality “shopping list”:

- When requirements to ITS is specified. The required functionality can be specified by making references to the architecture.
- When ITS is developed. The preferred functionality can be chosen from the architecture, and the system can be specified by referring to the architecture.
- When an ITS is to be purchased. The functionality provided by available systems can be compared against the functionality specified in the architecture.

1.1.7Transport Related Work Processes

Transport activities may be simple tasks involving one single stakeholder or complex activities involving a large number of stakeholders. Such activities can be described as work processes composed of activities ordered along a time axis. The activities may be performed sequentially as well as in parallel, and there may be interactions between stakeholders possessing several roles.

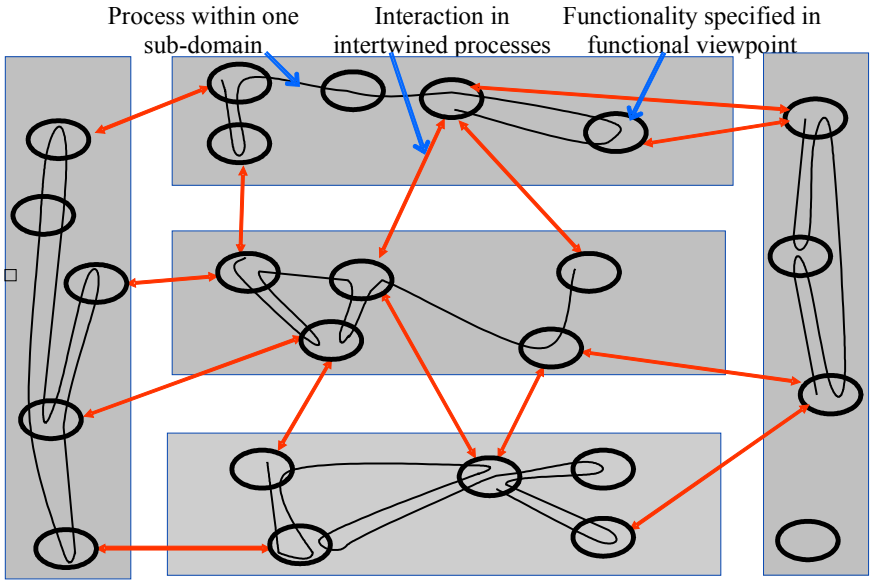


Figure 8 Intertwined processes (just an illustration - not a real case)

Figure 8 shows that functionality in the different parts of the reference model may work together and exchange information. Functionality (ovals) within the same part of the reference model (squares) may together accomplish a work process (indicated by the curved lines). These processes may again be a part of a larger process that also includes functionality in other parts of the reference model. Thus, interactions (straight lines with arrows in each end) between the different parts of the reference model are required.
ARKTRANS specifies functionalities that are generic building blocks in transport related work processes (the processes may however also encompass activities not covered by ARKTRANS, e.g. manual activities and activities supported by non-transport systems). The Figure illustrates how a transport process may involve functionality from several sub-domains, and several transport processes may also be intertwined (the example is pure fantasy, not a real case). The behaviour view in Chapter 11 illustrates a number of such scenarios. The following actions may for example take place within the processes (the sequence of actions carried out may vary and is not considered in the list below):

- In the Transport Demand sub-domain
    - The establishment of the transport chain is initiated based on a transport need
    - Information, e.g. meteorological information that may influence on the selection of transport modes and routes, is retrieved from the Transport Network Management sub-domain
    - The transport chain is established by interactions with the Transport Service Management sub-domain and the Terminal Management sub-domain
    - Status reports are received from Transport Service Management sub-domain
    - If required, service providers, e.g. terminal stakeholders, are informed about changes
    - Transport documents, e.g. the customs declaration, are submitted
- In the Transport Service Management sub-domain
    - Orders are received from the Transport Demand sub-domain
    - The required resources are allocated; the route is planned, etc.
    - Transport documents are submitted, e.g. for maritime transport information about dangerous cargo is reported to the Transport Network Management sub-domain
    - The required information is submitted to transport means in the On-board Support and Control sub-domain
    - The on-going transport operation is monitored
    - Status information and incidents reports are received from the On-board Support and Control sub-domain, and selected parts of this information is reported to the Transport Demand sub-domain
    - The Transporter may interact with the Terminal Management sub-domain about the terminal operations
- In the On-board Support and Control sub-domain
    - Information about the transport operation and the transport tasks that are to be accomplished is received from the Transport Service Management sub-domain
    - The driver receives dynamic information about the transport network, from the Transport Network Management sub-domain.
    - Status and incident information is reported to the Transport Service Management sub-domain
    - The driver may interact with the Terminal Management sub-domain about the terminal operations
- In the Transport Network Management sub-domain
    - Incoming requests for information are received and responded to
    - Customs clearance is accomplished
    - Incident reports are responded to
    - Information reports are handled according to regulations
- In the Terminal Management sub-domain

- Orders are received from the other sub-domains
- The required terminal operations are planned
- The required terminal operations are re-scheduled whenever changes are reported
- The terminal operations are supported

1.1.8Interoperability

ITS solutions should be able to interact with other ITS solutions. ARKTRANS specifies how interoperability can be achieved. Common conceptual information models, specified in the information view, are the basis for the interoperability. These models define the syntax as well as the semantics of information elements used in interactions between the transport systems. The information content that is exchanged will also be a part of the information view.

The technical realisation of the information flows between the sub-domains of the reference model is specified in the technical aspects of ARKTRANS. Only the realisation of information flows that are to be harmonised across all transport modes are specified, as described in 11.2.3.

5ARKTRANS Roles and Objects

Roles and objects are general names for stakeholders and units that may interact with an ITS, and stakeholders and units that may be managed by means of ITS.

5.1ARKTRANS Roles

A stakeholder may be a person, a team, an organization or an institute (which, in general, are region specific) and can be defined by means of one or more *responsibilities* (which are generic and organisation unspecific). The same responsibility can also apply to different types of stakeholders. To end this confusion there is a need to define a unique and consistent set of responsibilities. Using a responsibility as the basic entity we can define roles:

- One responsibility belongs to just one role.
- A role is used as a generic term that implements a particular set of (related) responsibilities.
- Using roles, the responsibilities of stakeholders can be handled in a generic way.
- Stakeholders can fulfil one or more roles.
- Stakeholders with identical responsibilities will implement the same set of roles.

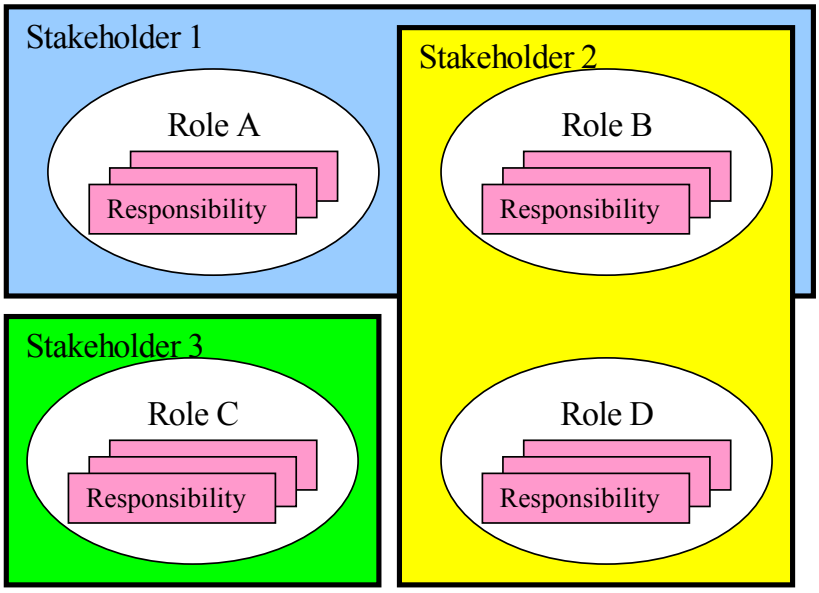


Figure 9 Stakeholders

In ARKTRANS, roles are used instead of stakeholder names to arrange for generic specifications:

- A role belongs to just one sub-domain or sub-area in the Reference Model.
- A role represents all stakeholders with the same set of responsibilities. The *Transporter* role for example represents all carriers and describes the carrier responsibilities. Thus, roles make it easier to make references to stakeholders and units in a generic way: It is favourable to use *roles* instead of using the unique labels or names that the stakeholders and units have in the real world. E.g. we use the role *Transporter* instead of the name of the transport company.
- Stakeholders that implement multiple roles can be handled by focusing on each role separately. A forwarder may for example be a *Transport User Agent* who books transport services on behalf of a Transport User. The same forwarder may also possess the *Transporter* role as the forwarder receives transports bookings from a Transport User that may not know that the forwarder is a forwarder and not the real carrier (see 5.5 for more information).

Roles support dynamic changes and organisational structure diversities

- Roles are independent of organisational issues and will persist through organisational changes (stakeholders may change, differences in different countries, etc.);

- A stakeholder can dynamically change the set of roles that he implements at any moment of time. At times of crisis a stakeholder may for example have to adopt roles on a rather semi-permanent basis;
- Roles support changing levels of automation. A role may for example be implemented by human beings, systems or by both at the same time. In any case the provider of a service can be referred to by means of the same roles, e.g. the *Information Provider* role.

In the tables below the roles specified by the means of the following columns:

- *Superior roles* – These are overall generic terms valid across all the transport modes and in some cases also for both freight and personnel transport.
- *Detailed roles* – Refinements of the superior roles. These are also valid across all the transport modes and in some cases also for both freight and personnel transport. A detailed role may be a superior role specified elsewhere in the table. In such cased the term is printed in *italic*.
- *Terms used in road transport* – Specifies road transport terms for the superior or detailed roles. Commonly known road transport roles or stakeholders may also be referred. The intention is to help stakeholders to understand the meaning of the superior and detailed roles.
- *Terms used in maritime transport* – Specifies maritime terms for the superior or detailed roles. Commonly known maritime roles or stakeholders may also be referred. The intention is to help stakeholders to understand the meaning of the superior and detailed roles.
- *Terms used in rail transport* – Specifies rail transport terms for the superior or detailed roles. Commonly known rail transport roles or stakeholders may also be referred. The intention is to help stakeholders to understand the meaning of the superior and detailed roles.
- *Terms used in air transport* – Specifies air transport terms for the superior or detailed roles. Commonly known air transport roles or stakeholders may also be referred. The intention is to help stakeholders to understand the meaning of the superior and detailed roles.

Only the superior roles and detailed roles are used in the system framework architecture. The superior roles are used in the overall parts of the architecture, like in the reference model. As more details are introduced the more detailed roles may also be used. However, whenever possible the superior roles should be preferred to the detailed roles.
The mapping towards the terms used in the different transport modes is done by Norwegian stakeholder and reflects the Norwegian situation. Norwegian terms may be used, and Norwegian stakeholders that possess the roles may be mentioned.

Roles related to Transport Network Management

The Transport Network Management sub-domain relates to a wide spectre of roles. Thus, this sub-domain is further decomposed into five sub-areas (see Chapter 6):

- Transport Network Infrastructure Management
- Transport Network Utilisation
- Emergency Management
- Regulation Enforcement
- Service Management

5.1.1.1Roles related to Transport Network Infrastructure Management

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Examples or terms used in road transport**	**Examples or terms used in maritime transport**	**Examples or terms used in rail transport**	**Examples or terms used in air transport**
Transport Network Manager	Transport Network Planner	Transport-infrastruktur-forvalter	Transport-infrastruktur planlegger	– Statens Vegvesen – Police – County authorities – Municipals – Private	– Coastal Administration	– Jernbaneverket – Who has the responsibility for the tram lines?	– Aviation authority
	Transport Network Operator		Transport-infrastruktur operatør	–	–	–	–
	Transport Network Information Manager		Transport-infrastruktur informasjonsansvarlig	–	–	–	–

5.1.1.2Roles related to Transport Network Utilisation

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Examples or terms used in road transport**	**Examples or terms used in maritime transport**	**Examples or terms used in rail transport**	**Examples or terms used in air transport**
Traffic and Transport Planner	Traffic and Transport Planner	Trafikk- og transport-planlegger	Trafikk- og transport-planlegger	– Fylkeskommunen[2] – Ministry of Transport and Communications[3] – Statens Vegvesen (førerkort) – Stortinget og SD (bomstasj.)	– Fylkeskommunen (ferger i et fylke) – Ministry of Transport and Communications (riksvegferger)	– Jernbaneverket – Ministry of Transport and Communications – Jernbanetilsynet	– Aviation authority – Ministry of Transport and Communications – Luftfartstilsynet
Traffic Support Planner		Trafikksupport-planlegger (ansvarlig for nødvendige ressurser og tjenester)		–	– Planning nautical support – Planning use of tug boat – Planning capacity of locks and bridges – Planning capasity of pilots	–	–
Traffic Information Central (TIC)	Traffic Information Central	Trafikk-informasjons-sentral (TIC)	Trafikkinformasjons-sentral	– Vegtrafikksentral en i Oslo (TIC-N[4]) – Regionale Vegtrafikksentraler – Trafikanten	– VTS-senter – Maritimt informasjonssenter (melding til sjøfarende) – Kartverket (etterretning til sjøfarende) – ShipRep	– Driftsoperativt senter (DROPS) – Toganvisere – Transportledere	– LETIS (Luftfartsverkets elektroniske trafikkinformasjons-sentral)

[2] The regional authority assigns transport permissions for freight and passenger transport within a region.
[3] The Department of Transport assigns transport permissions for freight and passenger transport across regions.
[4] Responsible for dissemination of traffic information towards national and international public media.

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Examples or terms used in road transport**	**Examples or terms used in maritime transport**	**Examples or terms used in rail transport**	**Examples or terms used in air transport**
Traffic Control Central (TCC)	Traffic Control Central	Trafikkontroll-sentral (TCC) (ansvar for informasjon og kontroll relatert til trafikken på transportinfrastruktu ren)	Trafikkontroll-sentral	– Vegtrafikksentral (VTS) (Regionale Vegtrafikksentraler[5]) – Vaktsentraler[6]	– VTS-centre	– (Sentralisert Trafikkontroll (CTC)) – Togledersentral – Lokale stillverk – Togledelse (JBV)	– Air traffic control centre – Approach control at airport
	Manual Traffic Control (consider to remove this – functional equal to automated control)		Manuell trafikkontroll	–	– Pilot	– TXP	– ”Follow-me” car
	Traffic Control Central Operator		Trafikk-sentraloperatør (trafikkkontrollsent ral)	– Trafikkoperatør – Vaktoperatør	– VTS-operator	– Togleder (Traffic superviser/controler)	– Air traffic contoller

[5]Control of tunnels and bridges.

[6] May be permanent or seasonal. May have subordinate centrals.

5.1.1.3Roles related to Emergency Management

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Examples or terms used in road transport**	**Examples or terms used in maritime transport**	**Examples or terms used in rail transport**	**Examples or terms used in air transport**
Emergency Authority	Emergency Preparedness Authority	Ulykkes-myndighet	Beredskaps-myndighet	– Statens Vegvesen – Forsvaret – Sivilforsvaret – DNMI – TBO – Transportbedriftenes Beredskapsorganisasjon	– SFT – Forsvaret – Coastal Administration – Interkommunale beredskapsutvalg – DNMI	– Jernbaneverket	– Aviation authority (plans) – Forsvaret (early warning in case of war/mobilisation)
	Search and Rescue Centre		*Rednings-sentral*	– Police – Rescue Coordination Centre – Rescue Sub-centre	– Police – Rescue Coordination Centre	– Police – Egne ulykkes-kommisjoner	– Police – Rescue Coordination Centre
	Accident Investigation Authority		Havari-kommisjon	– Ulykkeskommisjon	–	–	– Havarikommisjon
	Pollution Control Authority		Forurensnings-tilsyn	– Statens Forurensningstilsyn – Helsetilsynet	– Statens Forurensningstilsyn	– Statens Forurensningstilsyn	– Statens Forurensningstilsyn
Search and Rescue Centre	Search and Rescue Centre	Redningssentral	Redningssentral	– Redningstjeneste (NAF) – Vegtrafikksentral [7] – Fire department – Police – Rescue Centre	– SAR – Police – Rescue Centre	– Driftsoperativt senter (DROPS) – Police – Rescue Centre	– Police – Rescue Centre
	Search and Rescue Manager		Skadestedsleder	– Police – Rescue Coordination Centre – Rescue Sub-centre	– Police – Rescue Coordination Centre	– Police – Egne ulykkes-kommisjoner	– Police – Rescue Coordination Centre

[7] Tunnels and bridges

5.1.1.4Roles related to Regulation Enforcement

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Examples or terms used in road transport**	**Examples or terms used in maritime transport**	**Examples or terms used in rail transport**	**Examples or terms used in air transport**
Authority	Agricultural Authority	Myndighet	Landbruksmyndighet	–	–	–	–
	Armed Forces Authority		Militærmyndighet	–	– Coast Guard	–	–
	Arrival Notification Authority		Ankomstmyndighet	–	– Forsvaret – Kystverket	–	–
	Civil Law Authority		Politimyndighet	– UP (kontrollerende) – Trafikkpolitiet (ulykker) – Statens Vegvesen (begrenset)	– Coast Guard – Police	– Police	– Police
	Customs		Tollmyndighet	– Tollvesenet	– Tollvesenet	– Tollvesenet	– Customs
	Fare Authority		Takstmyndighet	– Kommuner (parkering) – Fylkeskommunen (kollektivtakster) – Ministry of Transport and Communications (kollektiv-takster - på tvers av fylker)	–	– Ministry of Transport and Communications – Stor-Oslo Lokaltrafikk – Oslo Kommune	– Fri takstfastsettelse av selskapene selv, unntatt kortbanenettet hvor Ministry of Transport and Communications er inne i anbudsrundene
	Fee Collection Authority		Innkrevnings-ansvarlig	– Toll og avgiftsdirektoratet[8]	– Coastal Administration – Toll og avgiftsdirektoratet[9]	– Jernbaneverket	– Aviation authority – Euro control
	HAZMAT Authority		Myndighet for håndtering av farlig gods	– Direktoratet for brann og eksplosjonsvern (ADR-forskrift) – Statens Vegvesen – SFT	– NCA (National Competence Authority) – SFT	– Sikkerhetstjeneste	– Luftfartstilsynet
	Health Authority		Helsemyndighet	–	–	–	–
	Immigration Authority		Immigrasjonsmyndighet	–	–	–	–
	Inspection Authority		Tilsyns-myndighet	– Statens Vegvesen v/Trafikkavdelingene (kjøretøy og fører)	– Sjøfartsdirektoratet	– Statens Jernbanetilsyn	– Aviation authority
	Legislative Authority		Lovgiver	–	– National Authorities – EU – International Authorities	–	–
	Licence Authority		Løyvemyndighet (løyver tildeles avhenging av kvalifikasjon)	– Fylkeskommunen [10] – Ministry of Transport and Communications[11] – Statens Vegvesen (førerkort) – Stortinget og SD (bomstasj.)	– Fylkeskommunen (ferger i et fylke) – Ministry of Transport and Communications (riksvegferger)	– Jernbaneverket – Ministry of Transport and Communications – Jernbanetilsynet	– Aviation authority – Ministry of Transport and Communications – Luftfartstilsynet
	Statistics Authority						
	Terminal Security Authority						
	Transport Means Authority						
	Veterinary Authority						

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Examples or terms used in road transport**	**Examples or terms used in maritime transport**	**Examples or terms used in rail transport**	**Examples or terms used in air transport**
	Waste Authority		Avfallsmyndighet	–	–	–	–

5.1.1.5Roles related to Service Management

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Examples or terms used in road transport**	**Examples or terms used in maritime transport**	**Examples or terms used in rail transport**	**Examples or terms used in air transport**
Information Provider	Environmental Resource Information Provider	Informasjons-leverandør	Leverandør av miljø- og ressurs-informasjon	– AREALIS-prosjektet – Statens Vegvesen	– Det Norske Veritas – Hydrographic Service – SFT	– Det Norske Veritas	– Aviation authority
	Geodata Provider		Leverandør av geografisk informasjon	– Statens kartverk – County authorities – Kommunenes sentralforbund – Landbruksdep. – Energiforsyningens fellesorg. – Telecom companies	– Hydrographic Service – C-Map	– Jernbaneverket – Statens kartverk	– Aviation authority –
	Traffic Condition Information Provider		*Leverandør av informasjon om trafikkforhold*	–	–	–	–
	Travel Information Provider		*Leverandør av reiseinformasjonstjenester*	–	–	–	–

[8] E.g. fee collection
[9] E.g. fee collection
[10] The regional authority assigns transport permissions for freight and passenger transport within a region.
[11] The Department of Transport assigns transport permissions for freight and passenger transport across regions.

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Examples or terms used in road transport**	**Examples or terms used in maritime transport**	**Examples or terms used in rail transport**	**Examples or terms used in air transport**
Service provider	*Information Provider*	Tjenesteyter	*Informasjons-leverandør*	–	–	–	–
	Insurance Provider		Forsikrings-selskap	– Forsikringsselskaper	– Insurance company	– Insurance company	– Insurance company – Egenassurandør
	Navigation Assistance Provider		Leverandør av navigasjons-assistanse	– Traffic Control Central – Traffic Information Central – Fleet Management Centre	– Traffic Control Central – Pilot service – Pilot – Tug boat operator – Tug boat	– Togledersentral – Transportledere	– Traffic Control Central
	Payment Service Provider		Betalings-formidler	– Fee collection company[12] – Ferjeselskap	– Ferjeselskap – Collector of annual fee and coastal fee	– Agents – Travel agencies – Samarbeidende operatører (Fylkeskommunale)	– Euro control (underveisavgift) – Airports – Aviation authority – Finansdep.
	Resource Provider		Leverandør av ressurser	– Lastebileier – Karneier – Leverandør av personell	– Reder	–	–
	Route Information Administration Provider		Leverandør av administrasjonstjenester for ruteinformasjon	–	–	–	–
	Search and Rescue Service Provider		Leverandør av rednings-tjenester	– Police – Fire department – Medical authorities – Defence forces – Telecom Companies – Civil Defence – Voluntary organisations	– Police – Fire department – Medical authorities – Defence forces – Telecom Companies – Civil Defence – Voluntary organisations – Pilot service – Port Authority	– Police – Fire department – Medical authorities – Defence forces – Telecom Companies – Civil Defence – Voluntary organisation	– Police – Fire department – Medical authorities – Defence forces – Telecom Companies – Civil Defence – Voluntary organisation – Air Traffic Control Service (FRS)
	Terminal Information Administration Provider		Leverandør av administrasjonstjenester for terminalinformasjon	–	–	–	–
	Ticket Controller		Billettkontrollør	– Transporter	– Ticket Validator	– Ticket Validator	– Ticket Validator
	Ticket Issuer						
	Ticket Trader						
	Travelling Service Provider						

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Examples or terms used in road transport**	**Examples or terms used in maritime transport**	**Examples or terms used in rail transport**	**Examples or terms used in air transport**
Traffic Condition Information Provider	Traffic Flow Information Provider	Leverandør av informasjon om trafikkforhold	Leverandør av -informasjon om trafikkflyt	– Traffic Control Central – Traffic Information Central – Radio channels – Transport Management centre – Internet service providers[13] – Text TV	– Traffic Information Central – Radio channels	– Traffic Information Central – Web	– Traffic Information Central
	Traffic Network Condition Information Provider						
	Physical Transport Network Information Provider		Leverandør av informasjon om ferdselsforhold.	– Weather offices – Traffic Control Central – Traffic Information Central – Radio channels – Transport Management centre	– Weather offices – Traffic Information Central – Radio and TV channels – Route planners	– Weather offices – Traffic Information Central	– Weather offices – Flyværtjenesten – Traffic Information Central
	Dynamic Transport Network Information Provider		Leverandør av fysisk infrastrukturinformasjon	– Traffic Control Central – Traffic Information Central – Transport management centre – Internet service providers[14] – Transport Network Authority	– Traffic Information Central – Transport Network Authority	– Traffic Information Central – Transport Network Authority – Web	– Traffic Information Central – Transport Network Authority
			Leverandør av dynamisk infrastrukturinformasjon	– Traffic Control Central – Traffic Information Central – Radiokanaler – Transport management centre – Internet service providers[15] – Transport Network Authority	– Traffic Information Central – Radio channels – Transport Network Authority	– Traffic Information Central – Transport Network Authority – Web	– Traffic Information Central – Transport Network Authority

[12] May operate on behalf of county or municipal authority. Operates toll roads, administrates fee collection, pays off loans, management of information, etc.
[13] In Norway among others Trafikk 24, Radio1
[14] In Norway among others Trafikk 24, Radio1, NRK, P4
[15] In Norway among others Trafikk 24, Radio1, NRK, P4

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Examples or terms used in road transport**	**Examples or terms used in maritime transport**	**Examples or terms used in rail transport**	**Examples or terms used in air transport**
Travel Information Provider	Door-to-door Travel Planner	Leverandør av reiseinformasjons tjenester	Leverandør av dør-til-dør reiseplanlegger	– Trafikanten	–	–	–
	Terminal Information Provider		Leverandør av terminalinformasjon	–	–	–	–
	Scheduled Transport Travel Planner		Leverandør av reiseinformasjonstjenester for rutegående transport	– Norsk Reiseinformasjon – Trafikanten	– Norsk Reiseinformasjon – Vessel owners	– Norsk Reiseinformasjon – NSB	– Norsk Reiseinformasjon – Air lines
	Non-scheduled Travel Planner Transport						
	Tourist Information Provider		Leverandør av reiseinformasjonstjenester for ikke-rutegående transport	– VisVeg – NAF – Gule sider	–	–	–
			Leverandør av turist-informasjon.	– Travel agencies – Reiseinformasjon for Sogn og Fjordane(?)	– Travel agencies –	– Travel agencies – Kundesentre	– Airline company – Travel agencies

1.1.9Roles related to Transport Demand

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Traveller	Scheduled Transport Passenger	Reisende (person som skal reise eller som er på reise)	Passasjer på rutegående transport	– Passenger – Public transport traveller	– Passenger	– Passenger	– Passenger
	On-demand Transport Passenger		Passasjer på ikke-rutegående transport	– Taxi passenger	–	–	–
	Crew		*Besetning*	–	–	–	–
	Crew in Transit		Tjenestereisende	–	–	–	–
	Transport Network User		Veibruker	– Road User – Pedestrian – Cyclist – Professional driver – Private driver	– Captain	– Train driver	– Pilot

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Public Purchaser	Public Purchaser	Offentlig innkjøper	Offentlig innkjøper	– Fylkeskommunen [16] – Ministry of Transport and Communications[17] – The parlament og Ministry of Transport and Com. (bomstasjoner) –	– Fylkeskommunen (ferger i et fylke) – Ministry of Transport and Communications (riksveiferger) –	– Fylkeskommunen – Ministry of Transport and Communications –	– Fylkeskommunen – Ministry of Transport and Communications –
Transport User	Consignee	Transport-bruker (etterspør transport)	Varemottaker	–	–	–	–
	Consignor		Avsender	–	– shipper	–	–
	Traveller		*Reisende*	–	–	–	–
	Cargo owner		Vareeier	–	–	–	–
	Transport Consumer		Konsument	– Company – Private persons	– Company – Private persons	– Company – Private persons	– Company – Private persons
Transport User Agent	Transport Organisator	Transport-brukeragent (opptrer på vegne av transport-bruker)	Transport-organisator	– Travel agency – Logistics provider – Forwarder ordering transport services – Tour operator – Postal administration – WEB-services – Transporter	– Travel agency – Logistics provider – Forwarder ordering transport services – Postal administration – WEB-services – Tour operator – Transporter	– Travel agency – Agent – Forwarder ordering transport services – Postal administration – Postal administration – WEB-services – Tour operator – Transporter	– Travel agency – Forwarder ordering transport services – Postal administration – WEB-services – Tour operator – Transporter
	Importer		Importør	–	–	–	–
	Exporter		Eksportør	–	–	–	–
	Chamber of Commerce		Handelskammer	–	–	–	–
	Declaration Agent		Tolldeklarerings-agent	–	–	–	–
	Logistics Provider		Logistikktilbyder	–	–	–	–

[16] The regional authority assigns transport permissions for freight and passenger transport within a region.
[17] The Department of Transport assigns transport permissions for freight and passenger transport across regions.

1.1.10Roles related to Transport Service Management

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Transporter	Freight Carrier	Transportør (eier eller operatør av transportmidler som tilbyr transport-tjenester)	Godstransportør (forwarding agent/shipping agent/freight forwarder, samlaster (consolidator))	– Forwarder accepting orders – Forwarder managing several Transporters – Taxi company – Rutebilselskap – Lastebilbedrift – Budfirma – Postal service – Transportsentral	– Forwarder accepting orders – Forwarder managing several Transporters – Rederi – Trampline – ikke regulære ruter – Rutebåtlinje (Freight line) – regulære ruter – Ferjeselskap	– Forwarder accepting orders – Forwarder managing several Transporters – NSB – Cargonet – Linx – Flytog	– Flyselskap – Helikopterselskap –
	Passenger Carrier		Persontransportør	– Taxiselskap – Rutebilselskap – Turbilselskap – Transportsentral – Kollektivselskap – Sporveier	– Rederi – Trampline – ikke regulære ruter – Rutebåtlinje (Freight line) – regulære ruter – Ferjeselskap – Kollektivselskap	– NSB – Sporveier – Flytog	– Flyselskap – Helikopterselskap – Kollektivselskap
Fleet Manager	Fleet Operator	Flåteoperatør	Flåteoperatør r	– Busselskap – Lastebilselskap – Drosjeeier	– Rederi – Operatørselskap	– NSBs driftsoperative senter (DROPS) – Cargonet – Flytoget – Dispatcher	– Flygeleder
	Fleet Management Centre		Flåtestyringssenter (Transport management center - TMC)	– Taxisentral – Kjørekontor – Trafikklederkontor	– Rederikontor	– Operatører – NSBs materiellenhet – JBVs strategisk ruteplankontor	– Flyselskapenes operative sentre
	Emergency Fleet Operator		Utrykningsflåte-operatør Ambulanse-tjenesteoperatør	– AMK-sentral – Piliti – NAF/Viking/Falken – Røde kors	– Redningsselskapet – Police – Coast Guard – Ambulansebåtoperatør	– Hovedrednings-sentral	– Luftambulanse – Hovedrednings-sentral
Transport Means Owner	Transport Means Owner	Transportmiddeleier	Transportmiddeleier	– Drosjeeier – Lastebileier	– Reder	–	–

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Transporter Agent	Handling Agent	Transportøragent	Håndteringsagent	–	– Skipsagent	–	– Handler
	Authorised Reporting Agent		Autorisert rapporteringsagent	–	–	–	–
	???		Pakkeoperatør	–	–	– Pakkeoperatør	–
Customer	*Transport User*	Oppdragsgiver	*Transportbruker*	–	–	–	–
	Transport User Agent		*Transportbrukeragent*	–	–	–	–

1.1.11Roles related to On-board Support and Control

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Crew	Captain	Besetning	Kaptein	– Fører	– Kaptein	– Engine driver[18] – Traffic Control Central Operator (takes decisions about conveying)	– Fartøysjef
	Chiefs						
	First Officer	(ombord på transportmiddel)					
	Driver		Maskinist	–	–	–	–
	Navigator		Nestkommanderende	–	– Styrmann	– Ombordansvarlig/ Togsjef/Conductor	– Flystyrmann
	People on duty						
	Passenger Manager		Fører	– Syklist – Fører av motorsykkel – Fører av personbil/varebil – Fører av lett lastebil – Fører av lastebil – Fører av minibuss – Fører av buss – Fører av traktor – Fører av beltemotor-sykkel, snøscooter – Taxisjåfør – Kollektivtransportsjåfør	– Rormann	– Trikkefører – Lokfører – Vognfører – Train driver – Locomotive engineer (US) – Engin driver (UK)	– Flyger
			Navigatør	–	–	–	–
			Mannskap	– Hjelpemann – Reservesjåfør	– Styrmann – Navigatør – Maskinist – Andre offiserer – Konduktør – Kundekontakter – Øvrig besetning	– Konduktør (also ticket conductor) – Billettør – Ombordpersonell – Servicepersonell	– Cabinpersonale – Navigatør – Maskinist
			Passasjeransvarlig	–	– Hotellsjef – Cateringpersonale	– Togsjef – Cateringpersonale – Sovevognskonduktør	– Purser

[18] May not have any influence on the conveying – managed by the control center and the signaling system)

1.1.12Roles related to Terminal Management

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Terminal Manger		Terminalsjef		– Terminaleier –	– Havnemyndighet – Havnesjef – Port authority	– Jernbaneverket – CargoNett –	– Lufthavnsmyndighet
	Terminal Security Manager			–	– Harbour master	– Jernbaneverket – CargoNett –	– Lufthavnsmyndighet
	Terminal Safety Manager			–	– Harbour master	– Jernbaneverket – CargoNett –	– Lufthavnsmyndighet
	Terminal Emergency Manager			–	– Harbour master	– Jernbaneverket – CargoNett –	– Lufthavnsmyndighet
	Terminal Pollution Manager			–	– Harbour master	– Jernbaneverket – CargoNett –	– Lufthavnsmyndighet
	Terminal Operation Manager			–	–	–	–
	Terminal Administrator			–	–	–	–
Terminal Operator		Terminaloperatør		– Transportør	– Havneopertør – Stevedore	– Terminalopertør – Godsselskap – Personselskap	–

English		Norwegian		Continuously updated (English and Norwegian)			
Superior roles	**Detailed roles**	**Overordnede rollebegrep**	**Detaljerte rollebegrep**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Terminal Actor	Terminal Worker	Terminaktør	Laste- og lossearbeider	– Terminaloperatør	– Stuer (Stevedore) – Kranfører – Godsformidlere (Feeder Sevice)	– Stuer – Kranfører – Skifter – Sikkerhetstjeneste	– Flyselskap – Operasjonssenter hos flyselskap
	Customs Agent						
	Warehouse Provider						
	Supplier		Fortollingsagent	–	–	–	–
	Renter		Leverandør av lagringsplass (lager, parkeringsplass, opplagsplass)	– Terminalmyndighet – Spesitør – Lageroperatør – Parkeringsetat	– Terminalmyndighet – Statens Forurensningstilsyn – dumping av avfall	– Terminalmyndighet	– Terminalmyndighet
	Counter Staff						
	Emergency Team		Leverandør av forsyninger og tjenester	– Cateringselskap – Oljeselskap – Warehouse provider	– Terminaler – Oljeselskap – Skipshandlere – Tug boat operator??? – Warehouse provider	– Cateringselskap – Oljeselskap – Technical service provider – Equipment provider – Skiftelokk??? – Warehouse provider	– Cateringselskap – Oljeselskap
	Security Personnel						
	Operative Quality Surveyor		Leietaker	– Butikk – Restaurant – Bank/post	– Butikk – Restaurant – Bank/Post	– Butikk – Restaurant – Bank/Post	– Butikk – Restaurant – Bank/Post
			Skrankepersonale	– Skrankepersonale	– Skrankepersonale	– Skrankepersonale	– Stuer –
			Redningsteam	–	– Fire team – Rescue team	– Beredskapstog	–
			Sikkerhets-personell	– Vektere	– Gate control personnel – Security Personnel – Vektere	– Vektere	–
			Sikkerhets- og kvalitetsinspektør	–	– Inspektører	– Traffiksikkerhets-ansvarlig	–
	Waste Reception Handler		Avfallshådnterer	–	–	–	–

5.2ARKTRANS Objects

Object names are general names for objects that may be related to ITS. We state the following reasons for using object names:

- Object names make it easier to make references to objects (equipment, technology, resources, units, etc.) in a generic way.
- Object names are common names used across all the transport modes on objects representing the same purpose. E.g.: The object name *Transport Means* instead of car, vessel, bus, train, etc., and the object name *Transport Network* is used instead of road, fairway, railroad, and air corridor.
- The architecture should as far as possible be independent of technological changes. Technology that can be handled like a “black box” (known functionality and known interfaces, but the realisation is not known or irrelevant) should be assigned object names. This may be COTS, or likely to become COTS in the near future. E.g. the object names *Communication Equipment* may be used instead of a specific GSM cellular phone. (There are many types of GSM phones, and technologies like UMTS may substitute them in the future.)

In the tables below the object names specified by the means of the following columns:

- *Superior object names* – These are overall generic terms valid across all the transport modes and in some cases also for both freight and personnel transport.
- *Detailed object names* – Refinements of the superior object names. These are also valid across all the transport modes and in some cases also for both freight and personnel transport. A detailed role may be a superior role specified elsewhere in the table. In such cased the term is printed in *italic*.
- *Terms used in road transport* – Specifies road transport terms for the superior or detailed object names. Commonly known road transport object may also be referred. The intention is to help stakeholders to understand the meaning of the superior and detailed object names.
- *Terms used in maritime transport* – Specifies maritime terms for the superior or detailed object names. Commonly known maritime objects may also be referred. The intention is to help stakeholders to understand the meaning of the superior and detailed object names.
- *Terms used in rail transport* – Specifies rail transport terms for the superior or detailed object names. Commonly known rail transport objects may also be referred. The intention is to help stakeholders to understand the meaning of the superior and detailed object names.
- *Terms used in air transport* – Specifies air transport terms for the superior or detailed object names. Commonly known air transport objects may also be referred. The intention is to help stakeholders to understand the meaning of the superior and detailed object names.

Only the superior object names and detailed object names are used in the system framework architecture. The mapping towards the terms used in the different transport modes is done by Norwegian stakeholder and reflects the Norwegian situation. Norwegian terms may be used, and Norwegian stakeholders that possess the roles may be mentioned.

1.1.13Object names related to Transport Network Management

The Transport Network Management sub-domain relates to a wide spectre of roles. Thus, this sub-domain is further decomposed into five sub-areas (see Chapter 5.5):

- Transport Network Infrastructure Management
- Transport Network Utilisation
- Emergency Management
- Regulation Enforcement
- Service Management

5.2.1.1Object names related to Transport Network Infrastructure Management

English		Norwegian		Continuously updated (English and Norwegian)			
Superior object names	**Detailed object names**	**Overordnede objektnavn**	**Detaljerte objektnavn**	**Examples or terms used in road transport**	**Examples or terms used in maritime transport**	**Examples or terms used in rail transport**	**Examples or terms used in air transport**
Transport Network	Transport Corridor	Transport-infrastruktur	Transportkorridor	– Road/street (vei, gate) – Gang og sykkelvei – Tunnel (Tunnel) – Bridge (bro)	– Fairway – Inland waterways – River	– Railroad	– Corridor –
	Leg		Strekning	– Vegstrekning	– Strekk	– Strekning	– ???
	Link		Lenke (mellom trafikknute-punkt)	– Vegstrekning	– -Strekk	– Blokk	– ???
	Transport Network Node		Trafikknutepunkt	– Ferjeleie – Veikryss – Terminal (se eget punkt)	– sted hvor farleder krysser eller skiller vei	– Knutepunktstasjon –skifte transportmiddel – Krysningsspor	– Airport
	Transport Network Equipment		*Utstyr tilknyttet transport-infrastruktur*	–	–	–	–
	Waiting area		Venteområde	–	–	–	–

English		Norwegian		Continuously updated (English and Norwegian)			
Superior object names	**Detailed object names**	**Overordnede objektnavn**	**Detaljerte objektnavn**	**Examples or terms used in road transport**	**Examples or terms used in maritime transport**	**Examples or terms used in rail transport**	**Examples or terms used in air transport**
Transport Network Equipment	Equipment for Traffic Control	Utstyr tilknyttet transportinfra-struktur	Trafikkregulerings-utstyr	– Equipment for ATC (Automated Traffic Control) – Utstyr for manuell trafikkontroll – Vektkontroll? – Signalanlegg – Sentralstyringsanlegg – Trafikksignalsentral	– AIS base stations – VTS	– Togradio/GSM-R – CTC (Centralised Traffic Control) – Stillverk – ATC (Automated Train Control) – Mobile phone Styringsanlegg – Sikringsanlegg – Penser – Blokktelefon	– VOR (Very High Frequency Omni range) – ILS (Instrument Landing System) – NDB (Non Directional Beacon) – Radar – UHF/VHF/HF – Air Control – Navigasjonssystem på bakken
	Traffic Monitoring Equipment						
	Electronic Fee Equipment						
	Transport Network Condition Monitoring Equipment						
	Equipment for Information		Trafikkovervåkings-utstyr	– Field station for measurement – Traffic information[19] (like speed, video, numbers) – Signal management (detectors, radar)	– Radar – Speed meters – Video monitors – AIS base station	– Speed meters – Video monitors – ATC-balisier – Mobile phones –	– Issensor – Bremseeffektmåler – Video monitors –
			Elektronisk betalingsutstyr	–	–	–	–
			Utstyr som overvåker ferdelsforhold	– Field station for measurement – Met. data (temp., wind, humidity, air pressure, view) – Environmental data (pollution, remaining salt)	– Met. sensors (temp., wind, humidity, air pressure, view) – Sailing conditions sensors (current, waves, water level) – Radar	– Met. sensors (temp., wind, humidity, air pressure, view) –	– Met. sensors (temp., wind, humidity, air pressure, view) –
			Informasjons-formidlingsutstyr	– Variable message sign – Variable information board – Punktradio – Communication equipment	– Communication equipment – AtoN (Aids to navigation)	– Elektroniske skilt – Communication equip – Togradio – Skifteradio – Konduktørradio – Mobiltelefon	– Electronical signs – Communication equipment – Monitors – ATIS (Automatisk provider of met.info)

[19] Ulike nivåer. Nivå 1 måler kontinuerlig. Nivå 2 Måler periodisk 2-4 ganger per år. Nivå 3 måler en periode hvert år.

5.2.1.2Object names related to Transport Network Utilisation

Not defined

5.2.1.3Object names related to Emergency Management

Not defined

5.2.1.4Object names related to Regulation Enforcement

Not defined

5.2.1.5Object names related to Service Management

English		Norwegian		Continuously updated (English and Norwegian)			
Superior object names	**Detailed object names**	**Overordnede objektnavn**	**Detaljerte objektnavn**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Ticket Equipment	Ticket Machine	Bilettutstyr	Billettautomat	– Betalingsautomater	–	– Betalingsautomater	–
	Validation Machine		Valideringsautomat	–	–	–	–
				–	–	–	–
Payment Equipment		Elektronisk betalingsutstyr		– Toll bar – Payment machine	–	–	–
				–	–	–	–

1.1.14Object names related to Transport Demand

English		Norwegian		Continuously updated (English and Norwegian)			
Superior object names	**Detailed object names**	**Overordnede objektnavn**	**Detaljerte objektnavn**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Transport Item	*Passenger*	Transportert enhet	*Passenger*	–	–	–	–
	Cargo		*Gods*	–	–	–	–
	Luggage			–	–	–	–
	Load Unit		*Lastenhet*	–	–	–	–

English		Norwegian		Continuously updated (English and Norwegian)			
Superior object names	**Detailed object names**	**Overordnede objektnavn**	**Detaljerte objektnavn**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Cargo	Termo Load	Gods	Termovare	–	–	–	–
	Environmental Affected Load		Miljøpåvirkelig last	–	–	–	–
	Non-floating bulk		Ikke.flytende bulk	–	–	–	–
	Floating bulk		Flytende bulk	–	–	–	–
	Special Cargo		*Spesialgods*	–	–	–	–
Luggage	Animals	Bagasje	Dyr	–	–	–	–
	Unhandy luggage		Uhåndterlig bagasje	–	–	–	–
Special Cargo	Food	Spesialgods	Matvarer	–	–	–	–
	Animals		Levende dyr	–	–	–	–
	Human Remains		Levninger	–	–	–	–
	Valuables		Verditransport	–	–	–	–
	Dangerous Cargo		Tarlig gods	–	–	–	–
Load Unit	Pallet	Lastbærer	Palle	–	–	–	–
	Container		Container	–	–	–	–

1.1.15Object names related to Transport Service Management

Not defined

1.1.16Object names related to On-board Support and Control

English		Norwegian		Continuously updated (English and Norwegian)			
Superior object names	**Detailed object names**	**Overordnede objektnavn**	**Detaljerte objektnavn**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Transport means	Transport Means	Transportmiddel	Transportmiddel	– Vechecle	– Fartøy (vessel) – Ferjer	– Tog – Motorvogn – Sporvogn – T-bane – Container	– Fly – Helikopter
	Private Transport Means		Privat transportmiddel	– Sykkel – Privatbil – Motorsykkel – Moped	– Fritidsbåter	– Privat vogn – Privat container	– Privatfly – Mikrofly – Hangglider
	Emergency Transport Means		Utrykningskjøretøy	– Utrykningskjøretøy – Ambulanse – Politibil – Brannbil – Bergingsbil – Politimotorsykkel	– Redningsskøyte – Ambulansebåt – Kystvaktskip	– Beredskapstog (det står blant annet et på Oslo S)	– Politihelikopter – Redningshelikopter – Utrykningsbåt – Utrykningskjøretøy
	Transport Means for Passengers		Transportmiddel for passasjerer	– Yrkesmessig kjøretøy som frakter passasjerer – Taxi – Buss – Sporvogn – Matebuss – Skolebuss – Turbuss – Ekspressbuss – Flybuss	– Hurtigbåter – Ferjer – Cruiseskip – Rutebåt – Svevebåt(Hovercraft) – Kombinerte passasjer- og lasteskip – Hurtigruta	– Passasjertog – Motorvogn – Sporvogn – T-bane – Lokaltog – Kombinerte passasjer- og godstog	– Passasjerfly – Rutefly – Charterfly – Helikopter
	Freight Transport Means		Transportmiddel for gods	– Yrkesmessig kjøretøy som frakter gods – Lastebil – Lastebil som frakter farlig gods – Budbil – Kjøretøy som driver egentransport[20] av gods – Kun: Godsbiler og tilhengere?	– Lasteskip – Bulkskip – olje, gjødsel, malm (ikke containere) – Containerskip perm. containerceller – Delvis containerskip – Lekter (Barge carrier) – Bilbåt (auto carrier) – Gen. lasteskip (kveg, paller,...) – Ro-ro skip – Kombinerte passasjer- og lasteskip – Ferjer – Hurtigruta	– Godstog – Kombinerte passasjer- og godstog	– Fraktfly – Rutefly – Helikopter – Charterfly
	Service Providing Transport Means		Transportmidler som tilbyr tjenester	– Redningsbil – Følgebil – Bil med gulblink	– Mateskip (Feeder) – Taubåt – Losbåt	– Skiftelok – Hjelpelok	–

English		Norwegian		Continuously updated (English and Norwegian)			
Superior object names	**Detailed object names**	**Overordnede objektnavn**	**Detaljerte objektnavn**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Transport Means Equipment	Communication Equipment	Utstyr ombord i transportmiddel	Kommunikasjonsutstyr	– Mobiltelefon/SMS – Radiokom. – FM RDS-TA[21] – RDS-TMC[22] – DAB T/PEG[23] – VHF – El.brikker (AUTOPASS)	– Mobiltelefon – Satellittkommunikasjon – VHF (radio) – Transponder (bl.a. AIS)	– Togradio – GSM-R – ATC	– Radio
	Equipment for ATC (Automated Traffic Control)		Utstyr for automatisk trafikkontroll	– Automatic sped adaption – Automatic lane keeping	–	– ATC (Automatic Train Control)	– ILS (Instrument Landing System) –
	Equipment for Positioning		Posisjoneringsutstyr	– Bildelen av flåtestyringssystem – Satellittløsninger – GPS/DGPS	– Satellittløsninger – GPS/DGPS – AIS med GPS	– Satellittløsninger – GPS/DGPS – Blokkadr. (togradio) – CTC (Centralised Train Control)	– Satellittløsninger – GPS/DGPS – MADS (Auto. Detection Service, posisjon for helikopter)
	Equipment for Driver Support		Utstyr som støtter føreren	– System for hastighetstilpasning – Elektroniske kart – Informasjonssystem – Bildelen av flåtestyringssystem	– Autopilot – Elektroniske kart – Info.system	– Info.systemer – Togtelegram (TTS) – ATC (Automated Train Control) – ATS (Automated Train Stop) – Signalsystem	– Autopilot – Elektroniske kart – Info.system
	Equipment for Driver Control		Utstyr som overvåker og evt. responderer på førerens atferd og tilstand	–	–	– Dødmannsknapp – ATC (Automated Train Control)	– Alarmer som gir beskjed ved uregelmessig flyging
	Equipment for Freight Monitoring and Control		Utstyr som overvåker og evt. responderer på lastens tilstand	– Temperatursensor – Fuktighetsmåler	– Temperatursensor – Gassdetektor – Geigerteller	– Temperatursensor	– Temperatursensor
	Equipment for Transport Means Monitoring and Control		Utstyr som overvåker og evt. responderer på transportmiddelets tilstand	– Automatisk nødanrop – Bildelen av flåtestyringssystem	– Automatisk nødanrop – Nødpeilesender	– Automatisk nødanrop – Posisjonering	– Automatisk nødanrop –
	Equipment for Identification		Utstyr som støtter identifisering	– Elektroniske brikker – AUTOPASS-brikke	– AIS	–	–
	Equipment for Environmental Issues		Miljørelatert utstyr	–	–	–	–
	Security Equipment		Tyveri- og ranssikringsutstyr	– Tyveridetektor	–	– Tyveridetektor?	–
	Equipment for Navigation Support						
	Speed recorder						
	Trip recorder						
	Equipment enabling monitoring						

[20] Egentransport er transport av gods for egen virksomhet, f.eks. tankbilen til meieriet (dårlig eksempel siden meieriene ikke eier bilene selv...)

1.1.17Object names related to Terminal Management

English		Norwegian		Continuously updated (English and Norwegian)			
Superior object names	**Detailed object names**	**Overordnede objektnavn**	**Detaljerte objektnavn**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Terminal	Junction Terminal	Terminal	Knutepunkt-terminal	– Bussterminal – Kollektivknutepunkt	– Ferjeleie	– Sentralstasjon	– Lufthavn – Passasjerterminal
	Passenger Terminal		Passasjerterminal	– Passasjerterminal – Skysstasjon – Holdeplass	– Passasjerterminal – Ferjeleie	– Stasjon – Holdeplass	– Flyfraktterminal
	Freight Handling Terminal						
	Ferry Type Terminal		Godsterminal	– Godsterminal – Containerterminal – Skysstasjon – Omlastingsterminal?	– Havn – Kai – Omlastingshavn – Containerhavn – Ro-ro terminal	– Godsterminal – Containerterminal – Sidespor – Depot	– Flyplass
			Fergetypeterminal	–	– Fergeterminal – Ro-ro terminal	– Motor rail terminal	–
Terminal Facility	Service Area	Terminal-område	Serviceområde	– Stasjoneringssted – Bensinstasjon – Butikk – Parkerings-/rasteplass – Hvileplass	– Dokkingterminaler	– Skiftestasjon – Lokomotivstall – Trikkestall – Vedlikeholdsbase	– Flytekniske områder
	Depot Area		Depot	–	– Depot	– Depot	–
	Transit Area		Transitområde	–	– Transit area	– Transit area	–
	Maneuvering Area		Manøvrerings-område	–	– Indre havneområde	– Spor – Reception area	–
	Ramp Area		Rampe	–	–	–	–
	Transhipment Area		Omlastingsområde	–	–	–	–
	Storage Area		Lagrer	–	–	–	–
Terminal Resource	Staff	Terminal-ressurser	Arbeisstokk	–	–	–	–
	Certificate		Sertifikat	–	–	–	–
	Terminal Equipment		*Terminalutstyr*	–	–	–	–
	Terminal Facility		*Terminalområde*	–	–	–	–
	Stop Point		Stoppunkt	– Busstopp	– Kai	– Track	– Gate

[21] RDS-TA – Radio Data System Traffic Announcement
[22] RDS-TMC - Radio Data System Traffic message Channel – datapakker som dekodes og kan benyttes av informasjonssystemer
[23] DAB T/PEG – Digital Audio Broadcast

English		Norwegian		Continuously updated (English and Norwegian)			
Superior object names	**Detailed object names**	**Overordnede objektnavn**	**Detaljerte objektnavn**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Terminal Equipment	Loading and Unloading Equipment	Terminalutstyr	Laste- og losseressurser	– Kran – Truck – Vekt – ???	– Kran – Truck – Container truck	– Kraner – Trucker – Vekt	– Bagasjehandlings-system – Highloader – Tralle – Vekt – Truck
	Cargo handling equipment (inside terminal)		Godshåndterings-utstyr	–	–	–	– Bagasjebånd
	Passenger Handling Equipment		Utstyr som betjener passasjerer	– Insjekkingsautomater – Info.systemer – Rullestol	–	– Insjekkingsautomater – Info.systemer	– Betalingsautomater – Insjekkingsautomater – Info.systemer – Bagasjestyring – Rullestol
				–	–	–	–
	Terminal Transport Means		Internt transportmiddel	–	–	–	–
	Mobile ICT device						
	Terminal Load Unit		Mobilt data- og kommunikasjonsutstyr	–	–	–	–
			Inten lastbærer	–	–	–	–
Terminal Asset	Monitoring Equipment	Terminaleiendel	Overvåkingsutstyr	– Utstyr som sporer gods – Utstyr som sporer terminalressurser – Utstyr som sporer transportmidler – Video	– Utstyr som sporer gods – Utstyr som sporer terminalressurser – Utstyr som sporer transportmidler – Video	– Visuelt – Utstyr som sporer gods – Utstyr som sporer terminalressurser – Utstyr som sporer transportmidler – Video	– ITV (inter-tv) – Utstyr som sporer gods – Utstyr som sporer terminalressurser – Utstyr som sporer transportmidler – Video
	Security Equipment						
	Access Control Equipment						
	Equipment for Information		Overvåkningsutstyr	– Video	–	–	–
	Emergency Equipment		Utstyr for tilgangskontroll	– Kortleser – Bomstasjon – Gate control equipment	– Gate control equipment	–	– Adgangskontroll
	Equipment for Management of Resources		Informaasjonsfor-midlingsutstyr	– Informasjonstavler –	– Informasjonstavler	– Info.tavler – Web	– Info.tavler – Monitorer
			Nødutstyr	–	–	–	–
			Utstyr som styrer disponering av ressurser	–	– Trafikksentral – Havnesystem	– Stillverk (lokal styring av spor til-gang på stasjon) – Sporadmin.	– Bakkekontroll

5.3Descriptions of Roles

The roles are described below.

1.1.18Authority

The public authorities, public agencies or officials in a state are responsible for the application and enforcement of the laws and regulations of that state. They shall promote safe, environmental friendly and efficient transport according to laws and regulations, and they shall also as far as possible fulfil the needs of the society. Professional as well as political issues have to be considered.

A public agency or authority may possess several of the authority roles described below (and of course also other roles not included in this document). The distribution of the roles will vary between the different European countries. The generic Authority may cover a set of tasks to achieve a public behaviour that is according to rules and regulations. The tasks conducted by an Authority may be more or less preventive or repressive, and they will in general be to:

- Provide general information to the public about rules and regulation and desired behaviour;
- Provide qualified advices to individual actors on desired behaviour in particular cases;
- Enforce rules and regulations by means of:
  - Inspections and certification with respect to rules and regulations;
  - Supervision of the actual behaviour of individual actors in order to detect rule and regulation violations;
  - Handling of rule or regulation violations.

5.3.1.1Authority / Agricultural Authority

Responsible for the execution of the laws concerning the admittance of agricultural products.

5.3.1.2Authority / Armed Forces Authority

Responsible for the enforcement of regulations and laws applicable to transport means and their presence in territorial areas.

5.3.1.3Authority / Arrival Notification Authority

Responsible for the processing of the arrival notifications sent by transport means before they are crossing the territorial boarders. Thus, responsible for knowing about foreign transport means.

5.3.1.4Authority / Civil Law Authority

Responsible for policing in case of violation of civil laws and regulations. Takes the necessary measures or actions to achieve compliance with laws, rules and regulations for the management of transport and traffic. If any violations of laws and regulations are detected, sufficient data for identification and prosecution initiation of the offenders is needed.

5.3.1.5Authority / Customs

Responsible for the levying of duties and taxes on imported goods from foreign countries and the control over the export and import of goods such as controls over prohibited goods. Receives customs declarations and verifies that the transport is according to rules and regulations with respect to export and import. Issues customs clearances.

5.3.1.6Authority / Fare Authority

Responsible for guidelines with respect to fare schemes for an area. Fares are also decided upon.

5.3.1.7Authority / Fee Collection Manager

Responsible for fee collection.

5.3.1.8Authority / HAZMAT Authority

Responsible for regulating and monitoring of the transportation of dangerous or polluting cargo and competent authority as for the classification of such cargo. This includes the availability of one or more points of notification for dangerous or polluting cargo, and the availability of solutions and routines that support the exchange of information about such cargo.

5.3.1.9Authority / Health Authority

Responsible for entrance of people or objects that may cause a health risk.

5.3.1.10Authority / Immigration Authority

Responsible for the enforcement of regulations and laws applicable to persons requesting to enter a country or territory.

5.3.1.11Authority / Inspection Authority

Responsible for rules and regulations that ensure safety. Instructs other parties in safety issues.

5.3.1.12Authority / Legislative Authority

Responsible for establishment of laws and regulations for transport and traffic.

5.3.1.13Authority / Licence Authority

Responsible for issuing licences and certificates based on quality of equipment and qualifications of personnel

5.3.1.14Authority / Statistics Authority

Responsible for the systematic collection of data and facts and establishment of statistics.

5.3.1.15Authority / Terminal Security Authority

National authority responsible for security issues at terminals.

5.3.1.16Authority / Transport Means Authority

Responsible for approval, inspection and certification and registration of transport means. Safety, efficiency and protection of the environment are emphasised.

5.3.1.17Authority / Veterinary Authority

Responsible for entrance/exit of animals and animal products.

5.3.1.18Authority / Waste Authority

Responsible for national enforcement of the laws and regulations on reception facilities for waste and residues. May issue exemptions.

1.1.19Crew

Persons that are on duty on transport means.

5.3.1.19Crew / Captain

The highest authority over the transport means. Responsible for the execution of the transport operation. May also be responsible for the cargo, the passengers and the crew. Often the non-commercial tasks of the captain result from the various laws and regulations.

5.3.1.20Crew / Chiefs

The person who is responsible of the operation of the engine.

5.3.1.21Crew / Driver

The person who steers or controls the transport means.

5.3.1.22Crew / First Officer

Operates on behalf of the captain.

5.3.1.23Crew / Navigator

Responsible the maintenance of navigational instruments and equipment and, with respect to navigation, assisting the Captain.

5.3.1.24Crew / Passenger Manager

Responsible for hotel services on board the transport means and the handling of and the safety of the passengers.

5.3.1.25Crew / People on duty

Crew with misc. responsibilities.

1.1.20Customer

The customer of a transport company.

5.3.1.26Customer / Transport User – See Transport User

5.3.1.27Customer / Transport User Agent – See Transport User Agent

1.1.21Emergency Authority

Emergency authorities shall carry out emergency planning and they shall manage search and rescue operations and investigations in case of emergencies.

5.3.1.28Emergency Authority / Accident Investigation Authority

Responsible for the investigation of accidents and incidents.

5.3.1.29Emergency Authority / Emergency Preparedness Authority

Responsible for: the presence of emergency and calamity preparedness in an area (local, regional or national), including the availability and of the required emergency abatement plans, and the availability of required services and actors that can be assigned the required responsibilities; agreements and procedures that ensures the required coordination and

collaboration between actors involved in a calamity abatement; the establishment of specific emergency abetment plans (e.g. search and rescue and salvage operations), including the allocation of resources and assignment of responsibilities.

5.3.1.30Emergency Authority / Pollution Control Authority

Responsible for: the establishment of rules and regulations with respect to pollution control; and the availability of strategic plans and resources for pollution prevention, detection and combat.

Also responsible for the planning of anti-pollution operations such as operation focusing on pollution prevention, pollution detection and actual pollution combat. This includes the establishment of generic pollution combat plans (standardised procedures, etc.), coordination between roles, the allocation of resources, and assignment of responsibilities.

Responsible for the operational planning and operational management of actual pollution combat operations.

5.3.1.31Emergency Authority / Search and Rescue Centre – see Search and Rescue centre

1.1.22Fleet Manager

Responsible for the management of a fleet of transport means operated by one or more Fleet Operators. The Fleet Manager manages the individual transport means and resources in such a way that the Transporter can offer the required transport services. This includes the strategical, tactical and operational planning of how and where to use the resources (crew included), monitoring, controlling and evaluating operations. (This role is not visible from the Transport User's point of view - the Transport User will interact with the Transporter).

5.3.1.32Fleet Manager / Emergency Fleet Operator

Fleet manager for emergency vehicles.

5.3.1.33Fleet Manager / Fleet Operator

Responsible for the actual accomplishment of the transport operations, the operation of the transport means and the crew. Also responsible of the planning of how transport means and crew are used and the compliance to law and regulations related to transport means and transport operations. Responsible for preparation, updating, checking and transferring documents, task assignment, load planning, operational route planning, provision of third party information, etc.

5.3.1.34Fleet Manager / Fleet Management Centre

Office or organisation from which the fleet management is carried out.

1.1.23Information Provider

Responsible for the provision of information services, e.g. portals, directories and on demand services providing access to relevant information or other service providers.

5.3.1.35Information Service Provider / Environmental Resource Information Provider

Responsible for the provision of information about vulnerable areas, recreation areas, specific environmental resources like nesting places, and resources that may be used in emergency situations (oil retention equipment, landing areas, etc.).

5.3.1.36Information Provider / Geodata Provider

Responsible for the provision of maps and information that can be included into maps.

5.3.1.37Information Provider / Traffic Condition Information Provider – see Traffic Condition Information Provider

5.3.1.38Information Provider / Travel Information Provider – see Travel Information Provider

1.1.24Public Purchaser

Responsible for the provision of transport services needed by the society, even though such services may not be business profitable. Evaluates the needs for transport services and enters contracts with the transporters assumed to be the best with respect to quality of services and costs. The contract usually is for a specific area or between specific destinations, and there are requirements with respect to capacities and frequencies.

1.1.25Search and Rescue Centre

Responsible for the operational planning and operational management of an emergency operation or calamity abatement operation.

5.3.1.39Search and Rescue Centre/ Search and Rescue Manager

Responsible for the management of a search and rescue operations including the operational planning and operational management of an emergency operation or calamity abatement operation, including the coordination of different activities.

1.1.26Service Provider

Responsible for the provision of services to stakeholders in the transport domain.

5.3.1.40Service Provider / Information Provider – see Information Provider

5.3.1.41Service Provider / Insurance Provider

Responsible for the provision of insurance services.

5.3.1.42Service Provider / Navigation Assistance Provider

Responsible for the provision of information about routes and tracks and support services to the Driver.

5.3.1.43Service Provider / Payment Service Provider

Responsible for the processing of electronic fund transfer requests. Enables the transfer of funds from a user of to the provider of a service. This may be tolls, parking, ferry, etc.

5.3.1.44Service Provider /Resource Provider

Responsible for the provision of resources like transport means, human resources, warehouses, etc.

5.3.1.45Service Provider / Route Information Administration Provider

Responsible for the provision of services for registration of route information and for converting the information into formats that fulfils national or local requirements. Such services are needed by transport companies that cannot provide route information according to national or local requirements.

5.3.1.46Service Provider / Search and Rescue Service Provider

Responsible for the provision of necessary services in emergency situations.

5.3.1.47Service Provider / Terminal Information Administration Provider

Responsible for the provision of services for registration of terminal information and for converting the information into formats that fulfils national or local requirements. Such services are needed by terminal owners and terminal operators that cannot provide route information according to national or local requirements.

5.3.1.48Service Provider / Ticket Controller

Responsible for the provision of ticked validation (actuates the ticket) and/or controls.

5.3.1.49Service Provider / Ticket Issuer

Responsible for the issuing tickets to the Transport User. Manages ticket information and responsible for the Transport User's access to the transport service. Guarantees that the provider of the transport service is paid.

5.3.1.50Service Provider / Ticket trader

Responsible for the provision of trading tickets on behalf of the Ticket Issuer.

5.3.1.51Service Provider / Travelling Service Provider

Provides services like accommodation, guided tours, etc.

1.1.27Terminal Actor

A terminal stakeholder.

5.3.1.52Terminal Actor / Counter Staff

Provides counter services at the terminal.

5.3.1.53Terminal Actor / Customs Agent

Carries out customs operation on behalf of the Transport User or Transport User Agent.

5.3.1.54Terminal Actor / Emergency Team

Handles emergency situations.

5.3.1.55Terminal Actor / Operative Quality Surveyor

Ensures that the terminal operations are carried out according to rules and regulations.

5.3.1.56Terminal Actor / Renter

Stores or other stakeholders who rents space in the terminal area.

5.3.1.57Terminal Actor / Security Personnel

Responsible for the actual handling security issues including the control of transport means, people and cargo; the reception of security notifications and certification; and monitoring and enforcement of certificates.

5.3.1.58Terminal Actor / Supplier

Provides supplies (food, water, equipment, etc.) or services. The supplies or services have to be explicitly booked.

5.3.1.59Terminal Actor / Terminal Worker

Execute terminal operations like loading and unloading, and operates terminal equipment.

5.3.1.60Terminal Actor / Warehouse Provider

Provides warehouse services.

5.3.1.61Terminal Actor / Waste Reception Handler

Responsible for the actual handling of waste disposal issues including the issuing of notifications and certificates.

1.1.28Terminal Manager

Responsible for the management of a terminal that may include several sub-terminals (that are managed by Terminal Operators). Also responsible for the provision of information about the overall services and facilities at the terminal and the contact towards the customers (Transport Users, Transport User Agents) regarding these services and facilities.

5.3.1.62Terminal Manager / Terminal Security Manager

Responsible for the security issues at a terminal, including the security plans.

5.3.1.63Terminal Manager / Terminal Safety Manager

Responsible for the safety issues at a terminal.

5.3.1.64Terminal Manager / Terminal Emergency Manager

Responsible for strategic, tactical and operational planning regarding emergency preparedness and emergency abatement. This includes emergency preparedness plans, resources and services; co-ordination towards local, regional and national authorities; and the follow up of emergency preparedness at the terminal.

5.3.1.65Terminal Manager / Terminal Pollution Manager

Responsible for strategic, tactical and operational planning regarding pollution prevention, detection and combat: This includes regulations and routines, pollution combat plans and pollution combat resources; co-ordination towards local, regional and national authorities; and follow up of pollution combat at the terminal.

5.3.1.66Terminal Manager / Terminal Operation Manager

Responsible for strategic, tactical and operational planning of services, co-ordination and follow up of operational services in port.

5.3.1.67Terminal Manager / Terminal Administrator

Responsible for gathering information for administrative purposes and for providing business related information to other parties, e.g. statistics and information for fee collection

1.1.29Terminal Operator

Responsible for the planning and provision of terminal services like loading, unloading and transhipment. Also responsible for the provision of information about the services and facilities provided at the terminal and the contact towards the customers (Transport Users, Transport User Agents) regarding these services and facilities.

1.1.30Traffic and Transport Planner

Responsible for strategically and tactical planning of traffic and transport issues in an area.

1.1.31Traffic Condition Information Provider

Responsible for provision of a total assessment of the situation in the transport network that may affect safety and efficiency or just elements of such information. Information elements that may be provided are *Traffic Flow Information*, *Transport Network Information* and *Transport Network Condition*.

5.3.1.68Traffic Condition Information Provider / Traffic Flow Information Provider

Responsible for provision dynamic traffic information and statistical traffic information about traffic flow, such as traffic density, speed and delay.

5.3.1.69Traffic Condition Information Provider / Traffic Network Condition Information Provider

Responsible for provision of dynamic information about abnormal and unplanned conditions in the transport network (slippery road, turbulence, high waves, obstructions, restricted view, air pollution, oil spill, etc.) due to situations that cannot be controlled (weather, incidents, accidents, etc.).

5.3.1.70Traffic Condition Information Provider / Dynamic Transport Network Information Provider

Responsible for provision of dynamic information about situations in the transport network infrastructure due to transport network conditions and events as well as regulations valid in the transport network, e.g. closed roads, platooning, speed limitations, quality, restrictions, constraints, general route and navigation guidelines about normal routes, alternative routes and route diversions (in case of obstructions).

5.3.1.71Traffic Condition Information Provider / Physical Transport Network Information Provider

Responsible for provision of static information about the transport network

1.1.32Traffic Control Central (TCC)

Central that monitors and controls the traffic flow, e.g. by controlling the infrastructure and by guidance or orders given to the driver. For some modes parts of the captain's responsibility is located to the traffic control centre (e.g. rail).

5.3.1.72Traffic Control Central (TCC) / Manual Traffic Control

E.g. txp.

5.3.1.73Traffic Control Central (TCC) / Traffic Control Central Operator

Operator on a TCC.

1.1.33Traffic Information Central (TIC)

Responsible for influencing the traffic in a positive way by means of coordination and emission of traffic conditions information.

1.1.34Transport Means Owner

Owner of transport means. May have employer's liability towards crew.

1.1.35Transport Network Manager

Responsible for the transport network infrastructure (planning, development, maintenance, etc.). Safety, efficiency and protection of the environment are emphasised.

5.3.1.74Transport Network Manager / Transport Network Planner

Responsible for the generic and in advance planning of the transport network and equipment related to the transport network.

5.3.1.75Transport Network Manager / Transport Network Operator

Responsible for the operation of the transport network and equipment related to the transport network. The transport network must be maintained and operated in such a way that the physical movement of the transport means can be done as safe and efficient as possible, and in such a way that the environment is protected.

5.3.1.76Transport Network Manager / Transport Network Information Manager

Responsible for management of information about the physical transport network.

1.1.36Transport User

Responsible for finding the best transport services and for preparing and follow up of either freight transport or personnel transport.

5.3.1.77Transport User / Cargo owner

The owner of the cargo that is to be transported.

5.3.1.78Transport User / Consignee

The receiver of cargo.

5.3.1.79Transport User / Consignor

The sender of cargo.

5.3.1.80Transport User / Consumer

Responsible for defining the transport demands (either freight transport or personnel transport); for finding the best transport alternative; transport planning; and; for the required transport follow up and re-planning. The originator of a transport request. May be the consignee, the consignor or a Traveller, or someone else.

5.3.1.81Transport User / Traveller – see Traveller

1.1.37Transport User Agent

Responsible for organising the transport on behalf of a Transport User. May be a travel agency, a tour operator or a forwarding agent that orders transport services on behalf of the Transport User. However, from the Transport User's point of view, a forwarding agent and a tour operator are Transporters that provide transport services (see notes in 5.3.1.86).

5.3.1.82Transport User Agent / Chamber of Commerce

Issues Cargine (documents that states that customs is not necessary) and
Provides advisory services and operates as an economical warrantor.

5.3.1.83Transport User Agent / Declaration Agent

Takes the cargo to the customs on behalf of the transport user.

5.3.1.84Transport User Agent / Exporter

Handles the export of cargo.

5.3.1.85Transport User Agent / Importer

Handles the import of cargo.

5.3.1.86Transport User Agent / Logistics Provider

Organises the transport.

5.3.1.87Transport User Agent / Transport Organisator

Organises the transport.

1.1.38Transporter

Responsible for the provision of transport services, i.e. the transport operation from one point to another. Also responsible for the provision of information about such services and the contact towards the customers (transport users or transport user agents).

Remarks:

- From the Transport User's point of view a forwarding agent or a tour operator also is a Transporter. They are responsible for the transport even though they operate as Transport User Agents towards the Transporters that actually carry out the transport operations. Thus, the role of a forwarding agent and a tour operator will depend on whom they relates to. From the Transport Users point of view they are Transporters. From a Transporters point of view they are Transport User Agents. However, a travel agency that also operates as a Transport User Agent is will never take the Transporter role. The role of a forwarding agent is different from the role of a travel agency with respect to responsibility for the

transport operation. A forwarding agent will be blamed if the transport is not carried out as planned. However, a travel agency is not blamed.
- In practise, the same stakeholder may act as a Transporter, a Fleet Manager and a Fleet Operator.

5.3.1.88Transporter / Freight Carrier

Responsible for undertaking the transport of cargo from one point to another.

5.3.1.89Transporter / Passenger Carrier

Responsible for undertaking the transport of passengers from one point to another.

1.1.39Transporter Agent

Responsible for performing particular functions on behalf of a transporter at an agreed payment. Is either a part of the organization of the carrier or an independent body.

5.3.1.90Transporter Agent / Handling Agent

Responsible for the handling of the arrivals, departures, bookings, etc. on behalf of the Transporter.

5.3.1.91Transporter Agent / Authorised Reporting Agent

Responsible for the accomplishment of reporting to authorities and others on behalf of the Captain (the Captain is however still responsible for the reporting).

5.3.1.92Transporter Agent / Package operator (Pakkoperatør)

This role has to be considered.

1.1.40Travel Information Provider

Responsible for the provision of travel information services. This may be travel planning services or information services.

5.3.1.93Travel Information Provider / Door to door Travel Planner

Responsible for the provision of services supporting door to door travel planning. A combination of scheduled and non-scheduled transport is supported.

5.3.1.94Travel Information Provider / Terminal Information Provider

Responsible for the provision of information about terminals.

5.3.1.95Travel Information Provider / Tourist Information Provider

Responsible for the provision of tourist information.

5.3.1.96Travel Information Provider / Scheduled Transport Travel Planner

Responsible for the provision of services that support the planning for travels by means of scheduled transport services.

5.3.1.97Travel Information Provider / Non-scheduled Transport Travel Planner

Responsible for the provision of services that support the planning of non-scheduled transport, e.g. driving car, walking and using bike.

1.1.41Traveller

Responsible for the accomplishment of the travel. May use a set of different transport modes. Traveller travelling as a passenger on scheduled transport services

5.3.1.98Traveller / Crew – see Crew

5.3.1.99Traveller / Crew in Transit

Crew that are not on duty. However, being on-board a transport means such crew has another role than ordinary passengers.

5.3.1.100Traveller / On-demand Transport Passenger

Traveller travelling as a passenger on non-scheduled transport services.

5.3.1.101Traveller / Scheduled Transport Passenger

Traveller travelling as a passenger on scheduled transport services.

5.3.1.102Traveller / Transport Network User

May be a pedestrian, or a person travelling by bike or a car driver. If travelling by car, the traveller may be a private or a professional driver.

5.4Descriptions of Objects

The ARKTRANS object names are described below.

1.1.42Cargo

The product that is transported.

5.4.1.1Cargo/Environmental Affected Cargo

Cargo that is or may be affected by its surroundings.

5.4.1.2Cargo/Floating Bulk

5.4.1.3Cargo/Non-floating Bulk

5.4.1.4Cargo/Thermo Load

5.4.1.5Cargo/Special Cargo – See Special Cargo

1.1.43Load Unit

A unit on or in which goods can be transported. The load unit is not a part of the transport means. However, it must be possible for transport means to carry them. The prime example of a load unit is the freight container

5.4.1.6Load Unit/Pallet

5.4.1.7Load Unit/Container

1.1.44Luggage
The Luggage of a traveller.

5.4.1.8Luggage / Animal
Animal.

5.4.1.9Luggage / Unhandy Luggage
Luggage needing special handling/treatment

1.1.45Payment Equipment
Provides payment facilities and registers payment information.

1.1.46Special Cargo
Cargo that requires special treatment.

5.4.1.10Special Cargo / Animals

5.4.1.11Special Cargo / Dangerous Cargo

5.4.1.12Special Cargo / Food

5.4.1.13Special Cargo / Human Remains

5.4.1.14Special Cargo / Valuables

1.1.47Terminal
The part of the transport infrastructure where passengers can enter, leave or change transport means or where cargo can be loaded, unloaded or transferred between transport means. Also an area where services can be performed.

5.4.1.15Terminal / Ferry Type Terminal
A terminal that arrange for ro-ro transport.

5.4.1.16Terminal / Freight Handling Terminal
A terminal that arrange for freight transport.

5.4.1.17Terminal / Junction Terminal
A terminal where a Transport Item can be transferred from one transport means to another.

5.4.1.18Terminal / Passenger Terminal
A terminal that arrange for passenger transport.

1.1.48Terminal Asset

Terminal assets are available to all terminal operations that need such assets, and the assets do not have to be booked. The assets may exchange information with systems or equipment

5.4.1.19Terminal Asset / Access Control Equipment

Monitors and checks the access to areas, buildings or other terminal resources.

5.4.1.20Terminal Asset / Emergency Equipment

Equipment used in emergency situations.

5.4.1.21Terminal Asset / Equipment for Information

Equipment that provides information to passengers and others.

5.4.1.22Terminal Asset / Equipment for Management of Resources

Interacts with systems or equipment connected to terminal resources. Manages the space allocation and the movement of resources within the terminal area.

5.4.1.23Terminal Asset / Monitoring Equipment

Equipment that monitors the movement of transport means, cargo and terminal resources.

5.4.1.24Terminal Asset / Security Equipment

Monitoring equipment.

5.4.1.25Terminal Asset / Ticket Machine

1.1.49Terminal Equipment

Terminal equipment that is to be booked. The equipment may exchange information with systems or equipment

5.4.1.26Terminal Equipment / Loading and Unloading Equipment

Terminal resources that have to be allocated to the terminal operations like loading and unloading.

5.4.1.27Terminal Equipment / Cargo Handling Equipment

Terminal resources that have to be allocated to the terminal operations cargo or luggage handling.

5.4.1.28Terminal Equipment / Mobile ICT Device

Mobile devices providing information and communication technology.

5.4.1.29Terminal Equipment / Passenger Handling Equipment

Terminal resources that have to be allocated to the terminal operations like passenger handling.

5.4.1.30Terminal Equipment / Terminal Load Unit

Load unit used within the area of the terminal.

5.4.1.31Terminal Equipment / Terminal Transport Means

Transport means used within the area of the terminal.

1.1.50Terminal Facility

An area of the terminal assigned specific tasks.

5.4.1.32Terminal Facility/Depot

Cargo is store in a depot while it is waiting for further handling (e.g. custom clearance) or collection. The storage in the depot will probably be charged.

5.4.1.33Terminal Facility / Manoeuvring Area

An area for manoeuvring of transport means that are visiting the terminal, e.g. to and from and between Stop Points. The area is under the supervision of the terminal.

5.4.1.34Terminal Facility/Ramp Area

An area assigned loading and unloading activities.

5.4.1.35Terminal Facility / Service Area

Area in which maintenance operations can be performed, equipment or supplies can be loaded or unloaded, or other services can be provided.

5.4.1.36Terminal Facility/Storage Area

An area for storage of Transport Items.

5.4.1.37Terminal Facility / Transit Area

An area in which Transport Items are waiting for further transport.

5.4.1.38Terminal Facility/Transhipment Area

An area assigned transhipment of Transport Items.

1.1.51Terminal Resource

A resource possessed by the terminal or terminal operator. A terminal resource must be booked, or the use must be planned.

5.4.1.39Terminal Resource/Certificate

Certificate documenting an ability and licence.

5.4.1.40Terminal Resource/Staff

People that may accomplish terminal operations.

5.4.1.41Terminal Resource/Stop Point

Location at a terminal at which a transport means stops.

5.4.1.42Terminal Resource/Terminal Equipment – see Terminal Equipment

5.4.1.43Terminal Resource/Terminal Facility – see Terminal Facility

1.1.52Ticket Equipment
Equipment that issues and handles tickets..

5.4.1.44Ticket Equipment / Ticked Machine
Provides payment facilities and issues tickets.

5.4.1.45Ticket Equipment / Validation Machine
Registers payment information

1.1.53Transport Means
Transport Means transports people or goods, in the air, on roads, on rails or water bound.

5.4.1.46Transport Means / Emergency Transport Means
Transport means used for emergency purposes.

5.4.1.47Transport Means / Freight Transport Means
Transport means used for freight transport.

5.4.1.48Transport Means / Private Transport Means

5.4.1.49Transport Means / Service Providing Transport Means
Provides services to other transport means in such a way that they can carry out their transport operations in a safe and efficient way.

5.4.1.50Transport Means / Transport Means for Passengers

1.1.54Transport Means Equipment
Equipment on-board the transport means.

5.4.1.51Transport Means Equipment / Communication Equipment
Provides mechanisms that enable communication with systems or equipment located outside the transport means, e.g. along the transport network, in other transport means, or elsewhere..

5.4.1.52Transport Means Equipment / Equipment for Driver Control
Monitors the mode and behaviour of the driver. May intervene to avoid emergency situations.

5.4.1.53Transport Means Equipment / Equipment for Driver Support
Laptops, PDAs or other equipment that provides access to information systems or other solutions useful to the driver. May support the driver with respect to the accomplishment of the driving operation and in emergency situations.

5.4.1.54Transport Means Equipment / Equipment Enabling Monitoring
Equipment that provides tracking information.

5.4.1.55Transport Means Equipment / Equipment for Environmental Issues

Monitors the transport means and the operation of the transport means. May intervene to avoid damage and emergency situations.

5.4.1.56Transport Means Equipment / Equipment for Freight Monitoring and Control

Monitors the freight. May intervene to avoid damage.

5.4.1.57Transport Means Equipment / Equipment for Identification

Identifies the transport means in a unique way.

5.4.1.58Transport Means Equipment / Equipment for Navigation Support

Equipment that helps the driver to find the required route.

5.4.1.59Transport Means Equipment / Equipment for Positioning

Provides position information.

5.4.1.60Transport Means Equipment / Equipment for Transport Means Monitoring and Control

Monitors the transport means. May intervene to avoid damage and emergency situations.

5.4.1.61Transport Means Equipment / Security Equipment

Equipment that may prevent thefts or other criminal acts as well as equipment that may support the police or the owner in case of thefts (e.g. tracking equipment).

5.4.1.62Transport Means Equipment / Speed recorder

5.4.1.63Transport Means Equipment / Trip Recorder

1.1.55Transport Means Owner

Owner of transport means. May have employer's liability towards crew.

1.1.56Transport Network

Infrastructure that makes physical movement of transport means possible.

5.4.1.64Transport Network / Leg

A leg consists of one or more links. May be the path a transport means have to go between two subsequent terminals

5.4.1.65 Transport Network / Link

Connects two transport network nodes. Divides the transport network into blocks.

5.4.1.66 Transport Network / Transport Network Node

Connection point between two or more links.

5.4.1.67Transport Network / Transport Corridor

A part of the infrastructure that enables transport between terminals.

5.4.1.68Transport Network / Transport Network Equipment – see Transport Network Equipment

5.4.1.69Transport Network / Waiting Area

Area where transport means are waiting due to traffic conditions or traffic situations, or they may be waiting for resources.

1.1.57Transport Network Equipment

An integrated part of the transport network (located along, over, under, or at specific points in the transport network). Provides means for traffic flow and traffic condition monitoring, traffic regulation, etc. There may be several strategies for signalling, communication and information dissemination. The same equipment may have several roles.

5.4.1.70Transport Network Equipment / Electronic Fee Equipment – see Electronic Fee Equipment

5.4.1.71Transport Network Equipment / Equipment for Information

Provides mechanisms for information services.

5.4.1.72Transport Network Equipment / Equipment for Traffic Control

Provides mechanisms for control of traffic flow .

5.4.1.73Transport Network Equipment / Traffic Monitoring Equipment

Monitors traffic flow, speed, traffic conditions.
Monitors traffic flow (amount of traffic, speed) and provides information about transport means and their behaviour.

5.4.1.74Transport Network Equipment / Traffic Regulation Equipment

Regulates the flow of traffic.

5.4.1.75Transport Network Equipment / Transport Network Condition Monitoring Equipment

Monitors transport network conditions, weather conditions that may affect the transport network conditions and environmental condition (pollution).

1.1.58 Transport Item

A piece of cargo that is transported or a Traveller. A Transport Item may contain other Transport Items, and so on.

5.4.1.76Transport Item / Cargo – see Cargo

5.4.1.77Transport Item / Load Unit – see Load Unit

5.4.1.78Transport Item / Luggage – see Luggage

5.4.1.79Transport Item / Passenger

Person transported by a Transporter.

5.5Deployment of Roles

A stakeholder may possess several roles and may have to relate to more than one sub-domain. Figure 10 illustrates the establishment of a freight transport chain.

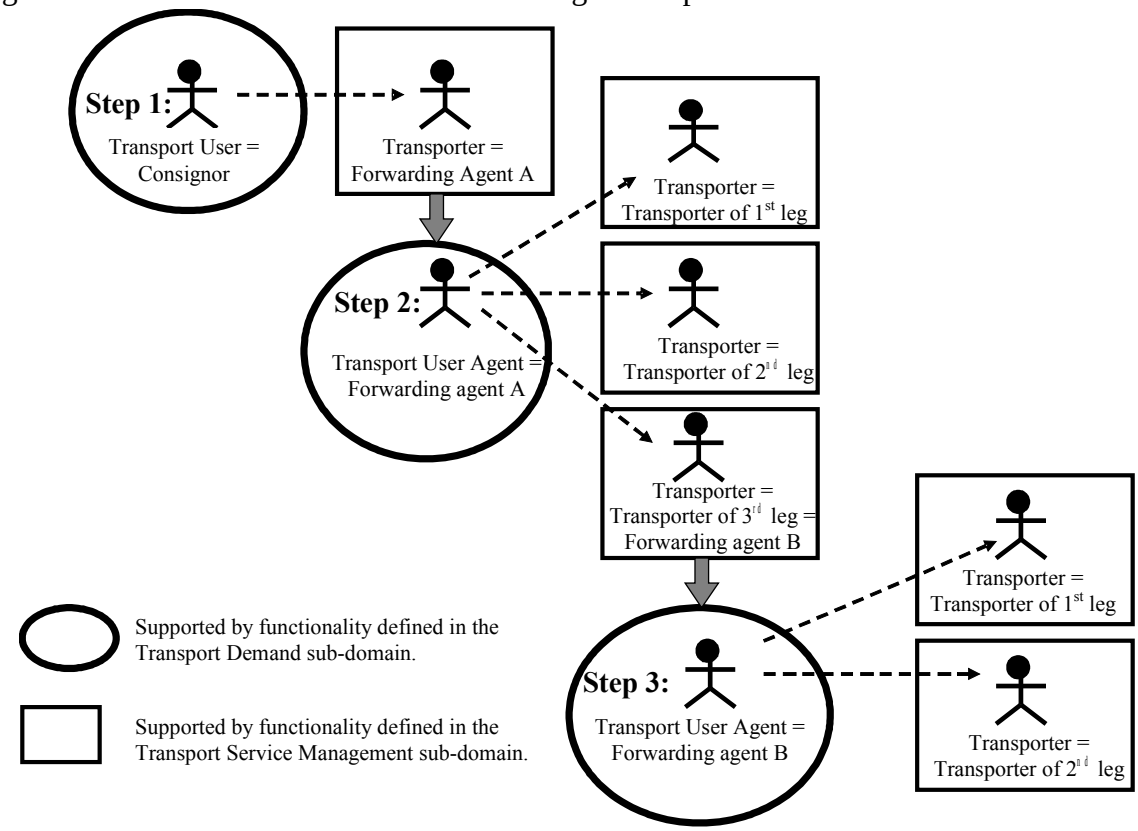


Figure 10 Transport Chain Establishment and Roles

- In step 1 the consignor possesses the Transport User role. The Transport User orders transport services from a Transporter. Forwarding agent A possesses the Transporter role.
- In step 2 the forwarding agent A orders transport services from several Transporters. The forwarding agent A possesses the Transport User Agent role. Forwarding agent B possesses the Transporter role of the 3rd leg.
- Forwarding agent B is the Transport User Agent that initiates step 3 by ordering transport services from subsequent transporters.

The forwarding agents involved in the transport chain on the Figure have 2 roles.

- On reception of an order from a Transport User or a Transport User Agent, the forwarding agent possesses the Transporter role. The Transport User may not know whether a Transporter is a real Transporter or a forwarding agent, and this knowledge is also irrelevant to the Transport User as long as the required transport services are provided.
- Whenever a forwarding agent orders transport services from a Transporter, he possesses the Transport User Agent role. He acts on behalf of the Transport User, and his objective is to order transport services and to follow them up.

The Transport User and the Transport User Agent will both need the same functionality. They are ordering and following up the transport services, and they will find this functionality in the Transport Demand sub-domain. The circles in the Figure indicate this. The forwarding agents in the role of a Transporter will find functionality supporting the reception and management of incoming orders in the Transport Service Management sub-domain.

6Functional View, Transport Network Management

The Transport Network Management sub-domain mainly focuses on the transport networks (roads, fairways, railroads, and air corridors), systems related to the transport networks (traffic regulation equipment, signalling systems, etc.), and the flow of transport means within the transport networks. Terminals for transhipment of goods and boarding of passengers are also important parts of the transport infrastructure. However, the management of terminals is handled in the Terminal Management sub-domain (see chapter 10).
The traffic, constituted by the flow of transport means within the transport network, is the outcome of freight and passenger transport. Such transport is crucial to our society, and the main objectives of this sub-domain are to ensure the efficiency and safety of such transport. The sub-domain will support the operation of the infrastructure, as well as the planning, monitoring and control of the traffic. The traffic must be as efficient, safe and environmental friendly as possible.
The Transport Network Management sub-domain is very comprehensive and provides functionality to a wide spectre of roles. Thus, it is further decomposed into 5 sub-areas. Each sub-area has assigned objectives and is strictly related to a set of roles as described in Chapter 5. The composition of the Transport Network Management and sub-domain is shown in Figure 7 on page 28.
The sub-areas will interact with each other and with the other parts of the transport domain. Some interactions, e.g. those towards the On-board Support and Control sub-domain, mainly have a scope limited to one specific transport mode, and they will be according to conventions or standards for that mode. However, several interactions should preferably be multimodal (i.e. equal for all transport modes) for example:

- Interactions to and from the Service Management sub-area that are required by all transport modes (e.g. meteorological services and statistics reporting)
- Interactions to and from the Emergency Management sub-area that are required by all transport modes (e.g. emergency reporting)
- Interactions to and from the Transport Network Utilisation sub-area that support the multimodal transport planning done in the Transport Demand sub-domain.

6.1Service Management

The Service Management sub-area provides functionality required by service providers. Several types of services may be offered the users of the Transport Network as well as to the sub-areas of the Transport Network Management sub-domain, e.g. information services with variable content like traffic flow information, transport network information, transport network condition information, tourist information, etc. The services will be carried out and managed in different ways, and the specific service content will vary.
The objectives of this sub-area are:

- To receive electronic input about market needs
- To manage information related to the provision of the services
- To support the provision of non-electronic services (e.g. by providing relevant information)

The responsibilities towards the other parts of the reference model are:

- To provide information about available services.
- To handle requests for services
- To provide electronic information services and reporting services.

- To provide liaison services that may transfer information or making information available to the right stakeholders in the right way. These may include transformations between different information formats, etc.

6.1.1Information Services

Many types of information should be made available. However, no matter what the content of the information is, there are certain needs for functionality such as directory services helping the user to find the requested information and Service Providers.

6.1.1.1Environmental Information Services

Information about protected areas, vulnerable areas and potential treats to the environment is established, maintained and made available.

6.1.1.2Traffic Condition Information Services

Transport Network Information, Transport Network Condition Information and Traffic Flow Information is established, maintained and made available.

6.1.1.3Travel Information Services

Travel information services is established, maintained and made available.

6.1.2Service Administration

The administrative and business related issues of service provision are handled.

6.1.2.1Service Booking Management

Service bookings are received and managed. Relevant information, e.g. information about dangerous cargo is received as a part of the booking.
Amendments may also be received due to change of plans (e.g. new ETA).

6.1.2.2Service Information Management

A service may need information, and this information has to be established and maintained. The information may also be distributed to other actors.

6.1.2.3Service Needs Identification

Long-term service demands are received. This information is stored so that it can be used for planning.

6.1.2.4Service Information Provision

Information about the services that are offered is made available. This may include directory services.

6.1.3Ticket services

Services dealing with the different parts of electronic ticketing.

6.1.4Payment Services

The following services are provided:

- Ticket issuing
- Ticket trading
- Ticket control

- Ticket validation
- Fee collection

6.1.5Report Acceptation Services

Reports can be delivered electronically.

6.2Emergency Management

The Emergency Management sub-area provides functionality required by emergency authorities and emergency centres and operates according to the following objectives:

- To improve the control of the emergency preparedness more efficient.
- To improve information flows in case if emergencies or pollution.

The responsibilities towards the other parts of the reference model are:

- To manage information about incidents, emergencies, calamities and pollution, and to derive knowledge about safety and environmental threats from this information.
- To establish calamity abatement, emergency abatement and pollution combat plans.
- To provide guidelines and requirements for emergency preparedness, pollution control, and pollution preparedness;
- To support emergency abatement operations.
- To support pollution combat operations.
- To support salvage operations.
- To support the investigation of calamities, accidents, pollution and incidents.

6.2.1Emergency Preparedness

Plans and responsibilities in case of emergencies must be prepared.

6.2.1.1Incident and Emergency Information Analyses

Historical information about incidents, accidents and pollution is used to produce statistics and to draw conclusions about causes and effects.

6.2.1.2Contingency Planning Support

6.2.1.3Contingency Training Support

6.2.1.4Pollution Monitoring

The environment is monitored to detect pollution.

6.2.2Emergency Operation and Investigation Support

Search and rescue operations and pollution prevention operations are supported. Required information is stored and used both during the operations and during investigations.

6.2.2.1Incident and Emergency Information Management

Information about incidents, accidents and pollution is managed. The type of information may vary depending on the type of incident or accident.
The information may be used to support ongoing search and rescue operations and pollution prevention operations. The information may also be used during the investigation.

6.2.2.2Search and Rescue Support

Relevant information such as information about people involved, the transport means involved, dangerous cargo involved, locations, emergency responsibilities, status, etc. must be provided.

6.2.2.3Pollution Prevention Support

Relevant information such as information about location, type of pollution, the extent of pollution, emergency responsibilities, status, etc. must be provided. Functionality that may support decisions, e.g. simulations of the drift of oil pollution, may be provided.

6.2.2.4Hazardous Goods Emergency Management

In case of emergencies involving dangerous cargo, information about the transport and the materials involved should be made available and distributed according to predefined planes.

6.2.2.5Tracing and Prediction Support

Previous situations, e.g. the positions of a vessel or a Transport Item (e.g. a load unit) at a given point of time, can be found. This information may for example be used to find possible sources of pollution (e.g. the source of an oil spill). Situations in the future, e.g. the propagation of an oil spill, may be simulated to support decisions concerning search and rescue or pollution prevention.

6.3Transport Network Utilisation

The Transport Network Utilisation sub-area provides functionality required by traffic information and traffic control centres, and by the Traffic and Transport Planner who is planning future transport solutions and services. The sub-area has the following objectives:

- To do strategic and tactical traffic and transport planning
- To do strategic and tactical planning of transport services
- To do operational planning of normal traffic as well as extraordinary transport operations
- To manage traffic information
-

Responsibilities of this part of the transport domain are as follows:

- To clarify the rules and regulations with respect to the traffic management in the area.
- To provide guideline, support and information that arrange for safe, secure, environmental friendly, and efficient accomplishment of the transport in the area.
- To manage arrivals, departures and traffic in conformance with laws and regulations in a way that optimises safety, security, environmental protection and efficiency.
- To manage the access to restricted areas and infrastructure objects
- To handle foreseen and occurred incidents in a way that minimise the threats to safety, environment, security, efficiency and property.
- To provide assistance and information to search and rescue and pollution combat operations and to maritime assistance operations.

6.3.1Transport Network Utilisation Planning

The Traffic and Transport Planner is responsible for strategic and tactical planning with respect to transport and traffic solutions and the provision of transport services that benefits the society.

6.3.1.1Traffic Planning and Optimising

Prospective transport networks or prospective traffic control strategies are planned and if possible tested by simulations. The traffic planning encompasses a restricted part of the transport network and a single transport mode. Different solutions for the restricted part of the transport network is considered, evaluated and planned.

6.3.1.1.1Traffic Modelling

The traffic in the restricted part of the transport network is modelled.

6.3.1.1.2Safety and Quality Evaluation

The safety and the quality of the suggested traffic plan are evaluated.

6.3.1.2Transport Planning and Optimising

Prospective transport networks or prospective traffic control strategies are planned and if possible tested by simulations. The transport planning may encompass alternative routes and several transport modes. Different strategies and political issues may be tested and evaluated. Route planning across several transport modes should be considered.

6.3.1.2.1Transport Modelling

The transport is modelled. Alternative routes and transport modes should be a part of the model.

6.3.1.2.2Safety and Quality Evaluation

The safety and the quality of the suggested transport plan are evaluated.

6.3.1.2.3Transport Demand Management

Strategies and plans for different types of overall demand management (influence on the traffic distribution and the choice of transport modes and transport means) are prepared and implemented. The demand management will be based on prognosis, and the objective is optimisation according to strategic parameters (efficiency, safety, environment, mobility, etc.).

6.3.1.3Transport Service Planning

The objective of the Traffic and Transport Planner is the provision of transport services that benefit the society. The need for transport services must be estimated, and, in case of limited capacity in the transport network, the required transport operations must be scheduled.

6.3.1.3.1Transport Demand Prognosis

The Traffic and Transport Planner focuses on the provision of transport services that benefit the society. Route and capacity requirements are estimated, and the transport services provided by Transporters (in the Transport Service Management sub-domain) are influenced. Call for tenders may be issued and evaluated if the required transport services are not profitable from a corporate economy point of view, and contracts may be entered with the Transporters providing the best services with respect to quality and costs. However, the establishment of such contracts and the ordering of the transport services are, according to ARKTRANS, done by Transport User. Thus, the Traffic and Transport Planner will possess the Transport User role, and the work will be done as a part of the Transport Demand sub-domain, see chapter 7.

6.3.1.3.2Scheduling

The Traffic and Transport Planner is planning the utilisation of the Transport Network (tracks, air corridors, etc.) by assigning resources and timeslots. Such plans are required in transport modes in which the transport network capacity is restricted.

6.3.2Operational Traffic Management

Ongoing traffic is managed based on information about the traffic conditions.

6.3.2.1Operational Traffic Planning

Occurrences that will affect traffic are registered, and the traffic control is planned.

6.3.2.1.1Traffic Exception Detection

Occurrences, such as arrangements, state visits, transportation of broad cargo, high cargo, etc., that may cause exceptions from normal traffic flow are registered. The traffic problems caused by the occurrences must be considered and handled.

6.3.2.1.2Checkpoint Pass Trough Administration

Information about estimated and actual arrivals to checkpoints is registered manually or automatically (based on incoming reports), and the information is made available to the traffic control.
Information about estimated time of arrival or departure (ETA/ETD) is received as well as information about specific issues, e.g. dangerous cargo.

6.3.2.1.3Prognosis Preparation

Prognosis for upcoming traffic conditions and traffic types are based on information about the transport network, historical information about traffic flow and transport network conditions for the season, meteorological and environmental prognosis, and information about upcoming issues (known arrivals and departures, planned maintenance, known exceptions, etc.).The resulting prognosis will be used in traffic control planning.

6.3.2.1.4Traffic Control Planning

Traffic control actions are planned based on information about expected traffic exceptions and traffic condition prognosis.

6.3.2.2Traffic Condition Monitoring

The ongoing traffic and the traffic conditions are monitored continuously to establish information about issues that may influence on safety and traffic flow.

6.3.2.2.1Traffic Flow Monitoring

Information about traffic flow and transport means is continuously received from several sources. Different technologies can be used to collect the information. The information must be collected and stored in such a way that it can be provided to other functions such as traffic control, incident management, emergency preparedness and management, preparation of prognosis, and traffic planning and optimising. Specific attention is given to transport means carrying dangerous cargo as well as other high risk transport means.

6.3.2.2.2Hazardous Goods Monitoring

Transport operations involving dangerous cargo are monitored. Overall information about the hazardous cargo (identifying the type of dangerous cargo) should available.

6.3.2.2.3Transport Network Condition Monitoring

Abnormal and unplanned transport network conditions that may influence on the traffic flow and on the safety are monitored. The information may be provided to functions providing traffic control and traffic assessment. Conditions that may be monitored are

- Specific transport network conditions due to meteorological conditions (see 6.3.2.4.4)
- Specific transport network conditions due to environmental conditions such as pollution, dust, smoke, noise, etc. (see 6.2.1.4).
- Obstructions (e.g. drifting objects, avalanche, potholes, etc.).

6.3.2.2.4Environmental Condition Monitoring

Meteorological conditions, pollution (dust, spill of harmful materials, etc.), noise, etc. are monitored to detect situations that may affect traffic flow or traffic safety.

6.3.2.3Traffic Control

The traffic is controlled and managed to achieve optimal efficiency and safety. The current traffic condition and the traffic development in short terms are assessed, and the traffic is managed by means of traffic information, route assignments and transport network equipment control.

The effectuation of the traffic control is done at a Traffic Control Centre as well as by automated systems that physically is a part of some transport network equipment. The latter equipment belongs to the Transport Network Infrastructure Management sub-area. However, those parts of the systems that lead to the traffic control decisions are considered to be a part of an extended traffic control centre.

6.3.2.3.1Traffic Flow Prediction

The short terms development of the traffic flow is predicted by means of for example empirical information, the current traffic condition and simulations. The results are used when traffic control decisions are made. For some transport modes intersecting movement of transport means with must be managed.

6.3.2.3.2Traffic Assessment

The traffic is assessed with respect to available information from the monitoring functions, transport network information (speed limits, capacity, type (e.g. tunnel), and planned situations such as maintenance, reduced capacity, restrictions, etc.), expected traffic changes, and predicted development. Potential dangerous situations are predicted. Empirical information can be used to foresee problems.

6.3.2.3.3Environmental Impact Management

Environmental issues that should influence on the traffic control are identified, and actions may be taken towards individual transport means. Restrictions may for example be put on transport means with dangerous cargo and transport means that make a lot of noise with respect to routes and time period in which they may travel.

6.3.2.3.4Traffic Flow Control

Decisions about actions that will affect traffic flow, traffic density, environmental issues, and individual transport means are taken. The decisions can be based on political, safety or environmental reasons.

Input from the traffic assessment and input about environmental conditions support decisions that will improve the environment, the traffic flow and traffic safety. Available information about the cargo, e.g. dangerous cargo, should also be considered as well as the transport network information and transport network maintenance information.

Demands from transport users or authorities, e.g. emergency authorities, must be considered, e.g. the priority or access of emergency cars.

6.3.2.3.5Route Assignment

The Transport Means are assigned specific routes or duties that should be followed (however, for some transport modes the captain can deviate from the assignment, but then he/she is responsible). The functionality is used for transport modes in which the usage of the transport network is strictly regulated (air, rail and partly sea). For other transport modes, route guidance is provided as traffic information (see 6.3.2.4). The route assignment information can be provided in various ways.

6.3.2.3.6Transport Network Equipment Control

The Transport Network Equipment is a part of the Transport Network Infrastructure Management sub-area, but the equipment is controlled as a part of the Transport Network Utilisation sub-area to affect the traffic in a positive way. Standardised procedures for traffic control and handling of different traffic conditions, normal as well as abnormal variations, are used depending on the situation. The equipment may for example:

- Assign or recommend routing
- Control the access to the transport network or parts of the transport network
- Assign or recommend speed or speed limits
- Promote better utilisation of the transport network (e.g. tidal flow control)
- Provide relevant information
- Introduce restrictions
- Enforce regulations

6.3.2.3.7Operative Safety

This function becomes operative on detection of incidents that may influence on the safety. Cause actions that prevent or minimise negative effects and emergencies (e.g. automatic train stop, closure of tunnels or bridges). (The function must be harmonised with work in CENTC 278 and ISO TC 204).

6.3.2.3.7.1Incident Triggered Driving Control

Functionality defined in control strategies is implemented, and the required commands are transferred to the Transport Means or to the Crew on the Transport Means (e.g. automatic train stop) by means of instructions that may be provided by transport network equipment. (The function must be harmonised with work in CENTC 278 and ISO TC 204).

6.3.2.3.7.2Incident Triggered Transport Network Control

This function may become operative on detection of incidents that may influence on the safety. This control includes functionality that controls the Transport Network, parts of the Transport Network or Transport Network Equipment, e.g. automatic train stop, closure of tunnels or bridges. (It must be harmonised with work in CENTC 278 and ISO TC 204)

6.3.2.3.7.3Incident Warning

Incident Warning may become operative on detection of incidents that may influence on the safety. Warnings are provided to relevant stakeholders.

6.3.2.4Traffic Information

Traffic information is established and disseminated from the Transport Information Centre to Transport Users, Drivers and Fleet operators to influence on safety and traffic flow. The dissemination is a part of the operational traffic management. Traffic information may also be provided by Service Providers as an information service (see 6.1.1.2). Meteorological and environmental information is always provided by Service Providers and not by the Traffic Information Centre, but such information may affect the traffic information, e.g. the Transport Network Condition Information.
The traffic information may be provided by means of many technologies and via several medias (notice to mariners, notice to airman, VHF communication, traffic messages, AIS, etc.). One or more types of traffic information may also be combined in a way that provides added value.
Traffic information may be prognosis for the future as well as information based on real time observations or measurements. Thus, the traffic information must contain meta information that reflects how the information is established (observation, measurement, calculated forecast, etc.).

6.3.2.4.1Route and Navigation Information

The Crew on one or more transport means may need information or guidance to accomplish the transport or to find or follow the optimal route with respect to traffic flow and safety. Based on available information and needs, general route and navigation guidelines about normal routes, alternative routes and route diversions (in case of obstructions) are communicated to the Transport Means.

6.3.2.4.2Traffic Image

Information about the transport means in the area with respect to position, speed, direction, and the destination they are heading for is provided. This may be of importance to other transport means (especially for air and sea transport) when they plan their operations.

6.3.2.4.3Traffic Flow Information

Traffic flow information is provided. This is dynamic traffic information and statistical traffic information about traffic flow, such as traffic density, speed and delay.

6.3.2.4.4Transport Network Condition Information

Transport Network Condition Information is provided. This is dynamic information about abnormal and unplanned conditions in the transport network (slippery road, turbulence, high waves, obstructions, restricted view, air pollution, oil spill, etc.) due to situations that cannot be controlled (weather, incidents, accidents, etc.)

6.3.2.5Incident Management

Detection and response to incidents that may influence on the safety are managed automatically or according to formal procedures. Some incidents arise due to emergency situations. However, most incidents are normal variations that may require no - or just minor adjustments.

6.3.2.5.1Incident Detection and Verification

Automatic Incident Detection (AIC) is supported as well as manual detection based on received information or monitoring. Information about the incident is established, verified and stored in such a way that it can be used in incident handling and dissemination of information about incidents.

6.3.2.5.2Incident Assessment and Handling

Incidents are assessed and handled automatically or according to formal procedures. The handling may for example be delegation of responsibility to traffic control, transport network maintenance, or emergency management.

6.4Transport Network Infrastructure Management

The Transport Network Infrastructure Management sub-area provides functionality required by those who are managing the physical infrastructure. The sub-area has the following objectives:

- To monitor the state and the capacity of the infrastructure
- To do strategic and tactical planning of infrastructure maintenance and improvements
- To mange deviations and continuous operation of the infrastructure
- To operate the transport network and the transport network equipment according to instructions received from the Transport Network Utilisation sub-area.
-

The responsibilities towards the other parts of the reference model are:

- To define and mange the transport network infrastructure in such a way the safety, protection of the environment, security and efficiency is optimised.
- To ensure proper operation of equipment and aids related to the infrastructure.
- To manage and publish information about the transport network infrastructure.
-

The management of the actual maintenance and the improvements are however not within the scope of ARKTRANS. But the activities must be considered during the operation of the transport network.

6.4.1Transport Network Maintenance Planning

The maintenance and improvements of the transport network is planned. This includes both the physical infrastructure as well as the functionality provided by the transport network.

6.4.1.1Maintenance Needs Identification

Needs with respect to maintenance are registered manually or automatically based on incoming reports.

6.4.1.2Maintenance Plan Management

Foreseen maintenance of the existing transport network and equipment related to this network is planned, and the resulting plans are made available to other functions. Traffic Management

functions should for example consider planned as well as ongoing activities when prognoses are made and when the traffic is controlled.

6.4.1.3Improvement Plan Management

Extension as well as repair is managed. Planned as well as ongoing activities are made available to other functions. Traffic Management functions should for example consider such activities when prognoses are made and when the traffic is controlled.

6.4.1.4Safety and Quality Evaluation

The safety and the quality of the plan are evaluated.

6.4.2Transport Network Operation and Maintenance

The maintenance and operation of the transport network is supported. This includes both maintenance of the physical infrastructure as well as maintenance of the functionality provided by the transport network.
Information about the Transport Network is established and updated, and the information is provided to functionality supporting the operation and maintenance of the Transport Network and to other functions whenever necessary.

6.4.2.1Transport Network Data Management

Information about the Transport Network is established, verified, updated and made available to other functions.

6.4.2.1.1Transport Network Data Establishment

Information about the transport network infrastructure is established and maintained in such a way that it can be used by functionality that needs such information. This includes:

- Physical Transport Network Information: Static information about the transport network.
- Dynamic Transport Network Information: Dynamic information about situations in the transport network infrastructure due to transport network conditions and events as well as regulations valid in the transport network, e.g. closed roads, platooning, speed limitations, quality, restrictions, constraints, general route and navigation guidelines about normal routes, alternative routes and route diversions (in case of obstructions).

Information about deviations is received from the Deviation registration function (6.4.2.2) and the Transport Network Maintenance Planning functions (6.4.1).

6.4.2.1.2Map Establishment and Update

Geographic information as well as information that can be related to geographic allocations is established in such a way that maps can be generated.

6.4.2.2Deviation Registration

The need for maintenance and improvement of faults as well as the need for continuous operation of the transport network is registered.
This is the contact point for those who want to report about traffic network conditions (e.g. slippery road, restricted view, etc.) and upcoming or effectuated transport network deviations due to incidents and accidents.

6.4.2.3Continuous Operation

Continuous operation of the Transport Network and the Transport Network Equipment that ensures a proper condition and operation (e.g. clearing, salting, etc.) is managed. Information about maintenance activities should be made available to other functions. Transport Network Utilisation functions should for example consider such activities when prognoses are made and when the traffic is controlled

6.4.2.4Transport Network Equipment Operation

The Transport Network Equipment that contributes to efficient and safe traffic flow may operate automatically or it may be operated by the Traffic Control functionality (see 6.3.2.3.6). The equipment may control the transport network properties, the access to the transport network, and the use of the transport network. The equipment may also interact with the transport means to provide information or guidelines, or to influence on the operation of the transport means by means of automatic traffic control (ATC).

6.4.2.5Safety and Risk Analysis Support

The safety and the risk are evaluated and corrective actions may be suggested.

6.5Regulation Enforcement

The Regulation Enforcement sub-area provides functionality required by authorities. Laws and regulations must be enforced. This includes operative control as well as the establishment and maintenance of directories holding relevant information. The sub-area has the following objectives:

- To manage directories with information about transport means and licences
- To manage fares
- To enforce tax and customs regulations
- To manage statistics
- To register regulation offences
-
- The sub-area has the following responsibilities:
- To prevent undesirable situations and unlawfulness by providing information to the public about rules and regulation and desired behaviour;
- To provide qualified advices to individual actors on desired behaviour in particular cases;
- To inspect and certify according to rules and regulations;
- To supervise the actual behaviour of individual actors in order to detect rule and regulation violations;
- To handle rule or regulation violations.

6.5.1Law Enforcement Operative Control

Functionality supporting checks performed by Authorities (Police, Customs, etc.), enforcement of laws and regulations, Exceptional situations with respect to the transport accomplishment are provided.

6.5.1.1Regulation Offence Registration

Information about regulation offences is registered.

6.5.1.2Offence Handling Support

6.5.2Transport Means Directory Management

Information about the transport means should be established, maintained and made available.

6.5.3Licence Management

Information about licenses (that documents right to perform or provide certain activities) and certificates (that documents qualifications or abilities to provide certain services) should be established, maintained and made available. The workflow concerning license and certificate requests and the responses to such requests should also be supported.

6.5.4Fare Management

6.5.5Hazardous Goods Management

Information about transports involving dangerous cargo is received and managed. The information is submitted to other stakeholders according to predefined rules.
Information about dangerous materials must be managed. Emergency situations involving hazardous cargo must be handled in a proper way.

6.5.5.1Hazardous Goods Characteristics Management

Information about dangerous materials and international codes identifying such materials must be managed as well as with information about how the materials shall be made available in case of emergencies.

6.5.5.2Multimodal Hazardous Goods Mapping

The identification of hazardous materials should be coordinated across the transport modes.

6.5.5.3Hazardous Goods Information Management

Information about transport operations carrying dangerous materials is received and managed. Overall information about the type of cargo should be provided to traffic control and others that may need such information. In case of emergencies, the required information must be made available.

6.5.6Regulation Management

Information about laws and regulations should be made available.

6.5.7Taxes and Customs Management

Customs declarations are received and processed. Customs clearances may be issued.

6.5.8Statistics

Reception and management of different types of imposed statistics.

6.5.9Import and Immigration Management

The import of cargo as well as the immigration is managed according to immigration, health, veterinary and agricultural regulations.

7Functional View, Transport Demand

The Transport Demand sub-domain harmonises travel planning (in personnel transport) and freight management. Thus, the sub-domain will support preparation, planning and management of a transport chain for freight as well as personnel transport. This involves pre-trip planning, transport order initiation and follow-up for transport chains of variable complexity, and several transport modes may be involved.
The sub-domain encompasses functionality needed by both Transport Users (consignors, consignees, cargo owner and travellers) and Transport User Agents (travel agencies and forwarding agents).
A Transport User Agent organises the transport on behalf of a Transport User. Transport Users traditionally request transport services through Transport User Agents or by means of human contact with the Transporters involved in the transport chain. However, the use of electronic services that enable self-service is increasing for fragments of the transport market (route information and booking services for personnel transport as well as portals for freight transport are available on the Web). However, there are as far as we know no open agreements on standards, and the different fragments cannot cooperate as easily and efficiently as wished. ARKTRANS will suggest how to harmonise the solutions. In that way multi modal transport services can be provided to the Transport User in a more efficient way.

7.1Transport Task Administration

A transport chain and its services and service providers are defined in a transport execution plan. Whenever such a plan is established, or whenever a transport execution plan has to be changed, formalities concerning effectuation or modification of the transport execution plan are handled.
The market is also monitored, and the long-term demand for transport related services are considered.

7.1.1Contract Management

A contract may be a standard contract or a special condition negotiated with a Transporter. For many transport tasks the standard contract of the Transporter is adopted as standard fees and conditions are accepted.

7.1.1.1Contract Agreement

Negotiations or bids using portals are supported.

7.1.1.2Contract Information Administration

Contract information must be established and stored in such a way that it can be processed automatically. Information about amendment conditions must for example be checked when a booking has to be changed (amendments must be made in accordance with the conditions specified in the contract).
A contract may encompass several transport tasks for a long period of time. The number or quantum of Transport Items that are transported in each task has to be registered. The total number or quantum for all the tasks has to be compared with the specifications in the contract.

7.1.2Transport Order Management

Out-going orders to Transporters and other service providers are managed. Actors possessing the Transport User Agent role may also receive incoming orders from Transport Users or

other Transport User Agents. However, in the latter case the actors will possess the Transporter role, and the management of the incoming orders are handled as described in the Transport Service Management sub-domain.

7.1.2.1Financial Transactions

Invoices are handled. COTS should as far as possible be used.

7.1.2.2Transport Order Administration

Transport services and other services are ordered according to a defined transport execution plan and if possible according to established contracts. The ordering may be for a complete transport chain or for separate legs of the chain. Services like terminal services, accommodation, etc. must also be ordered. Preliminary bookings are used if services are depending on each other. Firm bookings are usually not made until all preliminary bookings are confirmed.
The order will be described by means of transport execution plans and waybills. Several waybills may be related to one transport operation as the transport operation may encompass several transport tasks.
Joint booking (transport for more than one Transport Item is ordered in one booking) must be handled as well as joint loading (more than one piece of cargo into a load unit).
The follow-up of preliminary bookings must be supported. The Transport User or Transport User Agent must be notified if preliminary bookings are not confirmed, and in case confirmations are negative. In such cases an alternative transport chain or alternative services must be selected (7.2.4.5). The Transport User or Transport User Agent must also be notified when all preliminary bookings for a transport chain have achieved positive confirmations. This should trigger firm bookings of the services.
In case of amendments, the old booking must be cancelled (the consequences of amendments may be checked out by 7.1.2.3 and has to be carried out by functionality specified in 7.2.4.5). Relevant parts of the transport execution plan should follow the order. It should not be necessary to send the complete transport execution plan to all actors in the chain. Only the information relevant to the respective actor should be transferred.

7.1.2.3Transport Order Amendment Appraisal

The Transport User or Transport User Agent may want to change the transport execution plan and perform order amendments according a revised plan. However, the ability to change the booking depends on the contract conditions. The Transport User or the Transport User Agent must be informed about these conditions and the consequences in case of amendments (extra costs, etc.). If preferable, amendments can be made by means of functionality in 7.2.4.5.

7.1.3Market Information Management

7.1.3.1Service Provider Information Management

Information about available service providers and their services must be provided in such a way that transport execution plans with the best-fitted services and service providers can be established. This may be realised by local directories or by retrieval of information from external services.

7.1.3.2Available Services Monitoring

The spot market must be monitored and services selected.

7.1.3.3Statistics Request

Transporters and Service Providers are asked for statistics showing services and transport operations delivered to the Transport User or Transport User Agent.

7.1.4Long Term Demand Management

Long-term needs are considered to support decisions about contracts and agreements towards Transporters, Service Providers, etc. This may also influence on preferences.

7.2Transport Preparation and Planning

The Transport User has a transport need. The planning, preparation and ordering of transport services are supported. The Transport User or the Transport User Agent representing the Transport User may use the functionality.
The *general transport preferences* (GTP) of the Transport User as well as the *actual transport preferences* (ATP) for the specific transport task are used as guidelines.
The planning will result in a *transport execution plan* defining the transport chain and all services and service providers related to the legs and nodes in the chain. Schedules, the documents that are to be issued, and specifications of the deviations that shall cause alerts, are also included.
The transport chain planning may be a complex process if made from scratch, but a *transport execution plan template* may be used. A transport execution plan template is quite similar to a transport execution plan. However, the time schedule may not be specified, and several alternative services and service providers may be specified. The template may be more or less complete. It may contain alternative services and service providers for all nodes and legs, or some legs and nodes may be empty. The latter will require a more extensive transport execution plan definition process.

7.2.1Information Gathering

The Transport User or the Transport User Agent may need several types of information that can have an influence on the transport execution planning. Both market information established earlier (see 7.1.3) and information from external sources must be considered. Yellow pages may for example provide contact information.

1. Information about the traffic situation
   - Transport network information
   - Transport network condition
   - Traffic flow and traffic density
2. Market information
   - Information about available services (transport services, hotels, restaurants, gas stations, etc.)
   - Addresses and contact information
3. Information about locations and events
   - Tourist information

Information related to selection criteria in the defined transport execution plan can be collected and presented.

7.2.2General Transport Preferences (GTP) Definition

The general transport preferences (GTP) for a Transport User (or a Transport User Agent) are defined. One Transport User (or a Transport User Agent) may have several GTPs, each

indicating preferences for different types of transport demands (e.g. business travel, pleasure travel, demands related to different types of cargo, etc.).
The GTPs are the basis for the actual transport preferences defined for each transport operation. A GTP may for example include the preferred Transporters and the associated customer numbers, preferred transport modes, criteria for selection of transport modes (e.g. costs, time schedules, environmental issues), requirements (e.g. environmental profile, restrictions with respect to additional cargo on the transport means, no tunnels, no smoker, seat by the aisle, vegetarian food, accessibility for disabled people, preferred payment, etc.).

7.2.3Transport Demand Definition

The requirements and relevant information related to a specific transport demand are defined. The information may be retrieved from internal data stores (e.g. in case a Transport User Agent may have received the information in an order from a Transport User) or the required information may be registered from scratch.

7.2.3.1Actual Transport Preferences (ATP) Definition

The actual transport preferences (ATP) for a specific transport operation are defined. An ATP specifies the overall transport requirements. The content may be retrieved from internal data stores (e.g. in case a Transport User Agent may have received the information in an order from a Transport User), it may be based on an old ATP, or it may be registered from scratch. Relevant information from the GTP (general transport preferences) associated with the transport is included.
The ATP encompasses requirements such as start and end locations for the transport (door-to-door should be possible), departure times, arrival times, required transits, criteria for optimising (costs, time, comfort, quality, contract references, etc.), requirements concerning the ability to change the plans (deadline for cancellation or changes, costs related to changes, etc.), the ability to give alerts in case of deviations, etc. The ATP may be used in 7.1.2.2, 7.1.2.3 and 7.2.4.

7.2.3.2Transport Item Definition

Relevant information about the Transport Items to be transported (Passenger, Luggage, Load Item or Cargo) is established. The information may be retrieved from internal data stores (e.g. in case a Transport User Agent may have received the information from a Transport User), or it may be registered from scratch.
Transport Item Instructions that may contain guidelines for handling of the Transport Item (transport instructions, loading instructions, etc.) may be registered. However, the Transport Item type is in many cases sufficient information. The Transporter will now how to handle specific Transport Item types.

7.2.3.3Route Clarification

Usually it is up to the transporter or driver to decide about the route. However, in case of specific requirements, the transport user or transport user agent may have to clarify the ability to accomplish the transport. For freight transport it may for example be clarify that broad or long cargo can be transported in the transport network. Exception requests may have to be sent to traffic control centres. Route assignments, clearances, etc. are received to indicate feasibility as well as requirements with respect to the accomplishment of the transport. For passenger transport, the accessibility for disabled people may have to be clarified with Transporters and Terminals. Special assistance or attention may be requested.

7.2.3.4Waybill Definition

The required Waybills are established and may cover one or more Transport Items (joint booking) that have the same destination. Joint loading (more than one piece of cargo into a load unit with one waybill) must also be handled.
A waybill contains an id, a reference to the Transport User and a specification of the Transport Items that are managed by the waybill. A waybill may also contain transport item instructions that will follow the Transport Items to ensure proper handling through the whole transport chain.

7.2.4Transport Execution Plan Definition

A *transport execution plan* is the basis for the execution of the transport task that is carried out to satisfy the transport demand. The overall plan includes nodes and legs, the services and service providers involved, the time schedules, the documents that are to be exchanged, and the alert conditions that are defined as seen from the Transport User's or Transport User Agent's point of view. The transport execution plan will also encompass information about the Transport Items (Travellers or Cargo). The transport execution plan is the basis for bookings, submissions of transport documents, follow up, etc.
A *transport execution plan template* has to be defined before the transport execution plan can be established. The template specifies transport chain alternatives as well as service and service provider alternatives. The template can be defined from scratch by means of information about available contracts and services, or it can be based on an existing transport execution plan or transport execution plan template. The specification process may be iterative. Chains and services may be specified in any order by means of the following steps:

- Alternative transport chain structures defining the nodes and the legs and the types of services requested for each node and leg (see 7.2.4.1)
- Alternative service providers and resources (see 7.2.4.2)
- Transport documents related to the nodes and legs (see 7.2.4.3)
- Define the alert conditions (see 7.2.4.4)

The definition of documents and alert conditions may also wait until the preferred transport chain and services are defined in the transport execution plan. At any stage the set of transport chain alternatives and the associated set of services and service providers, transport documents and alert conditions may be stored as a transport execution plan template.
A transport execution plan is based on a transport execution plan template (see 7.2.4.5). The preferred chain, services and service providers are chosen from alternatives listed in the template.
Updates to a transport execution plan can be based on the transport execution plan template related to the current transport execution plan; the best alternatives specified in the template can be selected. Prior to such a selection the template can be modified by means of updates in the actual transport preferences (ATP), or by adding or removing chain, service and service provider alternatives.

7.2.4.1Transport Chain Definition

Alternative transport chains are to be defined. The resulting transport execution plan template may be further refined or it may be used when the transport execution plan is to be defined. Based on an ATP the alternative transport chains and associated service type requirements are defined. This may be a multi modal transport as well as chains involving just one transport mode. A generic ATP may be used to retrieve generic transport chains. However, the ATP

may also be for a specific transport operation. The latter will provide more customised transport chains.
The chains defined may be based on:

- Available transport execution plan templates (services and schedules must be validated against current timetables and current services)
- Established contracts defining available routes and service types as well as service providers
- Route information provided by Transporters

Chains satisfying the preferences in the ATP will be identified, e.g. the optimal chains with respect to environmental issues.
It may be necessary to change the chain during the transport operation due to derivations (see 7.3.1). If so, a re-definition of the transport execution plan template may be necessary. The modifications must be done in accordance with the respective contracts.

7.2.4.2Transport Service Selection

Service type requirements are identified for nodes and legs in the transport chain alternatives of the transport execution plan template. The service requirements have to be linked to actual service providers such as Transporters, Terminal Actors, Authorities, etc. and to the services provided by these service providers. Information about available service providers may be retrieved from

- Other transport execution plans
- Other transport execution plan templates (must be validated against current timetables and current services)
- Established contracts
- Service information received electronically from service providers

One or more alternatives services are selected based on the GTP and the ATP. The following services may be available:

- Transport services – transport from one location to another
- Cargo services – loading and unloading
- Agent services – preparations, etc.
- Inspection services
- Customs services
- Accommodation services
- Maintenance services
- Navigation support services (e.g. pilotage, tugboat)

For transport services the following information is relevant:

- Route information (time of departure, time of arrival)
- Comments (limited capacity, etc.)
- Costs
- Capacity
- Deviation information (statistics, expected delays, etc.)

For terminal services the following information is relevant:

- Transfer information (terminal information, expected time, etc).
- Transit times

- Check in times
- Available resources (equipment etc.)

7.2.4.3Transport Information Exchange Definition

As a transport task is carried out, the necessary transport documents must be prepared and exchanged. This can be defined as a part of a transport execution plan or a part of a transport execution plan template.
The submission of transport documents can be linked to nodes and links in transport chains, and the responsibility for the establishment and submission of the documents can be linked to service providers identified in the chain. The Transport User, or the Transport User Agent, may like to be informed when the documents are issued. Such notification requests should also be a part of the plan. The stages that a document has to go through may also be specified, e.g. prepared, signed, and confirmed.

7.2.4.4Exception Notification Definition

The transport task should be carried out according to the transport execution plan. However, deviations may occur, resulting in damages, delays and other problems.
Damages should always cause an exception notification. Additional conditions that shall cause exception notifications may be defined for each node and leg in a transport chain. E.g. a delay of more than 3 hours on a specific leg may cause problems, and the Transport User or Transport User Agent must be notified. Exception notifications may also be related to the submission of transport documents or to the stages that these documents go through.
The preferred way to receive the exception notifications should also be defined (automatic response to information system, SMS to mobile phone, etc.).
In many cases one Transporter may be responsible for several consecutive links in a transport chain. In those cases the Transporter will be responsible for the handling of deviations. For freight transport the Transport User or Transport User Agent will in some cases not bother as long as the last link fulfils the conditions. For personnel transport, however, the Transport User must be informed about changes in the new travel plan.

7.2.4.5Transport Execution Plan Establishment

A *transport execution plan template* defines one or more alternative transport chains and alternative services and service providers. A *transport execution plan* defines the preferred transport chain and the preferred set of services and service providers associated to this chain. These are selected from the alternatives listed in a transport execution plan template.
Documents that are to be exchanged and alert conditions may also be a part of the template. However, these are in most cases related to the final transport execution plan.
Services and alternatives in the transport execution plan template that are in conflict with parts of the GTP or parts of the ATP should be marked.
If possible the availability of the services and the correctness of time schedules must be validated (these may be inherited from an old transport execution plan templates).
It may be necessary to change the chain during the transport operation due to deviations (see 7.3.1). If so, the old transport execution plan template can be used to find alternative chains or services, or a more comprehensive re-definition of parts of the transport execution plan template may be necessary (see 7.2.4.1). Amendments may also be required due to changes in plans. Amendments must be made in accordance with conditions in the respective contracts. The different versions of a transport execution plan should be managed in such a way that changes can be traced.

7.2.4.6Transport Execution Plan Completion

In freight transport a forwarding agent may be responsible for planning and preparation of several consecutive legs in a transport chain. However, the Transport User or Transport User Agent, which are ordering services from the forwarding agent, may consider these legs as one leg. Actually, a Transport User that is using a Transporter that turns out to be a forwarding agent may consider the whole freight transport operation as one leg, from consignor to consignee. Thus, the legs and nodes reflected in a transport execution plan specified by a Transport User or a Transport User Agent do not have to reflect all the legs and nodes of the real transport chain. For personnel transport, however, the transport execution plan is the traveller's guide, and the Transport User must get the complete transport execution plan. This plan can also be used as a basis for information retrieval (see 7.2.1). Thus, for personnel transport a completion of the transport execution plan must be done, and this may also be a necessity in some freight transport operations as well.
In those cases a complete transport execution plan is a prerequisite, the transport execution plan must be completed with input from those responsible for the underlying transport chains. The underlying plans must be put together to a complete transport execution plan for the whole transport operation. Information about responsibilities with respect to follow up must be a part of the plan.
In case of deviations, Transporters may provide revised transport execution plans. In such cases the consistency of the plan must be checked (to se that delays do not effect the following legs), and the Transport User or the Transport Agent must also be allowed to make amendments (7.1.2.3).

7.2.5Tender Request Management

A tender request can be issued based on transport preferences defined in the ATP (Actual Transport Preferences). The responses should be specified as transport execution plan suggestions that can be compared with respect to costs, time schedules, etc.
Traditional tenders may not fit the needs related to some freight transports, e.g. fish transport. The whole value chain involving seller, buyer and transporters may be so intertwined that you cannot have separate tenders for separate types of actors.

7.2.6Transport Means Sharing Demand

Travellers may share a transport means on a trip or on parts of a trip. Services that support the combining of such people shall help the travellers to find relevant people and transport means.

7.3Transport Task Control

The transport task control is based on the operative transport execution plan. The progress of the transport task is compared to the plan.
Formal documents are issued as indicated by the transport execution plan, and information exchange is also triggered by the plan.
Ongoing transport operations are followed up by means of status and tracking information. Alerts are received on deviations, as specified in the transport execution plan.

7.3.1Deviation Management

Information about delays, damages and other deviations that may influence the fulfilment of the transport execution plan are provided as exception notifications (the notification conditions are specified in the transport execution plan as described in 7.2.4.4) and damage

reports. The service providers involved in the transport operations (Transporters, Service Providers, Terminal Actors, Authorities, etc.) provide such information.
In some cases an exception notification is followed by an adjusted transport execution plan that specifies the consequences (e.g. the Traveller is booked on the next plane, or the arrival of a transport is delayed). Such amendments may lead to problems for the following legs as these legs may have to be postponed, or the revised plan may also cause other problems. Thus, it must be possible to amend the revised transport execution plan (see 7.2.4 - Alternate chains or services can be used, or a more comprehensive re-definition may be necessary.)
Deviations may be followed by claims. The submission of such claims is not supported by functionality specified in ARKTRANS. However, ARKTRANS functionality may provide information that can document the reason for claims.

7.3.2Transport Tracking and Tracing

The Transporters provide tracking and tracing information on regular terms so that the physical location and status (delayed, in time, fulfilled, in warehouse, etc.) of the transport operations are available.
The Transport User may track Transport Items or Transport Means (e.g. to decide about when it will arrive).
Different tracking and tracing technologies may be used. Some Transporters may be able to provide continuous tracking of Transport Items, while others may just be able to provide information about departures from or arrivals to checkpoints (e.g. terminals).

7.3.3Transport Information Exchange

Relevant parts of the transport execution plan shall follow the Transport Item (traveller or cargo) on its way through the transport chain. Other documents, e.g. customs declaration, must also be issued in time, as required.
The required documents must be generated and exchanged or received as specified in the transport execution plan or on demand. Out-going documents are established based on available information. Information from incoming documents must be registered. Paper documents may be produced, however, as far as possible electronic information exchange should be preferred.
The issue and reception of documents should be logged.
Examples of incoming documents are tickets (or other confirmation), damage reports, proof of delivery and other transport documents issued by other actors in the transport chain.
Examples of outgoing documents are customs declarations, declarations of dangerous cargo, and manifests.

7.4Transport Task Termination

7.4.1Transport Experience Management

On termination of a transport task experiences should be stored. This may be statistics as well as calculated information and comments (typed in by a user).

7.4.1.1 Transport Performance Evaluation

When transport is executed information about the execution the services is stored. An evaluation and statistics are generated by the system, and the responsible user may add comments about services and actors. Information about costs and deviations is included.

7.4.1.2Transport Execution Plan Template Definition

A transport execution plan outline, a transport execution plan or parts of a transport execution plan may be stored as a template for new transports.

7.4.1.3Transport Performance Statistics

Statistics may be retrieved based on stored data.

8Functional View, Transport Service Management

The sub-domain encompasses functionality related to the management of transport services. The main purpose is to be able to plan and accomplish transport services based on demands from Transport Users and Transport User Agents provided via the Transport Demand sub-domain. Efficiency and safety are focused as well as environmental issues.
The main roles involved are the Transporter and the Fleet Manager. The Transporter has the overall responsibility for the transport of passengers and/or freight from one location to another. To ensure efficiency and safety the Fleet Manager manages the fleet and the fleet operations. This includes planning based on transport demands, available transport resources, required maintenance, tenders, and contracts.
The transport operations accomplished by one Transporter may cover a complete transport chain or just one or more legs in a more or less complex transport chain. For the latter, different Transporters may be responsible for different legs. The control of the total transport is however a part of the Transport Demand sub-domain.
One transport operation may encompass several transport tasks. That is, one transport means may carry Transport Items related to different orders.
The function area covers:

- Transport Business Management
  Administrative functions. Contracts and transport orders are handled; necessary information about resources and services as well as statistics and business related issues are established and managed
- Strategical and Tactical Fleet Operation Management
  The long-term aspects of operating a fleet of transport means are planned. Route planning and scheduling are important functions.
- Operative Fleet Management
  Includes operative planning as well as operative control of the fleet operations fulfilling transport orders.

8.1Strategical and Tactical Fleet Management

Transporters and fleet managers must make strategic plans for their position in the market and the services they are to offer. Tactical management plans for the operations must also be established. The following elements must be supported:

- Identification of customer’s needs
- Planning of regular services as well as on-demand services (adjustments to the market, etc.)
- Yield management planning (to decide about prices, service packaging, sales strategies, etc.)
- Resource scheduling and backup planning
- Planning the use of third party service providers
- Optimising the operations with respect to economy
- Configuration for deviation, incident and priority condition settings

8.1.1Transport Needs Identification

Long-term contracts and information about Transport User’s or Transport User Agent’s long-term transport needs are considered.

Transport service requests that have not been fulfilled may be logged (see 8.3.1.2.1), and the information can be used to identify Transport User demands.
For long time planning, information about the market, statistics, political guidelines, new trends, and new regulations as well as changes in the competition and transport network are considered.

8.1.2Transport Route and Service Planning

Overall transport products with fixed routes are developed, ensuring that the Transporter can provide the required services and qualities. The planning of individual routes as well as the synchronising with other routes is handled. This is the case for both passenger and freight transport.
Several types of information are used as the basis for the planning, e.g. foreseen needs for transport services, and empirical, static and dynamic information about the traffic conditions.
Route and service conditions may also be influenced by contracts that provide information about long-term needs for transport services. The Transporter may for example have entered contracts with Authorities concerning specific routes. Conditions with respect to route frequency, capacity, quality of service, etc. may be stated in the contracts.

8.1.3On-demand Services Planning

Transport services with no fixed routes are to be planned. This includes identification of service types and qualities.
Several types of information are used as the basis for the planning, e.g. foreseen needs for transport services, and empirical as well as static and dynamic information about the traffic conditions.

8.1.4Fleet Operation Performance Planning

The capacity for the fleet and transport services must be adjusted to the market. The foreseen needs for transport services as well as the planned routes and services are used when the performance is planned. This includes planning of capacity, frequencies, timetables, coordination with other transport means etc.
Strategies with respect to over-booking and fulfilment of timetables are decided upon.
Several types of information are used as the basis for the planning, e.g. foreseen needs for transport services, empirical as well as static and dynamic information about the traffic conditions.

8.1.5Yield Management Planning

The strategies that enable the transporter and fleet operator to realise optimum revenue from operation are established. The aim is to provide the right services to the right customer, in the right way, at the right time, for the right price.
The structure of the fares, and parameters determining this structure, are decided on. The pre-defined fares are to be determined and administrated, and the marketing of the transport must be planned.
The marketing and sales of the transport services are also planned and shaped. Integration with other transport modalities and other transport services are to be included in the structures of the fares.

8.1.6Transport Resource Scheduling

Schedules for transport means and crew are made for planned routes and on foreseen transport operations. The most optimum schedules must be made with respect to safety and economy. The workload as well as the need for maintenance, training and education must also be considered. Allocation of personnel has to be planned and optimised with respect to such issues as allocation of skills, licences and certificates, movement of personnel, regulation enforcement, etc.

8.1.7Service Demand Planning

The transporter and fleet manager may need services from third party service providers. The services may be requested on demand basis, or they may be controlled by long term contracts with Service Providers.

8.1.8Resource Backup Management

Backup resources (e.g. transport means and personnel) must be identified, and plans for replacement of personnel, transport means and other resources that may have to be withdrawn from operation are prepared. Plans for preparedness and use of assistant transport resources (in case of lack of capacity) are also handled by this function.

8.1.9Optimising

The transport services must be evaluated along several dimensions, such as costs, the price of services, and the utilization of resources such as transport means, infrastructure, equipment, areas, and manpower. It must be possible to check the power of plans, and decisions that may optimize the cost-benefit of the transport services should be supported.

8.2Operative Fleet Management

Operative Fleet Management functionality provides services and functionality to the fleet manager during the operational planning of the transport operations, the execution and monitoring of the fleet operations, and in the case of incidents and deviations. The operative fleet management is to be executed with the strategic and tactical plans as basis.

8.2.1Operative Planning and Preparation

The operative planning and preparation for a specific transport operation depend on the transport and resource plans from the strategic and tactical planning. General planning including time schedule and route is to be performed. Operative strategies, existing time plans and empirical data are used as input. Each transport operation is to be planned in a manner ensuring that the resources are optimally exploited. The planning must also ensure the required service level to the customers. Different types of transport tasks are:

- Transport according to a fixed schedule (for instance a bus in regular service)
- Transport without a fixed schedule (for instance taxies, transport of freight from one location directly to another)
- Transport without a fixed schedule where the transport means is shared (for instance freight pooling, airport taxies)
- The operational planning must support re-planning in case of deviation.

8.2.1.1Transport Operation Planning

Plans for a specific transport operation are made. Plans from the tactical planning can be used as templates. The transport operation planning should result in the following plans:

- Operational Route Plan – specifying the route for the specific transport operation (departure and arrival locations, time schedules, how to get between the locations, etc.). Relevant information regarding traffic conditions received from the Transport Network Management sub-domain is considered. Schedules may also be judged based on tracking information for ongoing or previous transport operations on the same route.
- Transport Operation Plan – specifying the transport operation. The Transport Items that are to be transported as well as their departure and destination locations (specified in the Operational Route Plan) and their seat or space allocation are specified.
- Resource Plans– specifying the working plan for the resources involved in the transport operation (personnel, equipment and transport means). The workload for the crew has to be considered.
- Handling Instructions – based on transport item instructions that specify conditions for the handling of a transport item defined by the contract and the transport order as well as on conditions defined by frameworks (e.g. related to type of Transport Means, type of cargo). May include requirements for special treatment and special terms of agreement, e.g. for handicapped Travellers, unaccompanied children, diseases/allergy.

8.2.1.2Space and Resource Allocation

If all conditions can be satisfied (e.g. the fulfilment of requirements with respect to transport item instructions, regulations, provision of administrative services, etc.), seat or space is allocated to the Transport Item on a scheduled Transport Means. The allocations are entered into the Transport Operation Plan.
Transport items that cannot be handled due to capacity problems may be put on waiting lists, and priorities may be assigned to them. Overbooking may also be a strategy. Just before departure, available resources (due to “no show” or overcapacity) may be allocated to Transport Items on waiting lists, and overbooking must be handled.
Space and resource allocations may be preliminary or firm, depending on the type of booking (see 8.3.1.2.1). When a preliminary booking expires, the resources allocated must be freed. Otherwise, the resource allocations must be made firm on reception of a related firm booking.

8.2.1.3On-Demand Transport Service Planning

Different transport orders are coordinated with a view to be able to share the seats or space within a transport means. The coordination is based on the following information:

- Available transport means and available space on these transport means
- Current location of transport means
- Departure and arrival locations
- Special conditions
- Time limits for the transport and waiting time

The planning will result in a Transport Operation Plan, an Operational Route Plan, a Resource Plan, and Transport Operation Conditions.

8.2.1.4No Show Management

Information about Transport Items that are boarded or loaded on the transport means is checked towards the bookings. The no show of Transport Items has to be managed, e.g. by acceptance of other Transport Items, or by means of the Yield Management function.

8.2.1.5Service Booking

Services and resources needed on terminals must be planned and booked. This may be terminal resources such as stop point (e.g. gate, track, and quay), loading and unloading personnel and equipment, special assistance for disabled people and unaccompanied minors, etc.

8.2.1.6Transport Documents Production

Transport documents that have to be provided to the miscellaneous actors such as terminal authorities and to the crew onboard the transport means are to be established. Electronic information received from the Transport User may be re-used. The transport documents may also be available on an electronic medium.

8.2.1.7Priority Condition Settings

The conditions related to the priorities are defined.

8.2.1.8Incident Condition Settings

The situations that shall be considered as incidents and the actions that shall be taken in case of each type of incident are defined. The situations are defined by means of results from the transport operation monitoring.

8.2.1.9Deviation Condition Settings

The situations that shall be considered as deviations and the actions that shall be taken in case of each deviation are defined. The situations are defined by means of results from the transport operation monitoring.

8.2.1.10Performance Management

The available capacity and the achievable performance have to be evaluated. Traffic conditions have to be considered. Situations like overbooking, overcapacity, possible deviations from the schedule, etc. has to be detected and handled.

8.2.1.11Yield Management

The prices and services that are to be offered, and the market channels that are to be used are planned. Transport services are offered through different market channels by means of the Transport Service marketing function (see 8.3.1.3). Prices and capacities are set according to the yield management strategy.

8.2.1.12Exceptional Transport Needs Management

Transport needs that are not foreseen in the tactical planning must be accounted for. Such needs may occur due to external activities (e.g. football games with many visitors) or internal problems like lack of capacity, lack of resources or cancellations.
Exceptional transport demands due to external activities must be identified, and the coverage and capacity of the planned services must be considered and adjusted as required, e.g. by allocation of backup resources (see 8.2.2.10).
In case of internal problems, different solutions must be considered depending on the problem. Backup resources may be allocated, or the Transport Items must be booked on other transport means. The transport execution plans related to the Transport Items may have to be consulted to see the consequences and to enable the fulfilment of requirements.

8.2.2Fleet Operation

The continuous operation of the fleet is managed in such a way that time schedules as well as quality and safety requirements are met. This counts for both planned scheduled transport as well as for on-demand transport.
Information about the current situation with respect to fleet management, the transport network and traffic and driving conditions, empirical data and schedules are used. Requests from the transport means, incidents and deviations uncovered by the fleet monitoring are responded upon. Information exchange is supported.

8.2.2.1Task Allocation

Transport tasks are assigned to a specific transport operation and the transport operation is planned. Resources are allocated and preliminary plans and preliminary information about the transport operation is established.

8.2.2.2Transport Item Information Management

Load information and information about the passengers are managed ahead of the transport operation, during the transport, and when the transport is terminated. Load lists (describing the cargo that is onboard the transport means) and the passenger lists (the passengers onboard the transport means) are managed as well as weight and balance information.

8.2.2.3Pooling Services Planning

The function allocates transport means for transport without a fixed schedule.

8.2.2.4Priority Request

Priority request for transport means is sent. The requested priority is decided based on the priority condition settings (see 8.2.1.7), delays, importance, traffic conditions and type of transport.

8.2.2.5Quality Assurance Control

It has to be verified that all required routines and checks are carried out prior to the start of the transport operation. Verification is received from the On-board support and Control sub-domain. If the required conditions are not satisfied, the start-up of the transport operation may be prohibited.

8.2.2.6Route Guidance

The function supports the driver’s navigation according to the Operational Route Plan. Information covering traffic conditions and other relevant conditions is communicated to the driver.

8.2.2.7Voice Communication

Voice communication with the Driver or other parts of the Crew (the On-board support and Control sub-domain) is supported.

8.2.2.8Schedule and Deviation Management

The Transport Operation Plan, the Operational Route Plan and the handling instructions (based on Transport Item Instructions and regulations) of a transport operation is followed up. Input from the Fleet Operation Monitor functions (see 8.2.3), including the Schedule and Deviation Evaluation function (see 8.2.3.6), enables detection of deviations with respect to

time schedule, damages, conditions, and services, as defined in the Deviation Condition Settings (see 8.2.1.9).
Several transport tasks may be handled by one transport operation. Thus, several Transport Execution Plans (reflecting conditions defined in one order) may be related to a single Transport Operation, and the actions to be taken and the management of the deviations will depend on the deviation settings and conditions specified in these transport execution plans.
Documents and reports defined in the Transport execution plans are issued (to terminal actors, authorities, other transporters, etc.). These documents may for example contain information about dangerous cargo, arrival information, departure information, etc. Status reports and Exception notifications is submitted to the Transport User or the Transport User Agent according to the agreement.
Actions that may correct deviations are considered (another route, adjusted speed, etc.). The Fleet Manager may for example respond upon the deviation by means of functionality such as Voice Communication, Route Guidance, Priority Requirements, Resource Backup Allocation, etc. If a cancellation of a transport operation is necessary, new operational planning may be required.
If a deviation cannot be corrected, a new Operational Route Plan with an updated time schedules is estimated, and affected transport execution plans are updated. The Transport Users must be notified according to the alert conditions defined in their transport execution plans.

8.2.2.9Incident Management

Each transport operation is monitored continuously by the Fleet Operation Monitor functions (see 8.2.3). The Safety Status Evaluation functionality (see 8.2.3.5) detects incidents according to the settings made by the Incident Condition Setting functionality (see 8.2.1.8). The incident settings also define actions that should be taken automatically in case of the specific incident (e.g. inform the driver).
Some incidents may require special actions not dealt with in ARKTRANS. However, an incident setting may for an example indicate that incident reports should be sent to the transport network management sub-domain. Depending on the incident detected and the actions taken, the Driver, the Transport User, Terminal and/or Authorities have to be informed.
Incidents are also logged so that empirical information can be used for further planning.

8.2.2.10Resource Backup Allocation

Backup resources are allocated either as a stand in for resources that have to be withdrawn from operation or as a complement to account for missing capacity.
If the backup resource allocation causes delays, it must be considered whether alerts should be sent to the Transport Demand sub-domain or not. Delays should also cause updates of Transport execution plans by means of the order management functionality (see 8.3.1.2.2).
If Transport Items have to be booked on backup transport means providing extra transport capacity, an order amendment is also managed by the same function.

8.2.2.11Automatic Driving Control

The control strategies are realised in commands to the controlled transport means or their Crew.

8.2.3Fleet Operation Monitoring

The transport operations are tracked, and the status of the transport means and Transport Items are also monitored. Events trigger the Schedule and Deviation Management function (see 8.2.2.8) and the Incident Management function (see 8.2.2.9).

8.2.3.1Transport Means Tracking

The movement of the transport means is tracked. Different ways of tracking is supported. If the transport means lack equipment for tracking, tracking can be done at checkpoints (e.g. at terminals).

8.2.3.2Transport Item Tracking

Transport Items (cargo or passengers) may be tracked by means of transport means tracking. However, some Transport Items may also be equipped with separate tracking technology that arranges for tracking of specific items.

8.2.3.3Transport Item Monitoring

The status of the Transport Item (cargo or passenger) is registered. For freight transport this includes information about whether it is loaded or unloaded as well as information about the condition (e.g. temperature, humidity, pressure and placing). For passenger transport this includes information about whether they have entered or left the transport means and general conditions on-board the transport means (e.g. OK). The Schedule and Deviation Evaluation function (see 8.2.3.6) will detect deviations (e.g. delayed loading). The deviations are managed by the Schedule and Deviation Management function (see 8.2.2.8).
Incidents are detected by the Safety Status Recording and Evaluation function, and handled by the Incident Management function (see 8.2.2.9).

8.2.3.4Equipment Monitoring

The communication and the equipment on-board the transport means are to be monitored. Dysfunctions and errors may be reported. The Schedule and Deviation Monitoring function will detect deviations (e.g. defect lights). The deviations are managed by the Schedule and Deviation Management function (see 8.2.2.8).
Incidents are detected by the Safety Status Evaluation function (see 8.2.3.5), and handled by the Incident Management function (see 8.2.2.9).

8.2.3.5Safety Status Evaluation

The safety status is evaluated based on results form the monitoring of the driver’s behaviour, the transport means and the condition of transport items. Incidents (irregular events or states) are detected. The incident condition setting functionality (see 8.2.1.8) defines such incidents. Detection of incidents triggers incident management, see 8.2.2.9

8.2.3.6Schedule and Deviation Evaluation

The tracking information collected by the Transport Means Tracking function (see 8.2.3.1) as well as state information with respect to the transport items, equipment and transport compliance are used to compare the actual transport with the schedule and transport execution plan. The deviation conditions settings functionality (see 8.2.1.9) defines the deviations. The Schedule and Deviation Management function (see 8.2.2.8) will handle the deviations.

It is also possible to judge the state of the transport network and the traffic conditions based on tracking information. This may provide input to Transport Operation Planning (see 8.2.1.1) for other transports.

8.2.3.7Transport Compliance Evaluation

The function evaluates the transport operation according to present regulations for driver behaviour. The Schedule and Deviation Monitoring function will detect deviations (e.g. speed regulation violence). The deviations are managed by the Schedule and Deviation Management function (see 8.2.2.8).
Incidents are detected by the Safety Status Recording and Evaluation function, and handled by the Incident Management function (see 8.2.2.9).

8.3Transport Business Management

By transport business management we mean all activities that affect the daily operation of the business that comprises the following:

- Commercial management and customer support
- Management of crew and other fleet resources
- Management of contracts and orders
- Management of statistics and information about the accomplishment of the transport services

8.3.1Commercial Management and Customer Support

Commercial management includes the management of contracts and orders related to the accomplishment of transport services. Customer support is service marketing, the handling of requests and information related to the orders as well as claims management.

8.3.1.1Contract Management

Contract Management supports negotiations, establishment and maintenance of a contract between the Transporter and a customer that is requesting transport services. A Transporter will have different types of contracts depending on the services that are offered, and the type of customers that are served (freight or passengers transport, special transport food transport, etc.). Information about the contracts and status of contracts is managed.
Contracts may also be negotiated and established as framework agreements, with authorities concerning transport services that benefit the society.

8.3.1.1.1Contract Agreement Support

A customer of a Transporter (Transport User or Transport User Agent) will in many cases have a specific contract concerning transport services and use of resources. A contract can be changed, renegotiated, or cancelled, and these processes have to be supported by means of for example functionality that requests the required information (information required by the Transporter as well as information that is to be acquired due to regulations) in combination with functionality that supports the work flow.

8.3.1.1.2Contract and Tender Information Administration

Information about tenders and contracts is managed. This may be standardised contracts as well as tenders and special contracts with specific customers.
Information such as customer information (in case of a special contract), details about the Transport Items and/or passenger to be transported, the collect locations, the deliver locations,

and information about the degree and status of a contract fulfilment are managed. In case of long-term contracts, information about orders and the execution of orders that are according to contracts must be registered.

8.3.1.2Customer Support

Requests for transport services are managed. The orders are processed, information about the orders and amendments are managed as well as claims.

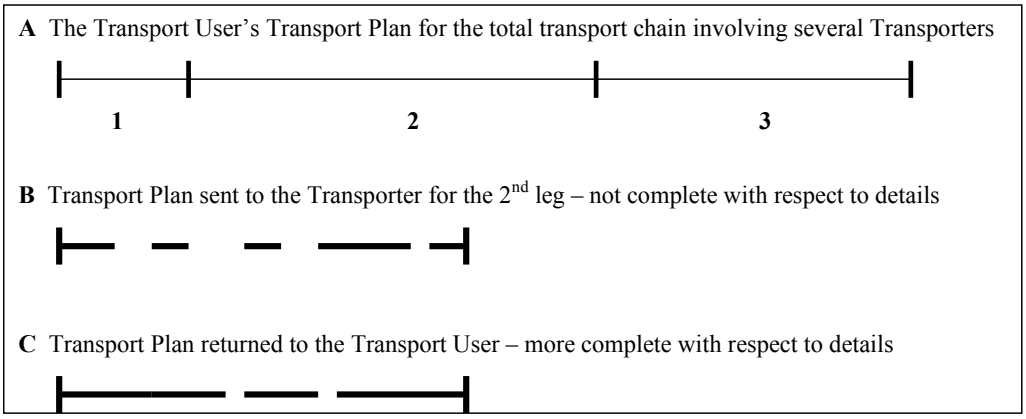


Figure11 Transport execution plan from different point of views and at different stages

A transport task is defined by means of a Transport Execution Plan. The content of the transport execution plan depends on the viewpoint. The transport execution plan, as seen from the Transport User's point of view (in the Transport Demand sub-domain), will encompass the whole transport chain and may consist of several legs, as shown in A of the Figure. However, a Transporter will just need the transport execution plan for the legs accomplished by this Transporter. Thus, just a subset of the total transport execution plan is usually the basis for the order (see B in the Figure).
An order with the required subset of the transport execution plan is received from the Transport Demand sub-domain. The plan may encompass one or more legs that are to be managed by this Transporter. The Transporter may also split a leg into more legs if such a split is feasible (in the example in the Figure the Transporter is responsible for one leg). Each leg will be described by a separate subset of the transport execution plan.
On reception of the order, the transport execution plan is not complete. Detailed route information, detailed time schedules, all legs, etc. may not be defined as indicated by the broken line in B. It is up to the Transporter to make a detailed plan (as shown in C in the Figure). If feasible, the detailed plan should be sent back to the Transport User.
A transport execution plan may contain the following information:

- Relevant parts of ATP
- Information about the Transport Items to be transported (passenger(s) or cargo)
- Departure and arrival locations
- Departure and arrival times
- Alert conditions
- Documents to be issued and submitted

8.3.1.2.1Transport Request Management

Incoming orders are received from the Transport Demand sub-domain. They may be issued according to an established contract, or they may not refer to any contract at all. In the latter

case a contract must be established, or the order may indicate a demand for a transport operation that is according to a standard contract with standard price and standard conditions. Some orders may be handled automatically. Others may require manual handling.
Requests that have to be rejected and the reason for the rejections should be logged. In that way knowledge about market demands can be used in strategic and tactical planning (see 8.1.1).
An order may contain a preliminary or a firm booking. A preliminary booking will expire if it is not followed by a firm booking. The order may also be a cancellation or an amendment of previous bookings. Such requests are handled according to the contract.

8.3.1.2.2Order Management

Preliminary or firm bookings sent by the transport user or transport user agent are confirmed (positive or negative). A positive confirmation may be accompanied with a transport execution plan containing for example seat allocations, detailed route information, etc., and in some cases also by a ticket. An updated transport execution plan is also provided to the transport user or transport user agent in case of booking amendments (initiated by the transport user or the transporter).
The information concerning the booking is managed. This includes the transport execution plan with information about the Transport Items, quantum, etc. The transport tasks are identified, and the handling of the Transport Items is described as well as relations to the associated transport operations and resources that are to be used (see 8.2.1.2). Status information is updated during the execution of the transport operations.
On execution of an order that is according to a long-term contract, the contract information management functionality (see 8.3.1.1.2) is informed about the extent of the order. Financial transactions related to orders and contracts are not a part of ARKTRANS. However, such transactions are likely to be initiated, and there must be access to support for financial transactions.
Order amendments initiated by the transport user are managed. Conditions in the contract may influence on the ability to make amendments or the conditions concerning such amendments. The Transporter may also have to make changes due to unforeseen reasons (cancellations, or too low capacity, etc.), as described by the Transport Booking Amendment function (see 8.3.1.2.3). Such changes must be reflected in the information about the booking. The Transport Demand sub-domain may have to be notified about the changes by means of an updated transport execution plan.
Historical information about bookings may be valuable input to the strategical and tactical planning.

8.3.1.2.3Transport Booking Amendment

The transporter may have to change one or more bookings (e.g. several transport tasks related to a transport operation) due to unforeseen problems such as cancellations, lack of capacity, etc. Alternative transport strategies that preferably fulfil the transport execution plans that are affected have to be found, and booking amendments must be made. The Transport Demand sub-domain may have to be notified about the changes.

8.3.1.2.4Claims Management

In case of damage, relevant information about the transport operation and the affected transport items is made available to support the decisions taken by those in charge.

8.3.1.3Transport Service Marketing

Information about the transport services is disseminated to market through several market channels to relevant stakeholders and applications (e.g. portals). The following information is relevant:

- Route information (time of departure, time of arrival)
- Transfer information (terminal information, expected time, etc).
- Information about the service types, e.g.:
  - Cost
  - Capacity
  - Deviation information (statistics, expected delays, etc.)
  - Comments
- Service offered

8.3.2Transport Information Management

This function covers information that is to be reported to authorities or others according to the present agreements and regulations. The information has to be established, and the submission time has to be entered into the Transport Execution Plan. Functionality that supports the establishment and inspection of relevant information is available. Information of interest may be:

- Hazardous Goods Declaration
- Customs Declaration
- Arrival and Departure Notification
- Manifest
- Waybill
- Booking Information
- Long Term Service Demand
- Proof of Delivery Confirmation

8.3.3Transport Resource Management

The maintenance and utilisation of the transport resources are managed. This includes resource status, maintenance operation planning, and resource disposition planning as well as the administration of the information the resources. Information about back-up resources is also managed.

8.3.3.1Fleet Maintenance Coordination

Maintenance of transport means and associated equipment is managed. The maintenance has to be planned and optimised with the basis in operative states as well as planned transport operations. Experience from different sort of maintenance, and also known defects have to be considered. If suitable, the maintenance should be coordinated with planned maintenance of the transport network.

8.3.3.2Certificate and Licence Management

Information about certificates (documenting qualifications of personnel, the quality of transport means and other equipment, or the ability to carry out certain operations) and licences (documenting the entitlement to carry out certain transport operations, e.g. transport of dangerous cargo) are established and managed.

Conditions related to the certificate types and licence types are also managed, e.g. conditions with respect to certain types of transport means or specific types of transport, e.g. food transport, animal transport, etc.

8.3.3.3Crew Management

Crew information is established and managed, including information regarding skills, availability, certificates, etc.

8.3.3.4Transport Means Management

Information about all transport means in the fleet is established and managed. This includes static information describing the transport means as well as more dynamic information about operative state, maintenance, economic transactions connected to the transport means, etc. Relevant parts of the information can be made available on board the transport means or it can be retrieved from the transport means, this according to present legislation. The information may be updated based on status reports received from the transport means or the driver (e.g. mileage).
Information about the overall capabilities according to the routes and the schedule is also a part of this function.

8.3.3.5Equipment Management

Information about equipment used in the transport means or by the driver is established and managed. This includes static information as well as more dynamic information about operative state, maintenance, etc. The information may be updated based on status reports received from the transport means or the driver.

8.3.3.6Sub-contractor Management

Information about agreements with sub-contractors and information about the degree of fulfilment of the agreements are managed. The services and resources that are delivered by sub-contractors are managed by means of the same functionality that manages services and resources provided by the transporter.

8.3.4Statistics and Management Information Administration

Statistics and management information support management, such as strategic and tactic decisions. For some types of transport the transporters are required to report statistics to the authorities.

8.3.4.1Payment Recording

Information about payments related to orders and transport operations is recorded.

8.3.4.2Transport Statistics

Statistics about the transport tasks are established.

8.3.4.3Customer Statistics

Statistics about the customers are established.

8.3.4.4Statistics Reporting

Statistics are generated and reported according to present legislations.

8.3.4.5Traffic Condition Monitoring

Information about historical, current and foreseen traffic conditions are acquired from the Transport Network Management sub-domain. This data will be used both for planning and for operational purposes.

8.3.4.6Transport Network Monitoring

Static as well as dynamic information about the transport network is acquired from the Transport Network Management sub-domain and from empirical data about fleet operations. This data will be used both for planning and for operational purposes.

8.3.4.7Fleet Operation Performance Evaluation

The fleet operation performance is to be evaluated based on collected information. The available capacity and the actual exploitation of the capacity are charted.

9Functional View, On-board Support and Control

The sub-domain provides functionality that operates on-board the Transport Means. The driving operation and the accomplishment of the transport operation are assisted, and the Crew, the Transport Means, the Transport Items (Cargo or Travellers) on-board the Transport Means are monitored and controlled.
On detection of irregularities, the Crew and/or the Transport Service Management sub-domain are notified. Different irregularities may be handled in different ways depending on the situation and on the transport mode (automated stop of an aircraft in the air is for example not feasible). Authorities in the Transport Network Management sub-domain may also be notified about irregularities that may influence on the traffic flow or if specific assistance is required.

9.1Transport Operation Support

Professional execution of transport operations concerning freight or passenger transport is supported. Information about the transport operation is established and made available to the Crew, and the execution of required quality assurance activities is registered (the quality assurance itself may not be supported as it mainly encompasses manual operations).

9.1.1Crew Information Establishment

Information about the Crew (at least the Driver) is established. This may be done on-board by several means (manually, smart card, etc.), or it may be done by information exchange with the Transport Service Management sub-domain. The information identifies the Crew responsible for the conveying of the Transport Means as well as their skills and preferences.

9.1.2Transport Operation Information Establishment

Transport operation requests are received from the Transport Service Management sub-domain, and the Crew may respond by issuing a positive or negative confirmation.
The information covering the current transport operation is established. This includes:

- Operational Route Plan – specifying the route for the specific transport operation (departure and arrival locations, time schedules, how to get between the locations, etc.).
- Transport Operation Plan – specifying the transport operation. The Transport Items that are to be transported as well as their departure and destination locations (specified in the Operational Route Plan) and their seat or space allocation are specified.
- Resource Plans– specifying the working plan for the resources involved in the transport operation (personnel, equipment and transport means).
- Handling Instructions – specifying conditions defined by the contract and the transport order (transport item instructions) as well as conditions defined by regulations and frameworks (e.g. related to type of Transport Means, type of cargo). May include requirements for special treatment and special terms of agreement, e.g. for handicapped Travellers, unaccompanied children, diseases/allergy.
- Transport Documents

9.1.3Quality Assurance

Quality assurance is done prior to the start up of the transport operation.

The information about the Crew and its qualifications and if required, the driver identification (e.g. by means of ID card), is used as basis for the approval (e.g. control of certificates and permissions). The Transport Means is also approved for the actual transport operation.
The Crew will usually carry out quality assurance procedures according to predefined checklists. The actual execution of the quality assurance procedures may not be supported; however, the responsible person may be able to confirm that specific tasks are carried out according to the quality assurance regulations.
Security deviations concerns are handled. If luggage is loaded, but the passenger is missing, the luggage may be unloaded.
Transport documents and documents describing the transport operation should be read and understood. This can be verified.
The Transport Service Management sub-domain is informed about the results, and the transport operation may be cancelled or postponed. The Automated Adaptation to Traffic Control (see 9.5.7.1) may also be effectuated and may prevent the start up of the transport operation.

9.1.4Transport Operation Monitoring and Reporting

The execution of the transport operation is monitored according to Transport Operation Plan, the Operational Route Plan, the Transport Operation Conditions and the Resource Plans. Transport Items that are loaded or unloaded are registered.
If there are any deviations in the execution of the transport operation, the Crew is informed as well as the Transport Service Management sub-domain. The Transport Network Management and Terminal Management sub-domains may also be informed if such reporting is required.
Some relevant reports are:

- Expected times of arrivals and departures, delays as well as exception requests whenever such requests are required may be reported to the Traffic Control Centre.
- Transport operation progress that may provide input to ETA or ETD (manually estimated and automatically calculated) is reported to the fleet operator
- Transport task progress report including cargo status (also damage reports), proof of delivery and reports about misc. problems is reported to the fleet operator
- Need for new services is reported to the fleet operator
- Tracking information in the case of transport items being tracked (the tracking of the transports means is however provided by the transport means monitoring and control functionality).

9.1.5Fee Payment

During the transport operation the Driver is assisted in planning and performing the fee payments necessary on the chosen route.
The payment may be manual, by credit card, electronic, prior to the transport or subsequent to the transport.

9.2Driver Behaviour Monitoring and Control

The Driver and the Driver’s actions are monitored and compared with a desired behaviour pattern. The Driver and/or the Transport Service Management sub-domain (thus, the Fleet Manager) will be notified in case of irregularities.

9.2.1Resting Hours Monitoring and Control

The resting hours are monitored and controlled for both for the Transport Means and the Driver. The monitoring ensures that all driving and all stops are logged. This information is compared with the regulations in force. When the Transport Means or the Driver is approaching the driving-hours limits, the Driver will be notified.
If a conflict with regulations is close or detected, the Transport Service Management sub-domain (thus, the Fleet manager) may be notified by the Incident and Emergency Management function. Automatic stop of Transport Means may for example become operative (e.g. for rail transport) by means of the Automated Adaptation to Traffic Control (see 9.5.7.1).

9.2.2Vigilance Monitoring and Control

The Driver's vigilance is monitored. A dead man's control or monitoring of eye movements may be used for this purpose. The Transport Network may also have built-in checkpoints to assist the monitoring. The Driver is given signals and has to respond to them. These signals are given at both fixed and random moments in time.
If the Driver does not respond, an alert will be given. In certain situations the Incident and Emergency Management function may also pass driver state information to the Transport Service Management and the Transport Network Management sub-domains. If the Driver does not respond to the alert, automatic operations may become operative by means of the Automated Adaptation to Traffic Control (see 9.5.7.1).

9.2.3Regulation Enforcement Monitoring and Control

When a transport operation is carried out, regulations regarding the operation itself, the Transport Item, the Transport Means, the Transport Network and the Driver, are to be consulted.
If rules or regulations are violated, the Driver is alerted, and the Transport Service Management sub-domain may also be informed by the Incident and Emergency Management function may also pass. Automated operation may be initiated by means of the Automated Adaptation to Traffic Control (see 9.5.7.1).

9.3Transport Means Monitoring and Control

The operation of the Transport Means is monitored. Information about different aspects of the operation (speed, engine parameters, etc.) is collected as well as information about the movement of the Transport Means (tracking). Automated support for Transport Means operation is also provided.

9.3.1Transport Means Status Monitoring

The status of Transport Means, including speed, temperature and different control systems, engine parameters, etc. is monitored. Irregularities may cause actions such as automatic operation of the Transport Means (e.g. train stop) by means of the Automated Adaptation to Traffic Control functionality (see 9.5.7.1). Information about irregularities may in some situations be passed on to the Transport Service Management sub-domain by the Incident and Emergency Management function.

9.3.2Movement Tracking

The movement of the Transport Means are monitored. The tracking can be accomplished in several ways. The Transport Means may for example be equipped with "black boxes" which

continuously logs the execution of the transport task, e.g. a speed recorder. The position of the transport means (and also other parameters such as speed) may also be communicated to specific recipients (e.g. the Transport Service management sub-domain) or broadcasted to its surroundings.

9.3.3Weight and Balance Monitoring and Control

The total weight of the Transport Means, including Transport Items, is monitored. The distribution of the weight on-board the Transport Means is monitored both vertically and horizontally. The weight information is communicated to the Driver.
If the allowed weight is exceeded or if the weight distribution exceeds the limits for the Transport Means, information is communicated to the Crew and in some situations also to the Transport Service Management sub-domain by the Incident and Emergency Management function. In such cases the transport task may not be effectuated. Automatic stop of the Transport Means may come into operation.

9.3.4Gas Monitoring and Control

The amount of gas in the Cargo compartment is monitored.
If the amount exceeds the risk limit, the Crew and possible Travellers are informed immediately. The Incident and Emergency Management function may also inform the Transport Service Management sub-domain and the Transport Network Management sub-domains. Automatic stop of Transport Means may be executed due to procedures.

9.3.5Fire Monitoring and Control

The Transport Means is to have fire-monitoring equipment.
In case of fire, automatic extinction is executed, and the Crew and possible Travellers are informed immediately. The Incident and Emergency Management function may also inform the Transport Service Management sub-domain and the Transport Network Management sub-domains. Automatic stop of Transport Means may be executed.

9.3.6Prevention of Transport Means Theft

Text to be added.

9.4Transport Item Monitoring and Control

The Transport Items (cargo and/or the passengers and their luggage) are monitored. Information about conditions (temperature, humidity, weight, etc.) is collected and provided to the Transport Service Management sub-domain. Automated actions may be taken to handle irregularities.

9.4.1Temperature Monitoring and Control

The temperature in the Cargo compartment and/or Traveller area is monitored. The Driver, Crew and Traveller are informed about the temperature.
If the temperature moves out of the tolerance zone for the actual freight or Travellers, the temperature is automatically adjusted. The Driver is notified in such case.
If the freight temperature has been outside the tolerance zone during a longer period of time, the Incident and Emergency Management function may inform the Transport Service Management sub-domain.

9.4.2Humidity Monitoring and Control

The humidity in the Cargo compartment and/or Traveller area is monitored. The Driver, Crew and Traveller are informed about the humidity.
If the humidity moves out of the tolerance zone for the actual freight or Travellers, the humidity ratio is automatically adjusted. The Driver is notified in such case.
If the humidity has been outside the tolerance zone during a longer period of time, the Incident and Emergency Management function (see 9.5.3) may inform the Transport Service Management sub-domain.

9.4.3Noise Monitoring and Control

The noise within the Transport Means is monitored.

9.4.4Visual Monitoring of Transport Items

The Transport Items (Travellers and Cargo) on-board the Transport Means are monitored.

9.4.5Cargo Theft Prevention

The sub-function offers functions for securing the freight onboard.

9.5On-board Support

The driving and navigation operations are supported. The professional execution of freight and passenger transport is however supported by 9.1.
On-board equipment with precise two-way interfaces is required. Information about irregularities detected by the on-board monitoring functionality, as well as transport network condition information from the Transport Network Management sub-domain is communicated to the Crew.

9.5.1Navigation Support

The navigation support may be provided by separate equipment or by separate systems, or the support may be done by integration of several tools. By means of the latter, several types of information (e.g. maps with information about traffic conditions) may be combined. Such integration may simplify navigation and support decisions. Functionalities that may be provided are:

- Electronic maps may show the real-time position of other Transport Means as well as the position and movement of the Driver's Transport Means.
- Route planning and route definition may be supported. The planning may for example be based on the Operational Route Plan received from the Transport Service Management. Several propositions for routes may be suggested. The chosen route can be defined and if required it may be communicated to the Transport Service Management.
- A planned route can be simulated. In that way the navigation can be tested in advance.
- The Driver may be guided through the planned route. The accomplished of the transport operation is, however, monitored as described in 9.1.4.
- Information about current position, deviations from the planned route, and status may be passed on to the Driver (and if needed also to the Transport Service Management).
- Information about the expected time of arrival can be provided.
- Information is collected (e.g. by means of the information services – see 9.5.2) and presented in an integrated way, e.g. on the map used for the navigation. This may for example be:
    - The current traffic situation (the density, incidents, accidents etc)

- The current condition in the Transport Network (the state of the Transport Network, cordons, one-way driving, etc)
- The current weather conditions
- The current regulations
- Notices to the Driver
- Information from the control functions and the monitoring functions

9.5.2Information Services

The Driver or other parts of the Crew may request several types of information, and on-board functions, e.g. Navigation Support, may also request such information. Information is collected and presented. This may for example be:

- Maps or map updates
- Meteorological conditions
- The current regulations
- Traffic Flow Information Dynamic traffic information and statistical traffic information about traffic flow, such as traffic density, speed and delay.
- Transport Network Condition Information Dynamic information about abnormal and unplanned conditions in the transport network (slippery road, turbulence, high waves, obstructions, restricted view, air pollution, oil spill, etc.) due to situations that cannot be controlled (weather, incidents, accidents, etc.).
- Dynamic Transport Network Information Dynamic information about situations in the transport network infrastructure due to transport network conditions and events as well as regulations valid in the transport network, e.g. closed roads, platooning, speed limitations, quality, restrictions, constraints, general route and navigation guidelines about normal routes, alternative routes and route diversions (in case of obstructions).
- Physical Transport Network Information Static information about the transport network
- Traffic Condition Information A total assessment of the situation in the transport network that may affect safety and efficiency or just elements of such information. Information elements that may be provided are Traffic Flow Information, Transport Network Information and Transport Network Condition.

9.5.3Incident and Emergency Management

Information about incidents, irregularities and emergencies detected by the monitoring functions is communicated to the Crew, or the Crew may detect and register such situations themselves. The handling of incidents and emergencies (e.g. emergency brake, accidents, robbery, pollution, specific transport network conditions, weather conditions etc.) is supported. The function also supports handling of different types of alarms.
In certain situations information about incidents and emergencies is reported to the Transport Service Management and Transport Network Management sub-domains.

9.5.4Visibility Enhancement

The function offers services that simulate, or in other ways, contribute to clarify the traffic for the Driver; this includes radar, integration of information from hidden areas with radar, projection of pictures of the transport network onto to Driver’s window etc.
The Driver’s view of the traffic as well as light and visibility conditions may be interpreted. If the view is considered too restricted, the Transport Means may change the lightning and also automatically flush windows and lights.

The Transport Network may offer functions giving more/better lightning in case of bad lightning or visibility conditions.

9.5.5Traffic Flow Management

The function supports the Driver in managing the traffic conditions (the traffic flow and the actual transport network conditions). Warnings or guidelines may be provided, and use of available functionality, e.g. automated driving support – see 9.5.7, may be suggested. In dense traffic or if the traffic moves on very fluently, functionality the integrated the transport means into the traffic (see 9.5.7.2) or collision avoidance (see 9.5.7.3) may for example be used.

9.5.6Transport Network Conditions Management

The function supports the Driver in the movement of the Transport Means in case of abnormal, unplanned conditions in the transport network (restricted view, slippery road or railway, high waves, etc.). Warnings may be provided and the Driver may be supported in the handling of dangerous or difficult conditions.

9.5.7Automated Driving Support

In certain areas some sort of automated driving support may be mandatory or possible, and in certain situations it may be necessary to overrule the Driver, or the Driver may want some assistance. The degree of automation and intervention may vary.

9.5.7.1Automated Adaptation to Traffic Control (Automatisk tilpasning til trafikkontroll)

The Transport Means is operated automatically, or specific actions are taken automatically, e.g. automatic train stop, automated speed adaptation in case of speed violation, etc. The intention is to avoid accidents. Thus, situations that may lead to accidents as well as violations of regulations are handled in an automated way.
The operations depend on the situation and on the transport. Specific operations may also be taken due to incidents detected or due to information received from the Transport Network Management sub-domain, e.g. about regulations or incidents in the traffic. The Transport Service Management sub-domains may also initiate automated operations whenever the behaviour of the Driver or Transport Means indicates the need for such operations.
Incidents causing automated operations are of predefined types, and the automated operations will be carried out according to predefined specifications. Violation of the speed limit may for example cause automated speed regulation.
The automated operations should be logged.

9.5.7.2Integration of Transport Means in Traffic

During the transport operation, information from the Transport Network and other Transport Means is communicated to the Transport Means. Based on this information, combined with information collected by the Transport Means itself, the Driver is assisted in the integration of the Transport Means in Traffic. This integration is mainly correction of speed, breaking and support for keeping lanes and corridors. The transport network conditions are to be considered.

9.5.7.3Collision Avoidance (Støtte for avverging av kollisjon)

Services to assist in avoiding collisions are provided when the Transport Means is in motion and when the Transport Means is parking.

9.5.7.3.1Longitudinal Collision Avoidance

This function has its basis in measures of the Transport Means according to elements in the longitudinal direction. The function offers:

- Parking support, this includes sensors for estimation of the free distance in front of and behind the Transport Means, and also sensors in the transport leg and terminal measuring the placing of the Transport Means
- Support for speed adjusting according to the present traffic situation
- Support for adjustable cruise control, the pattern of driving is adjusted to the Driver, the current placement in the Transport Network, the Transport Means, the weight and also the freight and Travellers onboard, and the transport network condition.
- Overruling of the Driver's speed, if the Driver if the speed is not adjusted manually and the traffic situation dictates that the speed should be changed to ensure flexible and/or safe accomplishment of the transport
- Automated emergency braking in case of an emergency situation in the traffic
- Support for putting the Transport Means forward in convoy. The leg to the Transport Means ahead and behind is automatically regulated and can be reduced compared with manually driving

Camera on the Transport Means, in the transport leg and terminal, give visual support to the Driver. This is important when parking the Transport Means.

9.5.7.3.2Lateral Collision Avoidance

This function has its basis in measures of the Transport Means according to elements in the lateral direction. The function supports the Driver in avoiding lateral collision with other Transport Means or other elements in the traffic. The function offers:

- Dynamic control of the Transport Means
- Support to the switch of transport lanes and also to keep the lane which the Transport Means is making use of
- Support for prioritising the Transport Means in determined and reserved transport lanes in the traffic
- Parking support

This function also makes use of cameras on the Transport Means, in the transport network and at terminals.

9.5.8Reporting Support

The reporting of issues concerning the transport means (e.g. mileage), the driving and/or navigation operation, incidents, meteorological conditions, environmental conditions and the traffic conditions is supported. The reports may be sent to the Transport Service Management, Transport Network Management, and Terminal Management sub-domains.

9.5.8.1Priority Request

Priority request for transport means is sent to the traffic control centre. The requested priority may be decided manually or automatically based on delays, importance, traffic conditions and type of transport.

9.5.9Voice Communication

In some cases the Crew needs voice communication with the Fleet Manager or the Traffic Control Centre.

10Functional View, Terminal Management

The Terminal Management sub-domain encompasses functionality related to the management of transport system nodes for transhipment of goods and passengers (ports, container terminals, railway stations, airports, bus stops, etc.). Such transport system nodes may be a single terminal or a collection of terminals that are co-located, or the nodes may be other locations where transport means stop for boarding/disembarking or loading/unloading. To simplify the specification, we will also refer to these stop locations as terminals.
The management focus may differ from the overall management of several terminals and their use of a more or less common infrastructure, to the management of a single terminal. Strategic and tactical management must be done in both cases. In the latter case, focus is on the business of a particular terminal and the management of terminal operations concerning inbound Transport Items, the transhipment of Transport Items and the management of outbound Transport Items.
The Terminal Management sub-domain focuses on ICT functionality related to the operational flow of transport means and Transport Items to, from and within the terminal area, the resources needed, and the operations accomplished related to supporting these flows. Strategic, tactical and operational planning included. The general business affairs of the terminal manager or terminal operator, like accounting, purchasing of services and commodities, etc. are not focused by ARKTRANS.

10.1Strategic and Tactical Terminal Management

Terminal managers and the terminal operators must make strategic plans for their position in the market and the services they are to offer. Tactical Management plans for terminal operations also have to be established. The following elements must be supported:

- Identification of the customer needs that may influence on the terminal management
- Planning of regular terminal services as well as on demand services
- Planning of terminal performance (adjustment of capacity to the market, etc.)
- Yield management planning (price strategies, service packaging strategies, sales strategies, etc.)
- Resource scheduling and backup planning
- Planning the use of 3rd party service providers
- Optimising the operations with respect to economy
- Configuration of deviation, incident and priority condition settings

10.1.1Terminal Needs Identification

The terminal has to identify the future needs of the customers to be in a position to provide the required terminal services (loading, unloading, tracking of cargo, oil and water supply, etc.) and resources (equipment, specific skills, storage areas, etc.). For long time planning, information about the market, statistics, political guidelines, new trends, new regulations, as well as changes in terminal infrastructure is considered.

10.1.2Regular Terminal Service Planning

Regular terminal services are planned based on contracts that provide information about long-term needs for terminal services. Information about terminal service that have been requested but not been fulfilled may be logged, and such logs may provide valuable information on demands for new services.

Statistics for regular traffic and ongoing activities at the terminal also provide valuable input. A terminal will normally operate with season's services, for example de-icing of aircrafts in the winter period, or services to cruise ships in the summer period.

10.1.3On-Demand Services Planning

The terminal must be able to provide "on demand services" to customers. On demand services cannot be planned on a regular schedule, but the terminal must be prepared to offer the required services, and the capacity that probably is required must be calculated. Several types of information may be used as the basis for the planning, e.g. foreseen needs for on-demand terminal services, statistics, information about customers, etc.

10.1.4Terminal Performance Planning

The capacity of the terminal must be adjusted to the market. The foreseen needs for terminal services and resources as well as the planned services are input to the performance planning. The foreseen needs for capacity and resources, the timetables, the needs for coordination with other actors, statistics, market information, etc. must be considered.

10.1.5Yield Management Planning

The strategies that enable the terminal to realise optimum revenue from operation are established. The aim is to provide the right services to the right customer, in the right way, at the right time, for the right price. Pre-defined prices are to be decided upon and administrated, and the marketing and sales of the terminal services must be planned.

10.1.6Terminal Resource Scheduling

A scheduling for terminal resources like stop points, staff, terminal equipment, means, and the terminal area must be planned. Demand forecasts based on information about long-term contracts, statistics, bookings from customers, etc. support the resource scheduling. Terminal visits are planned, resources are booked, and the required terminal services are planned at a defined terminal area at a defined time slot. The people operating the terminal, most likely on a shift basis, must possess the required skills and certificates.

10.1.7Service Demand Planning

The terminal manager or the terminal operator may need services from 3rd party service providers, which may possess roles such as terminal operator, warehouse provider, service provider, etc. The services may be requested on demand basis, or they may be controlled by long-term contracts with service providers. The services provided by the 3rd party may be very extensive, and the terminal manager or the terminal operator may operate as a contact point between the customers and the service providers. However, this will not be visible from the customer's point of view.

10.1.8Optimising

The terminal operations must be evaluated along several dimensions, such as costs, the price of services, and the utilization of resources such as infrastructure, equipment, areas, and manpower, etc. It must be possible to check the power of plans, and decisions that may optimise the cost-benefit of the terminal should be supported.

10.1.9Strategic Condition Settings

Strategic conditions about conditions related to the priorities and the situations that shall be considered as deviations and incidents are defined as well as the actions that shall be taken in case of each type of deviation and incident.

10.2Terminal Operation Management

Terminal Operation Management functionality provides services and functionality to terminal actors during the operational planning of terminal operations, the execution and monitoring of the terminal operations, and in the case of incidents and deviations. The terminal operation management is to be executed with the strategic and tactical plans as basis. Terminal operations can be divided into different phases:

- The *inbound phase* may include the following operations
  - The entrance of the transport means into the terminal area after getting the necessary clearances
  - Movement of the transport means to the ramp area and parking (use of internal infrastructure, use of resources that assist movement and parking, etc.)
  - Transport Item entry control, customs clearance declaration and other services related to the entrance of Transport Items
- The *transhipment and storage phase* may include the following operations
  - Establishment of logistics plan for transhipment and storage
  - Establishment of handling instructions
  - The unloading or disembarking of Transport Items according to handling instructions
  - Transhipment logistics according to plan (when, whereto and how to transport within the area of the terminal, treatment, splitting of load units, packing into load units, etc)
  - The management of transhipment and content of storage areas (space allocation, optimisation, etc.)
  - Transport Item and transport means monitoring (tracking, status monitoring, etc.)
  - The loading and boarding of Transport Items according handling instructions
- The *outbound phase* may include the following operations
  - Exit control for Transport Items
  - Exit control for Transport Means

10.2.1Operational Planning

The operational planning includes planning of inbound transport operations, transhipment and storage operations, and outbound transport operations. The first stage is the planning prior to the arrival of a transport means (the pre stage), during the terminal visit (during stage), and the activity to ship the goods to next destination (the post stage).
The operational planning must also support re-planning in case of deviation.

10.2.1.1Total Plan Management

The operational plan for the terminal is managed. Different views to the plan can be presented, e.g.:

- Resource plan
- Terminal operation plan (for one terminal operation, e.g. loading)
- Transhipment plan
- Terminal actor plan
- Transport Item plan

- Load unit plan
- Order plan (key information regarding how to handle an order)
- Security plan (e.g. according to ISPS – International Ship and Port Facility Security or JAR-OPS – Joint Aviation Requirements Operation)

Information can be provided to stakeholders whenever required.
The available capacity and the achievable performance have to be monitored and evaluated. Situations like overbooking, overcapacity, possible deviations from the schedule, deviations from contracts, etc. are detected. The contractual conditions related to the planned terminal operations must be consulted. Resource deviations are handled by the Exception Management (see 10.2.1.6). Involved actors are informed about changes in plans, exception notifications included.

10.2.1.2Inbound Planning

Inbound planning includes the planning of how and when an incoming transport means shall enter the terminal area, the services that are required in connection with the entrance, and the allocation of the resources that are required during the entrance.

10.2.1.2.1Slot Planning

The slot planning is the allocation of time slots for arrival as well as time slots for the stay at the terminal. This includes the planning of the inbound transport sequences for the transport means' destination point at terminal (e.g. gate).

10.2.1.2.2Resource Allocation

The operational resources needed to support the incoming transport means to reach the point of destination at the terminal must be allocated. That means to reserve needed means (e.g. tug boat, follow me car), equipment (e.g. stairs to the plain), ramp area for parking of the transport means, human resources, etc.

10.2.1.3Transhipment and Storage Planning

Handling instructions concerning loading/boarding and unloading/disembarking as well as storage plans are established.

10.2.1.3.1Logistics planning

A logistics plan for transhipment and storage includes plans for the use of terminal resources, the storage and transhipment facilities, required documentation, time slots for transhipment, and the optimal utilisation of the terminal area. The plan will also describe packing and splitting that are to be done as a part of the transhipment and storage operations.
Resources that are required for the fulfilment of the plan are allocated.

10.2.1.3.2Transport Item Instruction Management

The Transport Item Instruction is a part of the Waybill and is either instructions regarding the treatment of a passenger with specific requirements (e.g. due to age, disability or illness) or a cargo instruction concerning specific requirements or considerations that must be taken when transporting and handling the cargo. A cargo instruction can refer to regulations for a specific type of cargo, e.g. dangerous cargo. The instructions can be provided either by the cargo owner or the organizer of the transport. The transport item instruction information is managed, and affects the establishment of handling instructions (see 10.2.1.3.4).

10.2.1.3.3Dangerous Cargo Management

Documentation of the dangerous goods classification is a part of the Waybill. The classification includes instructions about how to handle incidents involving humans (MFAG) or the environment (EMS) and must always follow the transport of dangerous cargo. The information depends on the transport mode, the transport means and the classification of the goods.

10.2.1.3.4Handling Instruction Establishment

The handling instructions tell the terminal workers which Transport Items that are to be handled as well as orders about special treatment, and what to be packed or split, etc. The instructions are based on information provided in the Transport Item Instruction (apart of the Waybill), contractual information, on regulations, and on the work procedures of the terminal.

10.2.1.4Outbound Planning

This is the planning of slot and resource allocation when transport means are leaving the terminal.

10.2.1.4.1Slot Planning

The time slots for departure and the planning of the outbound transport sequences for transport means from locations at the terminal (e.g. gates) are planned.

10.2.1.4.2Resource Allocation

The operational resources needed to support the outgoing transport means are allocated. This may be means (e.g. tug boat, follow me car), services (e.g. de-icing), human resources, etc.

10.2.1.5Yield Management

The prices and services that are to be offered by the terminal and the market channels that are to be used are decided. Prices and capacities are set according to the strategy decided in the yield management planning.

10.2.1.6Exception Management

Terminal service needs that are not foreseen in the tactical planning must be accounted for. The reasons for the exception must be identified and accounted for. Exceptions may occur due to external conditions (e.g. many visitors to the harbour due to weather conditions), or internal problems like lack of capacity, lack of resources or cancellations.
Further actions are taken based on the exception situation.
Backup resources and services provided by sub-contractor may be acquired according to sub-contractor contracts.

10.2.2Inbound Control

The entry of transport means and Transport Items into the terminal must be managed.

10.2.2.1Transport Means Entry Control

The access of transport means that enter a terminal must be controlled. For large terminals, the driver of a transport means or someone representing the driver normally must contact the terminals (via a gate or by means of communication) to be declared to get access to the terminal area.
There may be many levels of access control:

- Access to use of infrastructure
  In some cases exclusive rights are required, and the required infrastructure must be allocated to the transport means
- Access to terminal area
  Access may be given to the whole area or to specific parts of the terminal
- Time limit for access
  Access may be given for one occasion, or on a more permanent and regular basis
- Transport document verification
  The required documentation of the Transport Items must be available

The level of security control that is to be performed must be decided. There may be different rules for security depending on the terminal status (whether it is a Schengen terminal or not, a high security terminal or not, etc.). Smaller terminals with only domestic transports might have a lower security level.

10.2.2.2Transport Item Entry Control

There may be rules about the entry control of Transport Items entering a terminal or a specific area at the terminal:

- Permission
  Some types of transport items may not be allowed entrance, e.g. items that may be a security threat.
- Transport documents
  The required transport documents must be available (e.g. documentation of origin)
- Certification
  Some Transport Items must be certified before they can enter (e.g. dangerous cargo). Some load units and other equipments must be certified before they can be used, e.g. load units for dangerous goods, and containers used in the transport to an oil installation. The correct papers and certificates must be available before storage in a dangerous goods area.
- Level of security control
  The level of security control that is to be held must be decided

10.2.2.3Personnel Entry Control

There may be rules about the entry control of personnel entering a terminal or a specific area at the terminal:

- ID
- Level of access
  The level of access that is assigned to this person

10.2.2.4Customs Declaration

The customs clearance is a part of the Transport Network Management sub-domain of ARKTRANS. For travellers, this includes passport and visa control. However, for freight transport, the customs agent at the terminal must establish a customs declaration. A customs clearance must have be received from the Transport Network Management sub-domain of ARKTRANS before cargo can enter domestic area.

10.2.3Transhipment and Storage Management

Transhipment and storage management are the management of activities related to

- Ramp activities like loading and unloading / boarding and disembarking
- Transhipment of cargo and load units to and from storage areas

- Transfer of passengers to and from transit areas
- Transhipment of Transport Items to, from and between transport means

In addition, transhipment and storage management also includes the management of deports (the content of storage areas) and transit areas.

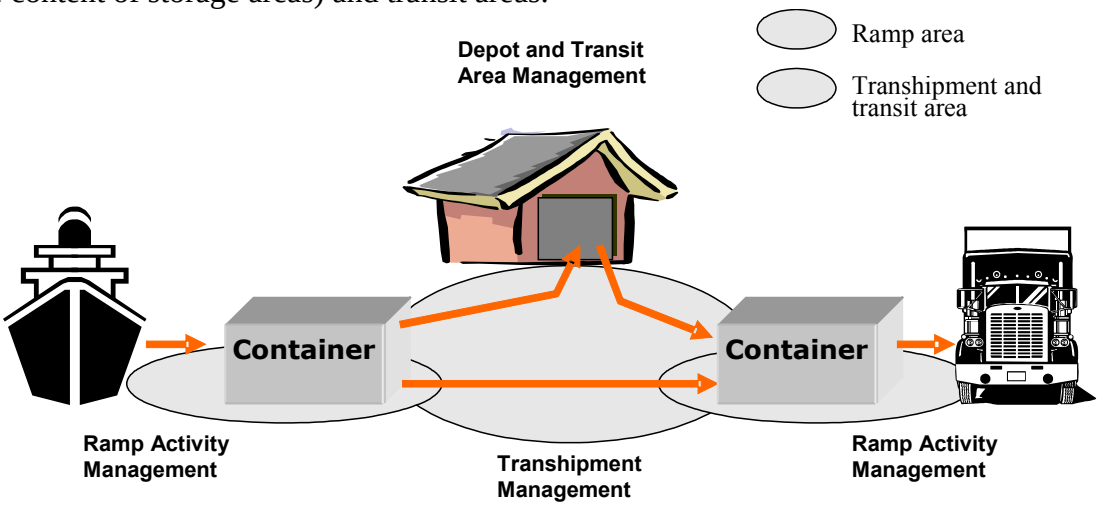


Figure 12 Functionality required related to transhipment and storage

10.2.3.1Ramp Activity Management

Ramp activities (unloading and loading / disembarking and boarding) must be performed according to the handling instructions. These instructions tell the terminal workers which Transport Items that shall be handled and whether special actions or considerations are required.

Transport Items that are unloaded/disembarked and loaded/boarded are registered by means of the monitoring functions (see 10.2.5), and their presence as well as the operations that are performed should if possible be verified towards the handling instructions.

10.2.3.2No Show Handling

The no show of Transport Items that are checked in is handled. This mainly relates to passengers that do not show up when luggage is loaded into the transport means (ref. air transport). The actions taken may be to get in contact with the passenger, and to notify the crew on-board so that correcting actions can be taken.

10.2.3.3Depot and Transit Area Management

Depot management includes the management of Transport Items in a storage or transit area. Depots may arrange for special treatment of Transport Items, e.g. customs clearance, dangerous goods handling, or storage while preparing customer instructions.

The following functionality may be supported:

- Entry control. Cargo without a customs clearance can for example not enter areas for cargo that has passed such control.
- Optimisation of area usage with respect to space allocation and throughput.
- Segregation control. Transport Items must be managed according to regulations, e.g. food cannot be stored together with chemicals.
- Information about the content of the area that influences on the management of the use of resources and the execution of operations. This may be:

- Overview of all Transport Items in the area;
  - their location;
  - the duration of their stay in this area;
  - their use of resources such as space, terminal load unit, cooling etc.;
- The operations that are to be executed (splitting, packing, customs clearance, checking, etc.): and
- Special treatment that is required (dangerous cargo, food, disabled, children travelling alone, etc.)

10.2.3.4Transhipment Management

The movement of Transport Items must be managed. They may be transferred directly to the next transport means, and if desired a cross docking can be used. Transport Items may also be transhipped between different storage areas or between transport means and storage areas. All movements must be according to the logistics plan for transhipment and storage that was generated during the transhipment and storage planning and according to handling instructions. The logistics plan also includes specifications of packing and splitting that are to be done as a part of the transhipment and storage.

10.2.4Outbound Control

The exit of the Transport Items from the terminal is managed. Outbound Transport Items must be checked in, or the existence of a correct check in must be verified.
On departure from the terminal the transport means has to enter the transport network. This is a traffic control issue handled by the Transport Network Management sub-domain of ARKTRANS.

10.2.4.1Transport Item Exit Control

There may be rules about the exit control of Transport Items from a terminal or a specific area of the terminal:

- Certification
  Some Transport Items must be certified before they can enter. Some load units must be certified, e.g. load units for transporting dangerous goods, and containers used in the transport to an oil installation. The terminal must have the correct papers and certificates to be allowed to store a container in a dangerous goods area
- Customs clearance verification
- Level of security control
  The level of security control that is to be performed must be decided

10.2.4.2Export Documentation

The properties (value, type of cargo, etc.) should if required be established, and the ownership of the freight must be controlled according to regulations. Travellers must document that they have the required transport documents (passport, visa, tickets, etc.).

10.2.5Terminal Operation Monitoring

The terminal operation monitoring functionalities monitor transport means, transport items as well as the resource of the terminal. The intentions may be

- To register information automatically (e.g. information about loading and unloading.
- To detect security violations (e.g. violations of access rights)
- To detect safety threats (e.g. due to dangerous cargo).

- To establish status information, e.g. which operations are executed, what the conditions (e.g. fault conditions) are, and what the location is.

10.2.5.1Terminal Resource Monitoring

Terminal resources are monitored. It is important to get status information on where they are located as well as getting the status information about their condition.

10.2.5.2Transport Means Monitoring

Visiting transport means are tracked and monitored so to make it possible to have a total control on where they are located at any time (within the terminal area).

10.2.5.3Transport Item Monitoring

Transport Items are tracked and monitored to collect information about status and localisation. The monitoring information may for example be used to control the required segregation between certain Transport Items based on knowledge about their contents. Information about the Transport Items handled by the Terminal is available. This may be:

- Load unit content or Transport Item
- Owner
- Status with respect to
  - Loading/unloading
  - Custom clearance
  - Storage
  - etc.
- Security control status
- Transhipment plans (when, picked up by whom, etc.)

10.2.5.4Safety and Quality Evaluation

Safety and quality are evaluated based on formation from the monitoring of resources, transport means, and Transport Items. The conditions for safety and security violations are set by the strategic condition settings functionality (see 10.1.9).

10.2.5.5Schedule and Deviation Evaluation

Schedule violations and other deviations are evaluated based on information from the monitoring of resources, transport means, and Transport Items. The deviation conditions are set by the strategic condition settings functionality (see 10.1.9).

10.2.6Incident and Emergency Management

The safety and security monitoring may detect incidents and emergencies (pollution, accidents, etc.). The incident conditions are defined by the strategic condition settings functionality (see 10.1.9). Incidents may also be detected by means of reports received from externals.

10.2.7Deviation Management

Deviation must be detected. Deviations caused by the terminal or deviations that occur in the terminal may affect actors outside the terminal. Such actors must be notified so that they can take corrective actions.

10.2.7.1Deviation Detection

Deviations such as delays, missing clearances, missing Transport Items, and damage may be detected by the schedule and deviation monitoring functionality (see 10.2.5.5), or information about such deviations may be received from terminal workers or other terminal actors. Externals may also report about deviations (e.g. delayed arrival or delayed pick up, etc.). Relevant information about the related terminal operation and the affected Transport Items must be made available so that the situations can be considered and decisions taken by those in charge. The consequences for the planned terminal operations and the allocation of terminal resources must be evaluated (e.g. delays, need for more resources, etc.), and if required, re-planning by means of the Operational planning functionality (see 10.2.1) must be initiated. Some serious deviations may be considered as order amendments. The amendments are handled by the order management functionality (see 10.3.1.2.2).
In some cases goods may for example be sent back to origin so that damages can be fixed. Such a decision will initiate new terminal operations that are to be administrated, planned and carried out.

10.2.7.2Deviation Reporting

Deviations that are caused by circumstances in the terminal or the terminal operations, and deviations that are detected at the terminal must be reported to affected actors outside the terminal. The deviation report may give the reason for the deviation as well as a plan for corrective actions.
Certain types of deviations, e.g. deviations that may affect security issues, must be reported to authorities.

10.2.7.3Damage Reporting

In case of damages, information about the damage must be reported to affected actors such as the cargo owners, the transport companies, the insurance company, etc.

10.3Terminal Business Administration

By terminal business administration we mean all activities that affect the daily operation of a terminal that comprises the following:

- Commercial management and customer support
- Management of contracts and orders
- Management of staff and other terminal resources
- Management of statistics and information about the accomplishment of terminal services

10.3.1Commercial Management and Customer Support

Commercial management includes the management of contracts and orders related to the accomplishment of terminal services and service marketing. Customer support is the handling of requests and information related to orders as well as claims management.

10.3.1.1Contract Management

Contract Management supports negotiations, establishment and maintenance of a contract between the terminal and a customer that is requesting terminal services. A terminal will have different types of contracts depending on the services that are offered, and the type of customers that are served (freight or passengers transport, long-term or short-term customers, etc.). Information about the contracts and status of contracts is managed.

10.3.1.1.1Contract Agreement Support

A customer of a terminal will in many cases have a specific contract concerning terminal services and use of resources. A contract can be changed, renegotiated, or cancelled, and these processes have to be supported by means of for example functionality that requests the required information (information required by the terminal as well as information that is to be acquired due to regulations) in combination with functionality that supports the work flow.

10.3.1.1.2Contract and Tender Information Administration

Information about tenders and contracts is managed. This may be standardised contracts as well as tenders and special contracts with specific customers. Information such as conditions, the services that are to be provided, the extent, payment, responsibilities, the status on the contract, etc. is managed.
Information about the degree and status of a contract fulfilment is also managed, so that both the terminal and the customer can see the progress and the status of the contract. Thus, information about orders and the execution of orders that are according to contracts must be registered, e.g. how many times a customer has been entering a terminal, how many litres of water supply they have bunkered, the status regarding the agreed transport volume, etc.

10.3.1.2Customer Support

Requests for terminal services are managed. The orders are processed, information about the orders and amendments are managed as well as claims.

10.3.1.2.1Terminal Request Management

Incoming orders are received from the Transport Demand and the Transport Service Management sub-domains. They may be issued according to an established contract, or they may not refer to any contract at all. In the latter case a contract must be established, or the order may indicate a demand for a terminal operation that is according to a standard contract with standard price and standard conditions. For passenger transport the order may include requests for special services at the terminal, e.g. assistance.
If the services requested are a part of the portfolio of the terminal, and if the required information is enclosed, the order is further processed (allocation of resource etc. and further handling by the Order Management functionality).
Request that have to be rejected and the reason for the rejections should be logged. In that way knowledge about market demands can be used in strategic and tactical planning.
Some orders may be automatically processed. Others may require manual handling.
Transport order cancellations and amendment requests are handled according to the agreements in the contracts. If the requested amendment is according to the order it is processed further. If amendments are not allowed, the request is rejected.
An order may be preliminary or firm. Preliminary orders must be followed up. The resources allocated to a preliminary order must be freed if a firm order is not received within the time limits, and the resource allocations must be made firm whenever a related firm booking is received.

10.3.1.2.2Order Management

All information about orders and bookings related to orders are managed. On execution of an order that is according to a long-term contract, the contract information management functionality (see 10.3.1.1.2) must be informed about the extent of the order. The status of an

order must be managed (unloaded and loaded Transport Items, assistance provided to passenger, etc.), and if required reported to the customer.
Order amendments are managed. Conditions in the contract may influence on the ability to make amendments.
Historical information about orders may be valuable input to the strategic and tactical planning. This also counts for requests that cannot be fulfilled.
Financial transactions related to transport orders and contracts are not a part of ARKTRANS. However, such transactions are likely to be initiated, and there must be access to support for financial transactions.

10.3.1.2.3Claims Management

In case of damage, relevant information about the related terminal operation and the affected Transport Items is made available to support the decisions taken by those in charge (e.g. reason for damage, costs, contract information, etc.). In worst case cargo must be sent back to origin so that the damages can be fixed. Such a decision will initiate new terminal operations that are to be administrated, planned and carried out.

10.3.1.3Service Marketing

Information about services provided by the terminal and its sub-contractors is published through several market channels to relevant stakeholders and applications (e.g. portals). This may be handling services offered to terminal operators, as well as terminal services offered by the terminal operators.
Passenger terminals may publish information about services and facilities at the terminal. Information about the accessibility to specific user groups, e.g. disabled people, should be included.
The services offered are those decided upon in the strategic and tactical terminal management. Service packaging, price structure and marked channels are according to the yield management.

10.3.2Terminal Resource Management

The maintenance and utilisation of terminal resources is managed. This includes resource status monitoring, maintenance operation planning, resources disposition planning, as well as the administration of the information about the resources. Information about backup resources is also managed.

10.3.2.1Resource Maintenance Coordination

Maintenance of terminal resources is managed. The maintenance has to be planned and optimised with the basis in operative states as well as planned terminal operations. Experience from different sort of maintenance, and also known defects have to be considered.

10.3.2.2Certificate Management

Information about certificates (documenting qualifications of personnel, the quality of the equipment, or the ability to carry out certain operations) and licences (documenting the entitlement to carry out certain terminal operations, e.g. handling of dangerous cargo) are established and managed.
Conditions related to the certificate types and licence types are also managed, e.g. conditions with respect to certain types of transport means or specific types of transport, e.g. food transport, animal transport, etc.

10.3.2.3Staff Management

The shifts and the use of the staff must be planned. Holidays, illnesses, and extra staff to serve specific demands must be considered. Information about the skills of the staff must be managed.

10.3.2.4Equipment Management

The use of equipment must be managed and as far as possible allocated to planned terminal operations. Equipment may for example be transport means, load unit, loading and unloading resources, and devices running ICT applications. Information about the equipment must be managed.

10.3.2.5Facility Management

The facilities on the terminal that are used during the transhipment and storage phase are managed.

10.3.2.5.1Ramp Area Management

Ramp areas (loading and unloading areas and boarding and disembarking areas) must be booked prior to terminal operations. Information about these areas is managed so that the qualities can be provided to potential customers as a part of the service marketing (thereby, potential customers can evaluate if a transport means can use a specific ramp area). Information on bookings (time schedules, type of cargo, customer, etc.) is also managed.

10.3.2.5.2Transit Area Management

Goods and passengers stay in the transit area when waiting for the next leg to be executed. Information about area and bookings (time schedules, type of cargo, customers, travellers, etc.) is managed.

10.3.2.5.3Storage Area Management

Cargo is stored in the storage area while waiting on the next event to take place. Information about area and bookings (time schedules, type of cargo, customer, etc.) is managed.

10.3.2.6Assets Management

Assets do not have to be booked in advance. They are used whenever they are needed as a part of normal operation or in specific situations. Examples of assets are equipment used frequently by a large number of people like ticket machines and information boards; equipment involved in a large number of terminal operations, e.g. monitoring equipment; equipment required in certain situations, e.g. emergency situations. Information about the assets should be available whenever it is required.

10.3.2.7Sub-contractor Management

The booking of services from sub-contractors is not a part of ARKTRANS. However, information about agreements with sub-contractors and information about the degree of fulfilment of the agreements is managed.
The services and resources that are delivered by sub-contractors are managed by means of the same functionality that manages services and resources delivered by the terminal operator himself (the terminal resource management functionality, the terminal operation management functionality, and the strategic and tactical terminal management functionality).

10.3.3Statistics and Management Information Administration

Statistics and management information supports management and strategic and tactical decisions. Such information may for example reveal capacity slacks or constraints as well as needs for new services. In some terminals, the operators are required to report statistics to for example the authorities.

10.3.3.1Terminal Statistics

A terminal will need statistic data about the inbound and outbound transport to the terminal as well as Transport Items on storage.

10.3.3.2Customer Statistics

Customer activities and trades must be registered, e.g. the extent of activities related to each costumer or type of customers. The customers that cannot be served due to lack of capacity or absence of the required services should also be registered.

10.3.3.3Statistics Reporting

Terminals may have to report statistics to the government according to guidelines defined by the authorities.

10.3.3.4Terminal Performance Evaluation

The terminal operation performance is to be evaluated based on collected information. The available capacity and the actual exploitation of the capacity are charted. Different types of performance reports are produced, e.g. earnings, time usage, growth trends, capacity utilisation, etc.

11Behaviour View

The functionality in the sub-domains of the reference model will interact during the planning and accomplishment of transport operations. Information will flow between the sub-domains, and between the sub-areas of the Transport Network Management sub-domain.

In this chapter, the functionality described in the functional view (see Chapter 6, 7, 8, 9 and 10) and the related information flows are put together to specify scenarios. It is important to notice that the scenarios are just examples, and they do *not* dictate how actions or operations shall be accomplished. The functionality may be used and combined in other ways as well. However, the interactions between the stakeholders, which are identified by the scenarios, will probably be quite general and needed in many cases.

The scenarios are further refined in related activities. Thus, the scenarios in this chapter are not the final ones. Inconsistencies with the functional view may also be found.

11.1Scenarios

Scenarios that illustrate operations and interactions that involve several sub-domains are established. They focus on the needs of stakeholders possessing specific roles, and so far the following scenarios are specified:

- Transport User/Transport User Agent scenarios: Transport preparation and planning, and transport chain management
- Transporter/Fleet Manager scenarios: Strategic and tactical planning; operational planning; and transport operation management. The latter includes start-up and administration of ongoing transport operation, schedule management, deviation management, incident management, transport operation monitoring, and the management of exceptional transport needs.
- On-board scenarios
    - Crew scenarios: Driving support; navigation support; and reporting support
- Transport Network Management scenarios
    - Service Provider scenarios: Provision of route and travel information
    - Traffic and Transport Planner scenarios: Strategical and tactical traffic and transport planning
    - TIC/TCC scenarios: Operational traffic planning, traffic monitoring, traffic control, and incident handling
    - Transport Network Manager scenarios: Transport network infrastructure operational planning, and Transport network infrastructure operation.
- Terminal Actor scenarios: Strategic and tactical planning; operational planning including inbound planning, transhipment and storage planning, and outbound planning; and terminal operation management including terminal operation monitoring, inbound control, transhipment and storage control, outbound control, and deviation management.

UML activity (‘swim lane’) diagrams are used to describe the scenarios. These diagrams mainly have one “swim lane” for each transport sub-domain and sub-area involved in the activity described by the scenario. The functionality represents activities or states. The dotted arrows show information flows (interactions) between the lanes.

The solid-drawn arrows within the swim lanes illustrate flow of control from one activity to another and *not* information flows. From the ARKTRANS point of view, the information flows within the lanes are internal matters to the systems involved, and the flows depend on the physical realisation of the systems. The functionality within one lane may indeed belong to separate systems, and the interfaces between must be defined by those developing the systems, but this a not a subject for ARKTRANS. Our hypothesis is however that some internal interactions probably may be equal to interactions that cross the domain boarders.

11.1.1Transport User Scenarios

The Transport User or Transport User Agent (who administrate the transport chain on behalf of the Transport User) is more or less involved in the whole transport operation.

11.1.1.1Transport Preparation

Transport Users or Transport User Agents play an active role during the preparation and planning, and at the initiation of the transport.

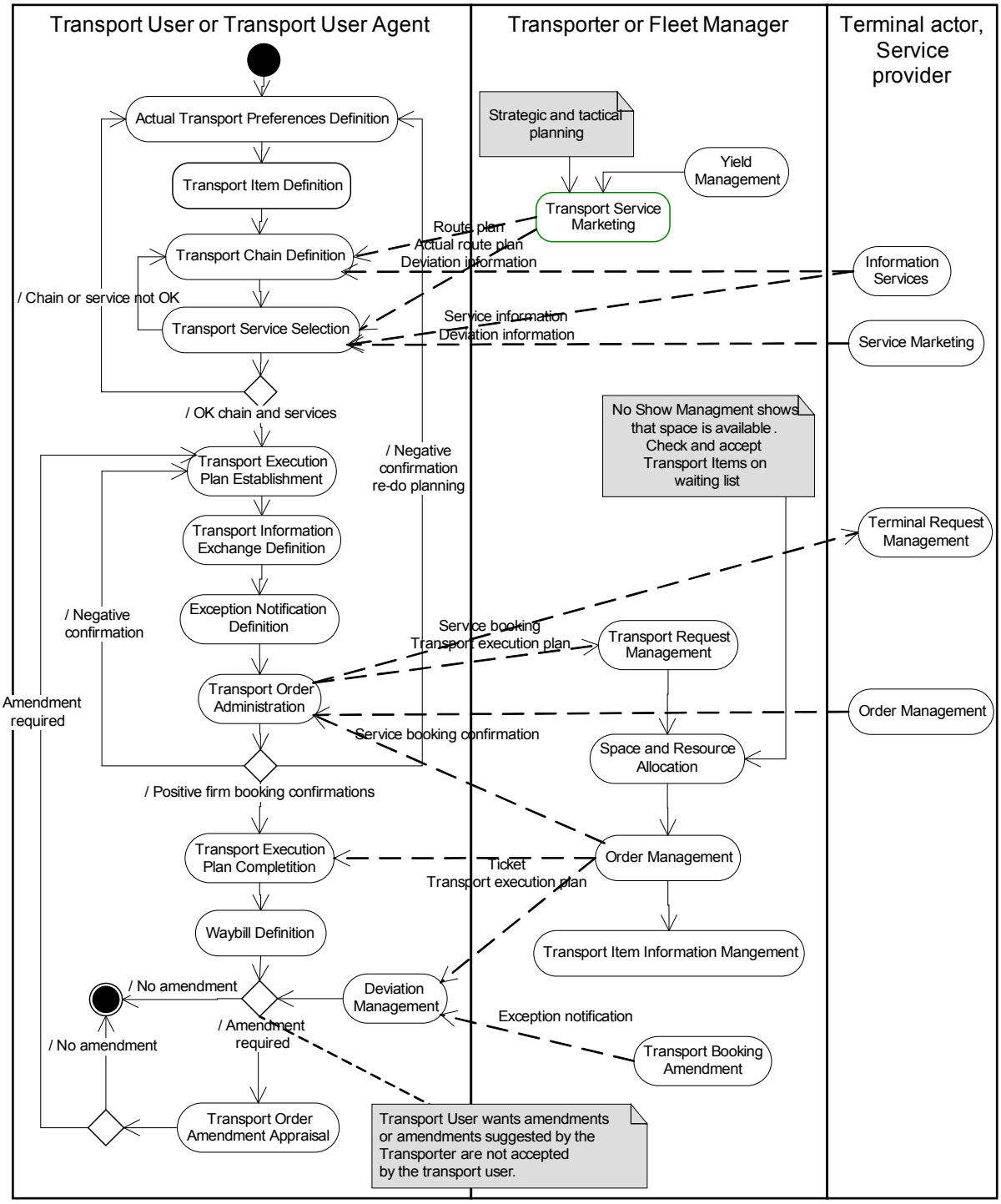


Figure 13 Transport preparations from the transport user's or transport user agent's point of view

11.1.1.2Route planning

Specific requirements, e.g. the ability to do the transport of broad or long cargo along the required route, may influence on the selection of the transport service and transport time.

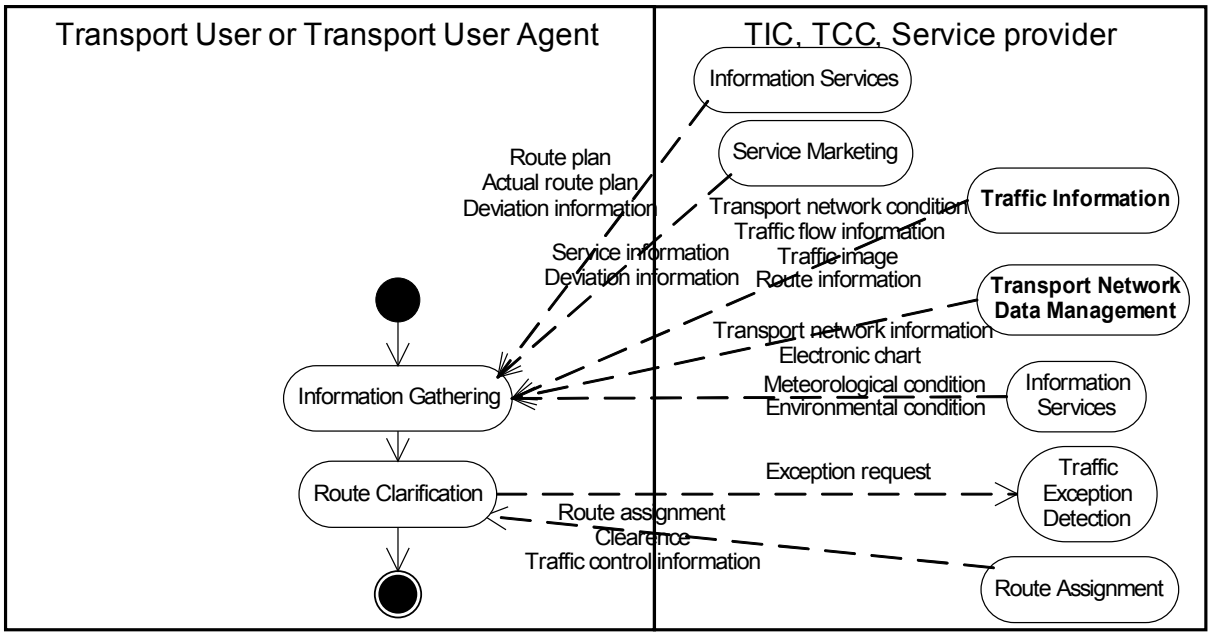


Figure 14 Route planning from the transport user's or transport user agent's point of view

11.1.1.3Chain management

Transport Users or Transport User Agents administrate the whole transport chain. Delays in one part of the chain may for example influence of other parts of the chain.

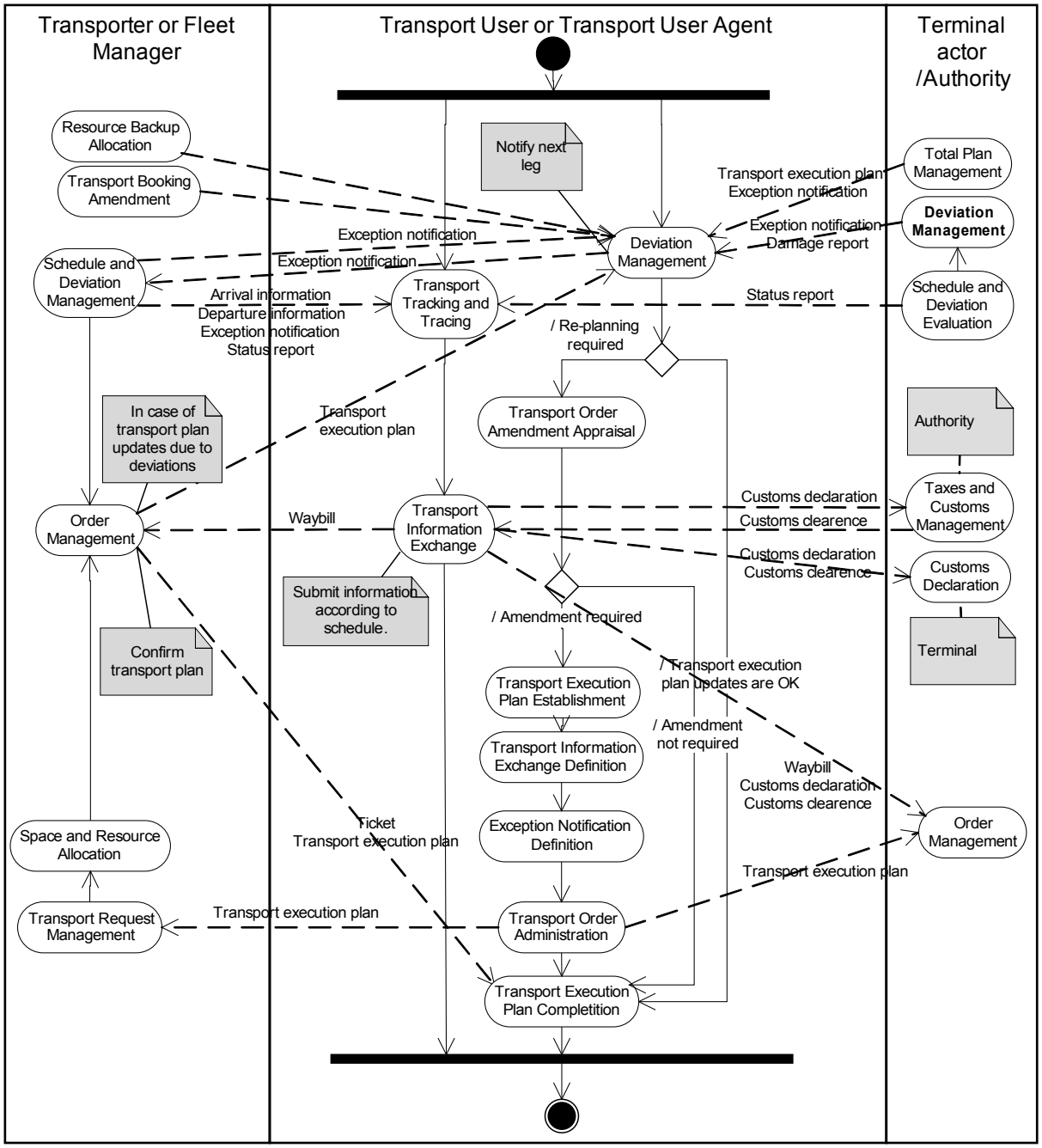


Figure 15 Transport chain management from the transport user's or transport user agent's point of view

11.1.2Transporter/Fleet Manager Scenarios

The activities of the Transporter and Fleet Manager include strategic and tactical planning, Operational planning, and management of ongoing transport operations.

11.1.2.1Strategic and Tactical Planning

The diagram illustrates the strategic and tactical planning done by the Transporter/Fleet Manager

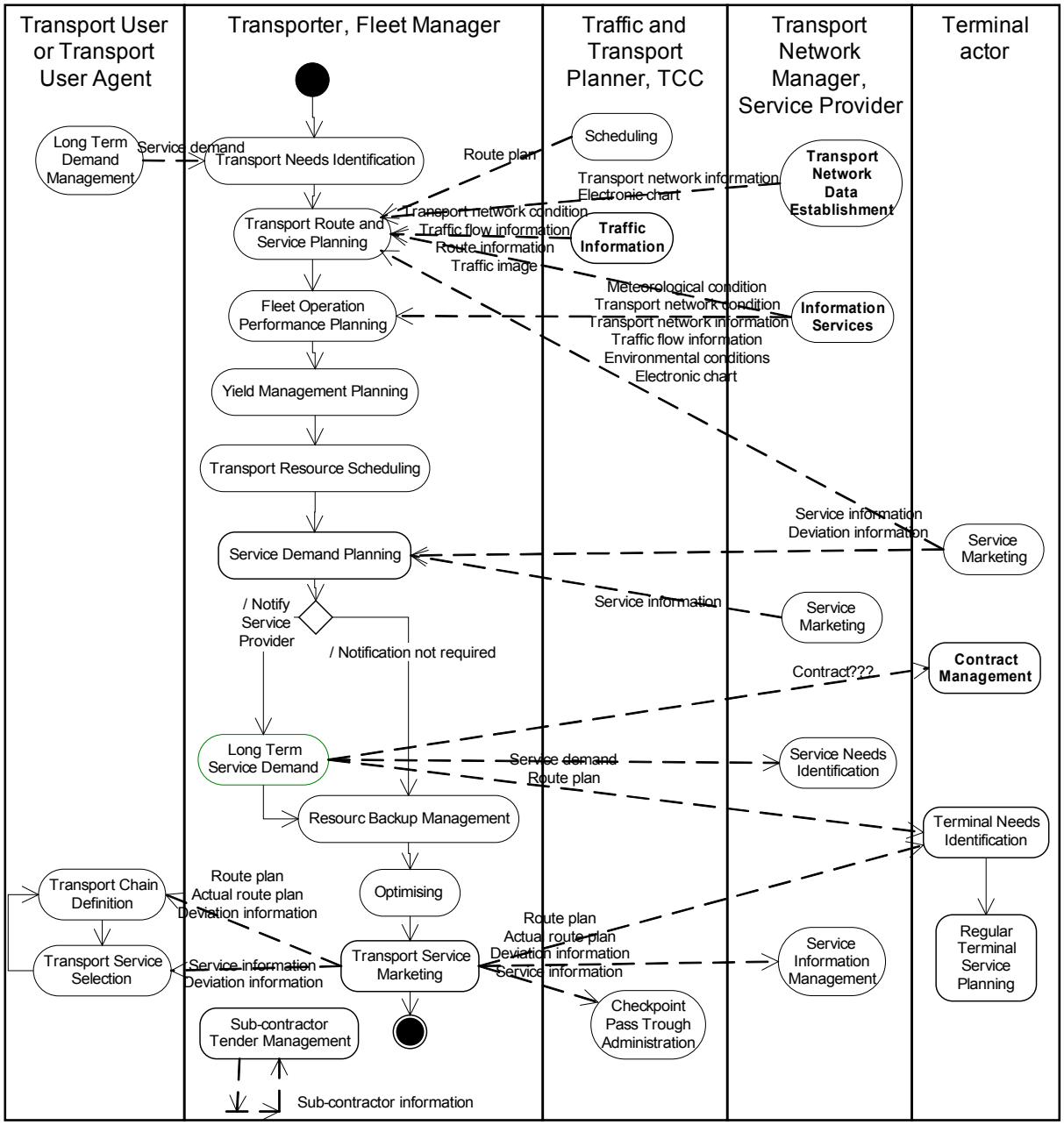


Figure 16 Strategic and tactical planning from the transporter's or fleet manager's point of view

11.1.2.2Booking, amendments and exceptions

The booking of transport services is made. Amendments may be required due to initiatives from the transport user or due to exceptions. The diagram illustrates the how exceptional needs for transport will be managed by the Fleet Manager. It may be many reasons for the exceptional needs for transport, e.g. unexpected transport demands, overbooking, cancellations, fault situations, etc.

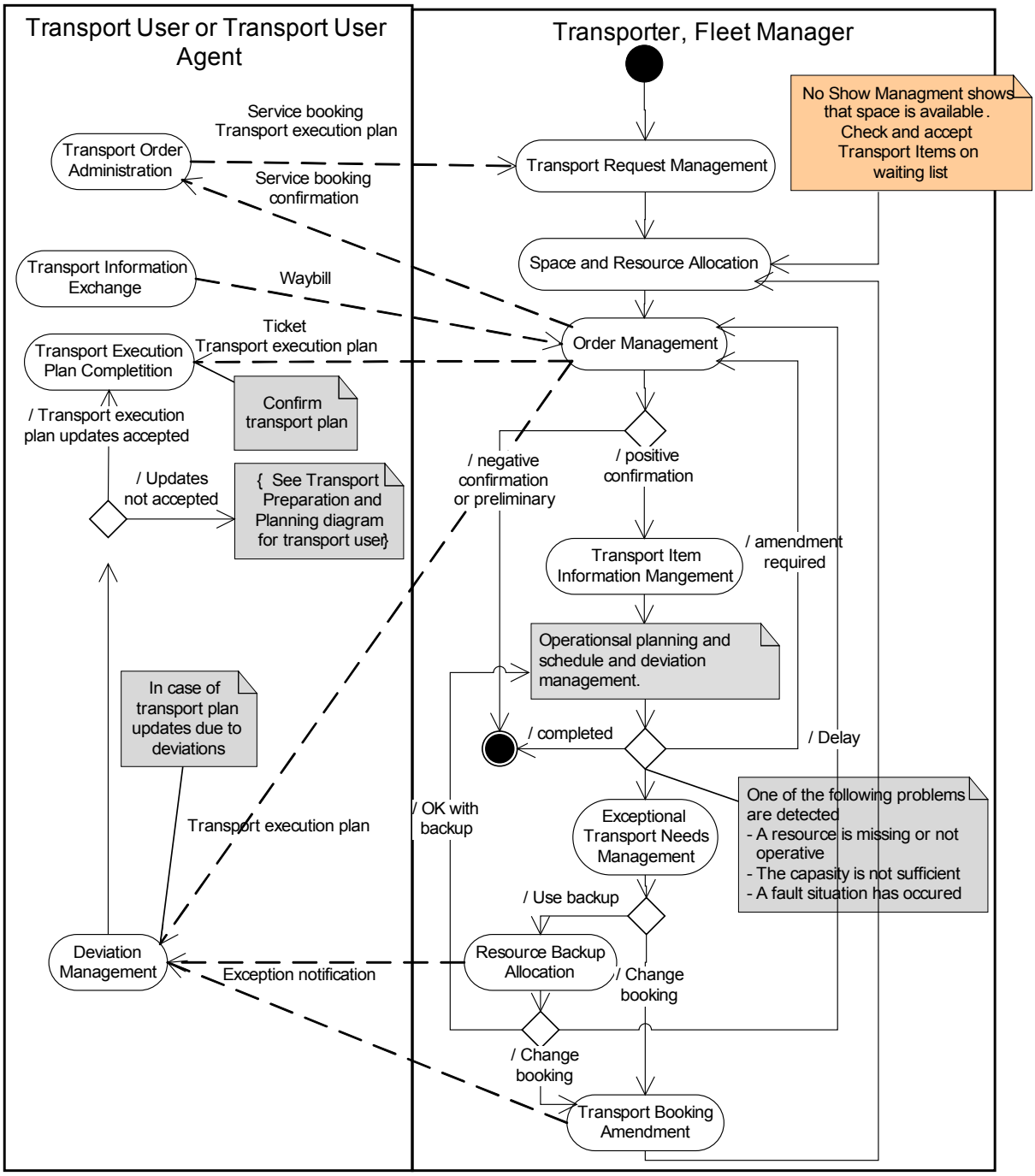


Figure17 Management of bookings, amendments and exceptions from the transporter's or fleet manager's point of view

11.1.2.3Operational Planning

The diagram illustrates the operational planning done by the Fleet Manager prior to a transport operation

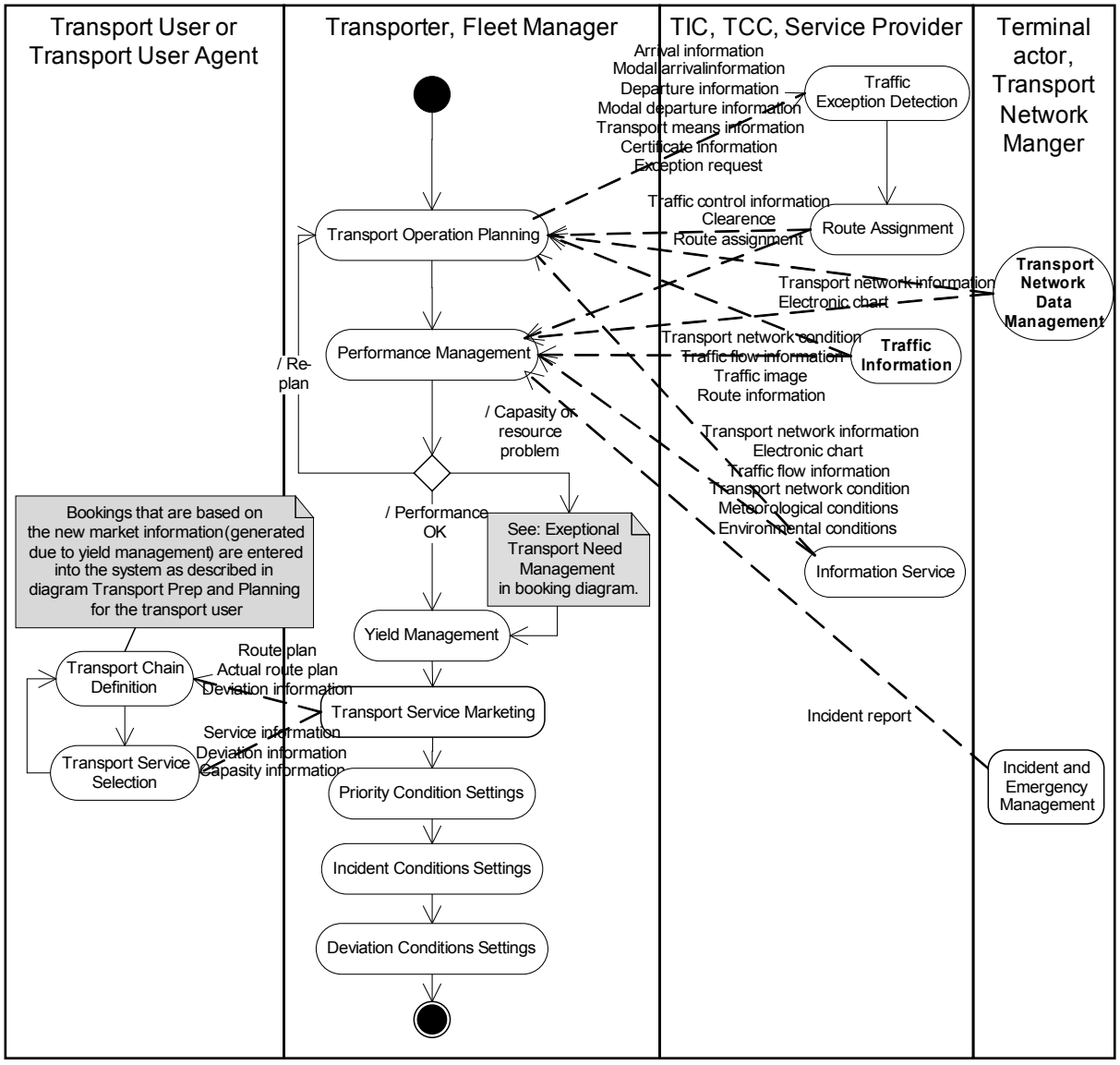


Figure 18 Operational planning from the transporter's or fleet manager's point of view

11.1.2.4Transport Operation Management

The management of ongoing transport operations include administration related to the start-up of the operation, transport operation monitoring, schedule management, deviation management, incident management, and the management of exceptional transport needs.

11.1.2.4.1Start-up and administration

The diagrams below illustrate the process before the transport task is started and administrative activities related to information management and information exchange. The latter is crucial with respect to information flow and coordination.

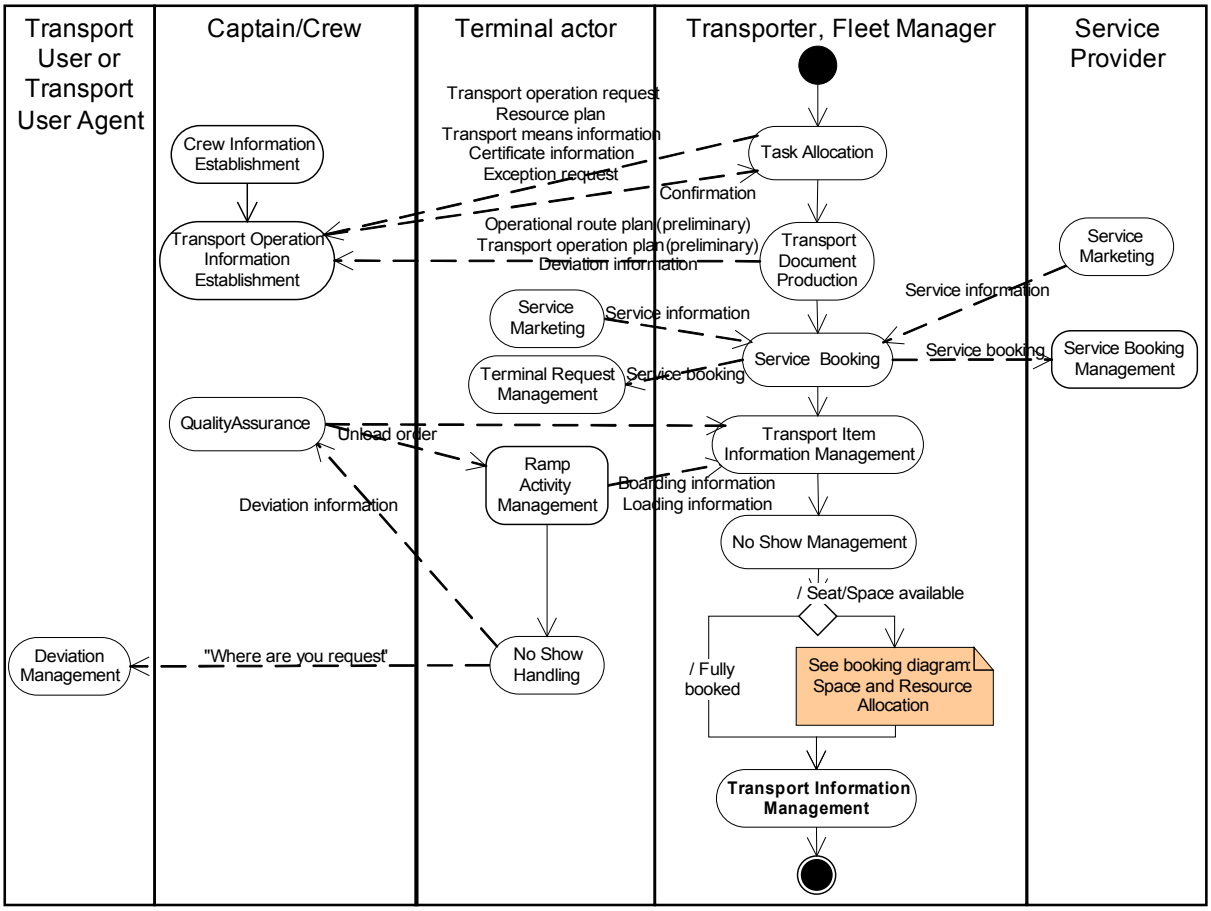


Figure19 Transport start-up and administration from the transporter's or fleet manager's point of view – Part 1

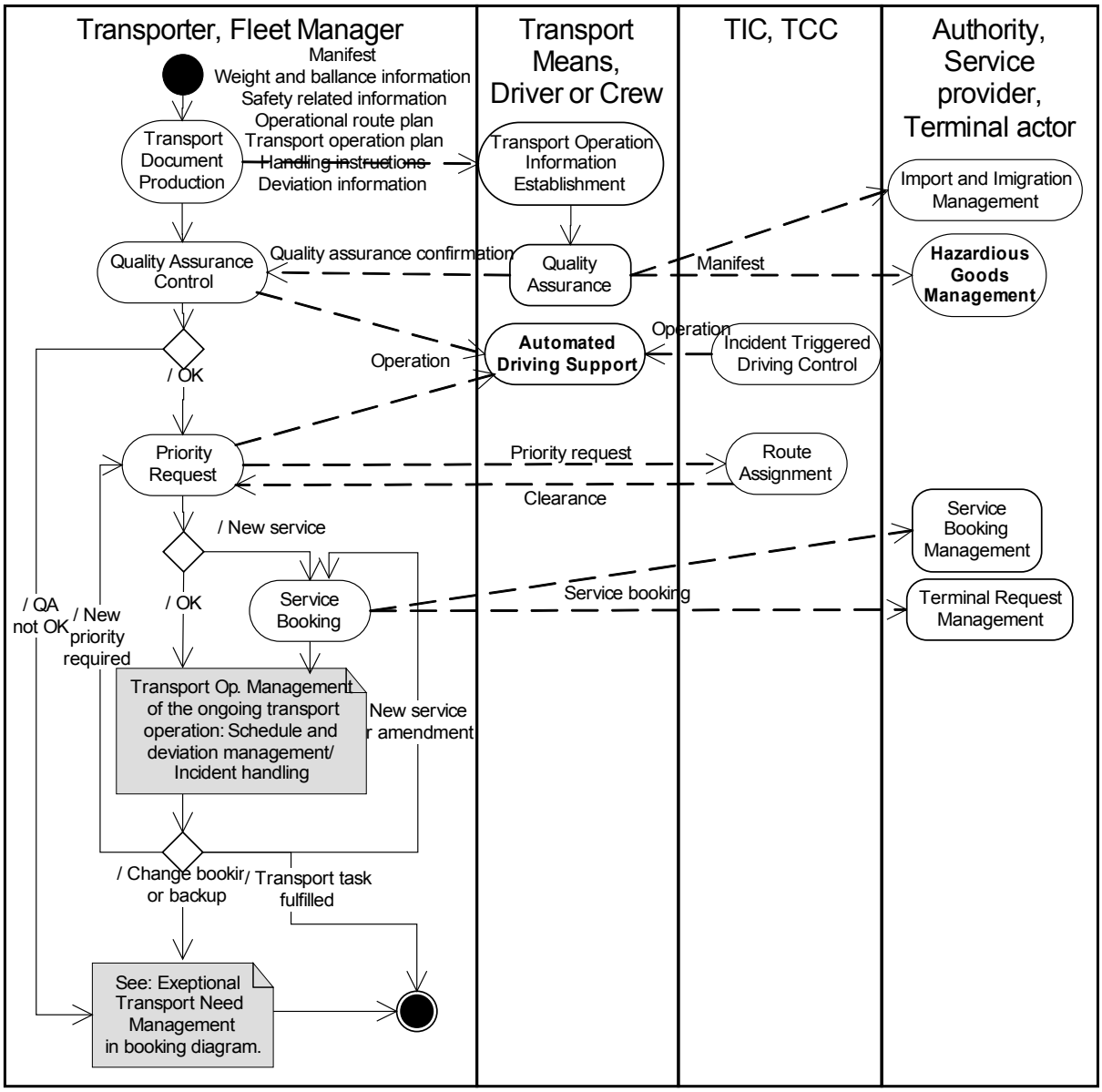


Figure 20 Transport start-up and administration from the transporter's or fleet manager's point of view – Part 2

11.1.2.4.2Transport Operation Monitoring

The diagram illustrates the monitoring of an ongoing transport operation. For management of deviations and incidents, see other diagrams below.

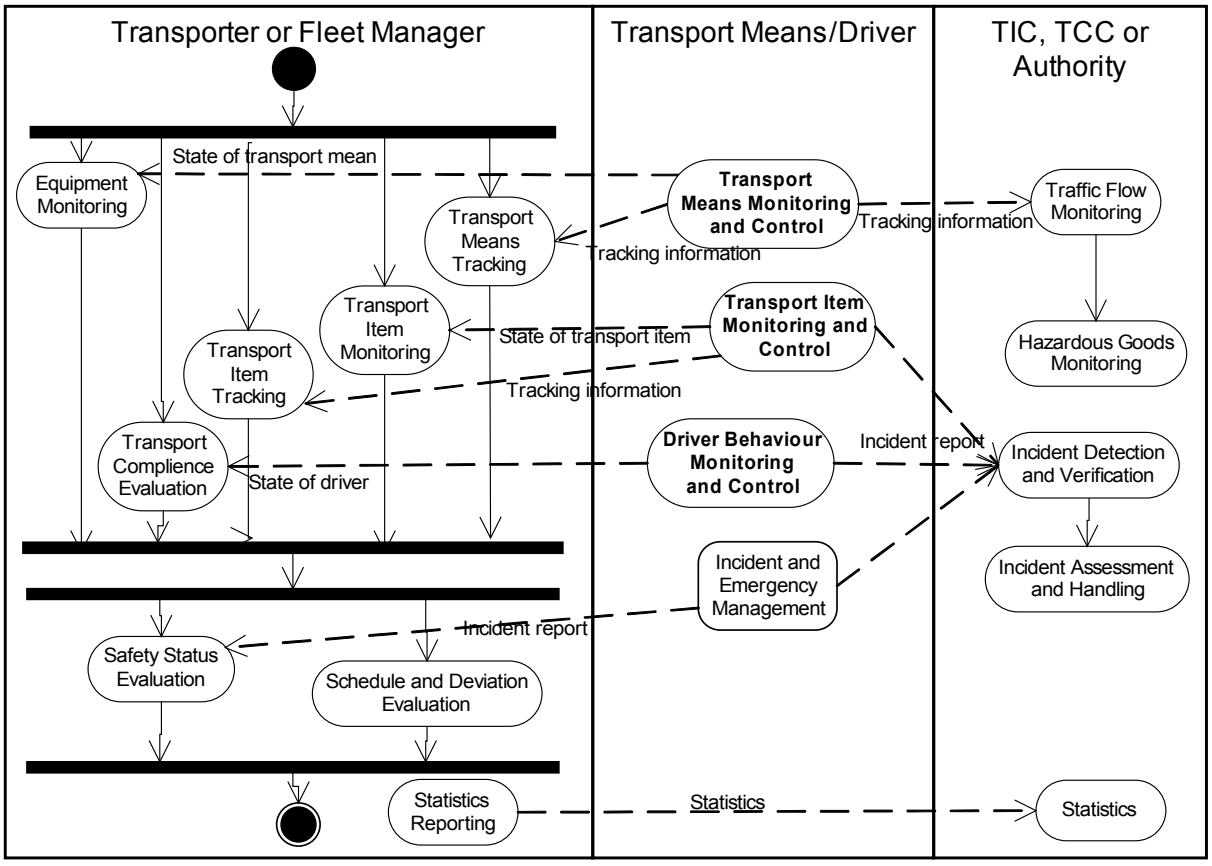


Figure 21 Transport operation monitoring from the transporter's or fleet manager's point of view

11.1.2.4.3Schedule Management

The time schedule is managed, and information that may affect the transport operation is received. Information is issued to other actors according to the transport execution plan, to ensure good information flow and coordination.

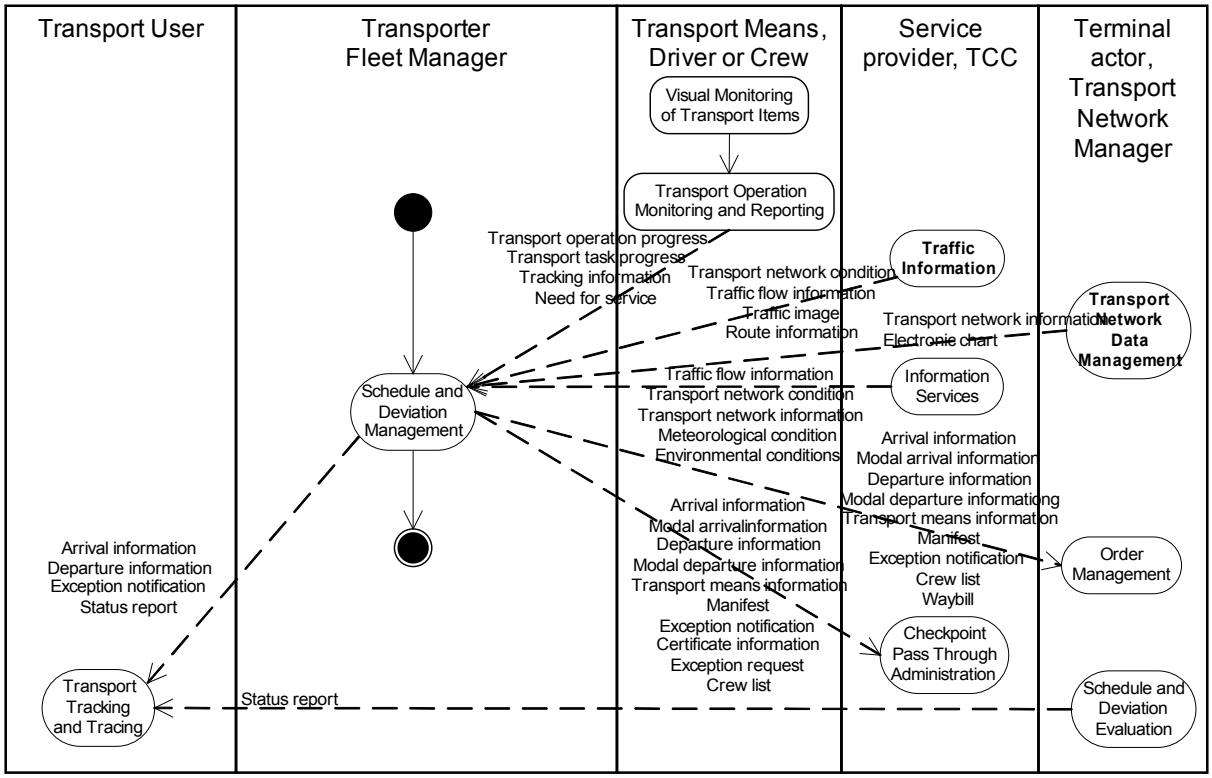


Figure 22 Schedule management from the transporter's of fleet manager's point of view

11.1.2.4.4Deviation Management

The ability to fulfil the transport operation according to the plans is considered depending on available information about traffic conditions and other conditions that may affect the plans. Affected actors are notified about actual deviations as well as deviations that are foreseen.

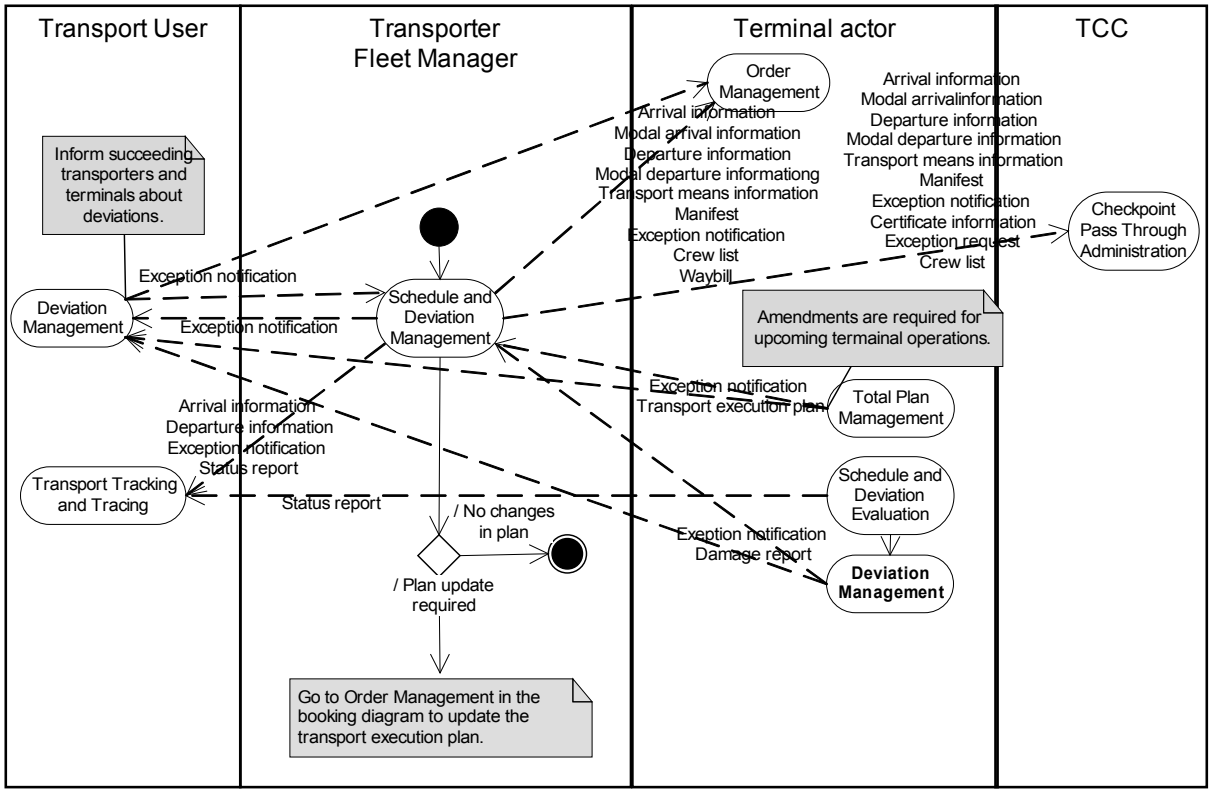


Figure 23 Deviation management from the transporter's or fleet manager's point of view

11.1.2.4.5Incident Management

Incidents are managed. If required, information about incidents is sent to other actors.

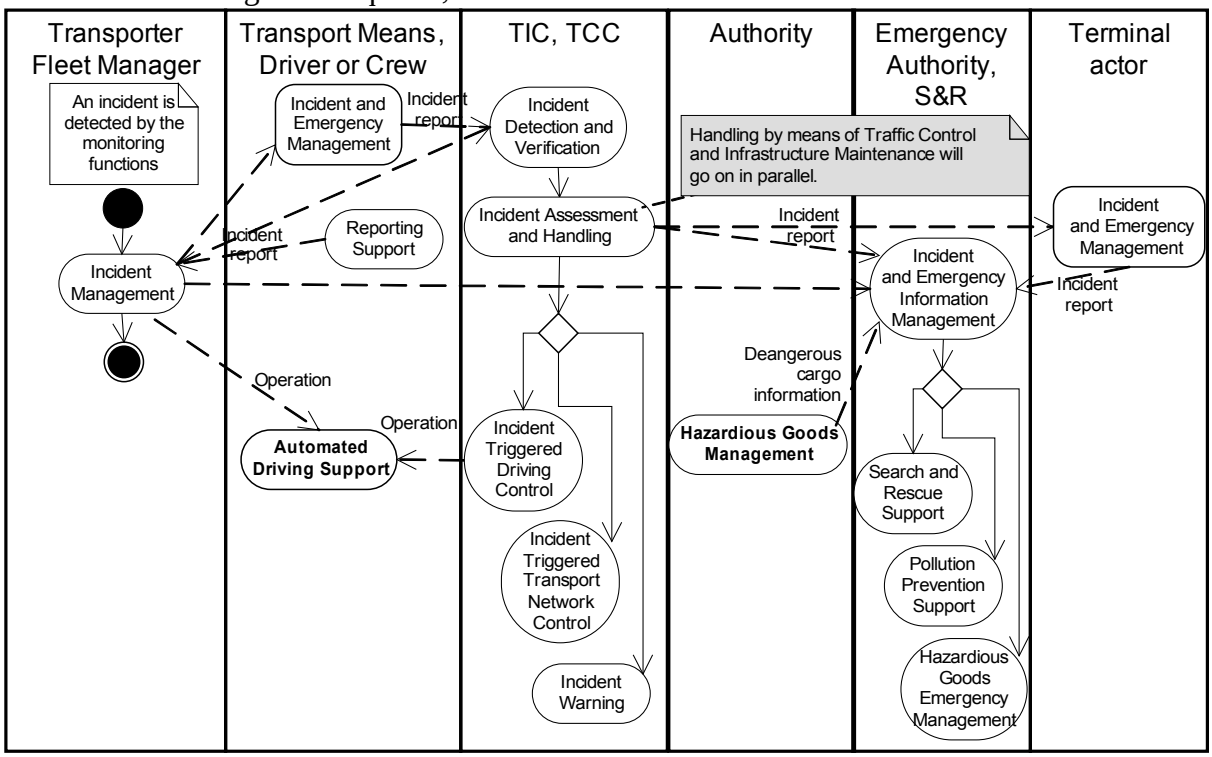


Figure 24 Incident management from the transporter's of fleet manager's point of view

11.1.3On-board Scenarios

The driving operation (to move the transport means as safely and efficiently as possible), the navigation (to find the destinations and to find the route), and reporting are supported.

11.1.3.1Driving support

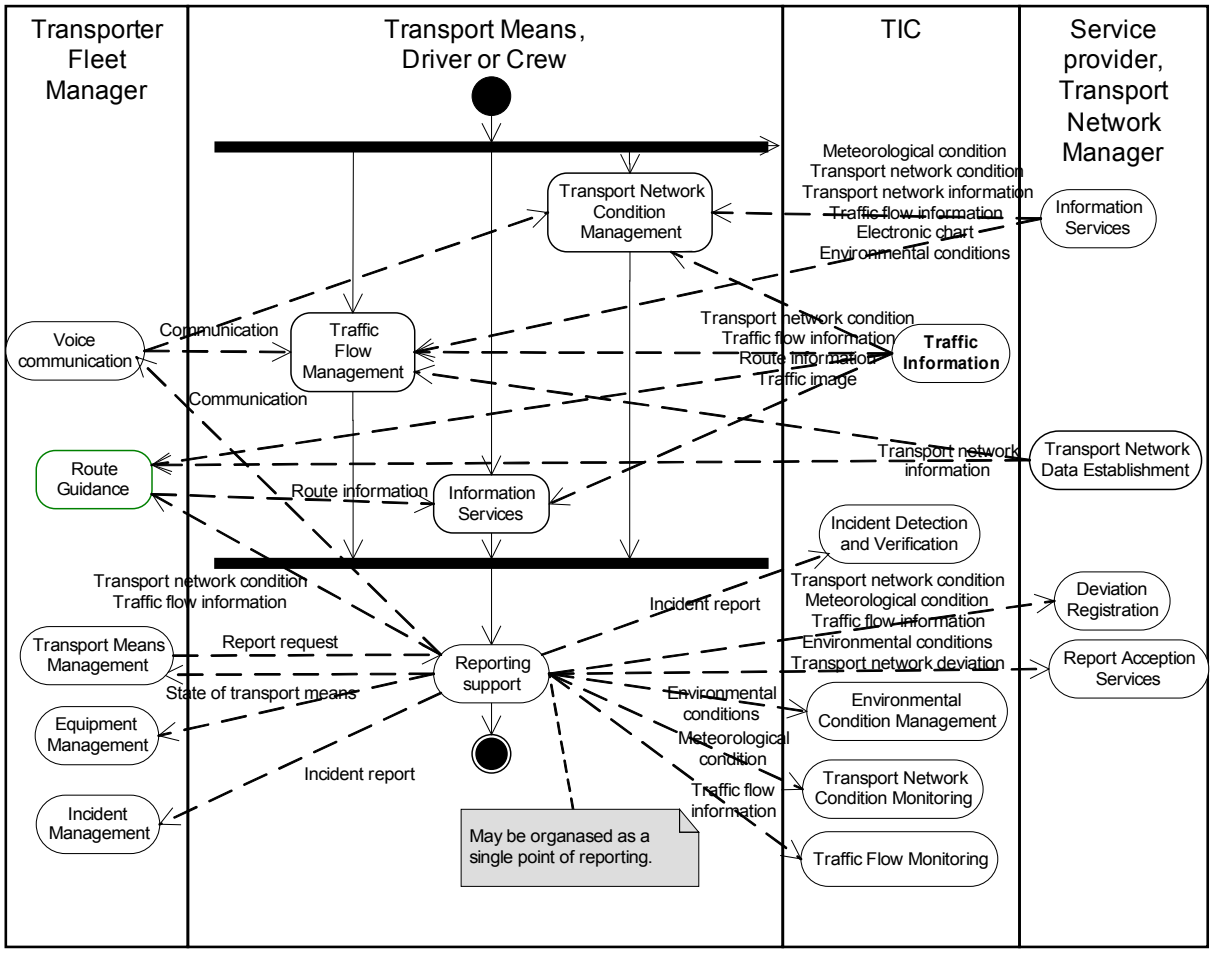


Figure 25 Driving support from the crew's point of view

11.1.3.2Automated Operation

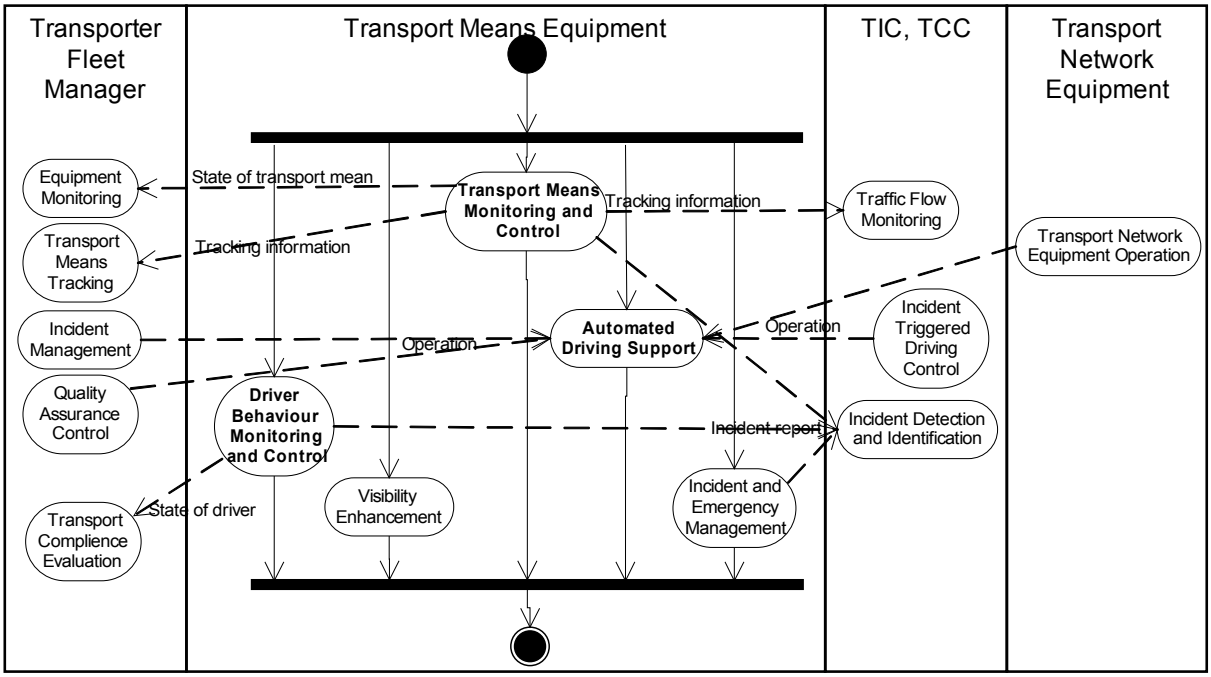


Figure 26 Automated driving support

11.1.3.3Navigation support

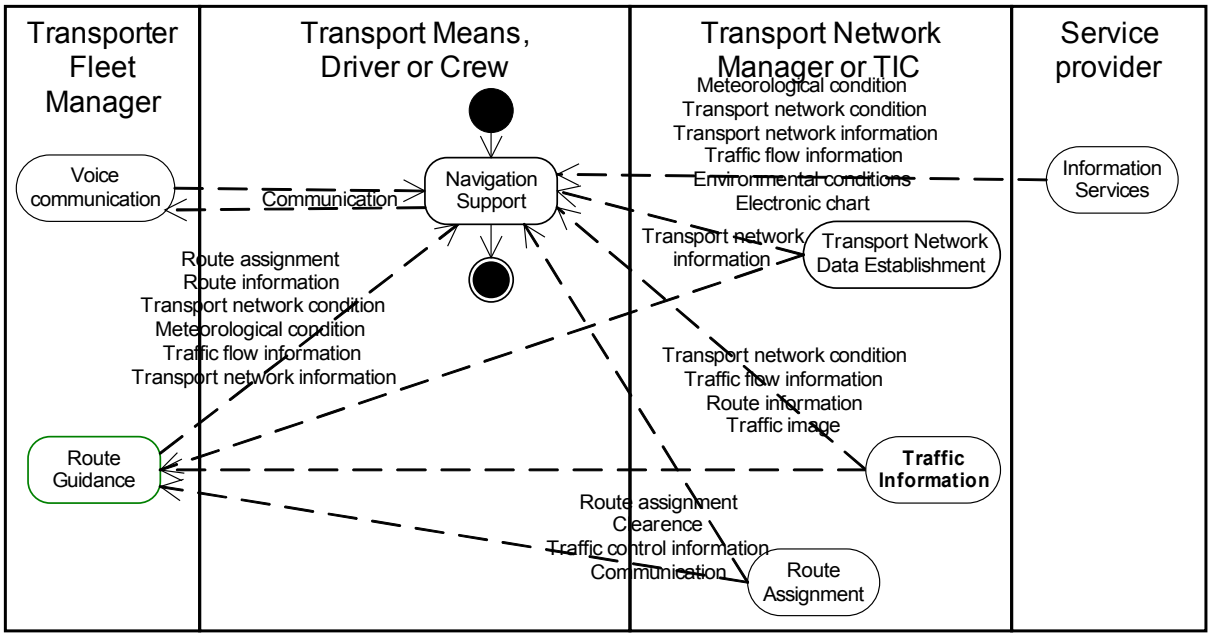


Figure 27 Navigation support from the crew's point of view

11.1.3.4Transport Operation

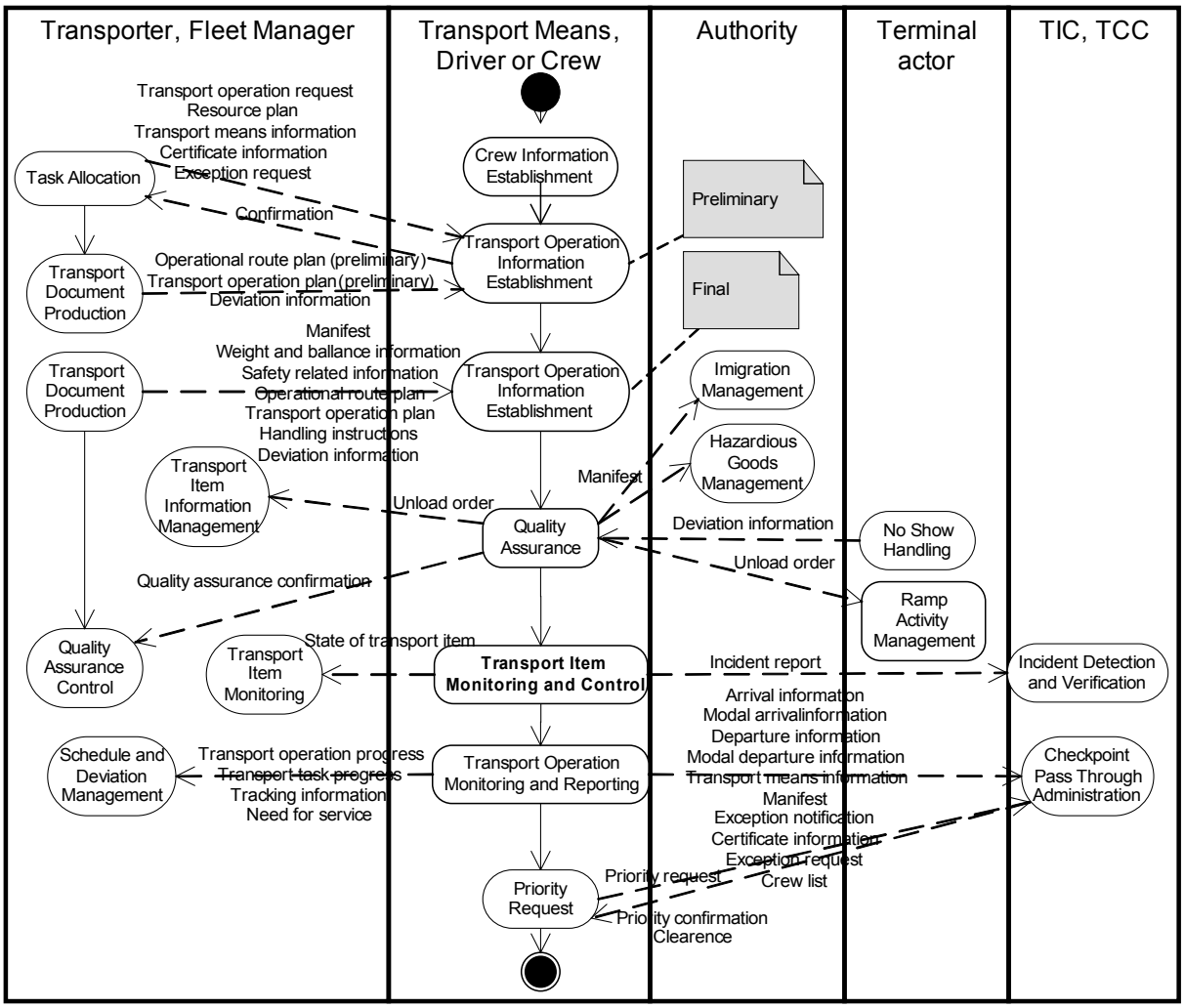


Figure 28 Transport operation from the crew's point of view

11.1.4Transport Network Management Scenarios

We have organized the scenarios related to Transport Network Management into groups corresponding to the sub-areas defined in the Functional view.

11.1.4.1Service Management Scenarios

Different service providers will provide services to the users of the transport network. The required background information must be collected, and the services must be provided to the audience.

11.1.4.1.1Provision of Route and Travel Information

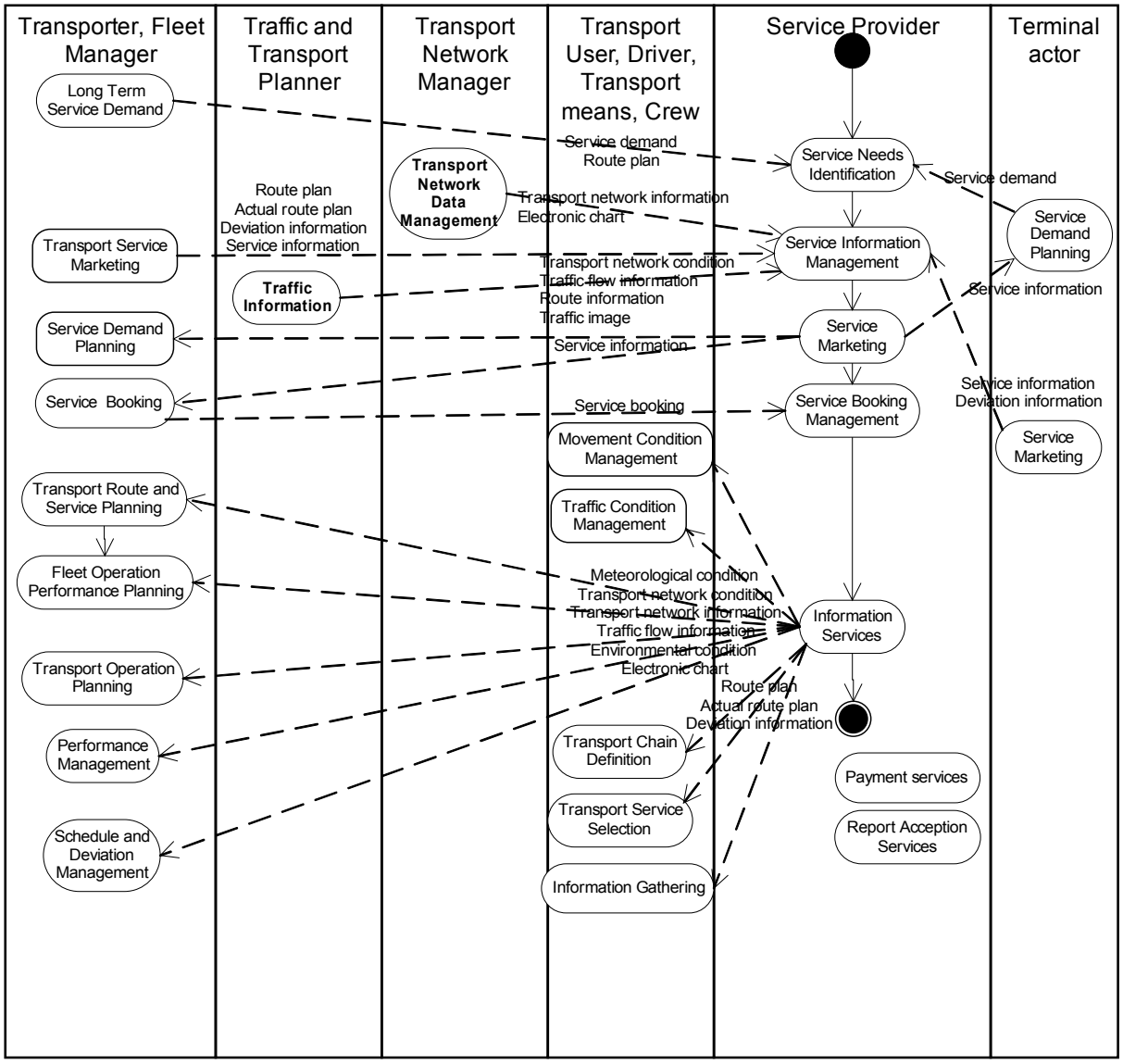


Figure 29 Provision of route and travel information services from the Service Provider's point of view

11.1.4.2Emergency Management Scenarios

Such scenarios are so far not established.

11.1.4.3Transport Network Utilisation Scenarios

Transport and traffic planning from a statistical point of view, operational traffic planning, traffic monitoring, traffic control, and incident handling are accomplished.

11.1.4.3.1Strategic and Tactical Transport and Traffic Planning

The Traffic and Transport Planner will do strategic and tactical planning with respect to how to provide safe and efficient traffic flow as well as strategic and tactical planning of transport services.

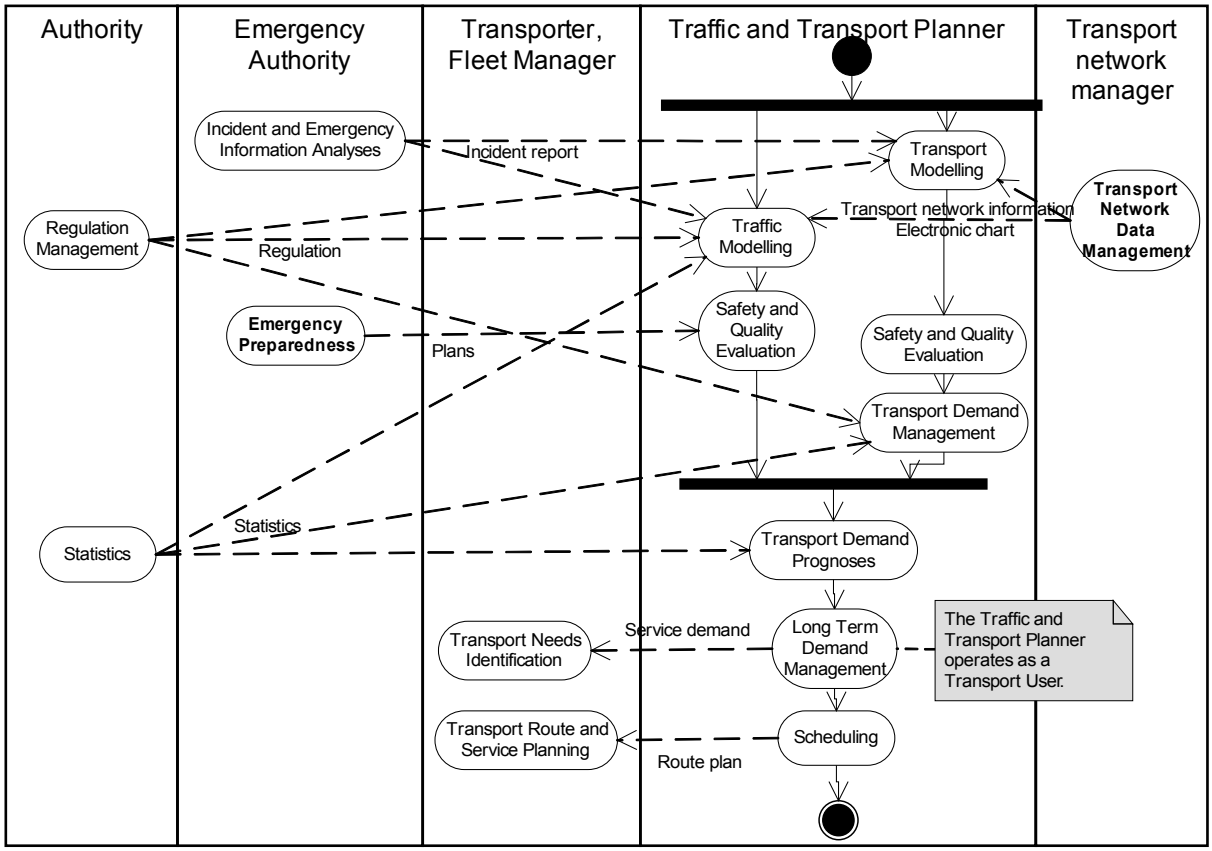


Figure 30 Strategic and tactical traffic and transport planning from TCC point of view

11.1.4.3.2Operational Traffic Planning

The operational traffic planning is for transport modes like sea, air and rail related to the planning of specific transport operations due to the restricted access to the transport network. For road transport, however, the operational planning is usually not focusing on the individual transport operations of each car, but on the flow of transport means.
Nevertheless, the planning of how to handle traffic exceptions is of relevance to all transport modes. Special cargo types (e.g. dangerous cargo) and special types of transport (broad cargo, slow transport, VIP transport etc.) may require specific actions.

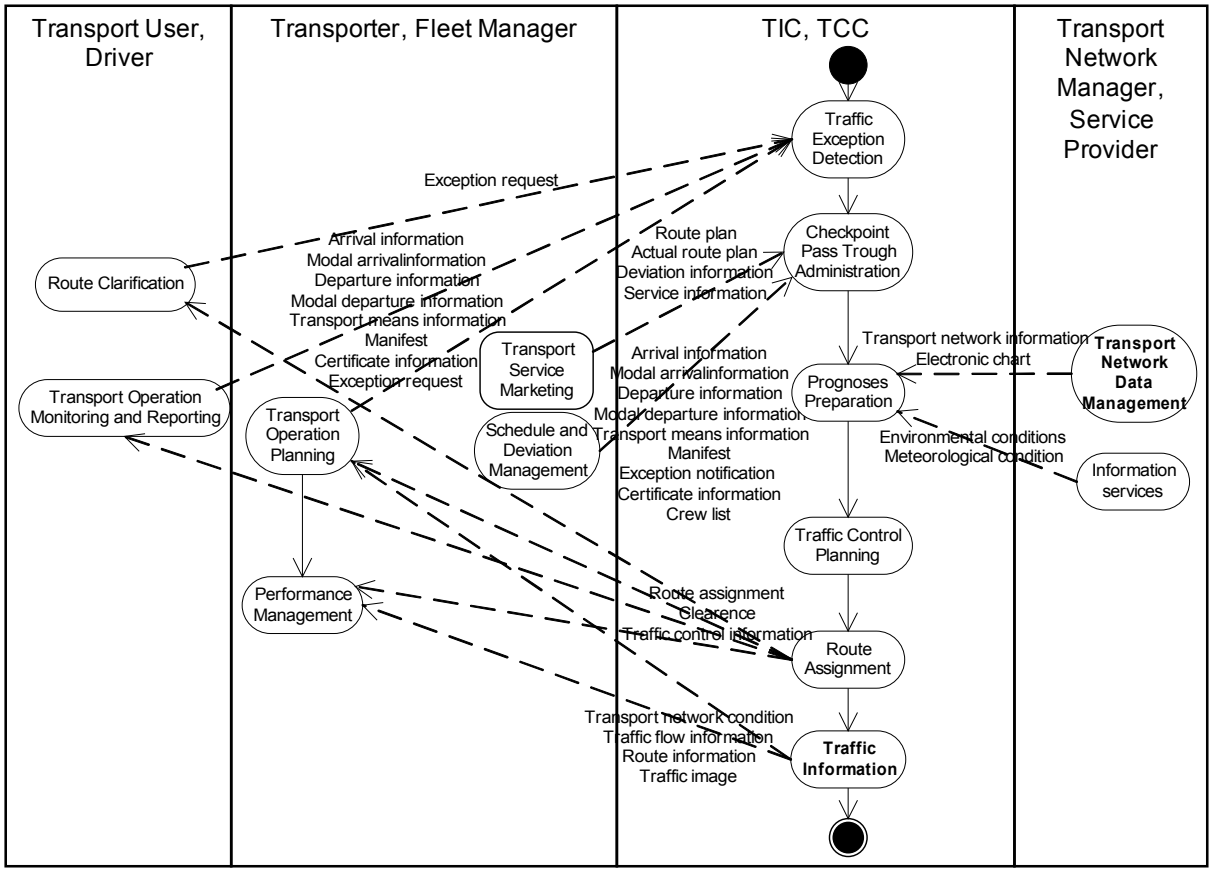


Figure 31 Operational traffic planning from TCC point of view

11.1.4.3.3Traffic Monitoring

The traffic flow in general and specific transport operations are monitored, as well as safety and environmental issues. Prognosis are calculated based on information about the current situation and statistics. Specific situations and incidents will be handled as described in 11.1.4.3.4 and 11.1.4.3.5.

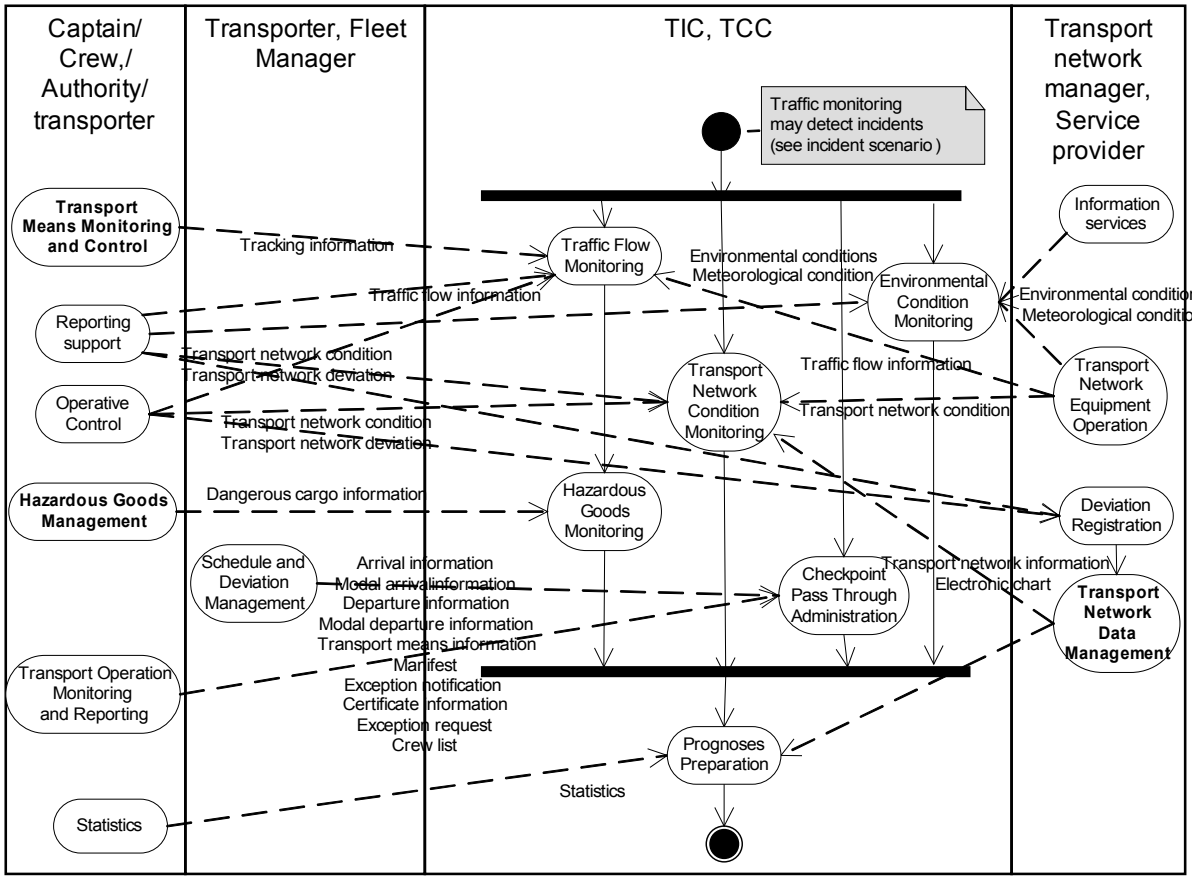


Figure 32 Traffic monitoring from TCC point of view

11.1.4.3.4Traffic Control

Based on information about the current situation and prognosis (provided by the traffic monitoring, actions are taken that shall ensure safety and efficient traffic flows.

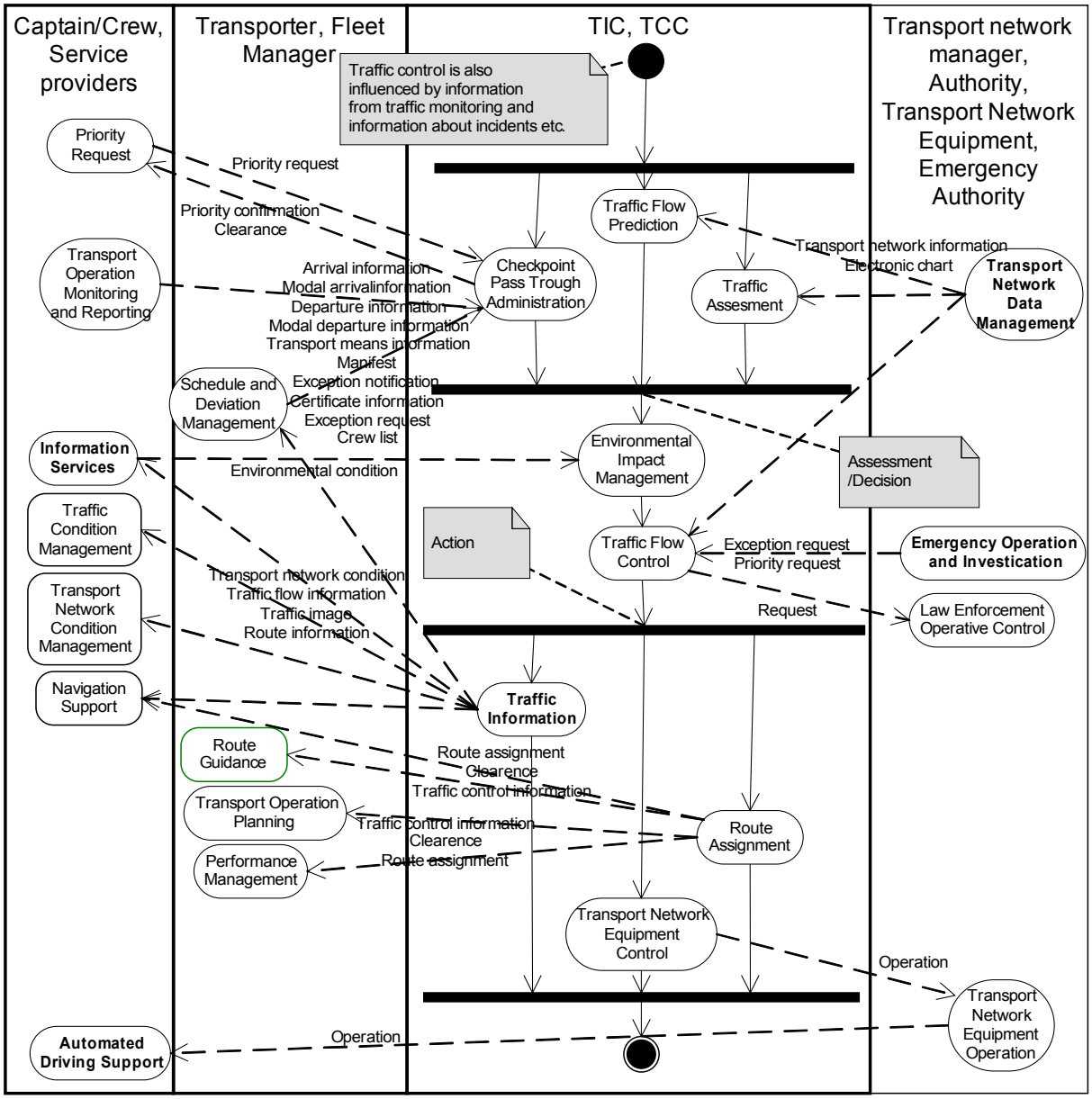


Figure 33 Traffic control from TCC/TIC point of view

11.1.4.3.5Incident Handling

Based on information about the current situation (provided by the traffic monitoring), incidents are handled.

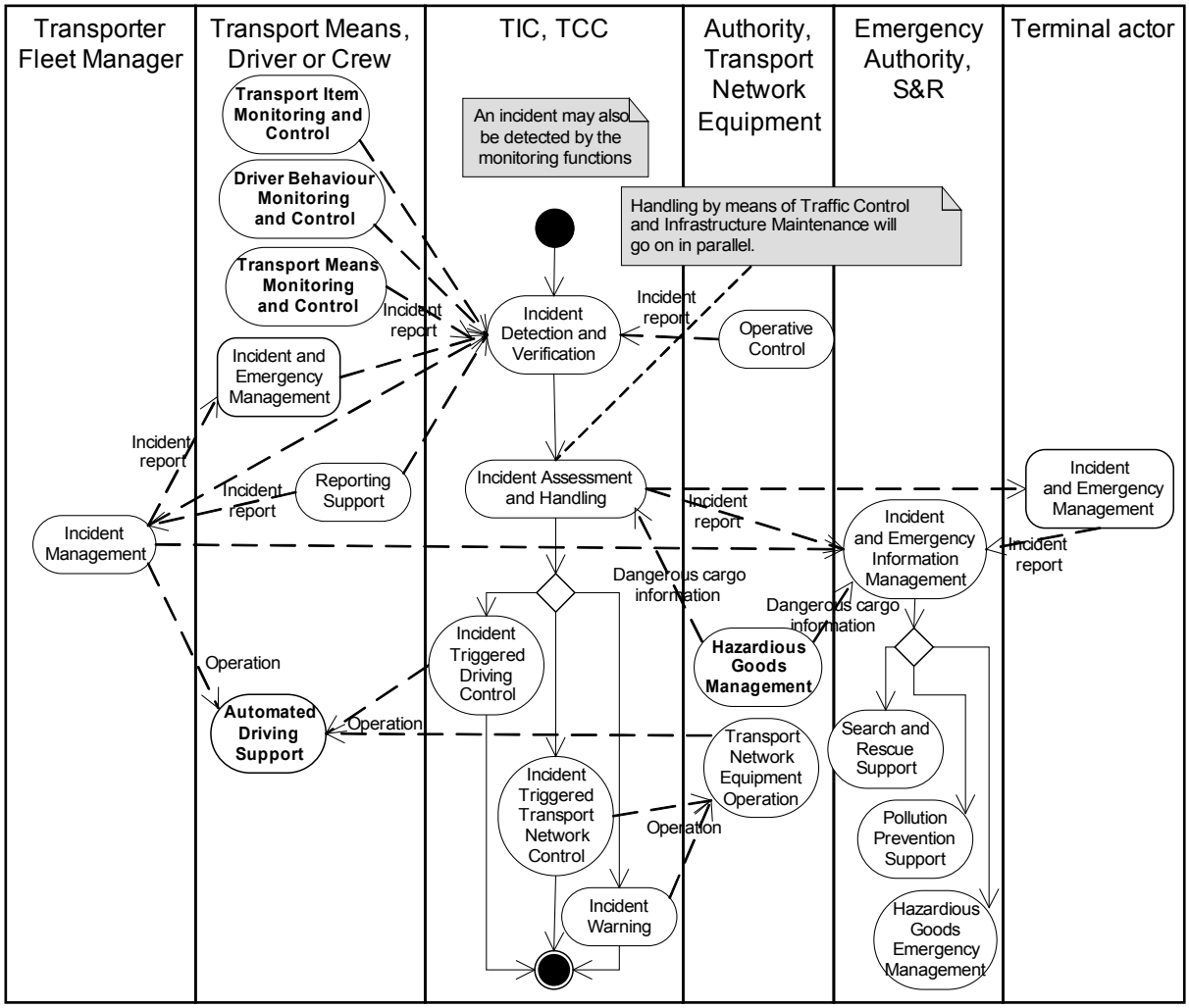


Figure 34 Incident handling from TCC/TIC point of view

11.1.4.4Regulation Enforcement Scenarios

These scenarios are so far not established.

11.1.4.5Transport Network Infrastructure Management Scenarios

The transport network infrastructure has to be managed.

11.1.4.5.1Transport Network Infrastructure Operational Planning

The operational planning must be based on information about deviations and transport network conditions.

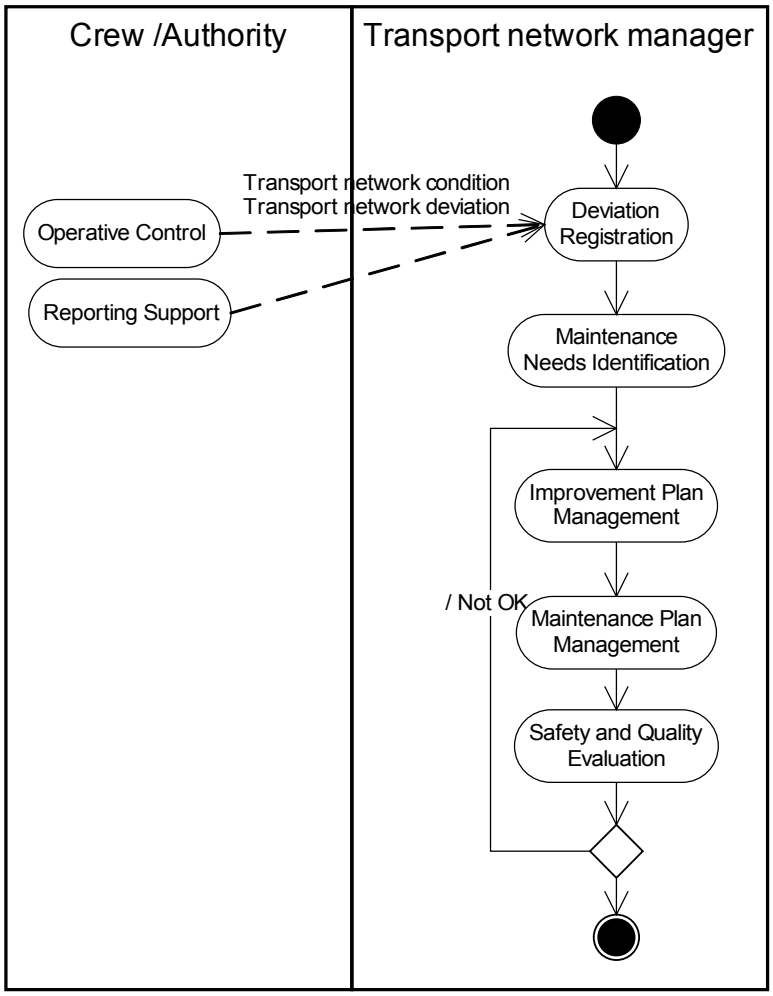


Figure 35 Operational planning from the transport network manager's point of view

11.1.4.5.2Transport Network Infrastructure Operation

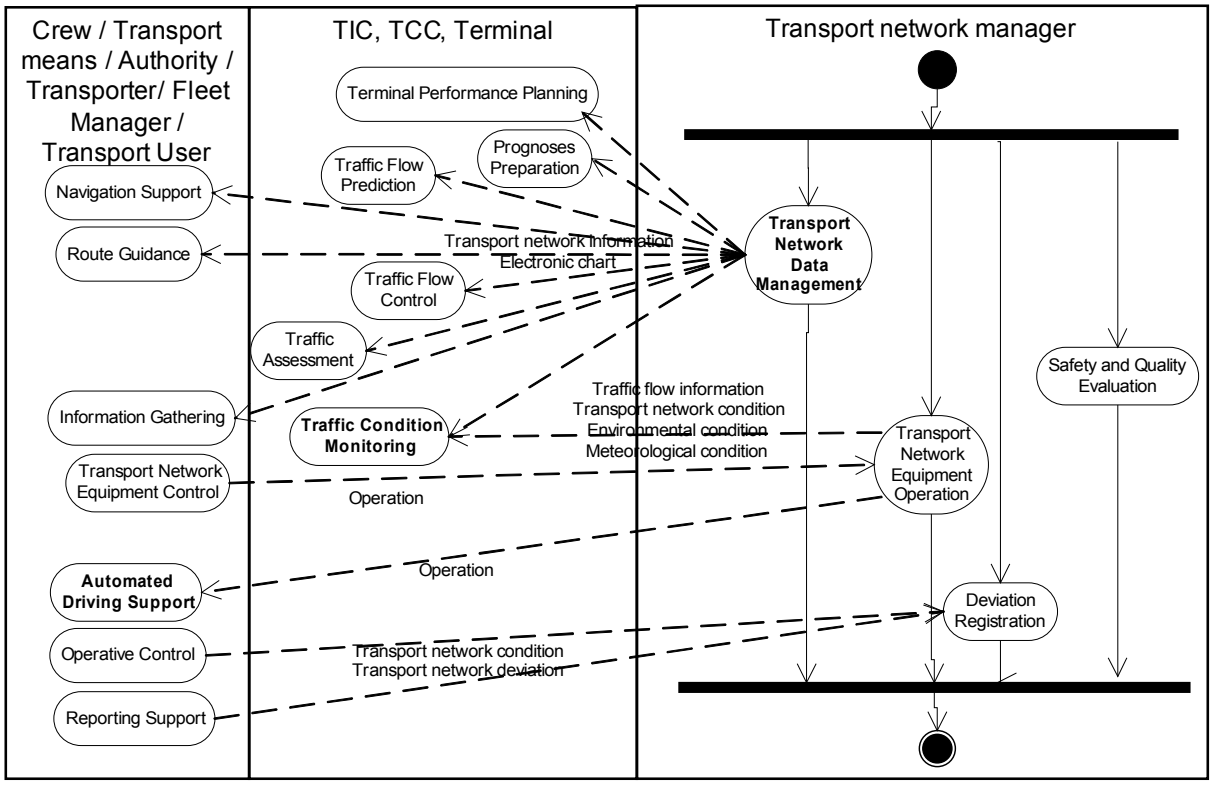


Figure 36 Operation from the transport network manager's point of view

11.1.5Terminal Scenarios

The activities of the Terminal Operator include strategical and tactical planning, Operational planning, and management of terminal operations.

11.1.5.1Strategic and tactical planning

The diagram illustrates the strategical and tactical planning done by the Terminal Operator.

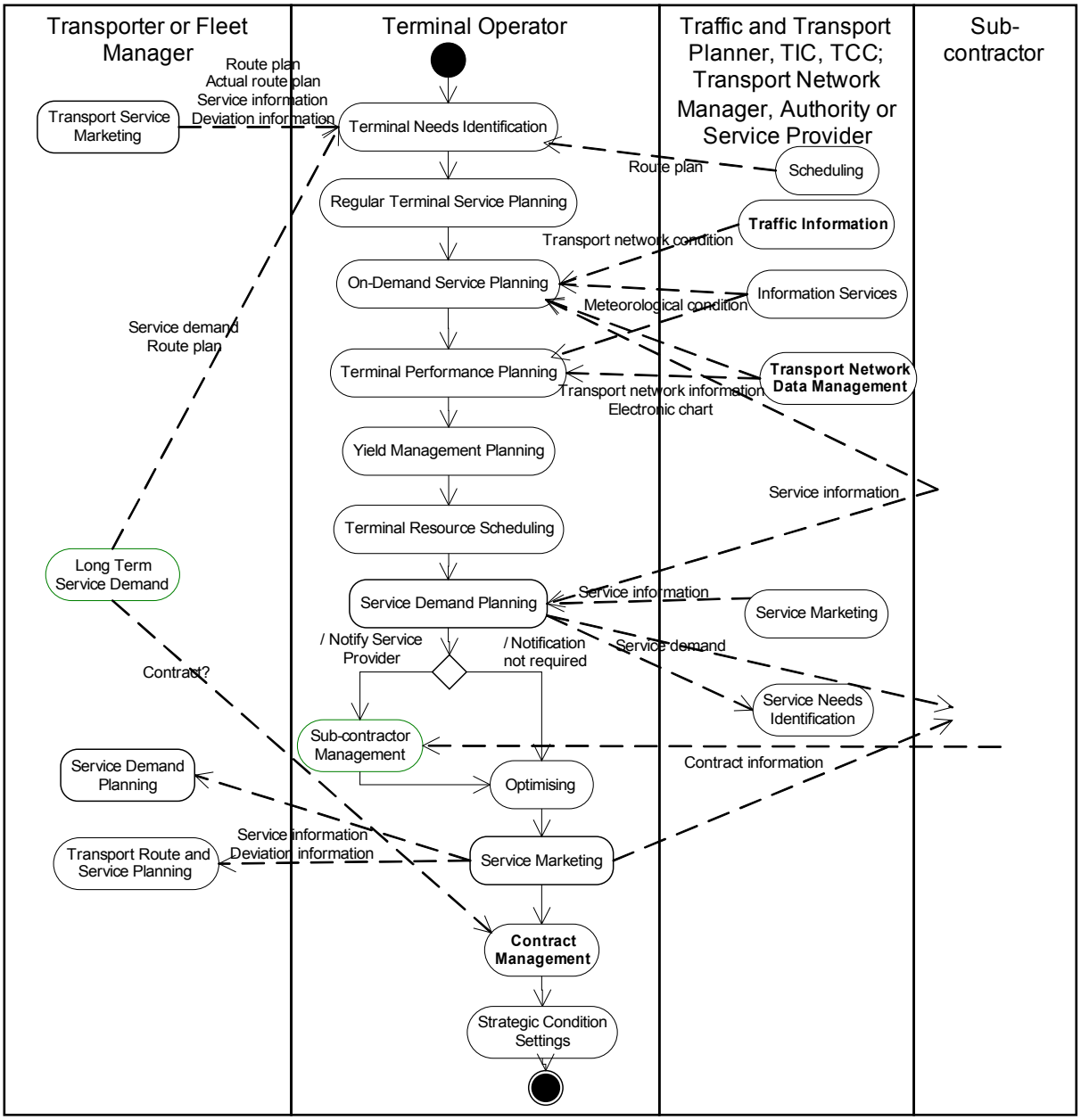


Figure 37 Strategic and tactical planning from the terminal operator's point of view

11.1.5.2Operational planning

The operational planning is composed of inbound planning, transhipment and storage planning, and outbound planning. Amendments must be handled.

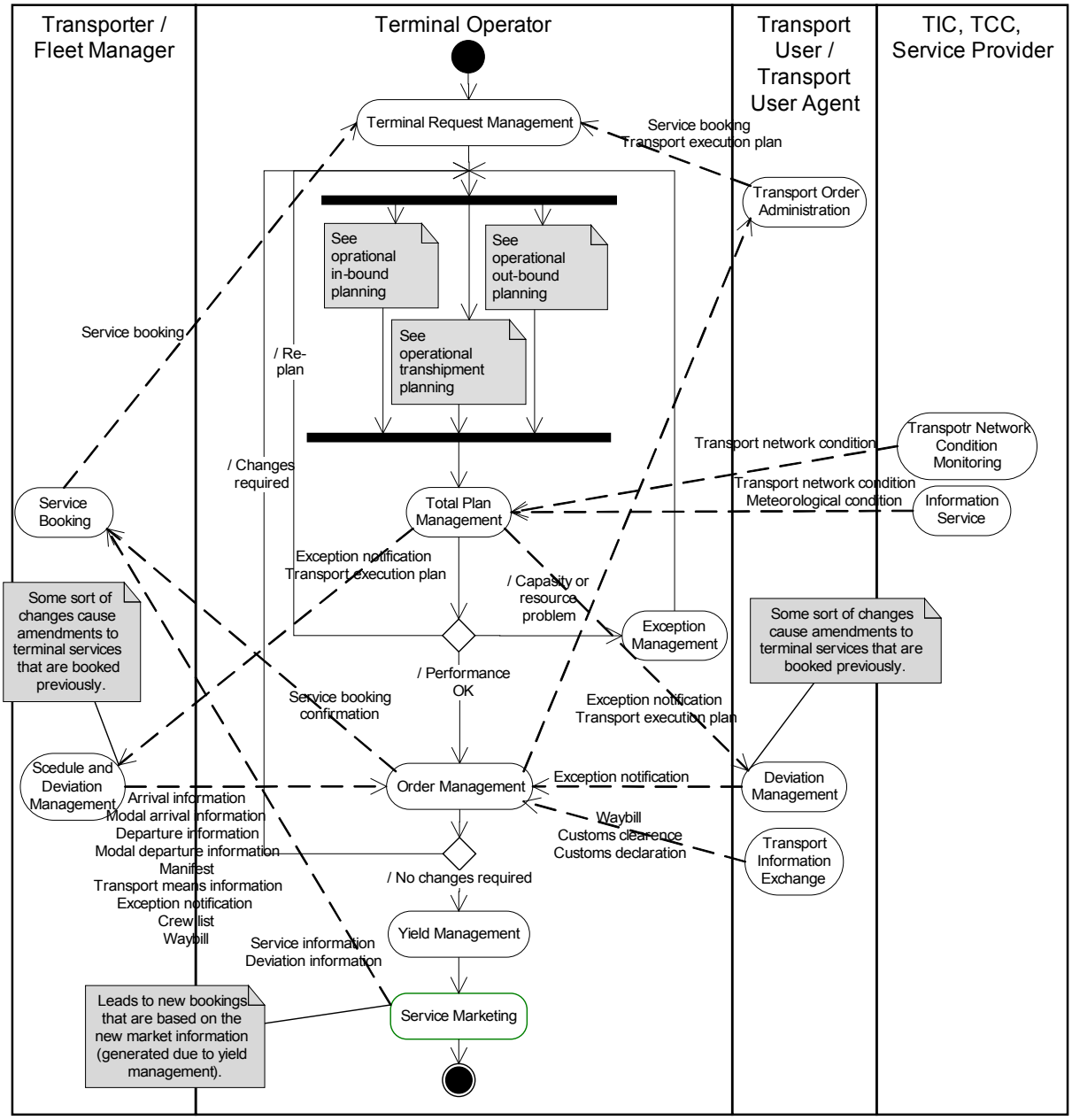


Figure 38 Operational planning from the terminal operator's point of view. For inbound, transhipment and outbound planning se diagrams below.

11.1.5.2.1Operational inbound planning

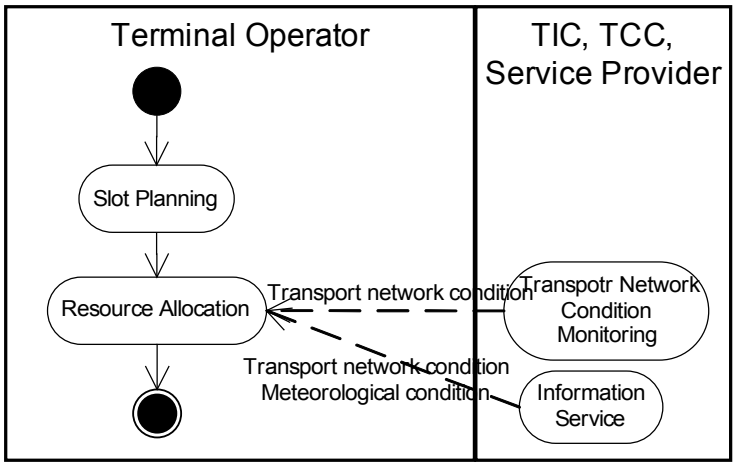


Figure 39 Operational inbound planning from the terminal operator's point of view

11.1.5.2.2Operational Transhipment Planning

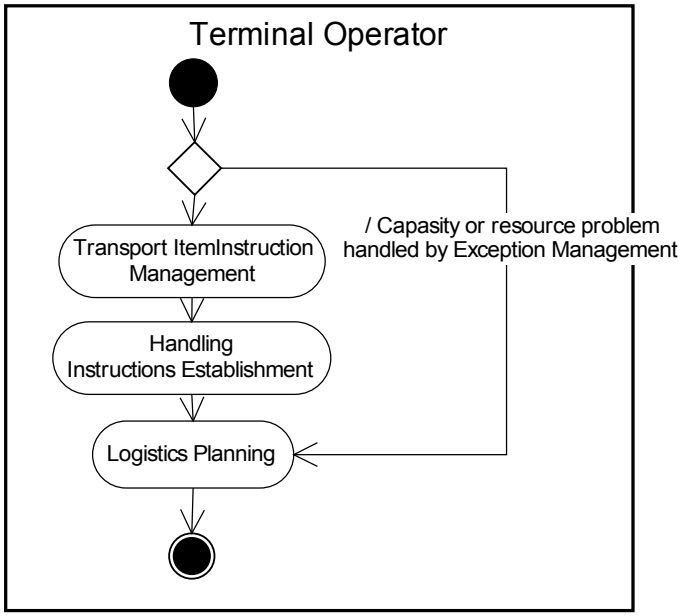


Figure 40 Operational transhipment planning from the terminal operator's point of view

11.1.5.2.3Operational Outbound Planning

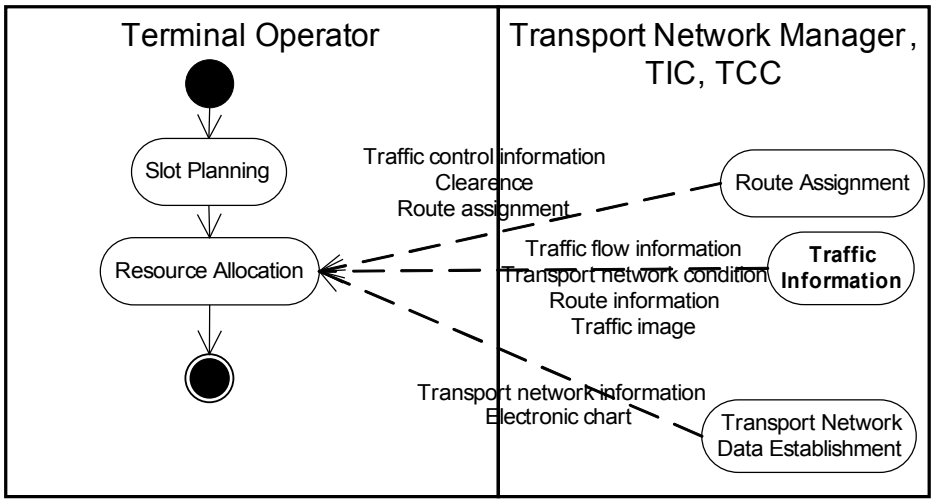


Figure 41 Operational outbound planning from the terminal operator's point of view

11.1.5.3Terminal Operation Management

The terminal management operation includes terminal operation monitoring, inbound control, transhipment and storage control, outbound control, and deviation management.

11.1.5.3.1Terminal Operation Monitoring

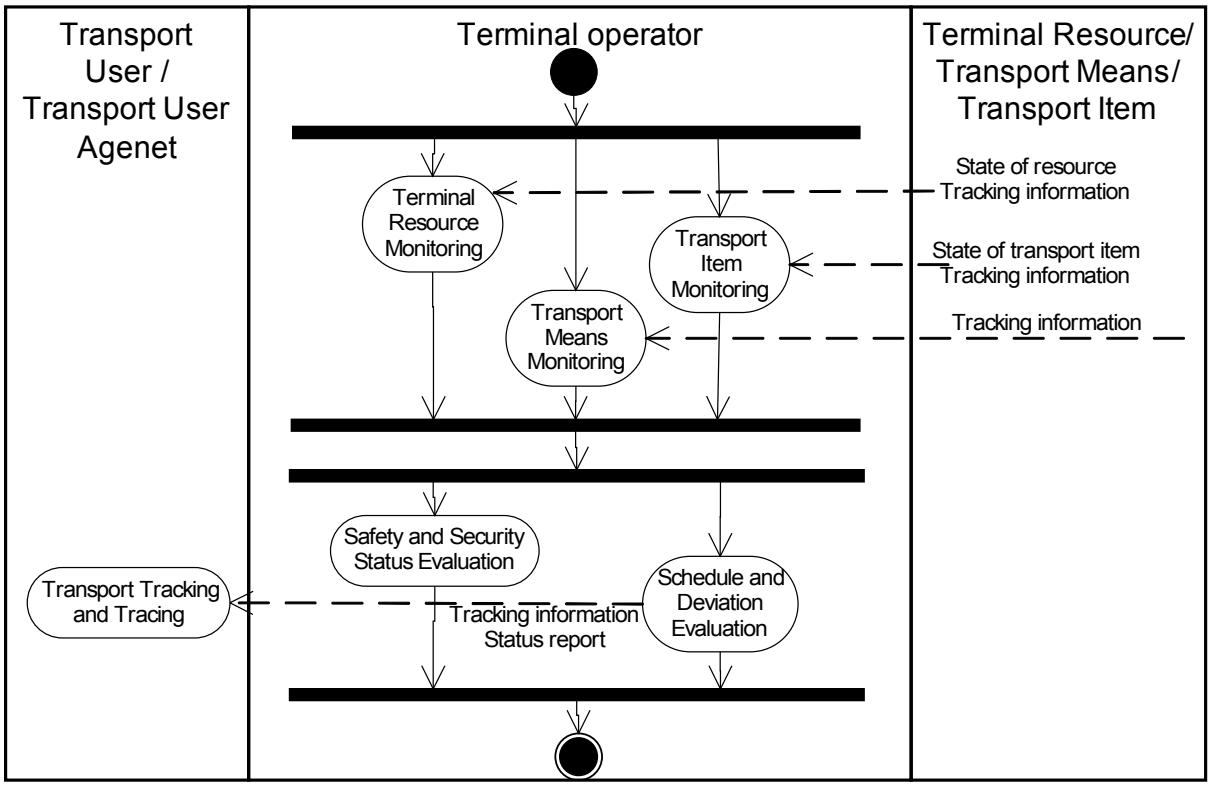


Figure 42 Terminal operation monitoring from the terminal operator's point of view

11.1.5.3.2Inbound Control

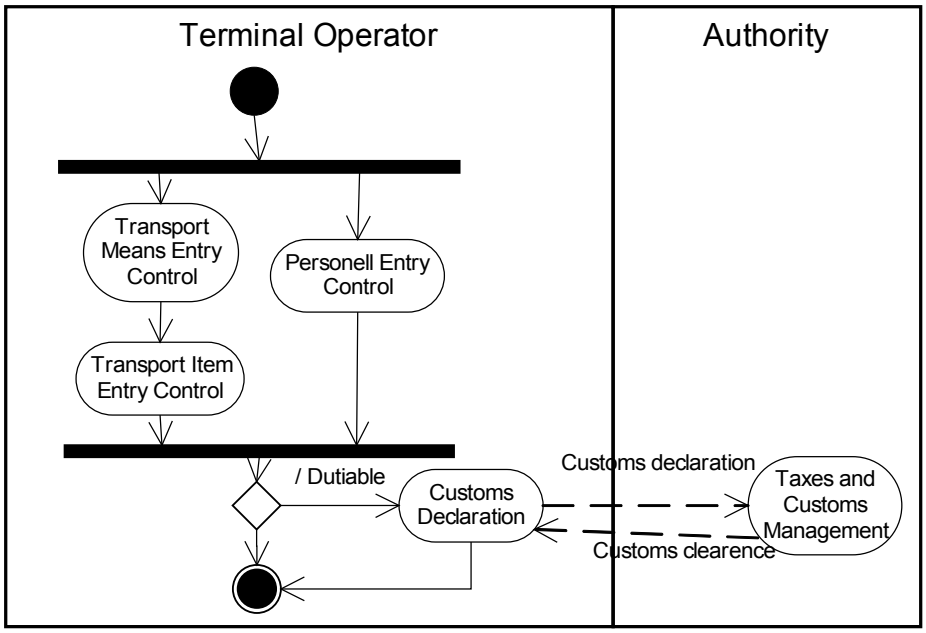


Figure 43 Inbound control from the terminal operator's point of view

11.1.5.3.3Transhipment and storage

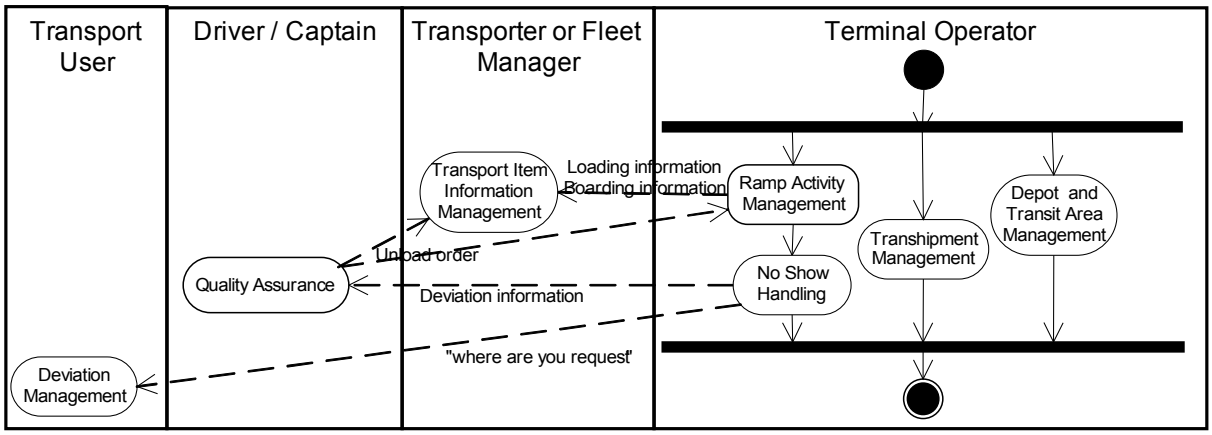


Figure 44 Transhipment and storage from the terminal operator's point of view

11.1.5.3.4Outbound control

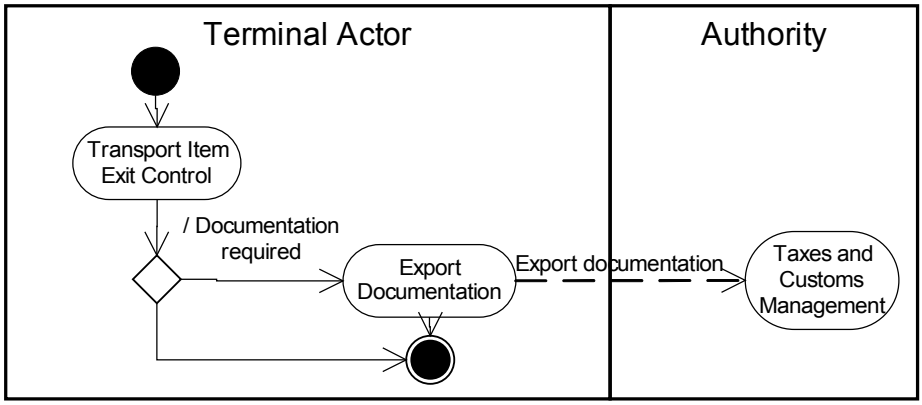


Figure 45 Outbound control from the terminal operator's point of view

11.1.5.3.5Incident and Deviation Management

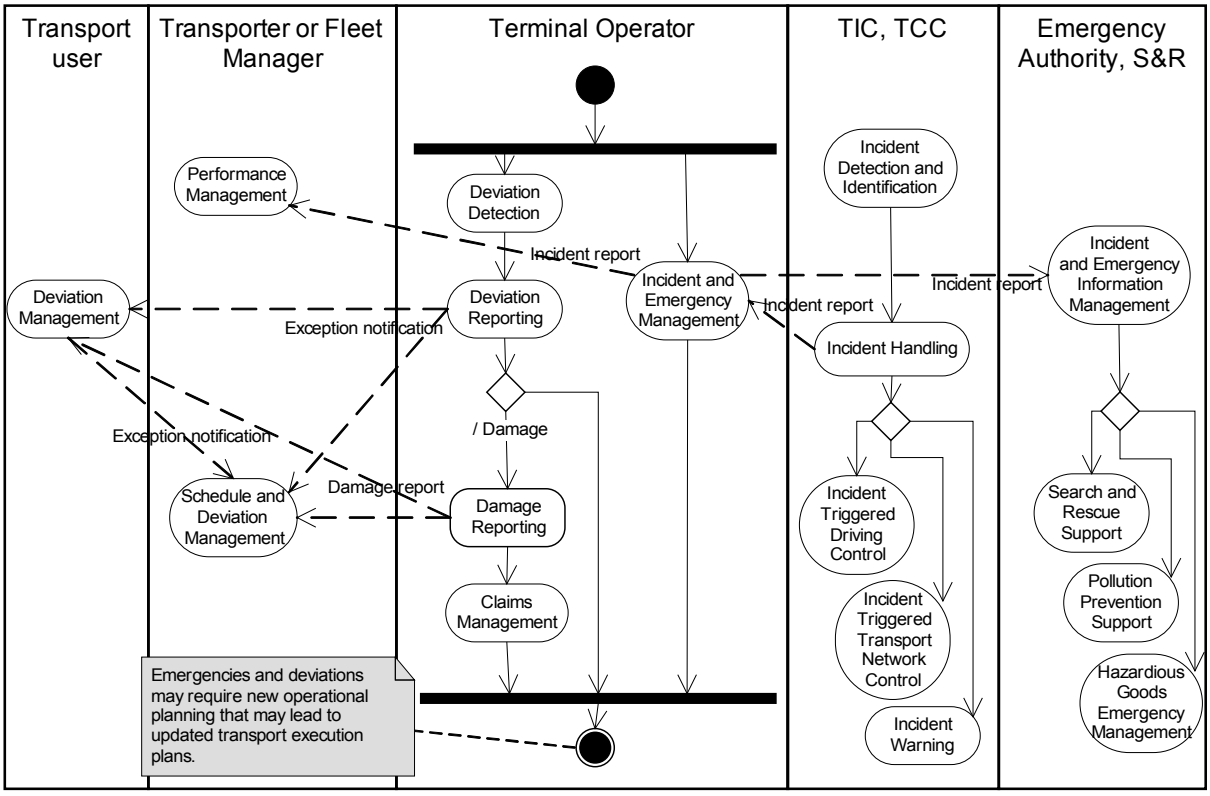


Figure 46 Incident and deviation management from terminal operator's point of view

11.2Interactions

Information will flow between the sub-domains of the reference model, and between the sub-areas of the Transport Network Management sub-domain. The scenarios above illustrate the need for such interactions.

11.2.1Interactions in the Swim Lanes

The table below shows the interactions in the diagrams shown in 11.1. The source and destination sub-domains (with reference to the ARKTRANS reference model) are shown.

Interaction	Relation to diagram in	Source	Destination
Actual route plan	Strat./tract. planning - Figure 16	Transport Service Management	Terminal Management
	Strat./tract. planning - Figure 16	Transport Service Management	Transport Network Management
	Transport preparation - Figure 13 Strat./tract. planning - Figure 16 Transp. op. planning - Figure 18	Transport Service Management	Transport Demand
	Route planning - Figure 14 Service – rout/travel - Figure 29	Transport Network Management	Transport Demand

Arrival information	Transp. schedule - Figure 22 Transp. deviation - Figure 23 Term. Op. plan - Figure 38	Transport Service Management	Terminal Management
	Transp. op. planning - Figure 18 Transp. schedule - Figure 22 Transp. deviation - Figure 23 TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	Transport Service Management	Transport Network Management
	Chain administration - Figure 15 Transp. schedule - Figure 22 Transp. deviation - Figure 23	Transport Service Management	Transport Demand
	On-board transp. op. - Figure 28 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	On-board Support and Control	Transport Network Management
Boarding information	Transp. op step 1 – Figure19 Term transhipment - Figure 44	Terminal Management	Transport Service Management
Capacity information	Transp. op. planning - Figure 18	Transport Service Management	Transport Demand
Certificate information	Transp. op step 1 – Figure19 On-board transp. op. - Figure 28	Transport Service Management	On-board Support and Control
	Transp. op. planning - Figure 18Transp. schedule - Figure 22 TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	Transport Service Management	Transport Network Management
	On-board transp. op. - Figure 28 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	On-board Support and Control	Transport Network Management
Clearance	Transp. op. planning - Figure 18 Transp. op. step 2 - Figure 20 Navigation support - Figure 27 TCC Op. planning - Figure 31 TCC traffic control - Figure 33	Transport Network Management	Transport Service Management
	Navigation support - Figure 27 On-board transp. op. - Figure 28 TCC traffic control - Figure 33	Transport Network Management	On-board Support and Control
	Route planning - Figure 14 TCC Op. planning - Figure 31	Transport Network Management	Transport Demand
	Term out plan - Figure 41	Transport Network Management	Terminal Management
Communi-cation	Driving support - Figure 25 Navigation support - Figure 27	Transport Service Management	On-board Support and Control
	Driving support - Figure 25 Navigation support - Figure 27	On-board Support and Control	Transport Service Management
Confirmation	Transp. op step 1 – Figure19 On-board transp. op. - Figure 28	On-board Support and Control	Transport Service Management
Contract	Strat./tract. planning - Figure 16	Transport Service Management	Transport Network Management
	Term strat plan - Figure 37	Transport Service Management	Terminal Management

Crew list	Transp. schedule - Figure 22 Transp. deviation - Figure 23 Term. Op. plan - Figure 38	Transport Service Management	Terminal Management
	Transp. schedule - Figure 22 Transp. deviation - Figure 23 TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	Transport Service Management	Transport Network Management
	On-board transp. op. - Figure 28 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	On-board Support and Control	Transport Network Management
Customs clearance	Chain administration - Figure 15 Term. Op. plan - Figure 38	Transport Demand	Terminal Management
	Term in control - Figure 44	Transport Network Management	Terminal Management
	Chain administration - Figure 15	Transport Network Management	Transport Demand
Customs declaration	Chain administration - Figure 15 Term. Op. plan - Figure 38	Transport Demand	Terminal Management
	Chain administration - Figure 15	Transport Demand	Transport Network Management
	Term in control - Figure 44	Terminal Management	Transport Network Management
Damage report	Transp. deviation - Figure 23 Term incident/dev - Figure 46	Terminal Management	Transport Service Management
	Chain administration - Figure 15 Transp. deviation - Figure 23 Term incident/dev - Figure 46	Terminal Management	Transport Demand
Dangerous cargo information	Transp. incident - Figure 24 TCC Incident h. - Figure 34	Transport Network Management	Transport Network Management
	TCC Traffic monitor - Figure 32	On-board Support and Control	Transport Network Management
Departure information	Transp. schedule - Figure 22 Transp. deviation - Figure 23 Term. Op. plan - Figure 38	Transport Service Management	Terminal Management
	Transp. op. planning - Figure 18 Transp. schedule - Figure 22 Transp. deviation - Figure 23 TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	Transport Service Management	Transport Network Management
	Chain administration - Figure 15 Transp. schedule - Figure 22 Transp. deviation - Figure 23	Transport Service Management	Transport Demand
	On-board transp. op. - Figure 28 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	On-board Support and Control	Transport Network Management

Deviation information	Strat./tract. planning - Figure 16 Term strat plan - Figure 37	Transport Service Management	Terminal Management
	Strat./tract. planning - Figure 16 Service – rout/travel - Figure 29	Transport Service Management	Transport Network Management
	Transport preparation - Figure 13 Strat./tract. planning - Figure 16 Transp. op. planning - Figure 18	Transport Service Management	Transport Demand
	Transp. op step 1 – Figure19 Transp. op. step 2 - Figure 20 On-board transp. op. - Figure 28	Transport Service Management	On-board Support and Control
	Transport preparation - Figure 13 Route planning - Figure 14 Service – rout/travel - Figure 29	Transport Network Management	Transport Demand
	Service – rout/travel - Figure 29	Terminal Management	Transport Network Management
	Strat./tract. planning - Figure 16 Term strat plan - Figure 37 Term. Op. plan - Figure 38	Terminal Management	Transport Service Management
	Transport preparation - Figure 13	Terminal Management	Transport Demand
	Transp. op step 1 – Figure19 On-board transp. op. - Figure 28 Term transhipment - Figure 44	Terminal Management	On-board Support and control
Electronic chart	Strat./tract. planning - Figure 16 Transp. op. planning - Figure 18 Transp. schedule - Figure 22 Transpo netw. Op - Figure 36 Service – rout/travel - Figure 29	Transport Network Management	Transport Service Management
	Route planning - Figure 14 Transpo netw. Op - Figure 36	Transport Network Management	Transport Demand
	TCC Strat. Plan - Figure 30 TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33 Transpo netw. Op - Figure 36 Service – rout/travel - Figure 29	Transport Network Management	Transport Network Management
	Term strat plan - Figure 37 Term out plan - Figure 41 Transpo netw. Op - Figure 36	Transport Network Management	Terminal Management
	Driving support - Figure 25 Navigation support - Figure 27 Transpo netw. Op - Figure 36 Service – rout/travel - Figure 29	Transport Network Management	On-board Support and control
Environmental condition	Strat./tract. planning - Figure 16 Transp. op. planning - Figure 18 Transp. schedule - Figure 22 Service – rout/travel - Figure 29	Transport Network Management	Transport Service Management
	Route planning - Figure 14	Transport Network Management	Transport Demand
	Driving support - Figure 25 Navigation support - Figure 27 Service – rout/travel - Figure 29	Transport Network Management	On-board Support and control
	TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33 Transpo netw. Op - Figure 36	Transport Network Management	Transport Network Management
	Driving support - Figure 25 TCC Traffic monitor - Figure 32	On-board Support and control	Transport Network Management

Exception notification	Transport preparation - Figure 13 Chain administration - Figure 15 Booking, amendment - Figure17 M Transp. schedule - Figure 22 Transp. deviation - Figure 23	Transport Service Management	Transport Demand
	Transp. schedule - Figure 22 Transp. deviation - Figure 23 TCC Op. planning - Figure 23 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	Transport Service Management	Transport Network Management
	Transp. schedule - Figure 22 Transp. deviation - Figure 23 Term. Op. plan - Figure 38	Transport Service Management	Terminal Management
	Chain administration - Figure 15 Transp. deviation - Figure 23 Term. Op. plan - Figure 38 Term incident/dev - Figure 46	Terminal Management	Transport Demand
	Transp. deviation - Figure 23	Terminal Management	Transport Service Management
	Transp. deviation - Figure 23 Term. Op. plan - Figure 38	Transport Demand	Terminal Management
	Chain administration - Figure 15 Transp. deviation - Figure 23 Term incident/dev - Figure 46	Transport Demand	Transport Service Management
	On-board transp. op. - Figure 28 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	On-board Support and Control	Transport Network Management
Exception request	Transp. op step 1 – Figure19 On-board transp. op. - Figure 28	Transport Service Management	On-board Support and Control
	Transp. op. planning - Figure 18 Transp. schedule - Figure 22 Transp. deviation - Figure 23 TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	Transport Service Management	Transport Network Management
	TCC traffic control - Figure 33	Transport Network Management	Transport Network Management
	Route planning - Figure 14 TCC Op. planning - Figure 31	Transport Demand	Transport Network Management
	On-board transp. op. - Figure 28 TCC Op. planning - TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	On-board Support and Control	Transport Network Management
Export doc-umentation	Perm out control - Figure 45	Terminal Management	Transport Network Management
Handling instruction	Transp. op. step 2 - Figure 20 On-board transp. op. - Figure 28	Transport Service Management	On-board Support and Control

Incident report	Transp. op. planning - Figure 18	Transport Network Management	Transport Service Management
	Transp. incident - Figure 24 TCC Incident h. - Figure 34 Term incident/dev - Figure 46	Terminal Management	Transport Network Management
	Term incident/dev - Figure 46	Terminal Management	Transport Service Management
	Transp. incident - Figure 24 TCC Incident h. - Figure 34	Transport Service Management	On-board Support and Control
	Transp. incident - Figure 24	Transport Service Management	Transport Network Management
	Transp. incident - Figure 24 TCC Strat. Plan - Figure 30 TCC Incident h. - Figure 34	Transport Network Management	Transport Network Management
	Transp. incident - Figure 24 TCC Incident h. - Figure 34 Term incident/dev - Figure 46	Transport Network Management	Terminal Management
	Transp. monitoring - Figure 21 Transp. incident - Figure 24 Driving support - Figure 25 Automated driving - Figure 26 On-board transp. op. - Figure 28 TCC Incident h. - Figure 34	On-board Support and Control	Transport Network Management
	Transp. monitoring - Figure 21 Transp. incident - Figure 24 Driving support - Figure 25 TCC Incident h. - Figure 34	On-board Support and Control	Transport Service Management
Loading information	Transp. op step 1 – Figure19 Term transhipment - Figure 44	Terminal Management	Transport Service Management
Manifest	Transp. op. step 2 - Figure 20 On-board transp. op. - Figure 28	Transport Service Management	On-board Support and Control
	Transp. op. step 2 - Figure 20 On-board transp. op. - Figure 28 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	On-board Support and Control	Transport Network Management
	Transp. schedule - Figure 22 Transp. deviation - Figure 23 Term. Op. plan - Figure 38	Transport Service Management	Terminal Management
	Transp. schedule - Figure 22 Transp. deviation - Figure 23 TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	Transport Service Management	Transport Network Management
Meteorological condition	Driving support - Figure 25	Transport Network Management	On-board Support and Control
	Route planning - Figure 14	Transport Network Management	Transport Demand
	Term strat plan - Figure 37 Term. Op. plan - Figure 38 Term op in plan - Figure 39	Transport Network Management	Terminal Management
	TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32 Transpo netw. Op - Figure 36	Transport Network Management	Transport Network Management
	Strat./tract. planning - Figure 16 Transp. op. planning - Figure 18 Transp. schedule - Figure 22 Service – rout/travel - Figure 29	Transport Network Management	Transport Service Management
	Driving support - Figure 25 TCC Traffic monitor - Figure 32	On-board Support and control	Transport Network Management
	Navigation support - Figure 27 Service – rout/travel - Figure 29	Transport Service Management	On-board Support and Control

Modal arrival information	Transp. schedule - Figure 22 Transp. deviation - Figure 23 Term. Op. plan - Figure 38	Transport Service Management	Terminal Management
	Transp. op. planning - Figure 18 Transp. deviation - Figure 23 TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	Transport Service Management	Transport Network Management
	On-board transp. op. - Figure 28 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	On-board Support and Control	Transport Network Management
Modal departure information	Transp. schedule - Figure 22 Transp. deviation - Figure 23 Term. Op. plan - Figure 38	Transport Service Management	Terminal Management
	Transp. op. planning - Figure 18 Transp. deviation - Figure 23 TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32	Transport Service Management	Transport Network Management
	On-board transp. op. - Figure 28 TCC Traffic monitor - Figure 32	On-board Support and Control	Transport Network Management
Need for service	Transp. schedule - Figure 22 On-board transp. op. - Figure 28	On-board Support and Control	Transport Service Management
Operation	Transp. op. step 2 - Figure 20 Transp. incident - Figure 24 Automated driving - Figure 26 TCC Incident h. - Figure 34	Transport Service Management	On-board Support and Control
	TCC traffic control - Figure 33 TCC Incident h. - Figure 34 Transpo netw. Op - Figure 36	Transport Network Management	Transport Network Management
	Transp. op. step 2 - Figure 20 Transp. incident - Figure 24 Automated driving - Figure 26 TCC traffic control - Figure 33 TCC Incident h. - Figure 34 Transpo netw. Op - Figure 36	Transport Network Management	On-board Support and Control
Operational route plan	Transp. op step 1 – Figure19 Transp. op. step 2 - Figure 20 On-board transp. op. - Figure 28	Transport Service Management	On-board Support and Control
Plan	TCC Strat. Plan - Figure 30	Transport Network Management	Transport Network Management
Priority confirmation	On-board transp. op. - Figure 28 TCC traffic control - Figure 33	Transport Network Management	On-board Support and Control
Priority request	Transp. op. step 2 - Figure 20	Transport Service Management	Transport Network Management
	TCC traffic control - Figure 33	Transport Network Management	Transport Network Management
	On-board transp. op. - Figure 28 TCC traffic control - Figure 33	On-board Support and Control	Transport Network Management
Quality assurance confirmation	Transp. op. step 2 - Figure 20 On-board transp. op. - Figure 28	On-board Support and Control	Transport Service Management
Regulation	TCC Strat. Plan - Figure 30	Transport Network Management	Transport Network Management
Report request	Driving support - Figure 25	Transport Service Management	On-board Support and Control
Resource plan	Transp. op step 1 – Figure19 On-board transp. op. - Figure 28	Transport Service Management	On-board Support and Control
Request	TCC traffic control - Figure 33	Transport Network Management	Transport Network Management

Route assignment	Transp. op. planning - Figure 18 Navigation support - Figure 27 TCC Op. planning - Figure 31 TCC traffic control - Figure 33	Transport Network Management	Transport Service Management
	Navigation support - Figure 27 TCC traffic control - Figure 33	Transport Network Management	On-board Support and Control
	Term out plan - Figure 41	Transport Network Management	Terminal Management
	Route planning - Figure 14 TCC Op. planning - Figure 31	Transport Network Management	Transport Demand
	Navigation support - Figure 27	Transport Service Management	On-board Support and Control
Route information	Strat./tract. planning - Figure 16 Transp. op. planning - Figure 18 Transp. schedule - Figure 22 Driving support - Figure 25 TCC Op. planning - Figure 31 TCC traffic control - Figure 33	Transport Network Management	Transport Service Management
	Route planning - Figure 14	Transport Network Management	Transport Demand
	Driving support - Figure 25 Navigation support - Figure 27 TCC traffic control - Figure 33	Transport Network Management	On-board Support and Control
	Term out plan - Figure 41	Transport Network Management	Terminal Management
	Service – rout/travel - Figure 29	Transport Network Management	Transport Network Management
	Driving support - Figure 25 Navigation support - Figure 27	Transport Service Management	On-board Support and Control
Route plan	Transport preparation - Figure 13 Strat./tract. planning - Figure 16 Transp. op. planning - Figure 18	Transport Service Management	Transport Demand
	Strat./tract. planning - Figure 16 Term strat plan - Figure 37	Transport Service Management	Terminal Management
	Strat./tract. planning - Figure 16 Service – rout/travel - Figure 29	Transport Service Management	Transport Network Management
	Strat./tract. planning - Figure 16 TCC Strat. Plan - Figure 30	Transport Network Management	Transport Service Management
	Route planning - Figure 14 Service – rout/travel - Figure 29	Transport Network Management	Transport Demand
	Term strat plan - Figure 37	Transport Network Management	Terminal Management
Safety related information	Transp. op. step 2 - Figure 20 On-board transp. op. - Figure 28	Transport Service Management	On-board Support and Control
Service booking	Transport preparation - Figure 13 Term. Op. plan - Figure 38	Transport Demand	Terminal Management
	Transport preparation - Figure 13 Strat./tract. planning - Figure 16 Booking, amendment - Figure17 M	Transport Demand	Transport Service Management
	Transp. op step 1 – Figure19 Transp. op. step 2 - Figure 20 Service – rout/travel - Figure 29	Transport Service Management	Transport Network Management
	Transp. op step 1 – Figure19 Transp. op. step 2 - Figure 20 Term. Op. plan - Figure 38	Transport Service Management	Terminal Management
Service booking confirmation	Transport preparation - Figure 13 Strat./tract. planning - Figure 16	Transport Service Management	Transport Demand
	Transport preparation - Figure 13 Term. Op. plan - Figure 38	Terminal Management	Transport Demand
	Term. Op. plan - Figure 38	Terminal Management	Transport Service Management

Service demand	Strat./tract. planning - Figure 16 Term strat plan - Figure 37	Transport Service Management	Terminal Management
	Strat./tract. planning - Figure 16 Service – rout/travel - Figure 29	Transport Service Management	Transport Network Management
	TCC Strat. Plan - Figure 30	Transport Network Management	Transport Service Management
	Strat./tract. planning - Figure 16	Transport Demand	Transport Service Management
	Term strat plan - Figure 37 Service – rout/travel - Figure 29	Terminal Management	Transport Network Management
Service information	Strat./tract. planning - Figure 16 Transp. op. planning - Figure 18	Transport Service Management	Transport Demand
	Strat./tract. planning - Figure 16 Term strat plan - Figure 37	Transport Service Management	Terminal Management
	Strat./tract. planning - Figure 16 Service – rout/travel - Figure 29	Transport Service Management	Transport Network Management
	Strat./tract. planning - Figure 16 Transp. op step 1 – Figure19 Service – rout/travel - Figure 29	Transport Network Management	Transport Service Management
	Term strat plan - Figure 37 Service – rout/travel - Figure 29	Transport Network Management	Terminal Management
	Transport preparation - Figure 13 Route planning - Figure 14	Transport Network Management	Transport Demand
	Strat./tract. planning - Figure 16 Transp. op step 1 – Figure19 Term strat plan - Figure 37 Term. Op. plan - Figure 38	Terminal Management	Transport Service Management
	Service – rout/travel - Figure 29	Terminal Management	Transport Network Management
	Transport preparation - Figure 13	Terminal Management	Transport Demand
State of driver	Transp. monitoring - Figure 21 Automated driving - Figure 26	On-board Support and Control	Transport Service Management
State of resource	Term monitoring - Figure 42	Terminal Management	Terminal Management
State of transport item	Transp. monitoring - Figure 21 Automated driving - Figure 26 On-board transp. op. - Figure 28	On-board Support and Control	Transport Service Management
	Term monitoring - Figure 42	Terminal Management	Terminal Management
State of transport means	Transp. monitoring - Figure 21 Driving support - Figure 25	On-board Support and Control	Transport Service Management
Statistics	Transp. monitoring - Figure 21	Transport Service Management	Transport Network Management
	TCC Traffic monitor - Figure 32	On-board Support and Control	Transport Network Management
	TCC Strat. Plan - Figure 30	Transport Network Management	Transport Network Management
Status report	Chain administration - Figure 15 Transp. schedule - Figure 22 Transp. deviation - Figure 23	Transport Service Management	Transport Demand
	Chain administration - Figure 15 Transp. schedule - Figure 22 Transp. deviation - Figure 23 Term monitoring - Figure 42	Terminal Management	Transport Demand
Sub-contractor information	Strat./tract. planning - Figure 16	Transport Service Management	Transport Service Management
Ticket	Transport preparation - Figure 13 Chain administration - Figure 15 Booking, amendment - Figure17 M	Transport Service Management	Transport Demand

Tracking information	Transp. monitoring - Figure 21 Transp. schedule - Figure 22 Automated driving - Figure 26 On-board transp. op. - Figure 28	On-board Support and Control	Transport Service Management
	Transp. monitoring - Figure 21 Automated driving - Figure 26 TCC Traffic monitor - Figure 32	On-board Support and Control	Transport Network Management
	Term monitoring - Figure 42	Terminal Management	Transport Demand
	Term monitoring - Figure 42	Terminal Management	Terminal Management
Traffic control information	Transp. op. planning - Figure 18 Navigation support - Figure 27 TCC Op. planning - Figure 31 TCC traffic control - Figure 33 Term out plan - Figure 41	Transport Network Management	Transport Service Management
	Route planning - Figure 14 TCC Op. planning -	Transport Network Management	Transport Demand
	Navigation support - Figure 27 TCC traffic control - Figure 33	Transport Network Management	On-board Support and Control
Traffic flow information	Strat./tract. planning - Figure 16 Transp. op. planning - Figure 18 Transp. schedule - Figure 22 Driving support - Figure 25 TCC Op. planning - Figure 31 TCC traffic control - Figure 33 Service – rout/travel - Figure 29	Transport Network Management	Transport Service Management
	Driving support - Figure 25 Navigation support - Figure 27 TCC traffic control - Figure 33 Service – rout/travel - Figure 29	Transport Network Management	On-board Support and Control
	Route planning - Figure 14	Transport Network Management	Transport Demand
	Term out plan - Figure 41	Transport Network Management	Terminal Management
	TCC Traffic monitor - Figure 32 Transpo netw. Op - Figure 36 Service – rout/travel - Figure 29	Transport Network Management	Transport Network Management
	Driving support - Figure 25 TCC Traffic monitor - Figure 32	On-board Support and control	Transport Network Management
	Navigation support - Figure 27	Transport Service Management	On-board Support and Control
	Driving support - Figure 25	On-board Support and Control	Transport Service Management
Traffic image	Strat./tract. planning - Figure 16 Transp. op. planning - Figure 18 Transp. schedule - Figure 22 Driving support - Figure 25 TCC Op. planning - Figure 31 TCC traffic control - Figure 33	Transport Network Management	Transport Service Management
	Service – rout/travel - Figure 29	Transport Network Management	Transport Network Management
	Route planning - Figure 14	Transport Network Management	Transport Demand
	Term out plan - Figure 41	Transport Network Management	Terminal Management
	Driving support - Figure 25 Navigation support - Figure 27 TCC traffic control - Figure 33	Transport Network Management	On-board Support and Control

Transport execution plan	Transport preparation - Figure 13 Chain administration - Figure 15 Booking, amendment - Figure17 M	Transport Demand	Transport Service Management
	Transport preparation - Figure 13 Chain administration - Figure 15 Term. Op. plan - Figure 38	Transport Demand	Terminal Management
	Transport preparation - Figure 13 Chain administration - Figure 15 Booking, amendment - Figure17 M	Transport Service Management	Transport Demand
	Chain administration - Figure 15 Transp. deviation - Figure 23 Term. Op. plan - Figure 38	Terminal Management	Transport Demand
	Transp. deviation - Figure 23	Terminal Management	Transport Service Management
Transport means information	Transp. op step 1 – Figure19 On-board transp. op. - Figure 28	Transport Service Management	On-board Support and Control
	Transp. schedule - Figure 22 Transp. deviation - Figure 23 Term. Op. plan - Figure 38	Transport Service Management	Terminal Management
	Transp. op. planning - Figure 18 Transp. schedule - Figure 22 Transp. deviation - Figure 23 TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	Transport Service Management	Transport Network Management
	On-board transp. op. - Figure 28 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33	On-board Support and Control	Transport Network Management
Transport network condition	TCC Traffic monitor - Figure 32 Trans netw. Op plan - Figure 35 Transpo netw. Op - Figure 36 Service – rout/travel - Figure 29	Transport Network Management	Transport Network Management
	Strat./tract. planning - Figure 16 Transp. op. planning - Figure 18 Transp. schedule - Figure 22 Driving support - Figure 25 TCC Op. planning - Figure 31 TCC traffic control - Figure 33 Service – rout/travel - Figure 29	Transport Network Management	Transport Service Management
	Term strat plan - Figure 37 Term. Op. plan - Figure 38 Term op in plan - Figure 39 Term out plan - Figure 41	Transport Network Management	Terminal Management
	Driving support - Figure 25 Navigation support - Figure 27 TCC traffic control - Figure 33 Service – rout/travel - Figure 29	Transport Network Management	On-board Support and Control
	Route planning - Figure 14	Transport Network Management	Transport Demand
	Navigation support - Figure 27	Transport Service Management	On-board Support and Control
	Driving support - Figure 25 TCC Traffic monitor - Figure 32 Transpo netw. Op - Figure 36	On-board Support and Control	Transport Network Management
	Driving support - Figure 25	On-board Support and Control	Transport Service Management
Transport network deviation	Driving support - Figure 25 TCC Traffic monitor - Figure 32 Trans netw. Op plan - Figure 35 Transpo netw. Op - Figure 36	On-board Support and Control	Transport Network Management
	Trans netw. Op plan - Figure 35 Transpo netw. Op - Figure 36	Transport Network Management	Transport Network Management

Transport network information	Strat./tract. planning - Figure 16 Transp. op. planning - Figure 18 Transp. schedule - Figure 22 Transpo netw. Op - Figure 36 Service – rout/travel - Figure 29	Transport Network Management	Transport Service Management
	TCC Strat. Plan - Figure 30 TCC Op. planning - Figure 31 TCC Traffic monitor - Figure 32 TCC traffic control - Figure 33 Transpo netw. Op - Figure 36 Service – rout/travel - Figure 29	Transport Network Management	Transport Network Management
	Term strat plan - Figure 37 Term out plan - Figure 41 Transpo netw. Op - Figure 36	Transport Network Management	Terminal Management
	Driving support - Figure 25 Navigation support - Figure 27 Transpo netw. Op - Figure 36 Service – rout/travel - Figure 29	Transport Network Management	On-board Support and Control
	Route planning - Figure 14 Transpo netw. Op - Figure 36	Transport Network Management	Transport Demand
	Navigation support - Figure 27	Transport Service Management	On-board Support and Control
Transport operation plan	Transp. op step 1 – Figure19 Transp. op. step 2 - Figure 20 On-board transp. op. - Figure 28	Transport Service Management	On-board Support and Control
Transport operation progress	Transp. schedule - Figure 22 On-board transp. op. - Figure 28	On-board Support and Control	Transport Service Management
Transport operation request	Transp. op step 1 – Figure19 On-board transp. op. - Figure 28	Transport Service Management	On-board Support and Control
Transport task progress	Transp. schedule - Figure 22 On-board transp. op. - Figure 28	On-board Support and Control	Transport Service Management
Unload order	Transp. op step 1 – Figure19 On-board transp. op. - Figure 28 Term transhipment - Figure 44	On-board Support and Control	Terminal Management
	Transp. op step 1 – Figure19 On-board transp. op. - Figure 28	On-board Support and Control	Transport Service Management
Waybill	Transp. schedule - Figure 22 Transp. deviation - Figure 23 Term. Op. plan - Figure 38	Transport Service Management	Terminal Management
	Chain administration - Figure 15 Booking, amendment - Figure17 M	Transport Demand	Transport Service Management
	Chain administration - Figure 15 Term. Op. plan - Figure 38	Transport Demand	Terminal Management
Weight and balance information	Transp. op. step 2 - Figure 20 On-board transp. op. - Figure 28	Transport Service Management	On-board Support and Control
Where are you request	Transp. op step 1 – Figure19 Term transhipment - Figure 44	Terminal Management	Transport Demand

Table 1 Interactions in scenarios

11.2.2Mapping towards Modal Terms

The table shows the interactions identified in the diagrams in 11.1 and the terminology within each transport mode that corresponds to the multimodal terminology (mainly in Norwegian)

used in ARKTRANS. The table is preliminary. Information is missing, and it has to be evaluated and updated by representatives from the transport mode.

Multimodal term - English	**Multimodal term - Norwegian**	**Road**	**Sea**	**Rail**	**Air**
Actual route plan	Aktuell ruteinformasjon	Sanntids-informasjon	Aktuell ruteinformasjon	Avviksinformasjon til kunde	Aktuell ruteinformasjon ETA/ETD
Arrival information	Ankomstmelding		Arrival information (Arrival confirmation) Arrival notification	Ankomstmelding (til PIA)	Aircraft arrival/offload Adhoc scheduled message Ankomstmelding
Boarding information	Boarding informasjon		Manifest	NA	
Capacity information	Kapasitets-informasjon	Kapasitets-informasjon			
Certificate information	Sertifikat		Certificate		
Clearance	Klarering		Ship clearance Acknowledge confirmation Priority status	Avgangsmelding	Clearance
Communication	Kommunikasjon		Communication		
Confirmation	Bekreftelse	Aktivitets-bekreftelse	Confirmation		
Contract					
Crew list					
Customs clearance	Toll klarering		-	Tollklarering	
Customs declaration	Toll deklarering	Tollmelding	-	Tolliste	
Damage report					
Dangerous cargo information					
Departure information	Avgangsinformajon		Departure notification	automatisk	Aircraft departure/onload Departure message
Deviation information	Avviksrapport	Avviksinformasjon	Deviation message Damage information Exeption notification	Avvik	
Electronic chart					
Environmental condition					
Exception notification	Avviksmelding		Exception Notification	Avviksmelding	
Exception request		Forespørsel om bred/høy/lang last	Forespørsel om special cargo		Forespørsel om special cargo
Export documentation					
Handling instructions			Loading instruction		
Incident report	Hendelse	Incident	Incident	Incident	Incident
Loading information	Lasteinformasjon Lasteliste		Loading report		
Manifest	Manifest	Lasteliste	Manifest Loading list Shipment list Stowage document Dangerous goods information se firm/pre/conf – consignment ved kontraktinngåelse	Lasteliste Manifest Vognopptak	Godsliste Manifest Farlig last
Meteorological condition			Weather conditions Wave hights (m) Wind strenght (m/s) Tide		
Modal arrival information					
Modal departure information					
Need for service			Service request		
Operation			Operation		
Operational Route	Operativ ruteplan	Kjøreplan	Voyage plan	Operativ ruteplan	Flight plan

Multimodal term - English	Multimodal term - Norwegian	Road	Sea	Rail	Air
Plan			Sailing information		
Plan					
Priority confirmation					
Priority request			-		
Quality assurance confirmation			-		
Regulation					
Report request			-		
Resource plan		Skiftplan Turnus	Crew list Shift list		Skiftplan
Request					
Route assignment			-		
Route information					
Route plan	Ruteplan	Ruteplan	Long term schedule Schedule	Ruteplan	Flightplan
Safety related information				Sikkerhetsrelatert informasjon	Special load notification to captain Summary of special loads
Service booking		Preliminary booking Firm booking Transportinstruksjon Fast oppdrag	Preliminary booking Firm booking Booking confirmation		Service booking
Service booking confirmation			Booking cancellation Booking confirmation		
Service demand			Long term forecast		
Service information			-		
State of driver			-		
State of resource					
State of transport item			-		
State of transport means			Vessel condition		Fuel monitoring
Statistics					
Status report					
Sub-contractor information			-		
Ticket			Boarding card		
Tracking information	Sporingsinformasjon		Status information Proof of delivery Monitoring Status report		
Traffic control information			-		
Traffic flow information		Trafikkavviklingsinformasjon	VTS information Traffic information		
Traffic image					
Transport execution plan	Transportgjennomføringsplan	Reiseinformasjon Reiseplan Forsendelsesplan Omstigningsinformasjon	Voyage plan (consignment)		
Transport means information			Vessel information	Toginformasjon	Flyinformasjon
Transport network condition			Status information Monitoring status		
Transport network deviation					
Transport network information		Elveg NVDB Telerestriksjoner Dynamic data	Kystinfo Fairway condition	Banedatabanken	Transport network condition
Transport operation progress			Progress report Voyage report		
Transport operation plan		Distribusjonsplan	Voyage plan?		Container/palledistibusjon

Multimodal term - English	Multimodal term - Norwegian	Road	Sea	Rail	Air
Transport operation request			Voyage request	NA	
Transport task progress					
Unload order					
Waybill	Fraktbrev		Bill of lading Seaway bill Konnossement Shipment	Waybill Consignment note Fraktbrev CIM (Fraktbrev ved utenlandstransport)	
Weight and balance information					
Where are you request			Position report Noon report		

Table 2 Mapping between multimodal terminology and modal terminology fro interactions

11.2.3Interaction Characteristics

The following characteristics can be stated about the transactions (interactions and related processing) of the transport domain (according to the EU D2D project):

- The information will sometimes travel through insecure communication channels.
- In some situations, the id of the actor will have to be authenticated.
- Data volume is typically low.
- The frequencies of interactions are typically low.
- There is typically no difference in priority between interactions
- The requirements for response time may vary.
- There is typically no deadline for completing business transactions
- Transactions are typically asynchronous (queued), but may in some cases be synchronous.
- Transactions may or may not have contractual (legal) implications invoking special regulations (functional requirements) imposed by external agencies, government etcetera. (traceability, authentication, security, non repudiation
- Transactions may or may not have economic implications invoking special regulations (functional requirements) imposed by external agencies, government etcetera.
- Some transactions may need to store data due to legal implications.
- Traceability, the storing of historical data, may vary depending on user/security/legal defined-requirements.

11.2.4Interaction Descriptions

Some of the interactions are multimodal, i.e. they should be harmonised across the transport modes. These are mainly interactions with the transport user (the Transport Demand sub-domain) and with the terminal (the Terminal Management sub-domain). These interactions, illustrated by means of bold arrows at the figure below, should preferably be the same for all transport modes, since the transport user as well as the terminal may have to relate to them all.

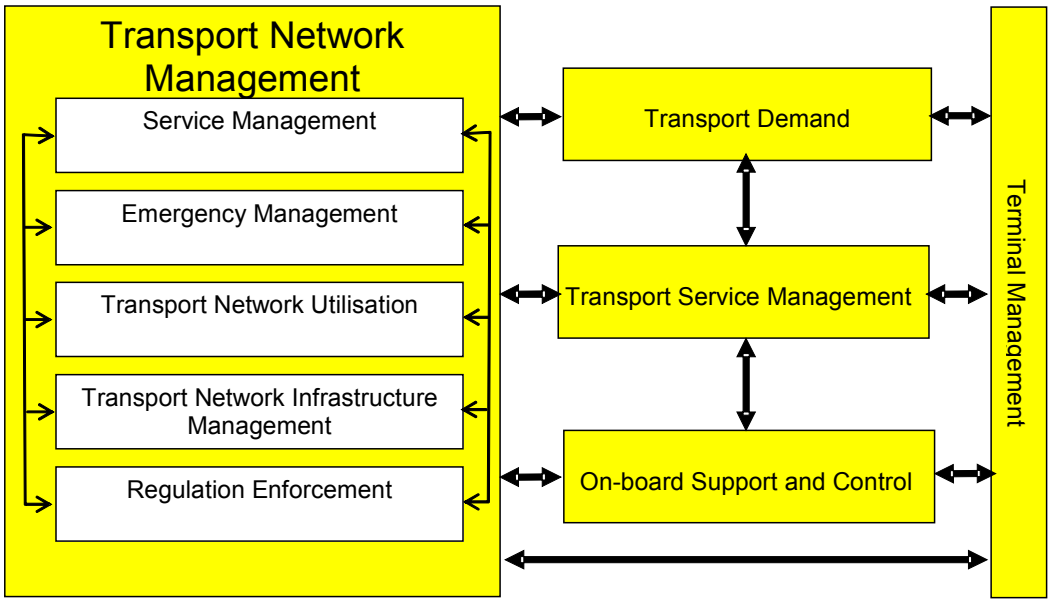


Figure 47 Multimodal interactions

Each interaction may be realised by one ore more information exchanges. The choreography for some of these information exchanges will be further specified in the information view.

11.2.4.1Actual Route Plan

Multimodal interaction.
See Route plan in 11.2.4.42.

11.2.4.2Arrival Information

Multimodal interaction.
Overall information about estimated or actual time of arrival directed to named recipient (e.g. a transport network authority, a terminal or a transport user). More detailed modal information may be required by specific actors, e.g. actors responsible for traffic control (see the Modal Arrival Information interaction).
May contain:

- Transport means identification or trip identification
- Timestamp
- Point of departure
- Destination
- ETA
- ATA

Realisation for personnel transport is further specified in the information view upon route information in chapter 12.

11.2.4.3Boarding Information

Multimodal interaction.
List of passengers that have actually boarded the transport means. This information may also include information about seat allocations, cabin allocations, etc. It may differ from the passenger list that is based on booking information.
In case of emergency situations, the boarding information provides information about passengers on-board.

11.2.4.4Capacity Information

Multimodal interaction.
This information is sent from the transporter to the transport user or transport user agent to indicate the amount of free space on a specific departure. May include:

- Route information
- Leg information
  - Departure terminal
    - Location
    - ETA
    - ETD
  - Destination
    - Location
    - ETA
  - Capacity

11.2.4.5Certificate Information

This information covers the certificates of the Crew. A certificate provides information about the qualifications of a person, e.g. the qualification of driving transport means carrying a specific type of dangerous cargo, navigation qualifications for specific areas, etc.
It has to be realised according to modal standards.

11.2.4.6Clearance

Provides permissions to access, arrive, depart, etc. May also be negative. Also response to an exception or priority request.
It has to be realised according to modal standards.

11.2.4.7Communication

Voice communication between transport means and fleet operator.
It has to be realised according to modal standards.

11.2.4.8Confirmation

Confirms that a transport task can be carried out.
It has to be realised according to modal standards.

11.2.4.9Contract

A contract describes business conditions. May contain

- ContractID
- Contract type (Standard, long term, short term, load unit type)
- Contract time frame
- Customer
- Service provider
- Service type (see service information in 11.2.4.47)
- Quantity
  - Type
  - Total quantity (min, max)
  - Trip quantity (min, max)
  - Committed quantity

    - Timeframe
- Quality
    - Priority (express, high speed, normal speed, post service)
    - Cost level
    - Security
    - Clean
    - Religious requirements
- Transport item information
    - Transport item type
    - Transport item description
    - Load unit type
    - Alert conditions
    - Transport item instructions (environment, temperature, ventilation, atmosphere, delivery air temperature, carbon dioxide, oxygen)
- Terms
    - Price
    - Payment
    - Penalty (Demurrage, Damage, ServiceDeviation)
    - Bonus (early delivery)
    - Commissions (broker – Percentage/min/max, terminal)
    - Ability to change
    - Availability
    - Other conditions
- Place of receipt
- Final destination

11.2.4.10Crew List

Multimodal interaction.
Provides information about the crew on board a transport means.

11.2.4.11Customs Clearance

Multimodal interaction.
Indicates that a Transport Item has passed the customs.

11.2.4.12Customs Declaration

Multimodal interaction.
Requests a customs clearance. Is sent by the Transport User or a Transport User Agent (Declaration Agent) that is representing the Transport user. May also be sent from a terminal. States a view upon whether duty is to be paid or not.

11.2.4.13Damage Report

Multimodal interaction.
Reports damage to a Transport Item.

11.2.4.14Dangerous Cargo Information

Multimodal interaction.

Overall information or detailed information (depending on the situation) about a transport means carrying dangerous cargo. In case of no emergency overall information informing about the presence of dangerous cargo is sufficient. In case of emergency detailed information is required. May contain one or more of the following:

- Information about the presence of dangerous cargo.
- Information about dangerous cargo type
- Information about the amount and localisation of dangerous cargo on board
- Information about how to handle such dangerous cargo

11.2.4.15Departure Information

Multimodal interaction.
Overall information about estimated or actual time of departure directed to named recipient (e.g. a transport network authority, a terminal or a transport user). More detailed modal information may be required by specific actors, e.g. actors responsible for traffic control for the specific transport mode (see the Modal Departure Information interaction).

May contain:

- Transport means identification
- Timestamp
- Point of departure
- Destination
- ETD
- ATD

Realisation for personnel transport is further specified in the information view upon route information in chapter 12.

11.2.4.16Deviation Information

Multimodal interaction.
Includes information about actual or foreseen deviations with respect to the provision of published transport services such as cancellations, delays, disruptions, early arrivals, transport alterations, stop alterations, reduced service, increased service, etc.
The Deviation Information may be public (Exception Notification is however directed to named recipients, e.g. the Transport User which has booked a specific transport, and may contain information about deviations with respect to the state of the Transport Item) and may include information about:

- Time schedule deviations
  - Delay. May
  - Early arrival/departure.
- Transport execution deviations
  - Disruption
  - Cancellation
  - Execution alterations with respect to transport modes, replacement of transport means, reduced capacity, and re-routing to new journey patterns.
- Service deviations
  - Reduced service (with reference to service)
  - Increased service (with reference to service)
- Stop deviation

    - New stop added
    - Stop omitted
- Other deviations
- Additional information
    - Transport means position
    - Number of people involved
    - Type of cargo involved
    - Dangerous goods involved,
    - Distance to third party

Realisation for passenger transport is further specified in the information view upon route information in chapter 12.

11.2.4.17Electronic Chart

Electronic chart used for navigation and provision of geographical information.
Realisation should be done by means of standards for provision of electronic charts.

11.2.4.18Environmental Condition

Multimodal interaction.
In formation about pollution (dust, spill of harmful materials, etc.), noise, etc.

11.2.4.19Exception Notification

Multimodal interaction.
Specific notification about a deviation concerning a booked or ongoing transport task. Indicates a deviation from a transport execution plan. The exception notification is directed to a specific actor, e.g. the Transport User. (The Deviation Information is however a general deviation report that may be public.)

An exception notification is issued according to exception notification conditions set by the Transport User in the transport execution plan. The exception notification may indicate a damage, a delay or violations to other conditions.
Exception notifications may be provided in different ways (according to predefined agreements) like automatic response to an information system, SMS to mobile phone, etc.
An exception notification must contain:

- Reference to the transport execution plan
- Reference to the Transport Items, bookings or waybills involved
- Type of deviation. This may be
    - Deviations with respect to Transport Item
        - Missing Transport Item
        - Un-registered Transport Item
        - Cargo deviations with respect to transport item instructions, quantity, and damage
        - Passenger deviations with respect to transport item instructions, injury and illness
    - Missing clearances for
        - Transport means
        - Transport Item
    - Time schedule deviations – Delay or early arrival
    - Transport execution deviations

    - Disruption
    - Cancellation
    - Execution alterations with respect to transport modes, replacement of transport means, reduced capacity, and re-routing to new journey patterns.
- Stop deviation
    - New stop added
    - Stop omitted
- Service deviations
    - Reduced service
    - Increased service
- Damage affecting or caused by third party

11.2.4.20Exception Request

Request for specific permission or assistance. E.g. related to the transport of load that is higher or broader that usual.
Realised according to modal standards.

11.2.4.21Export Documentation

Multimodal interaction.
Documentation required about Transport Items that are to be exported.

11.2.4.22Handling Instruction

Specifies conditions that are to be considered during a transport operation (also called cargo instructions). Based on the transport item instruction part of the waybill and on conditions defined by regulations and frameworks (e.g. related to type of Transport Means, type of cargo). For passenger transport the handling instruction may include requirements for special treatment and special terms of agreement, e.g. for handicapped Travellers, unaccompanied children, diseases/allergy, etc.
Realised according to modal standards.

11.2.4.23Incident Report

Multimodal interaction.
Is issued on detection of an incident. Regulations will provide rules for when and to whom the reports are to be sent. Some incident reports may for example be sent to the Traffic Control Centre that has to ensure that the incident does not cause emergencies.

An incident report will identify the type of incident and provide related information (location, timestamps, etc.). Some incident types may be local to a transport mode or to specific actors. Information about such incident will not be propagated further. However, some incident types may be common to the whole transport domain.
Incidents may be:

- Unwanted situations and situations that may lead to emergencies (e.g. minor accident, engine breakdown, error, dangerous behaviour, robberies, etc.)
- Near accidents
- Specific transport network conditions
- Specific weather conditions
- Specific environmental conditions (e.g. pollution)

Information about accidents may include:
- Type of incident
- Position
- Number of people involved
- Number of fatalities
- Number and types of injuries
- Dangerous goods involved,
- Surroundings

11.2.4.24Loading Information

Multimodal interaction.
Specifies the cargo that is loaded and where it is or is to be localised on-board the transport means and how it should be loaded or unloaded, specific loading instructions included.

11.2.4.25Manifest

Multimodal interaction.
A specification of all transport items on board the transport means for official and administrative purposes. May be
- List of passengers that have actually boarded the transport means. May include the following information for each passenger:
  - Passenger ID
  - Passenger category (man, woman, child, baby)
  - Agreement (business class, tourist class, etc.)
  - Resource allocation (seat, cabin, compartment, etc.)
  - Handling instructions. May include requirements for special treatment and special terms of agreement, e.g. for handicapped travellers, unaccompanied children, diseases/allergy.
- Information about all cargo on-board the transport means. May contain the following information for each Transport Item:
  - ID (Load unit ID or Waybill id)
  - Consignor and consignee (with respect to this trip)
  - Size and weight
  - Information about certificates
  - Information about special load (dangerous cargo, food, etc.)
  - Position on-board

11.2.4.26Meteorological Condition

Multimodal interaction.
Information about meteorological conditions.
Realisation for some types of meteorological information may be done according to ARKMIN . The ARKMIN Meteorological information model defines relevant information, and the meteorological request, response and report message elements may be used (see http://www.fargisinfo.com/Arkmin/Arkmin/index.html).

11.2.4.27Modal Arrival Information

Information about arrivals needed by for example the traffic control. May contain:
- Transport means identification

- Timestamp
- Point of departure
- Destination
- ETA
- ATA

Realised according to modal standards.

11.2.4.28Modal Departure Information

Information about departures needed by for example the traffic control. May contain:

- Transport means identification
- Timestamp
- Point of departure
- Destination
- ETD
- ATD

Realised according to modal standards.

11.2.4.29Need for Service

The transport means or the crew on the transport means may report about needs for misc. services, e.g. some sort of assistance, or amendments to services that already are booked.
Realised according to modal standards.

11.2.4.30Operation

Operation or command that will be handled and responded upon by Transport Means Equipment. May facilitate automated operation of transport means or automated support to the Driver.
Realised according to modal standards.

11.2.4.31Operational Route Plan

Specifying the route for a specific transport operation (departure and arrival locations, time schedules, how to get between the locations, etc.). Used by the Fleet Manager and sent to the Crew on the transport means to inform about the route and time schedule of a specific the transport operation.
May include:

- Route information (id, description, etc.)
- Valid for information
- General information
- List for one or more locations that should be visited
    - Location information (terminal, address, etc.)
    - ETA
    - ETD
    - Tasks to be done
    - Guidelines (how to drive, etc.)
    - Remarks

Realised according to modal standards.

11.2.4.32Plan

Emergency plans and other plans used for safety and quality evaluation in traffic control centres.
Realised according to modal standards.

11.2.4.33Priority Confirmation

Confirms (positive or negative) a Priority Request..
Realised according to modal standards.

11.2.4.34Priority Request

Request for specific priority.
Realised according to modal standards.

11.2.4.35Quality Assurance Confirmation

Confirms that safety and quality assurance procedures are accomplished according to regulations.
Realised according to modal standards.

11.2.4.36Regulation

Regulation information.
Realised according to modal or other standards.

11.2.4.37Report Request

Request for a specific status report.
Realised according to modal standards.

11.2.4.38Resource Plan

One for each resource involved in a transport operation. Specifies the working plan for personnel and transport means.
Realised according to modal standards.

11.2.4.39Request

Request for law enforcement assistance or other type of assistance.
Realised according to modal standards.

11.2.4.40Route Assignment

Specification of the route assigned to a specific transport means.
Realised according to modal standards. The assignment has to be followed.

11.2.4.41Route information

Distributed by TCC. Describes the recommended normal routes, alternative routes and route diversions (in case of obstructions). It is up to the crew on board to decide how to adapt to the route information.
Realised according to modal standards.

11.2.4.42Route Plan

Multimodal interaction.

Route plan information that will be of interest to Transport Users, Terminals, traffic control centres, and others outside the control scope of the Transporter or Fleet manager. (The Transporter, Fleet Manger and the Driver/Crew will however mainly use an Operational Route plan – see 11.2.4.31). May include the following types of route plans:

- Draft route plan - Used for strategic and tactical planning. Will be a preliminary version of the planned route plan.
- Planned route plan – The plan on which the operation is based (also called route plan)
- Actual route plan – The real time information about estimated or occurred arrivals and departures

The Actual Route Plan provides real time information about arrivals and departures, and the information may be published to a wide spectre of transport users by means of various information services. (Arrival and Departure Information is however directed to named recipients, e.g. a transport network authority, a specific terminal or a specific transport user).

Realisation for passenger transporters is further specified in the information view upon route information chapter 12. The route plan interaction may include one or more of the following messages:

- Trip information (id, description, etc.)
- Terminal information (id, transfer, services, etc.)
- Trip pattern information (terminals that are to be visited, etc.)
- Time table patterns showing planned routes
- Time schedule information including actual routes
  - Time schedules for one or more checkpoints on a route.
  - Deviation information about delays for one or more locations, cancellations, changes in level of service, etc. (However, the Deviation Information interaction, see 11.2.4.16, may also be used for this purpose.)
- Service information that includes information about services, features and restrictions related to trips, passenger terminals, stops, etc.

11.2.4.43Safety Related Information

Information that is provided to the crew ahead of a transport operation.
May include:

- Type and Quantities of Dangerous Goods
- Fire extinguishers onboard
- First Aid Skills of Crew
- Emergency Preparedness Means
- Onboard Contingency
- Plans
- Company Contingency Plans,
- Contact/Key-personnel
- Condition of Transport Means

Realised according to modal standards.

11.2.4.44Service Booking

Multimodal interaction.
Many types of bookings may be handled by this interaction:

- Preliminary booking – prior to a firm booking

- Firm booking
- Booking amendment – must be according to the contract

Includes information that enables a service provider to allocate the necessary resources for the requested period.
A booking of a transport service may contain:

- Administrative information such as
  - Booking reference (preliminary booking or booking that is to be amended)
  - Customer id
  - Customer reference
  - Customer agent id
  - Booking type (preliminary, firm, amendment)
  - ContractID (reference to standard contract or specific contract)
  - ReceiverId
  - Service preference
  - Place of receipt
  - Final destination
  - Agreement conditions such as
    - Costs
    - Payment
    - Earliest pickup time
    - Latest pickup time
    - Earliest delivery time
    - Latest delivery time
    - Pickup location (contact, address, reference)
    - Delivery location (contact, address, reference)
    - Notify party
    - Changing abilities
    - Penalty
- One or more information elements describing the required services
  - TransportUnitType
  - UnitID
  - Load unit type
  - Cargo type
  - Transport means (modality, code, name, actor customisation)
  - Preferences
  - Dangerous cargo
  - Transport item instruction (special needs, temperature, handling instruction, …)
  - Additional services (tracking, alert conditions, administrative services, etc.)
  - Quantity (type, value)

11.2.4.45Service Booking Confirmation

Multimodal interaction.
Confirmation of a service booking. May contain:

- Reference to service booking
- Positive or negative confirmation

- Selected parts of the service booking message used to confirm or provide information, e.g. price information

11.2.4.46Service Demand

Multimodal interaction.
Describes the need for services in the future and may contain.

- Service type
  - Administrative (documents, etc.)
  - Transport
  - Terminal (handling, load, unload, depot, storage, customs, transhipment, etc.)
- Quantity
  - Type
  - Total quantity (min, max)
  - Trip quantity (min, max)
  - Commited quantity
  - Timeframe
- Quality
  - Priority (express, high speed, normal speed, post service)
  - Security
  - Clean
  - Religious requirements
- Transport item information
  - Transport item type
  - Transport item description
  - Load unit type
  - Alert conditions
  - Transport item instructions (environment, temperature, ventilation, atmosphere, delivery air temperature, etc.)
- Place of receipt
- Final destination

11.2.4.47Service Information

Multimodal interaction.
Information about services provided by Transporters, Terminals, Service Providers, and others.
Information about the service types may be provided. May include:

- Service ID (identifies the service)
- Service provider information
- Service type description (see below)
- Provision of additional services
- Service quality information such as
  - Priority (express, high speed, normal speed, post service)
  - Security
  - Adaptation to cleanness requirements
  - Adaptation to handling requirements
  - Adaptation to religious requirements

- Terms
- Information related to this service type

The following services types are available:
- Misc. transport service like (transport from one location to another)
  - Passenger transport
  - Luggage transport
  - Car transport
  - Freight transport
- Misc. services related to passenger transport (Realisation is further specified in the information view upon route information in chapter 12.
  - En route services that are provided on-board the transport means, at stops and at terminals (handling services, entertainment services, payment services, travel information services, tourist information services, assistance provided, free offers, attendance)
  - Facilities that are provided on-board the transport means, at stops and at terminals (whereabouts facilities, surrounding facilities, office facilities, shopping facilities, ticket sale facilities, refreshment sale facilities, facilities for children, facilities for disabled people, accommodation, etc.)
  - Restrictions valid for trips and terminals (stop restrictions, transport restrictions, access restrictions)
- Handling services at terminals (check-in, load, unload, depot, storage, customs, transhipment, etc.)
- Administrative services – e.g. document preparation and issue (customs declarations, etc.)
- Agent services – preparations, etc.
- Inspection services
- Customs services
- Maintenance services
- Navigation support services (e.g. pilotage, tugboat)
- Trip service information (0..*)
- Stop service information (0..*)
- Passenger terminal service information (0..*)
- Transfer service information(0..*)

Information about service that can be provided is:
- Type of service
- Service provider information
- Costs
- Conditions

For transport services the following information is relevant:
- Comments (limited capacity, etc.)
- Costs
- Capacity
- Deviation information (statistics, expected delays, etc.)
- Information about transport means (kind of, size, etc.) and

For terminal services the following information is relevant:
- Transfer information (terminal information, expected time, etc).

- Transit times
- Check in times
- Available resources (equipment etc.)

11.2.4.48State of Driver

Important operational issues are

- The state of the driver with respect to driving and resting hours (influences on whether the transport can be done according to the plans.
- Driver tiredness
- Driver stress
- Level of disturbance/absence of mind
- Level of experience
- Level of knowledge about route and cargo and local traffic conditions

Realised according to modal standards.

11.2.4.49State of Resource

Static as well as dynamic information about operative state, maintenance, economic transactions related to resources, e.g. equipment on-board the transport means.
Realised according to modal standards.

11.2.4.50State of Transport Item

Multimodal interaction.
Static as well as dynamic information about physical state of a Transport Item provided from on-board the transport means and to the Transporter, or provided between terminal actors. (The Status Report interaction is however used towards the Transport User or Transport User Agent). May provide information about the state with respect to:

- Terminal operations (e.g. loaded, unloaded, in transit)
- Transport operation (e.g. collected, ongoing, delivered)
- The physical condition of the Transport Item (temperature, humidity, etc.)

11.2.4.51State of Transport Means

Static as well as dynamic information about operative state, maintenance, economic transactions related to the transport means. May provide routine reports, e.g. reporting of mileage.
Realised according to modal standards.

11.2.4.52Statistics

Multimodal interaction.
May be several statistics reports.

11.2.4.53Status Report

Multimodal interaction.
Reports to the Transport User or Transport User Agent about the status of a transport task and transport items with respect terminal and transport operation and with respect to the location of and the condition of the transport items. May include misc. information, e.g.:

- Status of terminal operations (e.g. loaded, unloaded, in transit)
- Status of transport operation (e.g. collected, ongoing, proof of delivery)

- Tracking information such as location
- The physical condition of the Transport Item (temperature, humidity, etc.)

11.2.4.54Sub-contractor Information

Realised according to modal standards.

11.2.4.55Ticket

Multimodal interaction.
Electronic confirmation of the entitlement to transport.

11.2.4.56Tracking Information

Multimodal interaction.
Reports the localisation of a Transport Means or a Transport Item. The tracking information is provided from on-board equipment or equipment attached to Transport Items. Tracking is provided to the Transporter or Fleet Manager, to TCC or between terminal actors. The Transport User or Transport User Agent will however get tracking information in the Status Report.

11.2.4.57Traffic Control Information

Specific traffic control information related to safety distributed from the TCC to Transporters, Fleet Operators, Crew onboard transport means and Transport Users.
Realised according to modal standards.

11.2.4.58Traffic Flow Information

Multimodal interaction.
Dynamic information about the amount the traffic flow. May include:

- Information about traffic density
- Information about traffic speed
- Information about incidents, etc.
- Indication of type of information (historical information, current situation or prognosis for the future (forecast), etc.)

11.2.4.59Traffic Image

Information about the transport means in an area with respect to position, speed, direction, and the destination they are heading for.
Realised according to modal standards.

11.2.4.60Transport Execution Plan

Multimodal interaction.
The basis for a transport order. The content of a transport execution plan depends on the viewpoint. The transport execution plan as seen from the Transport User’s point of view (in the Transport Demand sub-domain) will encompass the whole transport chain and may consist of several legs, as shown in A of the following figure. However, a Transporter will just need the transport execution plan for the legs accomplished by this Transporter. Thus, a subset of the total transport execution plan is the basis for the order (see B in the figure).

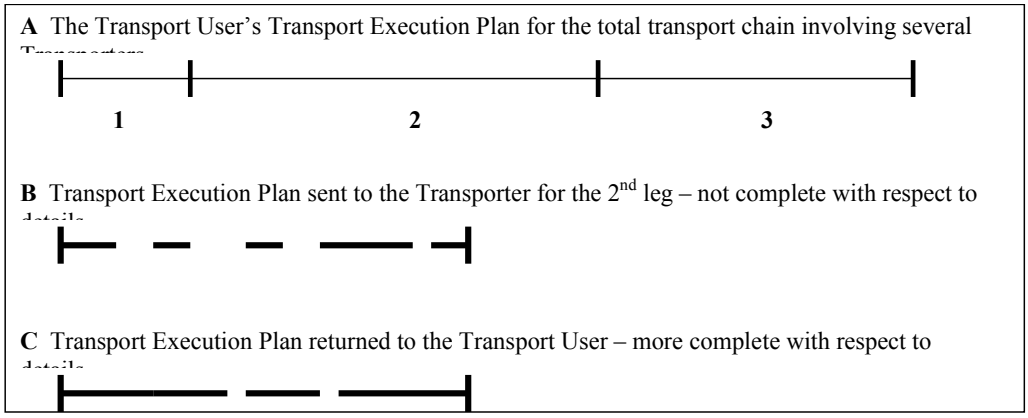


Figure 48 Transport execution plan

An order with the required subset of the transport execution plan is received from the Transport Demand sub-domain. The plan may encompass one or more legs that are to be managed by this Transporter. The Transporter may also split a leg into more legs if such a split is feasible (in the example in the above figure the Transporter is responsible for one leg). Each leg will be described by a separate subset of the transport execution plan.
On reception of the order, the transport execution plan is not complete. Detailed route information, detailed time schedules, all legs, etc. may not be defined as indicated by the broken line in B. It is up to the Transporter to make a detailed plan (as shown in C in the figure). If feasible, the detailed plan should be sent back to the Transport User.
A transport execution plan may contain the following information:

- Demand definition
  - Relevant parts of GTP (General Transport Preferences)
  - Preferred Transporters and the associated customer numbers
  - Preferred transport modes
  - Criteria for optimising (costs, time, comfort, quality, contract references, environmental issues, etc.)
  - Relevant parts of ATP (Actual Transport Preferences) such as
    - Preferred seat
    - Start location
    - End locations
    - Departure time or interval
    - Arrival time or interval
    - Required transits
    - Requirements concerning the ability to change the plans (deadline for cancellation or changes, costs related to changes, etc.), the ability to give Exception Notifications in case of deviations, etc.
    - Other requirements (e.g. environmental profile, restrictions with respect to additional cargo on the transport means, no tunnels, no smoker, transport item instruction, etc.).
  - Information about the Transport Items to be transported (passenger(s) or cargo)
  - Transport item instructions. May include requirements for special treatment and special terms of agreement for a transport item, e.g. for handicapped travellers, unaccompanied children, traveller with diseases/allergy, food, etc.
  - Exception Notification conditions

- Operational transport execution plan
  - Departure and arrival locations
  - Departure and arrival times
  - Documents to be issued and submitted
  - Services to be provided

The operational part of the transport execution plan can for passenger transport be realised by means of the itinerary information described in information view upon route information in chapter 12.

11.2.4.61Transport Means Information

Information about the transport means.
Probably realised according to modal standards.

11.2.4.62Transport Network Condition

Multimodal interaction.
Dynamic information about abnormal and unplanned conditions in the transport network (slippery road, turbulence, high waves, obstructions, restricted view, air pollution, oil spill, etc.) due to situations that cannot be controlled (weather, incidents, accidents, etc.). May affect safety as well as the traffic flow.

May be historical information, current situation or prognosis for the future (forecast).

11.2.4.63Transport Network Deviation

Reports about deviations in the transport network.
Realised according to modal standards.

11.2.4.64Transport Network Information

Multimodal interaction.
Static as well as dynamic information about planned situations in the transport network infrastructure and regulations valid in the transport network (e.g. closes roads, maintenance , platooning, speed limitations, restrictions, constraints, and diversions). The information may be used for route planning
May include:

- Route specifications
- Speed limitations
- Quality
- Constraint information:
  - Type of constraint
  - Localisation
  - Condition (normal, reduced)
  - Remarks

11.2.4.65Transport Operation Plan

Specifying the transport operation that is to be carried out by a transport means (what/who is to be transported between the locations specified in the Operational Route Plan).
Realised according to modal standards.

11.2.4.66Transport Operation Progress

Reports the progress of a transport operation. May provide ETA or ETD (manually estimated and automatically calculated).
Realised according to modal standards.

11.2.4.67Transport Operation Request

Requests whether the Crew can accomplish a transport operation or not.
Realised according to modal standards.

11.2.4.68Transport Task Progress

Information from Transport means/Crew to Fleet Manager about the status of a transport task, proof of delivery and misc. problems.
Realised according to modal standards.

11.2.4.69Unload Order

Multimodal interaction.
Information about specific Transport Item that is to be unloaded.

11.2.4.70Waybill

Multimodal interaction.
The Waybill is transport item information that is established by those who are organising the transport (transport user or transport user agent).

- For freight transport this will be an electronic waybill that specifies the cargo transported for a customer to a specific recipient (also called consignment note). The waybill is issued by the Transport User or Transport User Agent according to directions given by the transporters that are involved. In some cases the waybill is not issued until the check in.
- For passenger transport this can correspond to a ticket that is checked in (a boarding card)

One waybill may, if possible according to the waybill customs for the transporters involved, encompass several transporters. However, in many cases new waybills have to be issued for each leg.
The waybill may contain:

- Reference to load unit identifier, e.g. container ULD no (Unit LoadDevices no), or Waybill no for Transport Items that are not load units. A load unit may contain Transport Items with waybill numbers.
- Waybill no (for air transport: prefix that identifies transporter + sequence number within the forwarder’s interval for this transporter)
- List of shipment information defining the pre-booked route
  - Trip number
  - Part shipment information (the cargo related to the waybill may be spilt – transport accomplished by means of several trips)
- Check in information (whether the cargo is checked in or not)
- Invoice information
- Insurance information
- Transport user's reference
- Origin location
- Destination location

- Remarks – e.g. transfer information
- Consignee at the destination (who will pick up the cargo, may be the recipient, an agent, a transporter, etc.). This recipient may also be responsible for handling at the terminal, e.g. splitting.
- Transport item instructions
  Information about the Transport Item that follows the Transport Item to ensure proper handling through the whole transport chain.
- Transport Item information
  - Information about the cargo
    - Transport Item type
    - Quality certificate
    - Quantum
    - Value
    - Special needs (temperature, etc.)
  - Cargo type
  - Special load
    - Food
    - Animals
    - Human remains
    - Valuables
  - Dangerous cargo declaration for all relevant modes

nce Information

Information that has to be checked by the Captain.
Realised according to modal standards or agreements.

equest

Multimodal interaction.
Search for a Transport Item that is missing. Issued as a part of the no-show handling.

11.3Interaction Framework

We assume that the simple interactions are between two parties, the *service provider* and the *service user*. An ITS may possess both roles. Different types of interactions may be executed, depending on whether information is requested, pushed or reported:

1. Request - response interactions
   These interactions are motivated by a need for information. The service user *requests* information provided by the service provider. The service provider *responds* by transmitting the resulting reply to the service user.
2. Report interactions
   These interactions will fulfil established reporting procedures. The service user *reports* information to the service provider, which *responds* by transmitting a confirmation.
3. Push interactions
   These interactions are usually based on an agreement between the service user and the service provider. On fixed times or according to other agreements the service provider takes the initiative to push (send) information to the service user without any previous information request. The service user *responds* by transmitting a confirmation.
4. Business Transactions
   These interactions are used when more complex business relations are to be executed.

An interaction is the exchange of one or more messages according to some predefined rules defining the message types that can be exchanged and the sequence in which they can be exchanged. A specific message type contains information according to some predefined formats. In the following the message sequences for the interaction types are described.

11.3.1Request-response interaction message sequence

A service user requests information by sending a *request* message to a service provider expressing the need for information. On reception of the *request* message the service provider checks and processes the request. If the request is found to be valid it will be responded to by a *response* message containing the outcome of the request. A request that cannot be processed is responded to by a *response* containing an error indication.

Figure 49 Message sequence diagram for information request and response

11.3.2 Report interaction message sequence

A service user reports information by sending a *report* message to a service provider. The service provider checks and processes the information. The report will be responded to by a *confirmation* message that indicates either a successful reception or an error condition.

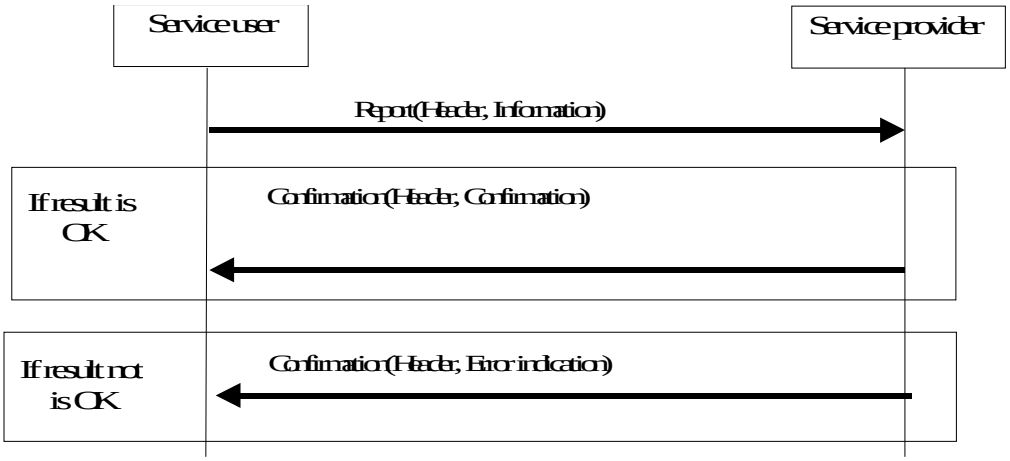


Figure 50 Message sequence diagram for the report interaction

11.3.3Push interaction message sequence

For pushing information the service provider sends a *push* message to the service user. The content is according to the agreement between the service user and the service provider. The service user will receive and process the information. To confirm the reception of a *push* the service user sends a *confirmation* message to the service provider. The *confirmation* either confirms a successful reception or indicates an error condition.

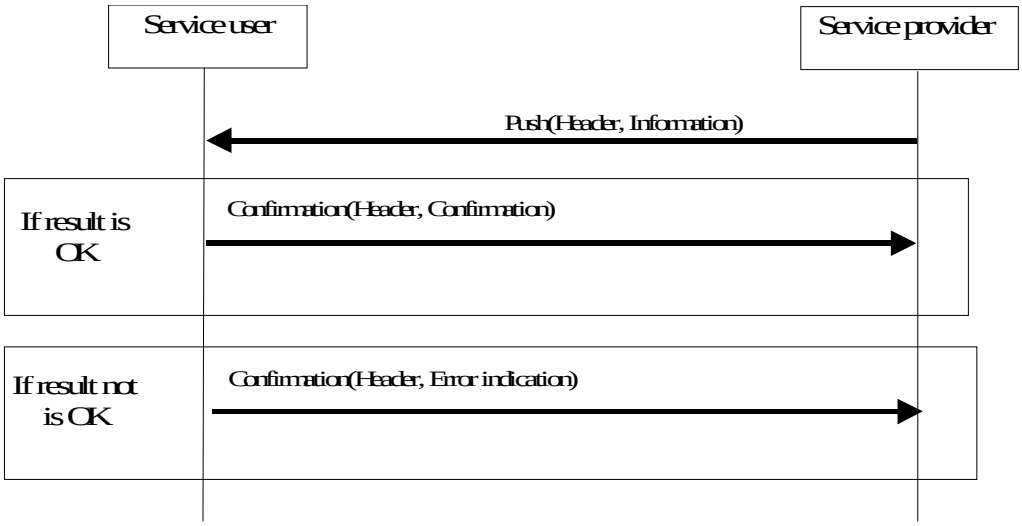


Figure 51 Message sequence diagram for information push interaction

11.3.4Business Transactions

Business Transactions may support more complex interactions (not simple request – response, report or push interactions) handling electronic business relations between actors. Such

business relations must be performed according to predefined rules that ensure consistency with agreements.
Several business transactions will be needed. However, they will have much in common when it comes to generic requirements, e.g. the ability to send and receive confirmations and cancellations at predefined states. Thus, an existing *business transaction framework* should if possible be used as the basis for the specification of the business transactions. The use of such a framework is favourable as it specifies generic mechanisms for the handling of business relations, and existing frameworks are likely to be more complete than any "home made" solutions.
This section describes some overall information about business transactions, the need for such transactions in the transport domain, and the use of an existing framework for business transactions. It has to be decided which of the interactions described in 11.2 that should be implemented as business transactions. Some technologies that may be used to realise such transactions are described in Chapter 16.

11.3.4.1Business Transaction Concepts

Some relevant definitions from the Web-service glossary of the World-Wide-Web consortium are:

- A *business* is "a series of processes, each having a clearly understood purpose, involving more than one organization, realized through the exchange of information and directed towards some mutually agreed upon goal, extending over a period of time."
- "The fundamental characteristic of a *transaction* is the ability to join multiple actions into the same unit of work, such that the actions either succeed or fail as a unit. Transaction is a feature of the architecture that supports the coordination of results or operations on state in a multi-step interaction."
- A *business transaction* is "a logical unit of business conducted by two or more parties that generates a computable success or failure state. The community, the partners, and the processes, are all in a definable, and self-reliant state prior to the business transaction, and in a new definable, and self-reliant state after the business transaction. In other words if you are still 'waiting' for your business partner's response or reaction, the business transaction has not completed."

According to OASIS :

- A *Business Transaction* is "a set of state changes that occur, or are desired, in computer systems controlled by some set of parties, and these changes are related in some application defined manner. A *Business Transaction* is subject to, and a part of, a *business relationship."*
- A *business relationship* is "any distributed state held by the parties, which is subject to contractual constraints agreed by those parties."
- The Business Transaction Protocol, specified by OASIS, assumes that "the parties involved in a *Business Transaction* have distinct and autonomous Application Systems, which do not require knowledge of each others' implementation or internal state representations in volatile or persistent storage. Access to such loosely coupled systems is assumed to occur only through service interfaces."
- Business collaboration

ARKTRANS will adopt these concepts. According to the definitions, interactions between parties that are to take place according to pre-defined agreements, e.g. the specifications in ARKTRANS, are business transactions. However, to minimise the overhead, we will consider restricting the use of the business transaction framework to complex interactions (not simple

request – response, report or push interactions) that may last for a longer period of time, and to interactions concerning commercial services.

11.3.4.2Business Transactions vs. Traditional Transactions

The nature of business transactions differ from the nature of traditional transactions in several ways:

- Business transactions are executed in loosely coupled environments involving many parties in many different organisations; traditional transactions are executed in closely coupled environments (e.g. accessed by a LAN);
- Traditional transactions have short duration and they lock data resources and hold physical resources (e.g., connections, threads, memory). The locking causes isolation in the sense that intermediate updates of for example data are not visible to others until the successful termination of the transaction. Business transactions may potentially last for hours and days, and in many cases the participants cannot afford to hold resources exclusively. Intermediate updates may have an impact outside the business transaction, and resources must be shared prior to the completion of the transaction.
- Traditional transactions are atomic. They abort if a sub-task fails. In business transactions, business logic will handle business exceptions and decide whether a transaction should abort or not. The failure of a single low-level task may not necessarily abort a business transaction. All participants are autonomous, and negotiations between the participants must be supported.
- In case of fault situations, it is inexpensive to abort and retry a traditional transaction (roll back is used). A business transaction that cannot be fulfilled may however have more complex repercussions. Information about customers and financial conditions may for example be affected and cause problems. Thus, it may be necessary to record all state transitions and related data. A *compensation* defines the logic for reversing the effects. The compensation must be effectuated after the transaction completes. A parent transaction fulfils its responsibility to compensate by providing its own set of activities, and by invoking the compensating activity of nested transactions.

11.3.4.3Business Transaction Message Sequences

There may be a need for both two-party and multi-party transactions. However, interactions are usually between pairs, and even multi-party transactions are usually composed of two-party sub-tasks that may be nested, where the coordination between interrelated sub-tasks is the responsibility of one party. Two-party sub-tasks are practical for many reasons. They simplify the management as accountability and economic commitments can be restricted to two parties. Contracts between two parties are also easier to establish, and changes will just involve those two parties. Security is also an important issue. In two-party contracts the parties just get to know what they need to know. Those parties that are coordinating sub-tasks must of course see to that the contracts between with the other parties contribute to the fulfilment of the business transaction.

12Information View on Multimodal Route and Travel Information

The information view on multimodal route and travel information shall arrange for the improvement and reconditioning of route and travel information services. Such services are crucial considering the addressed need for increased use of public transport. The work encompasses all transport modes (road, sea, rail and air) and is established as a joint effort by a wide spectre of Norwegian authorities and stakeholders who represent deep knowledge about route and travel information for road, sea, rail, and air transport. Thus, the results are harmonised across all transport modes, and the usability is also considered. We have also consulted representatives for people with disabilities to get input from transport users with specific needs. The special information needs for disabled, and the terms 'Universal design' and 'accessibility' have gained focus, and will be discussed in their own sections.

This Chapter describes the current version of the information models. Work is still going on, and the models will be changed.

12.1Problem Specification and Motivation

Travel planning and travel information services are emerging and offered by the transport companies themselves and by third party service providers. Good quality services require up to date information about time schedules, route patterns, and deviations. The information acquisition is however a bottleneck, especially for service providers that depend on input from many transport companies and multiple transport modes. Missing interoperability and poor harmonisation is a problem as there are several input formats, and the willingness and ability to provide input are also varying. Manual registration and processing is required, and bugs, missing information, and the lack of timely updates are significant problems. There's a challenge in registering too much information, and risk ending up with a lot of old and useless information, and too little information, not giving the users the information they want.

The planning of journeys that involve several transport companies and transport modes often is a problem. Planning services are to some extent established for local areas or regions, but the planning of more complex long-distance door-to-door travels that can be carried out in several alternative ways is not supported or limited to just a few of the available alternatives.

The travellers want dynamic services that provide timely information about status and deviations (delays etc.). Such services are to some extent provided by the transport companies or terminal operators through dedicated information channels at for example railway stations, airports and bus terminals, or via Web-pages and radio channels. However, the need for dynamic information should be addressed in a more individual and flexible way. Individual needs with respect to what information that is required, when it is required, and how it is to be provided are usually not reflected. Special concern should be given to disabled persons.

Information about services and facilities that can be provided on-board the transport means and at the terminals (toilet, nursery, support for disabled people, shops, etc.) is not collected and provided as a part of the travel information that spans more than one transport company. Such information may be crucial when the best transport alternative is to be selected, and should be part of a travel information service. Services and facilities at terminals could very well be a key for deciding if a travel is at all possible.

According to political statements in Norway and Europe, the use of public transport is to be increased. Studies have documented a need for improved travel information services and that such services also encourage people to change their habits towards more extensive use of public transport.

Route and travel information should simplify the use of public transport and provide information about the transport alternatives and their qualities with respect to travelling times, waiting times, provision of additional services and facilities, suitability for disabled people, etc. Travellers should be able to compare the alternatives to select the one that is best for them.

Real time information about status and deviations with respect to time schedules, next departure, estimated arrival, etc. is of importance to the users. It is also important that this information is presented in a way that suits the different kinds of users and disabilities. By providing such information in a more individual way, e.g. on cell phones some time before the actual arrival of the public transport means, people will be able to adjust to the deviations, and in certain cases they may also be able to find alternatives that fulfil their demands.

12.2Disabilities and universal design

It is difficult to find an agreed upon definition of the term ‘disability’. The United Nations High Commissioner for Human Rights has an ongoing ad-hoc committee that is still discussing the term disability, with different suggestions from countries . Several governmental and non-governmental organisations have developed their own definitions, and The Disability Discrimination Act 1995, DDA (c.50) in the United Kingdom defines a disabled person as one having “a physical or mental impairment which has a substantial and long-term adverse effect on his ability to carry out normal day-to-day activities” . The carrying out of such ’normal day-to-day activities’ is thus strongly related to the environment of the person. If he/she is in an environment where he/she is able to perform activities in a normal way, the person would in this particular situation not be considered disabled. “International Classification of Functioning” (ICF) is WHO’s framework for health and disabilities. In ICF, disability and functioning are viewed as outcomes of interactions between health conditions (diseases, disorders and injuries) and contextual factors . The focus has shifted from separating disabled from the rest (“cause”), and instead focussing on measuring ability to function in the society (“impact”) regardless of the reasons for one’s impairment. In ARKTRANS we focus on the transport domain and peoples’ use of this (either as travellers or workers), thus regarding a particular context. We have in this article chosen to define our use of the term disabled as DDA did, keeping the WHO definition of the disability being related to this context, in mind. The DDA definition in no way states that contextual factors are not important, contextual factors contribute to the abilities to carry out “normal day-to-day activities” such as using public transport. The focus is held on accessibility as in the ability to partake in a normal environment.

The population in many countries is getting increasingly older. Japan expects 33% of its citizens to be senior citizens by 2050, Europe and North America isn’t trailing far behind with figures around 25% . Older people in general tend to obtain a lot of disabilities, for instance problems with seeing, hearing and moving around. While medical and technical research provides us with tools and surgery that eases or even removes a person’s disability (for instance eye surgery and hearing aids), there is still a set of problems relating to disabled or elderly people which still cannot be helped in such ways. An example could be a person with a strong need to sit down and relax every hundred metres. In order for her to be able to

navigate the environment by herself, the environment must support this. Creating an environment that will let most people be self-manageable heightens their comfort level; people want to be self-reliant.

12.2.1Universal design

Public services have gradually changed from humans assisting you in different tasks to letting users themselves perform the task, be it withdrawing money from an ATM or using self-service machines at the airport to check in and mark your luggage with a baggage tag. It might very well be an efficient way of dealing with such services, but they also require the users to understand and be able to properly use such systems. Many people have tried to coin a definite term for what constitutes “universal design”. While “Design for all” is more often used in Europe, we will in this article use the term universal design (UD). Trost interprets UD as being “comprehensive philosophy” while design for all relates more to “practical applications” . Beecher and Paquet describe universal design as “a process intended to promote the development of products or environments that can be used effectively by all without adaptation or stigmatization” . This means that a person otherwise defined as disabled would be able to use a product or environment without having to resort to special support as manual assistance.

NCSU defines seven principles of universal design: equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance of errors, low physical effort and size and space for approach and use . There are efforts going on to produce equipment and tools with such principles in mind. In Japan companies are improving the accessibility of ATMs, and the Copenhagen Metro in Denmark is being designed with the concept “Stations for all” . The goal is to let people navigate systems and environments regardless of their otherwise hindering disabilities or impairments.

There’s a lot of research on advanced systems that will help disabled people in their daily activities. A prototype of an “American Sign Language recognition apparatus” which will translate sign language into spoken language. A guidance system for handicapped people suggests adding RFID tags in the environment, connected to information about the environment taking your special disability into consideration, is a way to helps travellers move around . While identifying the different needs depending on impairment or disability, Matsubara et al. also emphasize the semantic similarity of this information.

According to investigations, at least ten percent of the population have problems using the public transport system . The group with more severe disabilities related to transport is a small subset of these. Among the ten percent is a large group of people, often elderly, that do not use the transport because of small problems. This gives an indication that many people that would normally not use public transport today would be able to do so if it was accessible to them. Their otherwise hindering disabilities would, given a more accessible context, be rendered unimportant.

When linking universal design and availability to the transport sector, there are two main points to focus on: Design of the environment and information about the environment. In order to create a travel planner these two will be tightly linked. An environment with a small degree of accessibility would possibly be easier to navigate in if the traveller already knows about the limitations, and can plan for this. In such a case, experienced accessibility would be enhanced via the use of good information in advance.

One important aspect of creating an environment with focus on universal design is the impact it has, not only for disabled persons. People not normally physically or mentally impaired might in some situations have great use of a more accessible environment. Examples are

using prams, carrying heavy bags after a shopping spree, or having to use crutches after performing knee surgery.

12.2.2Disabled and design of the environment

There's currently a growing emphasis on creating environments that are available to all persons, regardless of any disabilities. In Norway there's a discussion proposition about altering the Norwegian laws in order to forbid discriminating persons with disabilities in a broad scale: "The Committee shall draft a new bill and/or proposals to amend existing legislation in order to strengthen the protection accorded by the law against the discrimination of persons with disabilities. The object is to promote full participation in society and equality between persons with disabilities and other citizens" . Focus in Norway and abroad has shifted from supporting for disabled as a welfare approach to a human rights approach, that "everyone is able to take part in society on an equal footing" (ibid.).
When designing an environment where all kinds of people can partake, one needs information on how to best design these. Support organisations in Norway have for a long time created guidelines for what constitutes a proper environment for their users . Deltasenteret (The Delta Center) is the Norwegian competence centre for "participation and accessibility for all". It is financed through the Directorate for Health and Social Affairs. Many of the organisations and the Delta Centre have cooperated in defining a proper public transport environment. Among them is the template for accessibility for public transport . This pamphlet covers the areas of infrastructure (accessibility on the terminal), means of transportation (the buses etc.), information needs and management / routines.

12.2.3Disabled and information about the environment

So far, we have only covered regulations and hopes for increasing the accessibility of the environment. But the environment isn't always designed like that. Users can have a wide range of disabilities, permanent or temporary. It doesn't help a blind user if the transport terminal has been developed only with wheelchair users in mind. In a travelling mode, it can be valuable to know the qualities of the terminals before deciding how to travel. Such information enables the travellers to find the most accessible terminals and transport means. The question is what kind of information one needs to know before deciding if and how to travel. Is there any subset of information that is more important to know before-hand, or does all kinds of information have to be treated in the same manner? Registering all kinds of information would risk ending up with a hard-to-maintain system, while registering too little information would give little value to the specific users. They key point is finding the appropriate level of information registration.

12.3Target Group

ARKTRANS addresses interoperability and information exchange between the transport companies, terminals, service providers and transport network managers that possess information about time schedules, route patterns, traffic conditions, deviations, services and facilities, and those who needs such information. The latter may be a transport user who needs transport, or more likely a service provider who provides more or less complex route and travel information services to the transport users. The service provider role may of course be possessed by the transport companies themselves.

Figure 40 shows the target group with reference to the sub-domains of the ARKTRANS reference model as described in chapter 4. Focus is on information content and the services

needed by the transport user, the transport user agent, the traveller, and the driver. The origins of the information that enables the composition of such services are transporters, terminals, the transport network manager, traffic information centrals, traffic control centrals and service providers.

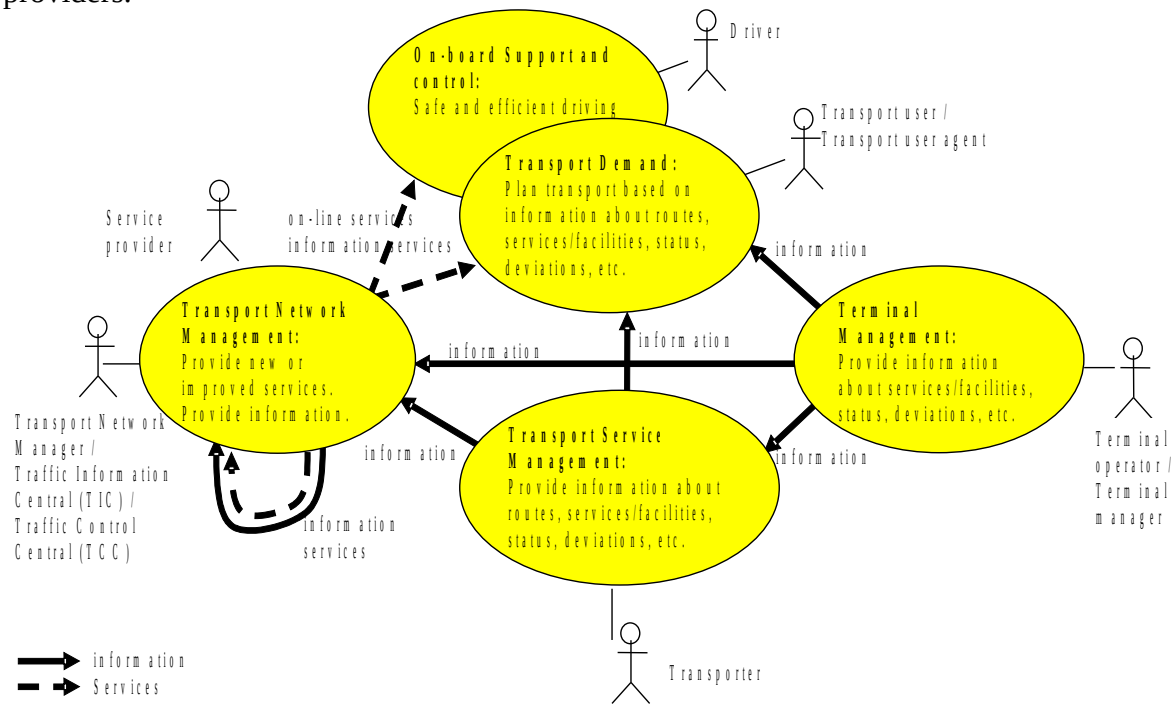


Figure 52 Target group with reference to ARKTRANS sub-domains and roles

12.4Overall Requirements

The focus is *not* on the establishment of the travel planning and travel information end-user services that are to be delivered to the transport users. The focus is on the basis for such services, what basis must be provided for such services to be implemented and used. The service providers should be able to build new and improved services based on information received from a wide spectre of transport companies and terminals operators representing airports, railway stations, ferry terminals, bus stops, etc. Interoperability and information exchange according to well defined interfaces are crucial, trough which planned time schedules as well as real time information about deviations have to be provided. If such information is available in a standardised way, new and improved services may emerge.

Existing route information formats quite often include information that is of no importance to the transport user, e.g. information used in fleet management and traffic control. Issues that are specific to one specific transport mode are often reflected, and an adaptation to other modes usually requires compromises. In ARKTRANS the focus must be on the information needed by the transport user, such as time schedules and route patterns and information about services and facilities provided on-board, at stops, and at the terminals. In addition real time information about status and deviations is required. Information elements needed in new or improved services as well as in more traditional services (e.g. printed time tables) must be available. The information shall count for all transport modes (road, sea, rail and air), and a multimodal terminology is to be used.

Information about fares and fare zones is omitted, even though such information is of importance to the transport user. Fares and fare zones are more or less independent of the routes, and many different zone systems may be used in parallel. Thus, fares and zones should be handled separately and linked to the route information to make a loose coupling.

Information about the terminals (bus stops, railway stations, airports, ferry terminals, etc.) and stop points must be available, and the terminals and stop points must have unique identifiers. In Norway, a national terminal register is being established, and the information provided by this register is to be harmonised with the information requirements stated by ARKTRANS.

12.5Related work

Existing route and travel information formats have been consulted during the ARKTRANS work to get input about the concerns of existing solutions. The participants of the work group that is addressing multimodal route information also have hands on experience with several formats.

12.5.1Exchange formats in operation

Route information exchange formats used today are mainly related to one transport mode, and applications to more transport modes required adjustments. Route information for trains may for example be specified by means of an air transport format, but the train departures have to be registered as flights. The available formats also have shortcomings with respect to provision of information about the availability of services and facilities, and dynamic information. Formats that so far are consulted during the ARKTRANS work are:

- REGTOPP formats are mainly used for buses, but may also be used for trams, metro and ferries. The format is widely used by Trafikanten, who participates in ARKTRANS.
- Swedish format for route information used by Samtrafiken
- The internal format used by Norsk Reiseinformasjon, who participates in ARKTRANS.
- SSIM commonly used for air transport and used by Braathens and Avinor, who both participate in ARKTRANS
- UIC formats for trains
- EDS International File Format used by The Norwegian State Railways, who participates in ARKTRANS

12.5.2TRIDENT

The TRIDENT (Transport Intermodal Data sharing and Exchange NeTworks) project (EU project IST-1999-10076) has specified comprehensive information model packages that are relevant to ARKTRANS. TRIDENT is also considered by ERTICO.

The following TRIDENT information model packages are of interest to ARKTRANS:

- The global package
  The general objects define the super object, TridentObject, which all objects inherit from. Thus, all objects will have an id, a version, a creation time, expiry time, a creator id, a validity domain, and a validity period.
- The data type package
  The PT enumerated data types include many data type definitions that are required by the other packages.
- The location package
  Specifies information models for locations and topology. Some of the specifications in

the PT package (see below) may be of more relevance with respect to the provision of route information to transport users, but the location package also provides many of the definitions that the PT package depends on.

- The public transport (PT) package
  Includes information models for timetables and the status of transport means.
- The trip package
  Includes information models for trip times for public transport rides, road journeys, and various connecting lines between transport modes and from the origin of journeys to the destination. An itinerary information model is also provided.

12.5.3TRANSMODEL

TRANSMODEL specifies a data model that supports public transport operation and management as well as passenger information. Multimodality is supported to some extent (bus, trolley bus, light rail), but does not fulfil the ARKTRANS view upon multimodality.

As far as we can see, TRANSMODEL is mainly related to fleet management (tactical as well as operational). Passenger information is limited to information about departures and arrivals. A terminology for public transport is defined, but so far ARKTRANS has chosen to use the terms preferred by the participants in the multimodal work group.

12.5.4TRIM

TRIM , a conceptual information model for freight transport recommended by ARKTRANS, defines arrivals and departures for freight transport, ad hoc transports included. A harmonisation of TRIM and the information model for multimodal route and travel information will be considered.

12.6Terminology

The route concept related to public transport is very unclear. A route may have many variations, it may be a repetition of strictly the same pattern every time, it may be composed of sub-routes, it may be circular, it may be a common reference to a public transport service in both directions between end points, or just in one direction, etc. Thus, we are not using the route concepts as an object in the information model. Focus is on the trip accomplished by a specific transport means as it is moving from a strait point to an end point along a particular route pattern. The following terms are of importance:

- Line
  The term line is commonly used about routes or trips that are known to the public by similar names or numbers
- Trip (term used in TRANSMODEL: JOURNEY PATTERN)
  A trip is a tour or voyage accomplished by a transport company according to a planned route or on a more ad hoc basis. A trip may consist of one or more legs, and may include stops at two or more terminals.
- Leg
  A leg is the part of a trip that is between the stop points of two consecutive terminals.
- Terminal (term used in TRANSMODEL: STOP AREA)
  A location or and area where transport means may stop to allow passengers to enter or leave the transport means, or to allow the loading and unloading of cargo. Terminals may be small stations or bus stops, or large and complex terminals that arrange for the handling

of many transport means at the same time, e.g. airports with many gates or railway stations with many tracks. Two or more terminals may be co-located, this co-location of terminals may be considered as a terminal as well, e.g. the Oslo Airport Gardermoen terminal that includes several airport terminals (domestic, international, arrival, departure, freight terminals, etc.), a railway station, and a bus terminal. A terminal must have a unique identification.

- Stop point
  A location at a terminal where transport means stops for boarding/alighting or loading/unloading. This may for example be a gate, a track, or a qui. A terminal may contain one or more stop points, and each stop point must have a unique identification.
- Service
  The term service will refer to services that are offered by service providers (meals served, help provided, etc.) as well as facilities (more physical installations like toilets, shops, etc.). Such services and facilities are available during the transport, at arrivals to and at departures from a terminal, and at terminals. We also use the term service about restrictions (actually the absence of a service), e.g. stop restrictions like "no boarding".
- Deviation
  A deviation is a deviation from a plan. This may be deviations with respect to the time schedule or the accomplishment of the transport, or deviations with respect to the services or facilities that are provided.
- Accessibility
  Accessibility defines the way a service is provided or the quality level of a service. Information about such accessibility is very important for some user groups. A lift may for example be available, but the physical conditions in the lift may influence on the usability.

12.7Conceptual Information Model

Focus in on information that can support electronic services required by the Transport User. Thus, the traditional concepts of printed route tables, like weekday routes, Saturday routes, Sunday routes, etc. are not used. However, this information can be extracted from the model, and printed routes with the wanted layouts and information can be formatted from the content of the information mode.

The information model is conceptual. That means it is not a physical data model that can be used as it is to realise a database. The conceptual model defines the information classes, their attributes, and their relations in a way that supports the composition of messages that enables exchange of standardised multimodal travel information. The design and implementation of the databases in the actual systems that will exchange information may differ from the conceptual information model. However, to achieve multimodal information exchange, the information from the individual databases must be mapped to the standardised multimodal messages according to the information elements defined by the conceptual model.

Much information is needed with respect to route information, and information model is divided into the sub-models to simplify the depiction. To allow for some flexibility with respect to comprehensiveness, many relations are optional. It is for example not mandatory to specify the operator that offers the services.

The models shown are translated to UML models and further refined in the MultiRIT project. Thus, the models are not in the final once. The models are the basis for the definitions of XML schemas defining the messages.

12.7.1Terminal Sub-model

The terminal sub-model is shown inside the square in Figure 53. It specifies information required about terminals, stop points, terminal access points and transfers.

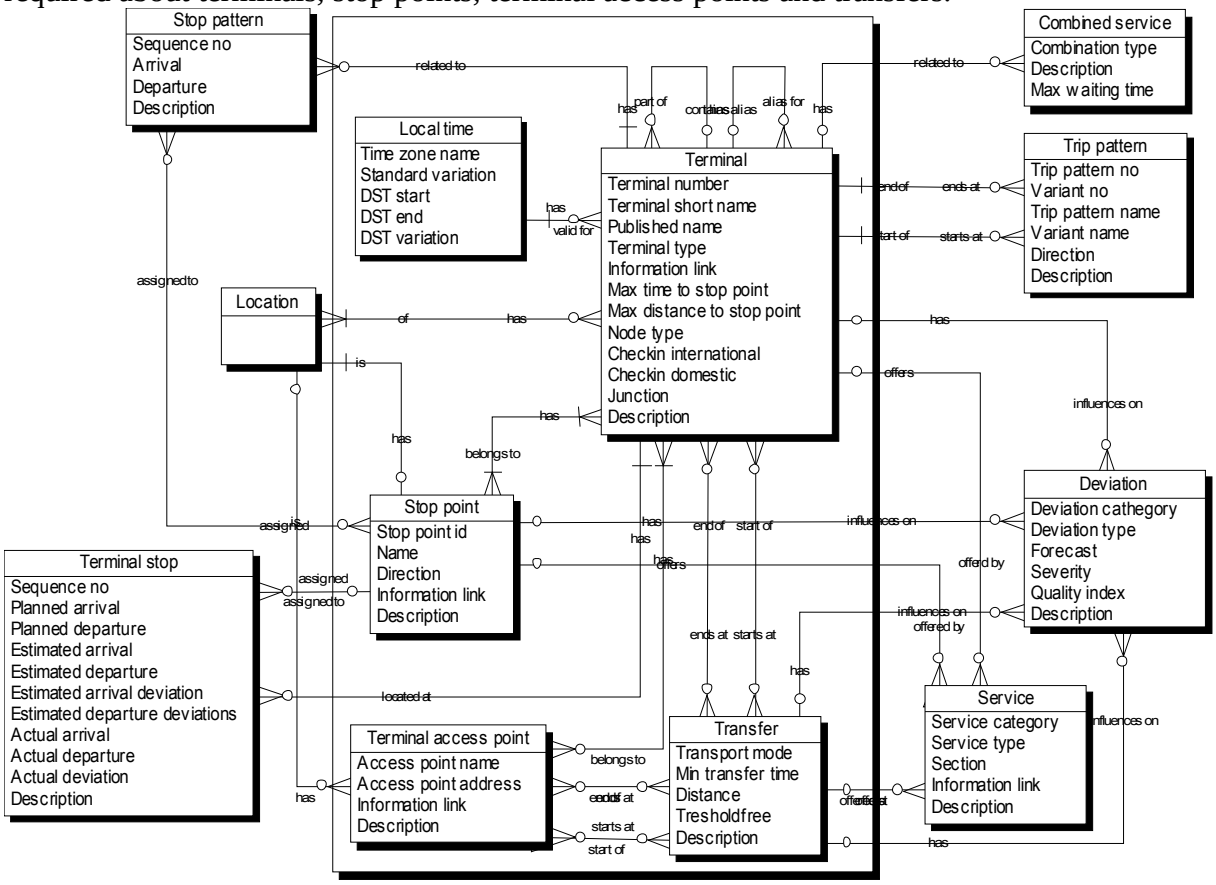


Figure 53 Terminal sub-model

- The Terminal has one or more Stop points
- A Terminal has a *Local time* (should consider to move this to another sub-model as it is not just relevant to the terminal)
- Many terminals may be co-located. Thus, a *Terminal* may be a *part of* a superior *Terminal* that *contains* many *Terminal*s
- A terminal may have many names. In such cased, a *Terminal has* an *alias* to another *Terminal*
- A Terminal has Stop points. One stop point may belong to more terminals, e.g. the arrival and departure terminal at an airport.
- A Terminal has Terminal access points that may be the entrance of the terminal or another well recognised point at the terminal used at waypoints during transfers. One access point may belong to more terminals, e.g. several co-located terminals.
- When changing transport means, it may be necessary to move from one terminal to another; the *Transfer* may *start at* one *Terminal* and *end at* another *Terminal.* However, a sequence of transfers may also be required. The first starts at the first Terminal and ends

at a Terminal access point. Then there may be successive transfers between different Terminal access points, and the last transfer ends at the second Terminal.

- On arrival or departure it is necessary to move between the terminal and terminal access points; the *Transfer starts at* or *ends at* a *Terminal access point*
- External relations are as follows:
  - The Terminal has a Location
  - A Stop Point has a Location
  - A Terminal access point has a Location
  - A Terminal has Terminal stops, and such a Terminal stops may be assigned to a Stop point
  - A Terminal may offer Services, and in case of deviations a Terminal has a Deviation
  - A Stop point may offer Services, and a Stop point may have Deviation
  - Also a Transfer may offer Services (e.g. assistance provided), and in case of deviations a Transfer has a Deviation (e.g. no assistance provided)

12.7.2Trip Pattern Sub-model

The trip pattern sub-model is shown inside the square in Figure 54. It specifies information about the trip patterns of a line.

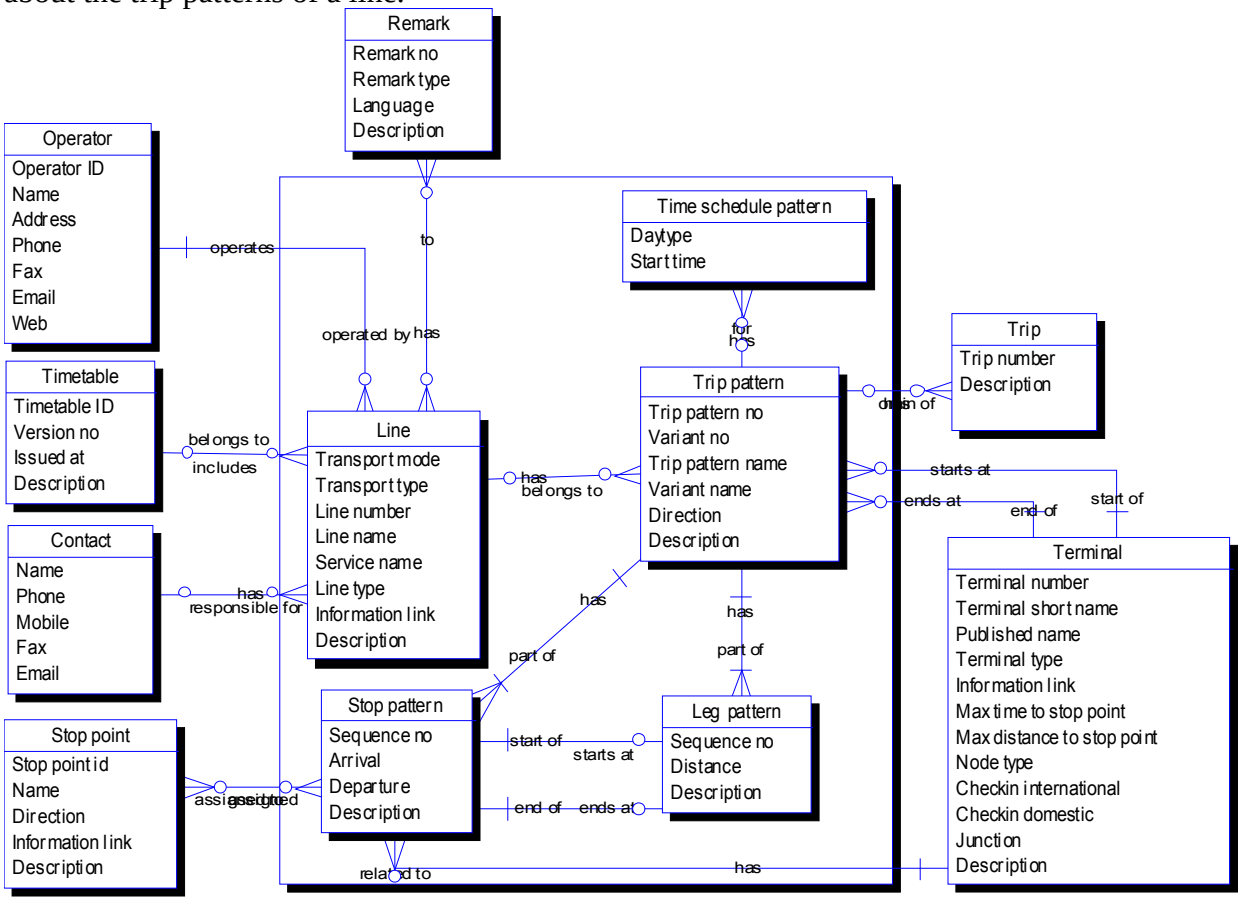


Figure 54 Trip pattern sub-model

- A *Line* is transport service that can be identified by means of a unique name. Quite often the line name indicates the start and the stop locations for the line, or another descriptive reference that refers to the route that the Line is serving.

- A *Line* often has several *Trip patterns*. Each trip pattern will be a version of the route that the line is serving. This may be quite different routes or quite similar routes with minor variations.
- A *Trip pattern* may have several *Time schedule patterns*. Each trip pattern will be a version of the route that the line is serving. This may be quite different routes or quite similar routes with minor variations. Different trip patterns may also be used to describe different directions of, for example, a bus line. Different trip patterns may also be used to describe the different segments of a line, e.g. two segments of a line that runs through a big city – from starting point to the big city and from the big city to the final destination.
- A Trip pattern may have several Time schedule patterns. The Time schedule pattern indicates the days and the start times for departures that will serve the trip pattern.
- A *Trip pattern* one or more *Leg patterns*, as the whole trip pattern consists of a sequence of one or more leg patterns, and a *Leg pattern* is a *part of* a *Trip pattern*.
- The *Trip pattern* also *has* one or more *Stop patterns*. A *Stop pattern* is a stay at a terminal, and such stops are carried out in a specific sequence. The arrival and the departure are provided relatively to the start time in the *Time schedule pattern* of the *Trip pattern*.
- External relations:
    - A Timetable may include the route information for several Lines.
    - One or more Contacts may be responsible for a Line
    - A Line will be operated by an Operator (however, the actual trips that constitute the Line may be operated by other operators – see the Trip timetable sub-model).
    - A Trip pattern may be the origin of one or more operational Trips
    - In the same way, Terminals and Stop points that are used by operational trips may be related to and assigned to Stop patterns.
    - There may be Remarks associated to a Line.

12.7.3Trip timetable Sub-model

The trip timetable sub-model is shown inside the square in Figure 55. It specifies information about actual trips, e.g. time schedules, services provided and deviations.

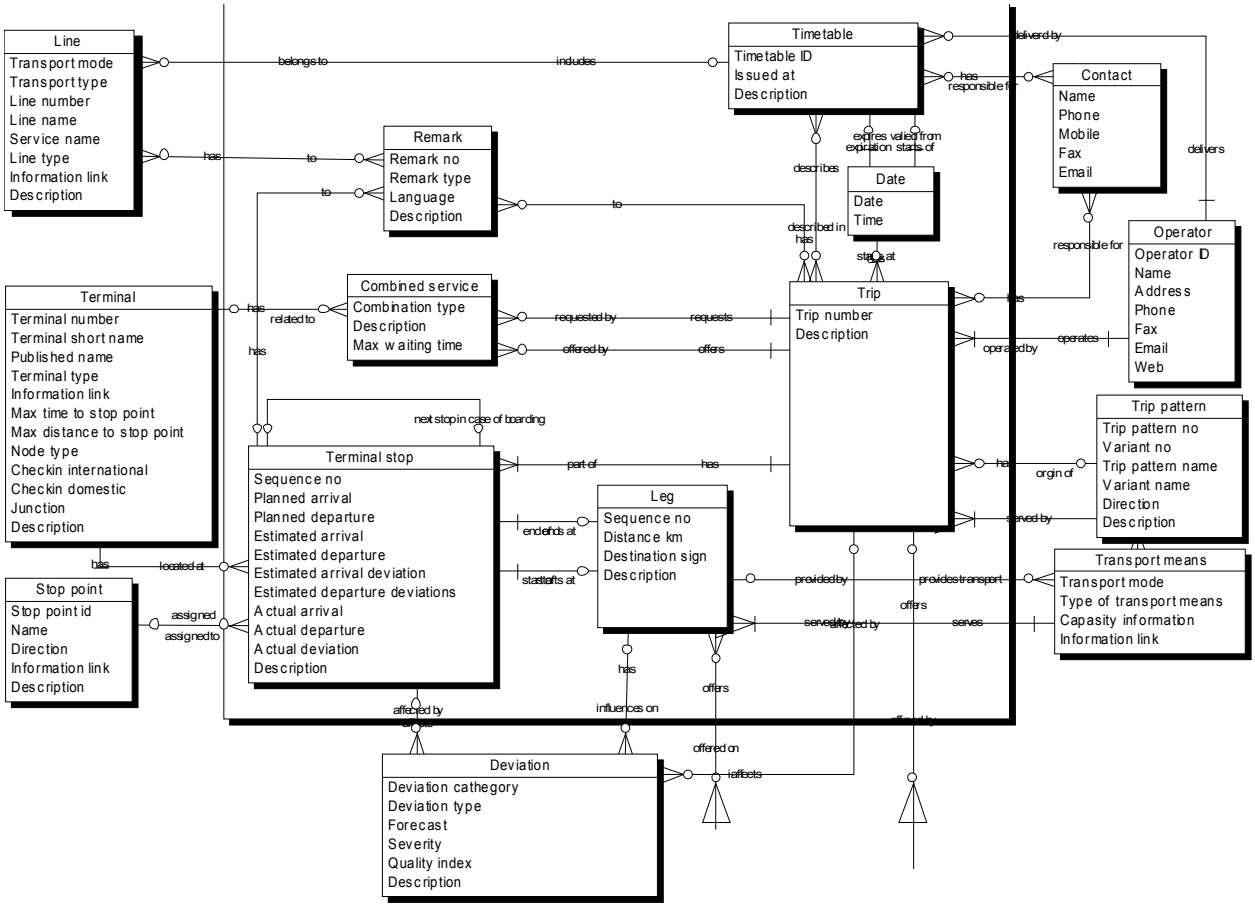


Figure 55 Timetable sub-model

- The Timetable is valid from a Date and expires at a Date.
- A Timetable may describe several Trips.
- The Trip starts at a Date.
- The *Trip has* two or more *Terminal stops*. A Terminal stop is a stay at a terminal that allows persons or cargo to enter or leave the transport means (stops caused by traffic situations are not a part of this stop concept). The stops are carried out in a specific sequence.
- A Terminal stop may be the start of the first Leg of a trip, it may be the end of a Leg and the start of another Leg, or it may be the end of the last Leg of a trip. In most cases, a Terminal stop has arrivals and departures according to a time schedule. However, some stops may not be dictated by time schedules as they may not be check points in the route plan. Thus, the arrival and departure attributes may have no values.
- There may be Remarks to Lines, Trips and Terminal stops.
- External relations:
    - A Timetable may include the route information for several Lines.
    - A Trip may be according to a Trip Pattern, and thus be a part of a Line. Such trips may usually be named according to the line name, the trip pattern name and, if present, the variant name of the trip pattern. Trips without trip patterns are for example on demand trips.
    - The Timetable is delivered by an Operator (will be the Operator that is operating the lines described in the timetable).
    - There may be one or more Contacts that are responsible for a Timetable

    - A Trip is an actual trip or tour operated by an Operator.
    - There may be one or more Contacts that are responsible for a Trip
    - A Terminal stop is located at a Terminal, and a Terminal usually has several Terminal stops. (We also use the term terminal about small bus stops.). However, terminals that are not in operation will have no stops.
    - A Terminal stop is assigned a Stop point. This may be done when the route plan is established, or it may be done just before the stop at the Terminal. In the last case no Stop point will be assigned to the Stop until just before the stop.
    - A Trip may be served by a Transport Means.
    - A Leg is also served by a Transport means.
    - A Trip as well as a Leg may offer a Service, and a Service may also be offered at a Terminal stop.
    - Deviations may occur, and a Deviation influences on a Trip, a Leg, and/or a Terminal stop.
- Some special conditions are handled by the sub-model
    - A Trip may be cancelled due to weather conditions or for other reasons. In such cases a Trip may be replaced by another Trip. The new trip may stop at the same terminals, but the route may also be different from the original route. E.g. the ferry may have to go from another berth due to the weather.
    - An express route may stop for passengers at several terminals. However, depending on the entry point, a passenger may not be allowed to leave the transport means at specific locations (to avoid competition with local routes). At a specific Terminal stop the next stop in case of boarding will be another Terminal stop, but not necessarily the next in the sequence of stops.
    - As mentioned above, a Leg is served by a Transport means. However, in some cases a Leg may have accompanied transport where the actual transport is provided by another Transport means, e.g. the leg may be served by a bus, but the complete bus may enter a ferry that provides the transport.
    - In some cases there is a Combined service between the arrival of one Trip and the departure of another Trip. The Combined service is related to a stop at a specific Terminal, and may for example be used to express that a connection can be provided despite of a short transfer time. A departure may for example wait for another trip for some time. A combined service may also be used to indicate a trough service (the same transport means will be used on both trips, and the passenger will not have to change transport means).

12.7.4Service and Deviation Sub-model

The service and deviation sub-model is shown inside the square in Figure 56. It specifies information required about services and deviations.

- A service may be affected by deviation. A *Service* may be *offered due to* a *Deviation*, or a *Service* may be *abandoned due to* a *Deviation*.
- A *Service* may have a set of *Accessibilities*.
- *Accessibility* may be *affected by deviation*. An Accessibility may be abandoned due to a Deviation.
- External relations are as follows:
    - During the transport, a Service may also be offered by a Trip in general, or a Service may be offered on a specific Leg. The availability of services may depend on whether the Service can be offered by the Transport means used.

- A Service may also be offered at a Terminal stop in relation to arrival or departure
- A Service may also be offered by a Terminal
- A Service may also be offered at a Transfer
- A Service may be offered by a specific Operator
- A Deviation concerning a delay or an early arrival or departure affects a Terminal stop
- A Deviation concerning the removal of a service abandons a Service
- A Deviation concerning the provision of a new service (e.g. as a substitute for another) offers a Service
- A Deviation influences on a Leg, a complete Trip, a Terminal, or on a Transfer

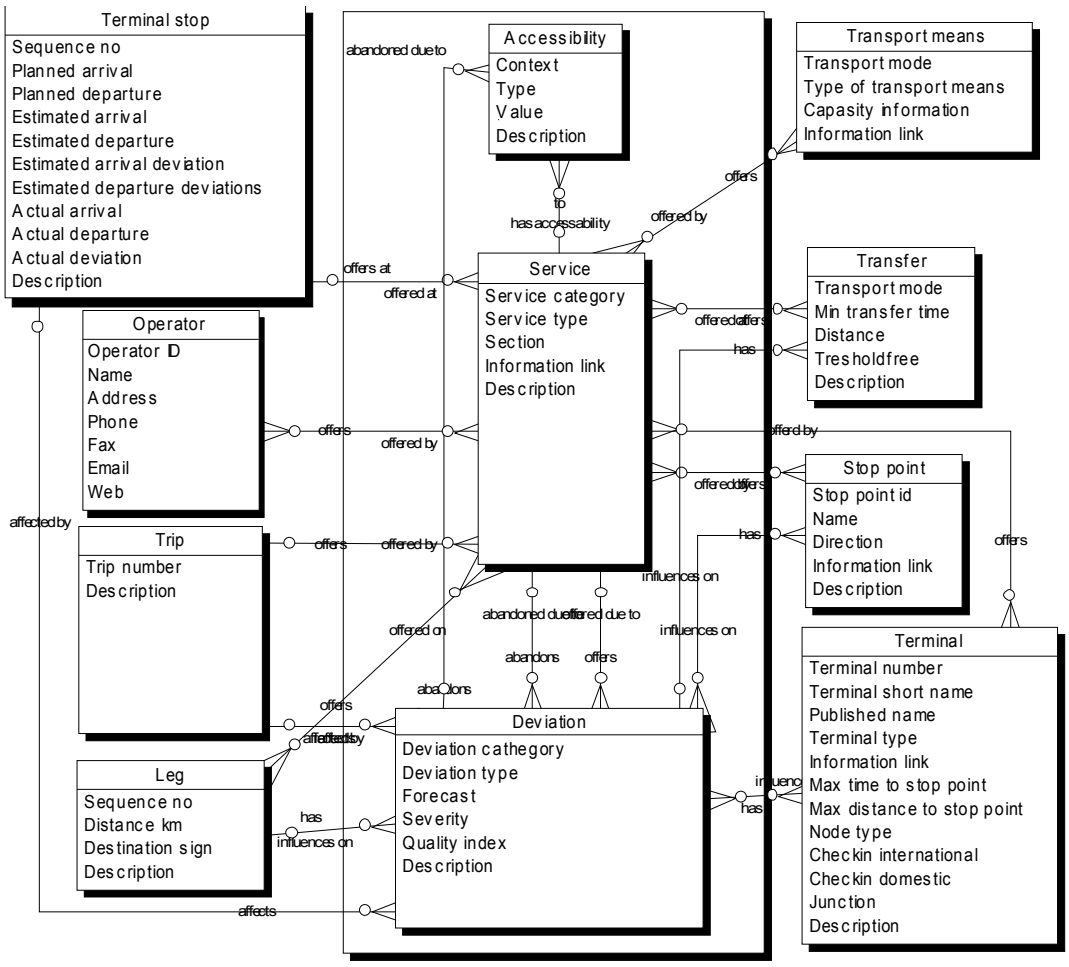


Figure 56 Service and deviation sub-model

12.7.5Other Information Model Elements

Elements such as Location, Operator and Transport Means are shown as external to the sib-models specified above. The Location element is not specified further as it has to be based on decisions taken by those who will register information about the terminals, stop points and terminal access points. The Operator and the Transport means elements are shown in the Figure below.

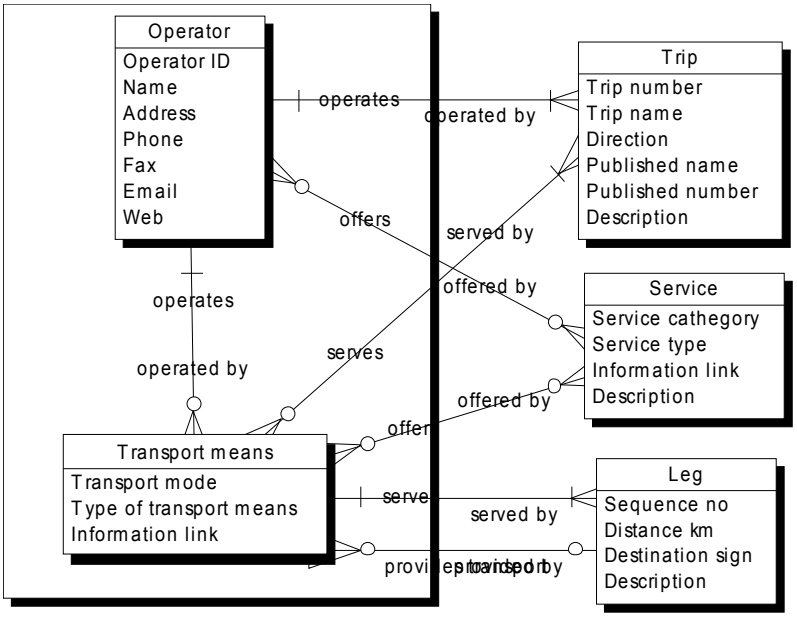


Figure 57 Other information model elements

12.8Comparison of ARKTRANS and TRIDENT

TRIDENT is multimodal to some extent, but the content is just partly harmonised across the transport mode. We think that a more complete harmonisation will benefit intermodal transport planning, and we also see that the TRIDENT information models lack information about many services and facilities that can be provided on-board the transport means and at the terminals. However, TRIDENT has much in common with ARKTRANS, and a harmonisation may be advantageous.

The TRIDENT information models (see 12.5.2) are to some extent overlapping with ARKTRANS. Mappings can be drawn between the classes of TRIDENT and ARKTRANS.

TRIDENT Class	ARKTRANS Class	Comments to TRIDENT Comparison TRIDENT - ARKTRANS
Line	Line	• Has a transportModeName attribute, but a Line may be accomplished by means of several transport modes. Thus, the transport mode should be used on Route or even better on the JourneyPattern and the operational VechicleJourney. • What about remarks?
Route	Trip pattern	• The wayBackRouteId attribute is not required. This information can be found by a travel planner. • The direction attribute is unclear o What about round-trip services? o Should be used on JourneyPattern instead? A route may be composed of many JourneyPatterns, and they may have different directions. o Enumerated types may not be enough. Text may be required. • What about remarks?
JourneyPattern	Trip pattern variant	• Defines topology by means of an ordered set of StopPoints. What if the stop points are not defined (may not be defined until just before arrival/departure – e.g. gates at airports)?

		The StopArea is however defined and should be used instead. • What about remarks?
VehicleJourney	Trip	• Operative version of Route and JourneyPattern. • A JourneyPattern corresponds to one VehicleJourney. However, it may be necessary to divide the journey into segments and to accomplish the segments by different vehicles, e.g. a bus on a part of the journey due to problems with the railroad. • Some ServiceStatusValues are missing (e.g. New stop added, Transport means replaced) • Information about the transport means is included, but should be replaced by a link a transport means class. Such a class may also include a link to detailed information, e.g. a map showing the cabins in a ferry.
StopArea	Terminal	• Should have link to more information, e.g. a map
StopPoint	Stop point	• Specialised into AirportStopPoint, BusStopPoint, MetroStopPoint, RailwayStopPoint and TrainStopPoint. What about ferry terminals? • MetroStopPoint contains information about the line using the stop point, but more than one line may use a stop point. • The direction attribute is unclear for BusStopPoint, MetroStopPoint and TramStopPoint. What if several routes/journey patterns are served by the same stop point and these have different directions? • What about maintenance? Different stakeholder will be responsible for the lines/routes and the terminals/stop points. o Who should maintain the linkage between the lines and the stop point whenever a line is changed, shut down or established? This should preferably be the responsibility of the transport company. (In ARKTRANS we emphasise that the information about terminals and stop points should be as static as possible, however, it must be possible to do updates) o Consider to have direction related to JourneyPattern or VehicleJournies and not to stop points due to the maintenance problem • In ARKTRANS we emphasise that all terminals should have an identifier that is unique across all transport modes in addition to a name. This will arrange for multimodal route planning. As far as we can see there is no such identifier in Trident. (The Point class, which StopPoint is a specialisation of, has a lot of relations to other classes that may hold something like this, but we are not sure.) • Consider localisation information related to stop points to help the transport user to find the right stop point among others, e.g. the side of the road on which the stop point is located (e.g. south side, the side serving outbound traffic with respect to the city centre, same side as the cathedral,

		etc.). Should probably be a full text description. • StopPoint is a specialisation of Point. An Address is related to just one Point. However, a StopArea, that may be defined by a set of points, and they should all have the same address. Suggestion: Address should be related to Location.
AirportStopPoint	Stop point	• Specialisation of StopPoint • May not be required. The ARKTRANS experience is that it is possible to harmonise the StopPoint descriptions across the transport modes.
BusStopPoint	Stop point	
MetroStopPoint	Stop point	
RailwayStopPoint	Stop point	
TramStopPoint	Stop point	
PTAccessPoint	Access point	• E.g. an entry to a terminal
ConnectionLink	Transfer	• Transfer between a Stop Area (terminal in ARKTRANS) and a Stop point and vice versa. Does the Stop point belong to the Stop Area? • What about transfers between co-located Stop areas (terminals in ARKTRANS)? This is of relevance to the transport user, e.g. between terminals at an airport, between a bus terminal and the co-located railway station, etc. • TRIDENT focuses on transfers between stop points. ARKTRANS does however focus on transfer to/from/between terminals (stop areas). o The logical division into terminals should be influenced by the availability of the stop points. Stop points that a far away from each other with respect to distance or transfer time should belong to different terminals. o It may be sufficient to describe the transfer from the terminal to the stop point by means of a max distance/time. Transfer information for all possible transfer between all possible stop points (e.g. gates at an airport) may be too much. • What is required with respect to travel times?
PtAccessLink	Transfer	• Transfer between a PtAccessPoint and a Stop point and vice versa. • Specialisation of ConnectionLink. • Do not see the point in the specialisations – they are all more or less the same.
PtLink	Leg	• The distance between to stops.
Facility	Service	• Very limited. • Should also be related to StopArea/StopPoint and VehicleJourneyAtStop
VehicleJourneyAtStop	Stop Time schedule	• The stop points may not be defined until just before arrival/departure. The StopArea is however defined and should be used
ConnectingService	Combined Service	• Provides the minimum connection time between two VehicleJournies. • A bit unclear. o If the minimum connection time is the minimum time needed for the transfer: • This is an overlap with ConnectionLink • The minimum connection time will depend on the stop points

		used. These stop points may not be decided until just before arrival/departure (e.g. airport gates). o If the minimum connection time is the minimum time slot that will enable a transfer • Partly overlap with Combined Service in ARKTRANS (the max waiting time for the departing trip). • No support for other combined services (e.g. through service)
Timetable	Time table	•
Period	Time table, Date	•
CalenderDay	Date	•
DayType	-	• enumerated
Company	Operator Contact	•
Status	Deviation	• Provides the status of VehicleJourney
Mobility	-	• Indicates whether the vehicle is moving or not?
OperatorActions	-	• Fleet management?
RelativeTimes	Time schedule	• Provides the delay of a PtLink or VehicleJourney
ServiceStatusValue	Deviation	• Do not include service deviations at terminals, in transport means, etc. • Missing value: Transport means replaced (to indicate that another transport means that the one in the original plans is used), e.g. another ferry is used, or a bus is used instead of train. • Should also be used about VehicleJourneyAtStop to describe status related to stops. In that case a value is missing: o New stop (to indicate that this stop is not according to the planned route)

In ARKTRANS exceptions and specialities that may occur related to route information are reflected by the information model. This is just partly true for TRIDENT:

- The cancellation of a VehicleJourney can be indicated by means of the statusValue
- There is no way to indicate that a VehicleJourney is replaced by another, e.g. that a ferry journey is replaced by another due to weather conditions (e.g. the ferry has to stop at another location).
- There is no way to indicate that a VehicleJourney partly is accomplished by another transport means. A JourneyPattern corresponds to one VehicleJourney. However, it may be necessary to divide the journey into segments and to accomplish the segments by different vehicles, e.g. a bus on a part of the journey due to problems with the railroad.
- It is to some extent possible to indicate that a VehicleJourney will have modified services/facilities. The statusValue can be used, but there is no way to describe the details about which services that are reduces/increased.
- There is no support for stop restrictions on express routes. An express route may for example stop for passengers at several StopAreas along the route. However, depending on the entry point, a passenger may not be allowed to leave the transport means at specific locations (to avoid competition with local routes). At a specific StopPoint, the next stop in

case of boarding will be another StopPoint, but not necessarily the next in the sequence of stops defined by the route.

- There may be some support for combined services. There may for example be a combined service between the arrival of one VehicleJourney at a StopPoint and the departure of another. The combined service may for example to some extent assure that a connection can be provided despite a short transfer time. The first VehicleJourney may wait for the other VehicleJourney for some time. A combined service may also be used to indicate a trough service (the same transport means will be used on both VehicleJourneys, and the passengers will not have to change transport means).
- There is no support for accompanied transport. The actual transport may be provided by another Transport means, e.g. the leg may be served by a bus, but the bus may enter a ferry that provides the transport.

12.9Information Model Attributes

The attributes of the sub-models above have to be specified further.

12.9.1Simple Enumerated Data Types

(preliminary – must be updated.)

Transport mode (partly harmonised with TRIDENT)

1. air
2. train
3. metro
4. tramway
5. bus
6. coach
7. ferry
8. water born
9. private vehicle
10. walk
11. others
12. bike

Terminal type

1. airport
2. heliport
3. railway terminal
4. metro terminal
5. tram terminal
6. bus terminal
7. seaport
8. waterway port
9. intermodal

12.9.2Service Categories and Types

Information about the services supports multimodal route planning across several transport modes. By describing the services that are available, also including the restrictions that are in force and the facilities available, by means of a standardised terminology, transport alternatives can be compared, and the door-to-door transport can be planned across all transport modes. The transport chain that satisfies the demands of the transport user can be chosen. By Service we mean

- Overall transport services
- En route services provided at terminals and on board transport means
- Information services at terminals and on board transport means
- Facilities at terminals and on board transport means
- Restrictions (actually the absence of a service)

All services can be decomposed into a set of service categories that contain standardised service types. As stated by the attributes in Figure, a service has a service category and a service type attribute. For some of the services it may also be relevant to inform about the section in which the service is available, for example which part of a terminal or which part of a transport means (e.g. whereabouts facility on deck 3 of the ferry).
Services can be related to the actual transport, to arrivals and departures, to the terminals, and to transits. Some services just make sense related to parts of the transport chain (e.g. at terminals). Other services may be provided on both transport means and terminals. Services may be specified for the whole trip or for specific legs.

12.9.2.1Overall transport services

The overall transport services describe the main types of transport services that are offered.

Service Category	Service Type
Route offers (Rutetilbud)	Predefined route (Rutegående transport) On demand (Behovsdefinert) On demand route (Behovsdefinert rute) Pre-booked space (Forhåndsbestilt plass) Space warranty (Plassgaranti)
Passenger transport (Passasjertransport)	
Luggage transport (Transport av reisegods)	Luggage check in (Bagasjeinnsjekking) Hand luggage only (Kun håndbagasje) Special luggage (Spesialbagasje) Luggage self service (Selvbetjening på bagasje)
Car transport (Biltransport)	
Freight transport (Godstransport)	Thermo transport (Termovarer) Controlled environment transport (Kontrollert transportmiljø) Bulk cargo transport (Bulktransport) Container transport (Containertransport) Ro-ro transport (Ro-ro transport) Dangerous cargo (Transport av farlig gods) Animal transport (Dyretransport)

Table 3 Service categories for overall transport services

12.9.2.2En route services

The en route services describe the services that are offered to the transport user at terminals, on-board the transport means, at stops, and at transfers during the transport.

Service Category	Service Type	Relevance
Handling services (Håndteringstjenester)	Check in (Innsjekking) Customs (toll) Luggage check in (Bagasjeinnsjeking) Luggage security control (Sikkerhetskontroll av bagasje) Passenger security control (Sikkerhetskontroll av passasjerer)	At terminal During transport
Entertainment services (Underholdningstjenester)	Children's entertainment (Underholdning for barn) Live music (Levende musikk) Movie (Film) Music channel (Musikkanal) News (Nyheter)	At terminal During transport
Payment services (Betalings-tjenester)	By phone (Via telefon) Cash (Kontanter) Credit card (Kredittkort) E-ticket (Elektronisk bilett)	At terminal During transport
Assistance provided (Assistanse tilbys)	Free transport of aids (Gratis hjelpemiddeltransport) Assistance to unaccompanied minors (Assistanse til barn som reiser alene) Assistance to sick people (Assistanse til syke) Luggage assistance (bagasjeassistanse) Assistance to disabled (Assistanse til funksjonshemmede) Assistance in security control (Assistanse i sikkerhetskontroll)	At terminal During transport At stops
Free offers (Gratistilbud)	Alcoholic beverages (Alkoholholdig drikke) Breakfast (Frokost) Cold meal (Kald mat) Dinner (Miiddag) Lunch (Lunsj) Newspapers (Aviser) Non-alcoholic beverages (Alkoholfri drikke)	At terminal During transport
Attendance (Betjening)	Cabin crew (Kabinpersonale) Conductor (Konduktør) Guard (Vakt)	At terminal During transport At stops

Table 4 Service categories and types for en route services

12.9.2.3Facilities

The facilities describe physical installations that are offered to the transport users at terminals, and departures, on-board the transport means and at arrivals during the transport.

Service Category	Service Type	Relevance
Whereabouts facilities (Fasiliteter på oppholdssteder)	Lounge with refreshments (Lounge med forfriskninger) Smoking area (Røykeområde) Seating accommodation (Sitteplasser) Silence (Stille sone) Physical unit (Enhet) – e.g. terminal, transport means Waiting-room (Venterom) Shelter (Lehus) Security control area (Område for sikkerhetskontroll)	At terminal During transport
Local facilities (Fasiliteter i omgivelsene)	Parking garage (Parkeringshus) Short time parking area (Korttidsparkering) Car rental (Bilutleie) Long time parking area (Langtidsparkering) Cycle parking (Sykkelparkering) Car service (Biltjenester) Park and ride Taxi stop Kiss and ride	At terminal
Entry and exit facilities	Terminal access (Terminalinngang) Transport means access (Av- og på-stigning)	At terminal Terminal stops
Commercial facilities (Kommersielle fasiliteter)	Misc. (Diverse) Kiosk (Kiosk) Cloths (Klær) Bank (Bank) Pharmacy (Apotek) Food (Mat) Tax Free (Tax free) Books (Bøker) Gifts (Gaver)	At terminal During transport
Ticket sale facilities (Bilettsalg-fasiliteter)	Attended ticket office (Bemannet bilettkontor) E-ticket reader (Leser av e-bilett) Ticket machine (Bilettautomat)	At terminal During transport
Refreshment sale facilities (Fasiliteter for salg av forfriskninger)	Bar (Bar) Coffee or Tea (Kaffe og te) Fast food (Hurtigmat) Restaurant (Restaurant) Trolley (Trallesalg)	At terminal During transport
Facilities for children (Fasiliteter for barn)	Nursery (Stellerom) Playroom (Lekerom) Infant room (Spebarnsrom)	At terminal During transport
Misc. facilities (Diverse fasiliteter)	Cash dispenser (Minibank) Chapel (Kapell) Cloakroom (Bagasjeoppbevaring) Computer (Datamaskin) Desk (Arbeidsbord) Emergency telephone (nødtelefon) Fax (Fax) Internet access (Internettaksess) Library (Bibliotek) Lost property (Hittegods) Luggage space (Bagasjeplass) Luggage trolley (Bagasjetralle) Meeting point (Møteplass)	At terminal During transport

Table 5 Service categories and types for facilities

12.9.2.4Information services

The information services are offered to the transport users at terminals and during the transport .

Service Category	Service Type	Relevance
Travel information services	Arrival and departure information (Ankomst- og avgangstider) Dynamic arrival and departure information (Dynamiske ankomst- og avgangstider) Traffic information (Trafikkinformasjon) Contact information (Kontaktinformasjon) Route pattern (Rutenett) Time tables (Ruteplaner) Terminal information (Terminalinformasjon) Terminal map (Oversiktskart over Terminal) Transport means map (Oversiktskart over transportmiddel) Trip information (Turinformasjon)	At terminal During transport
Tourist information services (Turistinformasjons-tjenester)	Activity information (Aktivitetsinformasjon) Location information (Lokasjonsinformasjon) Accommodation information (Innkvarteringsinformasjon) Historic information (Historisk informasjon)	At terminal During transport

Table 6 Service categories and types for restrictions

12.9.2.5Restrictions

The restrictions describe restrictions related to terminals, departures and arrivals, and to the transport.

Service Category	Service Type	Relevance
Stop restrictions (Begrensninger på stopp)	No alighting (Ingen avstigning) No boarding (Ingen påstigning) Stops on signal (Stopper på signal) Must be pre-booked (Må forhåndsbestilles)	Terminal stops
Transport restrictions (Begrensninger på transport)	Age restriction (Aldersbegrensning) Bikes prohibited (Forbud mot sykler) Check-in required (Innsjekking kreves) Must be pre-booked (Må har forhåndsbestilling) Must have space reservation (Obligatorisk plassreservering) Must have ticket (Må ha gyldig bilett ved påstigning) Pets prohibited (Forbud mot kjæledyr) Smoking prohibited (Røyking forbudt) Wheelchair restrictions (Restriksjoner på rullestol)	During transport
Access restrictions (Aksessrestriksjoner)	Must be entitled to admission (Må ha rett til adgang) Must have entrance card (Må ha adgangskort) Must have ticket (Må ha gyldig bilett)	At terminal

Table 7 Service categories and types for restrictions

12.9.2.6Accessibilities

Accessibility defines the way a service is provided or the quality level of a service. Information about such accessibility is very important for some user groups. A lift may for example be available, but the physical conditions in the lift may influence on the usability.

The accessibilities are organised into contexts and types. There will be several types for each context. For each type there will be a value set defining the different levels of accessibility support.

In the table below the contexts and the types associated to each context is defined. The service categories related to each accessibility context is also defined. However, the results are so far preliminary, and further studies are needed.

Accessibility context	**Accessibility Type**	**Relevant to service categories**
Accessibility for allergic people (Tilgjengelighet for allergikere)	Cleaning (Rengjøring) Mould (Mugg) Pets (Dyr) Pollen (Pollen) Smoking (Røyking)	Accommodation (Innkvartering) Commercial facilities (Bank, apotek og butikker) Local facilities (Fasiliteter i omgivelsene) Misc. facilities (Diverse fasiliteter) Whereabouts facilities (Fasiliteter på oppholdssteder)
Accessibility supported by light conditions and contrast (Tilgjengelighet støttet ved lys og kontrast)	Contrasts (Kontraster) Light (Belysning)	Accommodation (Innkvartering) Commercial facilities (Bank, apotek og butikker) Facilities for children (Fasiliteter for barn) Local facilities (Fasiliteter i omgivelsene) Misc. facilities (Diverse fasiliteter) Refreshment sale facilities (Fasiliteter for salg av forfriskninger) Ticket sale facilities (Bilettsalgfasiliteter) Whereabouts facilities (Fasiliteter på oppholdssteder)
Information accessibility (Informasjons-tilgjengelighet)	Audio information (Lydinformasjon)) Marking (Merking) Tactile information (Taktil informasjon) Visual information (Visuel informasjon)	Accommodation (Innkvartering) Commercial facilities (Bank, apotek og butikker) Entry and exit facilities (Fasiliteter ved inngang) Facilities for children (Fasiliteter for barn) Local facilities (Fasiliteter i omgivelsene) Refreshment sale facilities (Fasiliteter for salg av forfriskninger) Ticket sale facilities (Bilettsalgfasiliteter) Travel information services Tourist information services (Turistinformasjons-tjenester)
Information means providing accessibility (Informasjons-måter)	Equipment for interactive information (Utstyr for interaktiv informasjon) Information desk (Informasjonsskranke) Information displays (informasjonsskjermer) Information handouts (Trykt informasjon) Information placards (Oppslag med informasjon) Internet access Maps Mobile services Route map (Rutekart)	Accommodation (Innkvartering) Commercial facilities (Bank, apotek og butikker) Entry and exit facilities (Fasiliteter ved inngang) Facilities for children (Fasiliteter for barn) Local facilities (Fasiliteter i omgivelsene) Refreshment sale facilities (Fasiliteter for salg av forfriskninger) Ticket sale facilities (Bilettsalgfasiliteter) Travel information services Tourist information services (Turistinformasjons-

Accessibility context	Accessibility Type	Relevant to service categories
	Signs and icons (Skilting og ikoner) Voice information (Informasjon over høyttaler)	tjenester)
Machine accessibility (Automat-tilgjengelighet)	Easy to find (Tilgjengelige) Usability (Brukbarhet)	Local facilities (Fasiliteter i omgivelsene) Misc. facilities (Diverse fasiliteter) Ticket sale facilities (Bilettsalgfasiliteter)
Misc. accessibility (Diverse tilgjengelighet)	Handicap toilet (Handikaptoalett) Seats adoption (Tilpassing av sittemuligheter)	Misc. facilities (Diverse fasiliteter)
Physical accessibility (Fysisk tilgjengelighet)	Broadwise gradient (Fallforhold) Doors (dører) Gradient (Stigning) Tactile and visual guidelines (Ledelinje) Lift (Heis) Space requirement (Plassbehov) Surface (Overflate) Tactile marking (Taktil markering) Threshold (Nivåsprang) Waiting area / passages (Venterom/gang) Well arranged interior (Overskuelig innredning) Wheelchair area (Rullestolområde)	Accommodation (Innkvartering) Commercial facilities (Bank, apotek og butikker) Facilities for children (Fasiliteter for barn) Misc. facilities (Diverse fasiliteter) Local facilities (Fasiliteter i omgivelsene) Refreshment sale facilities (Fasiliteter for salg av forfriskninger) Ticket sale facilities (Bilettsalgfasiliteter) Whereabouts facilities (Fasiliteter på oppholdssteder)
Terminal entrance accessibility (Tilgjengelig adkomst til holdeplass)	Gradient (Stigning) Handicap parking (Handikapparkering) Lane line (Ledelinje) Tactile marking (Taktil markering) Threshold (Nivåsprang)	Entry and exit facilities (Fasiliteter ved inngang)
Transport means accessibility (Tilgjengelighet til transportmiddel)	Angle (Vinkel) Distance (Avstand) Grip (Håndtak ved rampene) Height level difference (Nivåforskjell) Lift (Heis) Wheelchair platform (Rullestolrampe)	Entry and exit facilities (Fasiliteter ved inngang)

Table 8 Accessibilities related to Services

12.9.3Deviation Categories and Types

Deviations may occur related to the accomplishment of the transport represented by the trips and the legs, to the terminal, to specific terminal stops or to transfer. A deviation is temporary, and is defined as a deviation to the planned or normal situation. The table below also includes deviations that may not be reported to transport users, e.g. unlawful interferences, damages and security deviations.

Deviation Category	Deviation Type	Relevance
Time schedule deviation (Tidsavvik)	Delayed arrival (Forsinket ankomst) Delayed departure (Forsinket departure) Early arrival (For tidlig ankomst) Early departure (For tidlig avgang)	Route/travel information: Terminal stop
Transport execution deviation (Endring i transportgjennom-	Cancelled (Kansellert) Disrupted (Avbrutt) Transport mode altered (Endret transportmodus)	Route/travel information: Trip/Leg

Deviation Category	Deviation Type	Relevance
føringen)	Transport means replaced (Nytt transportmiddel) Reduced capacity (Redusert kapasitet) Re-routed (Ny rute)	
Stop deviation (Endring av stopp)	New stop (Nytt stopp) Stop omitted (Stopp fjernet)	Route/travel information: Terminal stop
Service deviation (Tjenesteavvik)	Reduced service (Redusert service) Increased service (Tilleggstjeneste) Reduced accessibility (Redusert tilgjengelighet)	Route/travel information: Terminal Trip/Leg Terminal stop Transfer
Unlawful interferance (Lovbrudd)	Sabotage (Sabotasje) Terrorism (terrorisme) Theft (Tyveri)	Transport management: Traffic control Fleet management Etc.
Damage (Skade)	Illness (Sykdom) Cargo damage (Skade på gods)	Transport management: Traffic control Fleet management Terminal operation Etc.
Security deviation (Sikkerhetsavvik)	Missing passenger Manglende eller feil dokumentasjon Wrong packing Dangerous cargo Unruely passenger	Transport management: Traffic control Fleet management Terminal operation Etc.

Table 9 Deviation categories and types

13Information View on Freight Transport

13.1Problem Specification and Motivation

The focus is the transport requirements of the Transport User and how they can be fulfilled. The Transport User may book the required transport and terminal services and follow up the transport, or the Transport User may hand over the work on the establishment of the transport chain and the follow up of the chain to a Transport User Agent (this may be a forwarder or a chain manager). As seen from the Transport User or the Transport User Agent a typical business scenario for freight transport may, among others, consists of the following steps:

- Pre-ordering: Information is exchanged between a Transport User or a Transport User Agent and a service provider (in this case a provider of transport or terminal services) prior to the traditional order cycle. Can be considered as a preliminary booking that clarifies the terms and the ability to provide the services and the terms.
- Ordering: Information is exchanged between a Transport User or a Transport User Agent and a service provider (a provider of transport or terminal services) for the ordering of products and/or services. A firm booking or a booking amendment.
- Forecasting: Forecast and inventory management including consigned inventory is exchanged between a Transport User or a Transport User Agent and a service provider (a provider of transport or terminal services).
- Physical distribution: Information is exchanged between the service providers (transports or terminal actors) and the Transport User or Transport User Agent and about the progress of the transport operation.

13.2Target Group

The Transport User and the Transport User Agent will both need the same functionality for ordering and following up of transport and terminal services, and they will find such functionality in the Transport Demand sub-domain. Information exchange with the Transporters and Terminal Actors represented by the Transport Service Management and Terminal Management sub-domains are required. Figure 58 shows the target group with reference to the sub-domains of the ARKTRANS reference model as described in chapter 4.

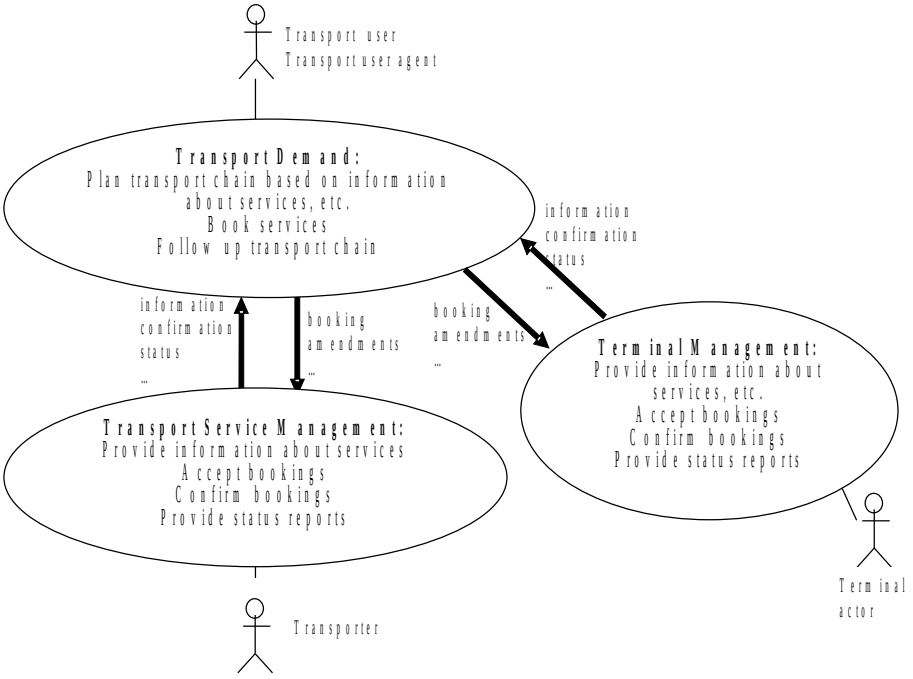


Figure 58 Target group with reference to ARKTRANS sub-domains

13.3Overall Requirements

ARKTRAS focuses on multimodal transport. Thus, multimodal solutions where the same information is exchanged for all transport modes are desired. Thus, it will be easier to switch between service providers and transport modes.

13.4Related work

There are a large number of initiatives focusing on message exchange for freight transport. However, so far the initiatives have mainly focused on separate transport modes. The most promising initiative on multimodal freight transport is accomplished by the European D2D (Door-to-Door) project. There has been a close collaboration between ARKTRANS and D2D, and so far ARKTRANS will recommend the D2D results, or solutions further developed form these results, even though they are neither complete nor sufficiently general.

Many modal standards have derived from the EDIFACT family and are following the EDIFACT approaches (UN/EDIFACT - United Nation's Electronic Data Interchange for Administration, Commerce, and Transport - http://www.unece.org/trade/untdid/d99b/trmd/conitt_c.htm). In Europe the EDIFACT messages are still most frequently used, while in the US the X12 (established by the American National Standards Institute - ANSI) is more used. The EDIFACT solutions are not unambiguous. The way of using the standards have to be decided in every case. Former Norsk EDIPRO, now Norstella (http://www.norstella.no/), is the Norwegian Centre for EDI and Trade Procedures. One of the tasks of Norsk EDIPRO is to promote Norwegian interests in relevant international fora, e.g. UN/CEFACT, CEN, EUROPRO, etc. Norstella has also established a road transport solution for some Norwegian stakeholders. However, so far multimodal solutions have not been found.

The XML messages seems to be the winner in the very near future and are taking market shares from the others, but the messages are very often based on standard EDI messages like the EDIFACT family.

OASIS (Organization for the Advancement of Structured Information Standards - a not-for-profit, global consortium- http://www.oasis-open.org/home/index.php) drives the development, convergence and adoption of e-business standards, and has focused on developing secure e-business standards for applying XML and Web services in industry (ebXML). One of these committees is OASIS ebXML Business process TC (http://www.oasis-open.org/committees/ebxml-bp/charter.php). This committee is trying to find generic meta models for business processes, activities, and collaboration.

13.5Conceptual Information Model

TRIM (the Transport Reference Information Model) is the ARKTRANS conceptual information model for freight transport. TRIM can be found on http://www.sintef.no/units/informatics/projects/trim/

14Information View on Other Aspects

The ARKMIN project established information models that also may be useful for other transport modes. ARKMIN can be found on
http://www.fargisinfo.com/Arkmin/Arkmin/index.html
ARKMIN contains the following information models

- The ARKMIN Contingency sub model
- The ARKMIN Location sub model
- The ARKMIN Meteorological sub model
- The ARKMIN Navobj sub model
- The ARKMIN Tide sub model

15Information View on Route and Travel Information Messages

The Route and travel information message elements and messages specified in this chapter are preliminary and will be further refined in the MultiRIT project that starts in 2005. Some message examples are listed in Annex D.

15.1Message Elements

The message elements are the building blocks that are used when messages (see 15.2) are composed.

15.1.1Message Elements related to Trip pattern sub-model

The message elements in the route information models are the building blocks that are used when messages (see 15.2) are composed. The Trip pattern sub-model (see 12.7.2) is the basis for the message elements defined in this section.

15.1.1.1Leg pattern

Leg pattern

- selected attributes

15.1.1.2Line

Line

- selected attributes
- Operator (1)
- *Remark* (0..*)
- *Contact* (0..1)

It must be possible to identify lines by unique identifiers. A local line number (e.g. bus number) is not enough. The same line number may for example be used in many cities and for several transport modes. The information elements in this identifier are:

- Transport mode
  The primary transport mode of the line (other modes may be used in case of deviations. This will however be handled as a deviation)
  - 1 – Road
  - 2 – Sea
  - 3 – Rail
  - 4 – Air
  - 5 – Tram
  - 6 – Cableway
  - 7 – Underground
  - 8 - Others
- Norwegian county code

- Transport type
  Indicates the type of the line (based upon coverage, speed, target group, etc.).
- Line reference
  A reference that together with the Line identifier (see below) allows a unique identification of a line for a specific transport mode and transport type. May be

  - An area code that identifies the area in which the line operates (it is assumed that the line identifiers are unique within this area).
  - The operator of the line (will together with the start and stop destinations identify the line)
- Line identifier
  The format and content depends on the transport mode. May be
  - The number used by the transport users (e.g. bus number)
  - An internal number that is not known to the transport user
  - Another value (references to start and stop destinations)
  - Empty, e.g. if the transport type provides a unique identification (e.g. Hurtigruta)

Table 10 Line attributes for road transport – Transport mode is 1

Norwegian county code[24]	Transport type	Line reference	Line identifier	Comment
Norwegian county code or list of such. Indicates the county in which the line operates or the counties which in which the line stops. 01 = Østfold 02 = Akershus …. 20 = Finnmark E.g. 16 or 16, 17, 18	01 = Local transport (Lokaltransport)	Area code (identifies a part of the county or a city)	Line number	Lines within a county or lines crossing county boarders that are not long distance or express lines (less than 100 km). May be lines between cities or between a city and the surrounding area.
	02 = City transport (Bytransport)		Line number	Lines within a city (10.000 people).
	03 = Local express transport (Lokal ekspressrute)		Line number	Local transport (less than 100 km) with limited number of stops. Used when there is local express transport in addition to more time consuming local transport.
	04 = School transport (Skolerute)		Line number	Route pattern is decided by the school transport demands (school holidays, school starting and ending hours).
	05 = Night transport (Nattbussrute)		Line number	Limited route pattern decided by demand for transport during night time. Mainly in cities.
	06 = Shuttle service (Tilbringerrute)		Line number	To express transport, subway, etc.
	07 = Airport transport (Flybuss)		Line number	Transport to airport. May differ from shuttle service in the way that airport transport is not subsidised.
	15 = Adapted transport (Fast servicerute)		Line number	Scheduled transport with facilities adapted to special transport demands (these demands may be reported in advance). Fixed stop locations.
	16 = On demand transport (Servicerute)		Line number	Not-scheduled transport. Stop locations and times depend on demands.
	22 = Express transport (Ekspressrute)	NA	Line number	Fast Limited number of stops. More than 100 km.
	23 = Long distance transport (Langdistanse-rute)		Line number	Slower than express transport and more stops. More than 100 km
	30 = International transport (Internasjonal rute)	Country code for the other country	Line number	Lines connecting Norway with other countries

Table 11 Line attributes for sea transport – Transport mode is 2

Norwegian county code[25]	Transport type	Line reference	Line identifier	Comment

[24] May not be required. The area code used a a line reference may be sufficient.

Norwegian county code or list of such. Indicates the county in which the line operates or the counties which in which the line stops. 01 = Østfold 02 = Akershus …. 20 = Finnmark E.g.16 or 16, 17, 18	01 = Local transport (Lokal båtrute)	Area code (identifies a part of the county or a city)	Line number (rutenr)	Slow sea transport within a county or crossing county boarders. (Less than 100 km). May be lines between cities or between a city and surrounding area.
	03 = Local express transport (Lokal hurtigbåt)		Line number (rutenr)	Fast local transport (less than 100 km).
	08 = Ferry transport (Fergetransport)		Line number (rutenr)	
	11 = Tourist transport (Turistrute)		Line number (rutenr)	Transport for tourists.
	22 = Express transport (Ekspress-båtrute)	NA	Line number (rutenr)	Fast transport (more than 100 km).
	23 = Long distance transport (Langdistanse-båtrute)		Line number (rutenr)	Slow transport (more than 100 km).
	24 = Coastal liner		NA	"Hurtigruten"
	30 = International route	Country code for the other country	Line number (rutenr)	Lines connecting Norway with other countries

Table 12 Line attributes for rail transport – Transport mode is 3

Norwegian county code[26]	**Transport type**	**Line reference**	**Line identifier**	**Comment**
Norwegian county code or list of such. Indicates the county in which the line operates or the counties which in which the line stops. 01 = Østfold 02 = Akershus …. 20 = Finnmark E.g. 16 or 16, 17, 18	01 = Local transport (Lokaltogrute)	Area code (identifies a part of the county or a city)	Line number	Lines within a county or lines crossing county boarders that are not long distance or express lines (less than 100 km). May be lines between cities or between a city and surrounding area.
	03 = Local express transport (Intercityrute)		Line number	Fast local transport (less than 100 km) with limited number of stops.
	05 = Night transport (Nattogrute)		Line number	Limited route pattern decided by demand for transport during night time. Mainly in cities.
	07 = Airport transport (Flytogrute)		Line number	Transport to airport. May differ from shuttle service in the way that airport transport is not subsidised
	11 = Tourist transport (Museums-togrute)		Line number	Transport for tourists. Old trains, etc.
	21 = Express transport (Ekspresstog-rute)	NA	Line number	Fast with limited number of stops. More than 100 km.
	30 = International route (Internasjonal togrute)	Country code for the other country	Line number	Lines connecting Norway with other countries

Table 13 Line attributes for air transport – Transport mode is 4

Norwegian county code[27]	**Transport type**	**Line reference**	**Line identifier**	**Comment**

[25] May not be required. The area code used a a line reference may be sufficient.
[26] May not be required. The area code used a a line reference may be sufficient.
[27] May not be required. The area code used a a line reference may be sufficient.

List of Norwegian county codes of the airports that are visited by the line. 01 = Østfold 02 = Akershus …. 20 = Finnmark E.g. 19, 17	41 = Regional routes (Regionale ruter)	Airline code	To elements: - Country and IATA code for from location. - Country and IATA code for final destination	In air transport, there are no line numbers (just the flight numbers of individual trips). The IATA location codes are used instead. A line includes all the flights of an airline between two destinations (no matter the number of via locations)
	42 = National routes (Nasjonale ruter)			
	43 = Helicopter routes (Helikopter-ruter)			
	30 = International route (Internasjonal rute)			There are no line numbers (just the flight numbers of individual trips). The IATA location codes are used instead. A line includes all the flights of an airline between two destinations (no matter the number of via locations)

Table 14 Line attributes for tram, cableway and underground transport – Transport mode is 5, 6 or 7

Norwegian county code[28]	**Transport type**	**Line reference**	**Line identifier**	**Comment**
5 = Tram	01 = Local transport (Lokalrute)	Area code (identifies a part of the county or a city.	Line number	Lines within a county
6 = Cable-way	01 = Local transport (Lokalrute)	Area code (identifies a part of the county or a city)	Line number	Lines within a county
7 = Under-ground	01 = Local transport (Lokalrute)	Area code (identifies a part of the county or a city)	Line number	Lines within a county

Table 15 Line attributes for other transport modes – Transport mode is 8

Norwegian county code[29]	**Transport type**	**Line reference**	**Line identifier**	**Comment**

[28] May not be required. The area code used a a line reference may be sufficient.
[29] May not be required. The area code used a a line reference may be sufficient.

Norwegian county code or list of such. Indicates the county in which the line operates or the counties which in which the line stops. 01 = Østfold 02 = Akershus …. 20 = Finnmark E.g. 16 or 16, 17, 18	01 = Local transport (Lokalrute)	Area code indication which part of the county	Line number	
	02 = City transport (Byrute)		Line number	
	03 = Local express transport (Lokal ekspresstransport)		Line number	
	04 = School conveyance (Skoleskyssrute)		Line number	
	05 = Night transport (Nattrute)		Line number	
	06 = Shuttle service (Tilbringerrute)		Line number	
	07 = Airport transport (Flyplass transport)		Line number	
	08 = Ro-ro transport		Line number	Ferry type, roll on- roll off
	11 = Tourist transport		Line number	
	15 = Adapted transport (Servicerute)			
	16 = On demand transport		Line number	
	22 = Express transport (Ekspressrute)		Line number	
	23 = Long distance transport (Langdistanse-rote)		Line number	
	30 = International transport (Internasjonal rute)	Country code for the other country	Line number	

Line identifier - Line numbers for trains

Trains usually do not have a line number. Thus, a line number must de derived from other information. Different strategies are used for the different operators:

- NSB: The railway segment number (strekningsnummer) is used as line number (for some departures NSB also calls this ‘lines’).
- Airport train to Gardermoen.

Operator	Line no.	Line name
NSB	01	Oslo - Halden – Göteborg
NSB	21	Oslo - Trondheim
NSB	22	Åndalsnes – Dombås
NSB	23	Skien - Oslo - Gardermoen Lillehammer
NSB	25	Oslo - Hamar - Røros - Trondheim
NSB	26	Steinkjer - Trondheim - Røros – Oppdal
NSB	41	Oslo – Bergen
Flomsbanen	42	Flåm – Myrda
NSB	43	Bergen – Arna
NSB	45	Bergen - Voss – Myrdal
NSB	50	Oslo S – Kristiansand
NSB	51	Kristiansand – Stavanger
NSB	52	Notodden – Porsgrunn
NSB	59	Egersund – Stavanger
NSB	71	Trondheim – Bodø

NSB	300	Skøyen - Oslo - Hakadal - Jaren – Gjøvik
NSB	400	(Drammen) - Asker - Oslo – Lillestrøm
NSB	440	(Drammen) Skøyen - Oslo - Jessheim – Dal
NSB	450	Eidsvoll - Oslo - Drammen – Kongsberg
NSB	460	Skøyen - Årnes – Kongsvinger
NSB	500	Skøyen - Oslo – Ski
NSB	550	Spikkestad - Oslo – Moss
NSB	560	Skøyen - Oslo - Mysen – Sarpsborg
NSB	702	Eidsvoll - Oslo - Drammen – Kongsberg (large stations)
NSB	704	Moss - Ski - Kolbotn - Holmlia - Oslo S (large stations
NSB	31	Norden
NSB	32	Vest Europa
NSB	33	Øst Europa
Flytoget		Asker – Oslo - Gardermoen

Line numbers for flights
In air transport, there are no line numbers, just the flight numbers of individual trips. The same route may be served by several flight numbers.

The IATA location codes are used to identify lines. A line includes all the flights of an airline with the same start and the same stop destination, no matter the number of via locations.

To elements are used to identify a line:
- The line reference is the airline code
- The line identifier contains two elements
  - Country and IATA code for from location.
  - Country and IATA code for final destination

15.1.1.3Line reference

Line reference
- selected attributes of Line

15.1.1.4Stop pattern

Stop pattern
- selected attributes

15.1.1.5Time schedule pattern

Time schedule pattern
- selected attributes

15.1.1.6Trip pattern

Trip pattern
- selected attributes
- Ordered sequence of stops (1..*)
  - *Stop pattern* (1)
  - *Terminal reference* (1)
  - *Stop point* (0..*)
  - *Leg pattern* (0..*) (previous leg)

A trip pattern mainly corresponds to the headings in the printed time tables. The variants represent different paths and stop patterns associated to this heading. The variants are often represented by columns and footnotes in the printed time tables.

Table 16 Trip pattern attributes

Attribute	M/O	Description
Trip pattern no	M	Pattern id. (May be internal) Identifies an overall route pattern
Variant no	M	1 should indicate the normal pattern Identifies a specific deviation from the normal pattern (extra stop, stop omitted, etc.)
Trip pattern name	O	Published name. May be used *in addition to* Line name to give information about the trip, for example to give direction. May be equal to a heading in the printed time tables today)
Variant name	O	May be published in addition to trip pattern name
Direction	O	Compass direction (N, E, S, W) Clockwise Counter clockwise Towards centre Away from centre Through transport Other textual description
Description	O	E.g. more detailed description

Table 17 Trip pattern attributes applied on transport modes

Transport mode	Trip pattern no	Trip pattern name	Variant no	Variant name	Comment
Road	Sequence number	Examples: Risvollan - Dronningens gt. Dronningens gt. – Stavset Stavset – Dronningens gt. Dronningens gt. - Risvollan	1 if just one pattern or first variant or higher sequence number	Name to be published in addition to trip pattern name (if there is a need for a more detailed name) Examples: Via St.Olavs hospital. A B	One or more Trips, identified by means of trip numbers will be related to each trip pattern.
Sea	Sequence number	Example: Line name Kystekspressen Trondheim – Kristiansund Kystekspressen Kristiansund - Trondheim	1 if just one pattern or first variant or higher sequence number	Name to be published in addition to trip pattern name (if there is a need for a more detailed name) Example: No call at Brekstad	One or more Trips, identified by means of trip numbers will be related to each trip pattern.
Rail Alternative 1	Sequence number	Example: Line name	1 if just one pattern or first variant or higher sequence number	Name to be published in addition to trip pattern name (if there is a need for a more detailed name) Examples: No stop at Kongsvoll Reduced number of stops	One or more Trips, identified by means of train numbers + date will be related to each trip pattern.
Rail Alternative 2	Train	Example:	1	Name to be published in addition to trip pattern name (if there is a	One or more Trips, identified

Transport mode	Trip pattern no	Trip pattern name	Variant no	Variant name	Comment
(probably the best one)	number	Line name		need for a more detailed name) Example: Via Bodø	by means of train number + date will be related to each trip pattern.
Air	Flight number		1	Name to be published in addition to trip pattern name (if there is a need for a more detailed name)	One or more Trips, identified by means of flight number + date will be related to each trip pattern.

Table 18 Description of some of the attributes of Trip pattern

15.1.1.7Trip pattern reference

Trip pattern reference

- selected attributes of Trip pattern

15.1.2Message Elements Related to Timetable sub-model

The Timetable sub-model (see 12.7.3) is the basis for the message elements defined in this section.

15.1.2.1Combined service

A combined service is between two trips that stop at the same or co-located terminals. In case of arrival the combined service refers to a trip that may offer a combined service to this trip (the other trip may for example wait for this trip). In case of departure, the combined service refers to a trip that is offered a combined service by this trip (this trip may for example wait for the other trip).

Combined service

- selected attributes
- *Line* (1)
- *Trip pattern reference*(1) (trip that offers or is offered a combined service)
- Trip reference (0..1)
- *Terminal stop* (1) (of trip that is offered/offers a combined service)
- Time schedule deviation (0..*)

15.1.2.2Date

Date

- selected attributes

15.1.2.3Leg

Leg

- selected attributes

- served by (0..*) (in case of differences from trip - replaces the trip's transport means)
  - *Transport means* (1)
- provided by (0..*)
  - Transport means (1..*)
- *On-board service* (0..1) (in case of differences from trip services – these services replaces trip services)
- *On-board deviation* (0..1) (in case of deviations)

15.1.2.4Leg reference

Leg reference
- selected attributes

15.1.2.5Remark

Remark
- selected attributes

15.1.2.6Terminal stop

Stop
- selected attributes
- Terminal reference(1)
- Stop point (0..*)
- *Remark* (0..*)
- Start of (0..1)
  - *Leg* (0..1) (next leg if any)
- Offers on arrival (0..*)
  - *Combined service* (0..*) (is offered a combined service)
- Offers on departure (0..*)
  - *Combined service* (0..*) (offers a combined service)
- Duration (0..1)
  - calculated value (1)
- Stop Service (0..1)
- Terminal stop deviation (0..*)
- Time schedule deviation (0..*)
- Next stop in case of boarding (0..*)
  - *Terminal reference* (1)

15.1.2.7Time table

Timetable
- selected attributes
- *Operator* (1) (of the lines in the time table)
- Validity start (1)
  - *Date* (1)
- Validity end (1)
  - *Date* (1)

15.1.2.8Trip

A detailed specification of the trip is provided. All stops are specified. (If a more overall specification of the trip or a specification of a trip segment is required the Ride message element may be used – it provides information about just the departure and the final arrival.

Trip
- selected attributes
- Operator (0..*)
- *Contact* (0..*)
- *Remark* (0..*)
- *Transport means* (0..*) (if same transport means for all legs)
- On-board service (0..1)
- On-board deviation (0..1)
- Route - ordered sequence of (1)
  - *Terminal stop* (1..*)
- Replaced by (0..*)
  - *Trip reference* (1..*)
- Replaces (0..*)
  - *Trip reference* (1..*)

Attribute	M/O	Description	Road	Sea	Rail	Air
Trip number	M	Trip ID	Tour number	Tour number	Train number + timestamp	Flight number + timestamp
Description	O					

Table 19 Description of some of the Trip attributes

15.1.2.9Trip reference

Trip reference
- selected attributes of Trip

15.1.3Message Elements Related to Terminal sub-model

The Terminal sub-model (see 12.7.1) is the bases for the message elements defined in this section.

15.1.3.1Local time

Local time
- selected attributes

15.1.3.2Stop point

Stop point
- selected attributes
- Location (1)

15.1.3.3Terminal

Terminal

- selected attributes
- Location (1)
- Local time (1)
- Part of (0..*)
  - *Terminal reference* (1)
- Contains (0..*)
  - *Terminal reference* (1..*)
- Stop point (0..*)
- Terminal services (0..*)
- Terminal deviation (0..*)
- Transfer (0..*)

15.1.3.4 Terminal access point

Terminal access point
- selected attributes

15.1.3.5Terminal reference

Terminal reference
- selected attributes

15.1.3.6Transfer

Transfer
- Transfer start (1) choice
  - *Terminal reference* (0..*)
  - *Terminal access point* (0..*)
- Transfer end (1) choice
  - *Terminal reference* (0..*)
  - *Terminal access point* (0..*)
- selected attributes of Transfer
- Transfer service (0..*)
- Transfer deviation (0..*)

15.1.3.7Transfer reference

Transfer reference
- Terminal reference (1)
- selection
  - *Terminal reference* (0..*)
  - *Terminal access point* (0..*)

15.1.4Message Elements Related to Service and Deviation sub-model

The Service and Deviation sub-model (see 12.7.4) is the bases for the message elements defined in this section.

15.1.4.1Services

The services may be represented by many different message elements depending on the service category and type. Information about the accessibility may be related to the information about the services.

15.1.4.1.1Terminal service

Terminal service

- Information services (0..1)
  - *Travel information service type (0..1)*
  - *Tourist information service type (0..1)*
- Terminal en-route service (0..1)
  - *Handling service type (0..1)*
  - *Entertainment service type (0..1)*
  - *Payment service type (0..1)*
  - *Travel information service type (0..1)*
  - *Assistance provided service type (0..1)*
  - *Free offers service type (0..1)*
  - *Attendance service type (0..1)*
- Terminal facility (0..1)
  - *Whereabouts facility type (0..1)*
  - *Local facility type (0..1)*
  - *Entry and exit facility type (0..1)*
  - *Office facility type (0..1)*
  - *Commercial facility type (0..1)*
  - *Ticket sale facility type (0..1)*
  - *Refreshment sale facility type (0..1)*
  - *Children adaptation facility type (0..1)*
  - *Misc. facility type (0..1)*
  - *Accommodation facility type (0..1)*
- Terminal restriction (0..1)
  - *Access restriction type (0..1)*

15.1.4.1.2On-board service

On-board service

- Information services (0..1)
  - *Travel information service type (0..1)*
  - *Tourist information service type (0..1)*
- On-board en-route service (0..1)
  - *Handling service type (0..1)*
  - *Entertainment service type (0..1)*
  - *Payment service type (0..1)*
  - *Assistance provided service type (0..1)*
  - *Free offers service type (0..1)*
  - *Attendance service type (0..1)*
- On-board facility (0..1)
  - *Whereabouts facility type (0..1)*
  - *Entry and exit facility type (0..1)*
  - *Office facility type (0..1)*
  - *Commercial facility type (0..1)*
  - *Ticket sale facility type (0..1)*
  - *Refreshment sale facility type (0..1)*
  - *Children adaptation facility type (0..1)*
  - *Misc. facility type (0..1)*
  - *Accommodation facility type (0..1)*
- On-board restriction (0..1)
  - *Transport restriction type (0..1)*

15.1.4.1.3Stop service

Stop service

- Stop en-route service (0..1)
  - *Assistance provided service type (0..1)*
  - *Attendance service type (0..1)*
- Stop facility (0..1)
  - *Entry and exit facility type (0..1)*
- Stop restriction (0..1)
  - *Stop restriction type (0..1)*

15.1.4.1.4Transfer service

- Transfer facility (0..1)
  - *Whereabouts facility type (0..1)*

15.1.4.1.5En-route services

15.1.4.1.5.1Handling service type

Handling service type

- Check in (0..*)
  - Service attributes
- Customs (0..*)
  - Service attributes
- Luggage check in (0..*)
  - Service attributes
- Luggage security control (0..*)
  - Service attributes
- Passenger security control (0..*)
  - Service attributes

15.1.4.1.5.2Entertainment service type

Entertainment service type

- Children's entertainment (0..*)
  - Service attributes
- Live music (0..*)
  - Service attributes
- Movie (0..*)
  - Service attributes
- Music channel (0..*)
  - Service attributes
- News (0..*)
  - Service attributes

15.1.4.1.5.3Payment service type

Payment service type

- By phone (0..*)
  - Service attributes
- Cash (0..*)
  - Service attributes
- Credit card (0..*)

- Service attributes
- E-ticket(0..*)
  - Service attributes

15.1.4.1.5.4Assistance provided service type

Assistance provided service type

- Assistance for disabled (0..*)
  - Service attributes
- Assistance to sick people (0..*)
  - Service attributes
- Assistance to unaccompanied minors (0..*)
  - Service attributes
- Free transport of aids (0..*)
  - Service attributes
- Luggage assistance (0..*)
  - Service attributes

15.1.4.1.5.5Free offers service type

Free offers service type

- Alcoholic beverages (0..*)
  - Service attributes
- Breakfast (0..*)
  - Service attributes
- Cold meal (0..*)
  - Service attributes
- Dinner (0..*)
  - Service attributes
- Lunch (0..*)
  - Service attributes
- Newspapers (0..*)
  - Service attributes
- Non-alcoholic beverages (0..*)
  - Service attributes

15.1.4.1.5.6Attendance service type

Attendance service type

- Cabin crew (0..*)
  - Service attributes
- Conductor (0..*)
  - Service attributes
- Guard (0..*)
  - Service attributes

15.1.4.1.6Facilities

15.1.4.1.6.1Whereabouts facility type

Whereabouts facility type

- Lounge with refreshments (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Seating accommodation (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Security control area (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Shelter (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Reclining chair (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Silence (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Smoking area (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Physical unit (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Waiting-room (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)

15.1.4.1.6.2Local facility type

Local facility type

- Car rental (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Machine accessibility (0..*)
  - Information accessibility (0..*)
- Car service (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Machine accessibility (0..*)
  - Information accessibility (0..*)
- Cycle parking (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Machine accessibility (0..*)
  - Information accessibility (0..*)
- Kiss and ride (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Machine accessibility (0..*)
  - Information accessibility (0..*)
- Park and ride (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Machine accessibility (0..*)
  - Information accessibility (0..*)
- Short time parking area (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Machine accessibility (0..*)
  - Information accessibility (0..*)
- Long time parking area (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Machine accessibility (0..*)
  - Information accessibility (0..*)
- Parking garage (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Machine accessibility (0..*)
  - Information accessibility (0..*)
- Taxi stop (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Machine accessibility (0..*)
  - Information accessibility (0..*)

15.1.4.1.6.3Entry and exit facility type

Entry and exit facility type

- Terminal access (0..*)
  - Service attributes
  - Information accessibility (0..*)
  - Terminal accessibility (0..*)
  - Transport means accessibility (0..*)
- Transport means access (0..*)
  - Service attributes
  - Information accessibility (0..*)
  - Terminal accessibility (0..*)
  - Transport means accessibility (0..*)

15.1.4.1.6.4Commercial facility type

Commercial facility type

- Bank (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- Books (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- Cloths (0..*)
  - Service attributes

- Physical accessibility (0..*)
- Accessibility supported by lightning and contrast (0..*)
- Accessibility for allergic people (0..*)
- Information accessibility (0..*)

- Food (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- Gifts (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- Kiosk (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- Misc. (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- Tax Free (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- Pharmacy (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)

15.1.4.1.6.5Ticket sale facility type

Ticket sale facility type

- Attended ticket office (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Machine accessibility (0..*)
  - Information accessibility (0..*)
- E-ticket reader (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Machine accessibility (0..*)
  - Information accessibility (0..*)
- Ticket machine (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Machine accessibility (0..*)
  - Information accessibility (0..*)

15.1.4.1.6.6Refreshment sale facility type

Refreshment sale facility type

- Bar (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
- Coffee or Tea (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
- Fast food (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
- Restaurant (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
- Trolley (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)

15.1.4.1.6.7Children adaptation facility type

Children adaptation facility type

- Nursery (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
- Playroom (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
- Infant room (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)

15.1.4.1.6.8Misc. facility type

Misc. facility type

- Cash dispenser (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Machine accessibility (0..*)
- Chapel (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Cloakroom (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Computer (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
- Desk (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
- Emergency phone (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Machine accessibility (0..*)
- Fax (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Machine accessibility (0..*)
- Internet access (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
- Library (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Lost property (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Luggage space (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Luggage trolley (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
- Phone (0..*)
  - Service attributes

- Misc. accessibility (0..*)
- Physical accessibility (0..*)
- Accessibility supported by lightning and contrast (0..*)
- Accessibility for allergic people (0..*)
- Machine accessibility (0..*)

- Physical training (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Power supply (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Machine accessibility (0..*)
- Pram space (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Seats (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Swimming pool (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Table (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
- Toilet (0..*)
  - Service attributes
  - Misc. accessibility (0..*)
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)

15.1.4.1.6.9Accommodation facility type

Accommodation facility type

- Allergy room (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- Single (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- Room adapted to disabled (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- Shared (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- Shared bath room (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- Suite (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)
  - Information accessibility (0..*)
- With bath room (0..*)
  - Service attributes
  - Physical accessibility (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Accessibility for allergic people (0..*)

- Information accessibility (0..*)

15.1.4.1.7Information services

15.1.4.1.7.1Travel information service type

Travel information service type

- Transport means map (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)
- Arrival and departure information (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)
- Terminal information (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)
- Dynamic arrival and departure information (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)
- Traffic information (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)
- Route pattern (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)
- Contact information (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)
- Trip information (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)
- Terminal map (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)
- Time tables (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)

15.1.4.1.7.2Tourist information service type

Tourist information service type

- Accommodation information (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)

- Machine accessibility (0..*)
- Physical accessibility (0..*)

- Location information (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)
- Historic information (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)
- Activity information desk (0..*)
  - Service attributes
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Information means providing accessibility (0..*)
  - Machine accessibility (0..*)
  - Physical accessibility (0..*)

15.1.4.1.8Restrictions

15.1.4.1.8.1Stop restriction type

Stop restriction type

- No Alighting (0..*)
  - Service attributes
- No boarding (0..*)
  - Service attributes
- Stops on signal (0..*)
  - Service attributes
- Must be pre-booked (0..*)

15.1.4.1.8.2Transport restriction type

Transport restriction type

- Age restriction (0..*)
  - Service attributes
- Bikes prohibited (0..*)
  - Service attributes
- Check-in required (0..*)
  - Accessibility supported by lightning and contrast (0..*)
  - Information accessibility (0..*)
  - Service attributes
- Group restriction (0..*)
  - Service attributes
- Must be pre-booked (0..*)
  - Service attributes
- Must have space reservation (0..*)
  - Service attributes
- Must have ticket (0..*)
  - Service attributes
- Pets prohibited (0..*)
  - Service attributes
- Smoking prohibited (0..*)
  - Service attributes
- Wheelchair restrictions (0..*)
  - Service attributes

15.1.4.1.8.3Access restriction type

Access restriction type

- Must be entitled to admission (0..*)
  - Service attributes
- Must have entrance card (0..*)
  - Service attributes
- Must have ticket (0..*)
  - Service attributes

15.1.4.2Deviations

The deviations may be represented by many different message elements depending on the deviation category and type.

15.1.4.2.1Terminal deviation

Terminal deviation

- Terminal service deviation (1)

15.1.4.2.2Time schedule deviation

Time schedule deviation

- *Time schedule deviation* (0..1)
  (Related to arrival or departure)
  - Delayed arrival deviation type (0..*)
    - deviation attributes
  - Delayed departure deviation type (0..*)
    - deviation attributes
  - Early arrival deviation type (0..*)

- deviation attributes
- Early departure deviation type (0..*)
  - deviation attributes

15.1.4.2.3Terminal stop deviation

Terminal stop deviation
- Stop deviation (0..1)
- Stop service deviation (0..1)

15.1.4.2.4On-board deviation

On-board deviation
- Transport execution deviation (0..1)
- On-board service deviation (0..1)

15.1.4.2.5Transfer deviation

Transfer deviation
- Transfer service deviation (1)

15.1.4.2.6Service deviations

15.1.4.2.6.1On-board service deviation

On-board service deviation
- Increased on-board service deviation type (0..1)
  - deviation attributes
  - On-board service (0..1)
- Reduced accessibility type (0..1)
  - deviation attributes
  - Terminal service (0..1)
- Reduced on-board service deviation type(0..1)
  - deviation attributes
  - On-board service (0..1)

15.1.4.2.6.2Stop service deviation

Stop service deviation
- Increased stop service deviation type (0..1)
  - deviation attributes
  - Stop service (0..1)
- Reduced accessibility type (0..1)
  - deviation attributes
  - Terminal service (0..1)
- Reduced stop service deviation type(0..1)
  - deviation attributes
  - Stop service (0..1)

15.1.4.2.6.3Terminal service deviation

Terminal service deviation
- Increased terminal service deviation type (0..1)
  - deviation attributes
  - Terminal service (0..1)
- Reduced accessibility type (0..1)
  - deviation attributes
  - Terminal service (0..1)
- Reduced terminal service deviation type(0..1)
  - deviation attributes
  - Terminal service (0..1)

15.1.4.2.6.4Transfer service deviation

Transfer service deviation
- Increased transfer service deviation type (0..1)
  - deviation attributes
  - Transfer service (0..1)
- Reduced accessibility type (0..1)
  - deviation attributes
  - Terminal service (0..1)
- Reduced transfer service deviation type(0..1)
  - deviation attributes
  - Transfer service (0..1)

15.1.4.2.7Stop deviations

Stop deviation
- New stop deviation type (0..*)
  - deviation attributes
- Stop omitted deviation type (0..*)
  - deviation attributes

15.1.4.2.8Transport execution deviation

Transport execution deviation
- Cancelled deviation type (0..*)
  - deviation attributes
- Disrupted deviation type (0..*)
  - deviation attributes
- Transport mode altered deviation type (0..*)
  - deviation attributes
- Transport means replaced deviation type (0..*)
  - deviation attributes
- Reduced capacity deviation type (0..*)
  - deviation attributes
- Re-routed deviation type (0..*)

- deviation attributes

15.1.4.3Accessibility

The accessibility may be represented by many different message elements depending on the service category and type.

15.1.4.3.1Accessibility for allergic people

Accessibility for allergic people

- Cleaning (0..*)
- Mould (0..*)
- Pets (0..*)
- Pollen (0..*)
- Smoking (0..*)

15.1.4.3.2Accessibility supported by lighting and contrast

Accessibility supported by lighting and contrast

- Contrasts (0..*)
- Lightening (0..*)

15.1.4.3.3Information accessibility type

Information accessibility type

- Audio information (0..*)
- Marking (0..*)
- Tactile information (0..*)
- Visual information (0..*)

15.1.4.3.4Information means providing accessibility

Information means providing accessibility

- Equipment for interactive information (0..*)
- Information desk (0..*)
- Information displays (0..*)
- Information handouts (0..*)
- Information placards (0..*)
- Internet access (0..*)
- Maps (0..*)
- Mobile services (0..*)
- Route map (0..*)
- Signs and icons (0..*)
- Voice information (0..*)

15.1.4.3.5Machine accessibility

Machine accessibility

- Usability (0..*)
- Easy to find (0..*)

15.1.4.3.6Misc. accessibility

Misc. accessibility

- Seats adoption (0..*)
- Handicap toilet (0..*)

15.1.4.3.7Physical accessibility

Physical accessibility
- Broad wise gradient (0..*)
- Doors (0..*)
- Gradient (0..*)
- Lane line (0..*)
- Lift (0..*)
- Space requirement (0..*)
- Surface (0..*)
- Tactile marking (0..*)
- Threshold (0..*)
- Waiting area / passages (0..*)
- Well arranged interior (0..*)
- Wheelchair area (0..*)

15.1.4.3.8Terminal entrance accessibility

Terminal entrance accessibility
- Gradient (0..*)
- Handicap parking (0..*)
- Lane line (0..*)
- Tactile marking (0..*)
- Threshold (0..*)

15.1.4.3.9Transport means accessibility

Transport means accessibility
- Angle (0..*)
- Distance (0..*)
- Grip (0..*)
- Height level difference (0..*)
- Lift (0..*)
- Wheelchair platform (0..*)

15.1.5Other Message Elements

15.1.5.1Contact

Contact
- selected attributes

15.1.5.2Journey segment

The movement of a transport user may be composed of one or more journey segments of different types (car driving, walking, use of different types of public transport, use of bicycle, etc.). A transfer from a terminal access point to a terminal and a transfer between two terminals may also be journey segments.

Journey segment
- Choice
  - *Ride* (0..*)
  - *Walking (0..*)* (to be specified later)
  - *Driving (0..*)* (to be specified later)

- *Transfer* (0..*)

15.1.5.3Local time

Local time
- selected attributes

15.1.5.4Location

Must be specified

15.1.5.5Operator

Operator
- selected attributes

15.1.5.6Ride

A ride is a journey segment that corresponds to a Trip or a part of a Trip.

Ride
- *Line* (1)
- Trip pattern reference (1)
- Trip reference (1)
- Trip information (0..*)
  - *Operator* (1)
  - *Remark* (0..*)
  - *Transport means* (0..*) (if true for all legs)
  - *On-board service* (0..1)
  - *On-board deviations* (0..1)
- Departure (1)
  - *Terminal stop* (1) (start of ride)
- Arrival (1)
  - *Terminal stop* (1) (end of ride)
- Ride description (0..*)
  - ordered sequence of *Stop* (1..*) (all stops of the ride)

15.1.5.7Transport means

Transport means
- selected attributes

15.2Messages

The following messages are required
- Arrival information
  Information about arrivals to specific terminals
- Departure information
  Information about departures from specific terminals
- Deviation information
  Informing about deviations related to actual trips, terminals and transfers
- Itinerary information
  Informing about how to travel between two locations (door-to-door)
- Service information
  Informing about the availability of services at terminals, at transfers, on trips and at stops

- Trip information
  Informing about the time schedules, services and deviations for actual trips
- Time schedule information
  Time schedule for actual trips
- Time table pattern information
  Informing about time tables
- Trip pattern information
  Informing about the topology of trips (terminal visits etc.).

15.2.1Arrival information

Arrival information for specific terminals for a specific trip or trips is provided. The trip/trips are identified by some sort of selection criteria, such as

- Planned arrival times or time frames (e.g. a day, between two days, hours, etc.)
- Line or Trip identifications (number, names, published name, etc.)

Arrival information

- Timestamp (1)
- Terminal reference (1)
- Stop point (0..*)
- *Arrival* (0..*) (for specific trip/trips)
  - *Line (1)*
  - *Trip pattern reference (1)*
  - *Trip reference (0..*)*
  - *Time schedule (1)*
  - *Time schedule deviation (0..*)*

15.2.2Departure information

Departure information for specific terminals for a specific trip or trips is provided. The trip/trips are identified by some sort of selection criteria, such as

- Planned departure times or time frames (e.g. a day, between two days, hours, etc.)
- Line or Trip identifications (number, names, published name, etc.)

Departure information

- Timestamp (1)
- Terminal reference (1)
- Stop point (0..*)
- Departure (0..*) (for specific trip/trips)
  - *Line (1)*
  - *Trip pattern reference (1)*
  - *Trip reference (0..*)*
  - *Time schedule (1)*
  - *Time schedule deviation (0..*)*

15.2.3Deviation information

Deviation information (preliminary – must be considered)

- Trip deviation information (0..*)
  - *Line (1)*
  - *Trip pattern reference (1)*
  - *Trip reference (1)*
  - *On-board deviation (1)*
  - *Departure deviation (0..1)* *(what about deviations on the way?)*
    - *Time schedule* (1)

        - *Time schedule deviation* (0..*)
    - *Arrival deviation (0..1)*
        - *Time schedule* (1)
        - *Time schedule deviation* (0..*)
- Stop deviation information (0..*)
    - *Terminal reference (1)*
    - *Arrival deviation (0..1)*
        - *Time schedule* (1)
        - *Time schedule deviation* (0..*)
    - *Departure deviation (0..1)*
        - *Time schedule* (1)
        - *Time schedule deviation* (0..*)
    - *Terminal stop deviation (1)*
- Terminal deviation information (0..*)
    - *Terminal reference (1)*
    - *Terminal deviation (1)*
- Transfer deviation information (0..*)
    - *Transfer reference (1)*
    - *Transfer deviation (1)*

15.2.4Itinerary information

Itinerary information

- Timestamp (1)
- Date of departure (1)
- Ordered sequence of *Journey segment* (0..*)

15.2.5 Service information

Service information

- Timestamp (1)
- Trip service information (0..*)
    - *Trip reference (1)*
    - *On-board service (1..*)*
    - *Leg service information (0..*)*
        - *Leg reference* (1)
        - *On-board service* (1..*)
- Stop service information (0..*)
    - *Terminal reference (1)*
    - *Trip reference (1)*
    - *Stop service (1..*)*
- Terminal service information (0..*)
    - *Terminal reference (1)*
    - *Terminal service (1..*)*
- Transfer service information(0..*)
    - *Transfer reference (1)*
    - *Transfer service (1..*)*

15.2.6Trip details

Time schedules, routes, services and deviations for specific trips are provided. The trips are identified by selection criteria, such as

- Departure or arrival times or time frames (e.g. a day, between two days, hours, etc.)
- Line or Trip identifications (number, names, published name, etc.)

Trip details
- Timestamp (1)
- Line information (1..*) (time table for specific trip/trips)
  - *Line (1)*
  - *Trip information (1..*)* *(for all relevant dates/departures)*
    - *Date* (1)
    - *Trip pattern reference* (0..*)
    - *Trip* (1)

15.2.7Time schedule information

A time schedules for specific trips are provided. The trips are identified by selection criteria, such as
- Departure or arrival times or time frames (e.g. a day, between two days, hours, etc.)
- Line or Trip identifications (number, names, published name, etc.)
- Type of time schedule information (planned, actual or both)

Time schedule information
- Timestamp (1)
- Line schedule (1..*) (time table for specific trip/trips)
  - *Line (1)*
  - *Trip pattern time schedule(1..*)* *(for all relevant dates/departures)*
    - *Date* (1)
    - *Trip pattern reference* (0..*)
    - *Trip schedule*(1)

15.2.8Time table pattern information

A time table pattern provides an outline of departure at different week days

Time table pattern information
- Time table (1)
- Timestamp (1)
- Line pattern time table (1..*)
  - *Trip pattern time table (1..*)*
    - *Line* (1) (how distinguish between route patterns in different directions?)
    - *Daytype* schedule (1..*) (for all possible day types)
      - Daytype n (n is a daytype value – holidays, etc.)
      - *Time schedule pattern* (0..*)
      - *Trip pattern* (0..*)

15.2.9Trip pattern information

Trip pattern information
- *Line* (1)
- Trip pattern (1..*)

16Technical Aspects

This chapter describes technologies and possible solutions that arrange for interoperability between ITS solutions. The specifications are preliminary and will need further details and clarifications.

The logical specifications of interaction in Chapter 11 are to be realised by means of available technologies.

Loose Integration

A loose integration of ITS solutions is preferred, mainly trough synchronous/asynchronous messages realized by the now ubiquitous “web services” technology. The interactions have to be specified with respect to:

- Their information content. XML messaging should be used
- The description of the service, e.g., by means of WSDL or ebXML Collaboration Protocol Profile (CPP).
- Support for complex services supporting business processes/workflow, transactions, service descriptions, etc.
- The messaging solution. The best selection for interaction with loosely coupled systems is currently probably SOAP with XML encoded messages. ebXML Messaging Specification (ebMS) is also an alternative.
- The communication solutions. These should be allowed to vary depending on the situation

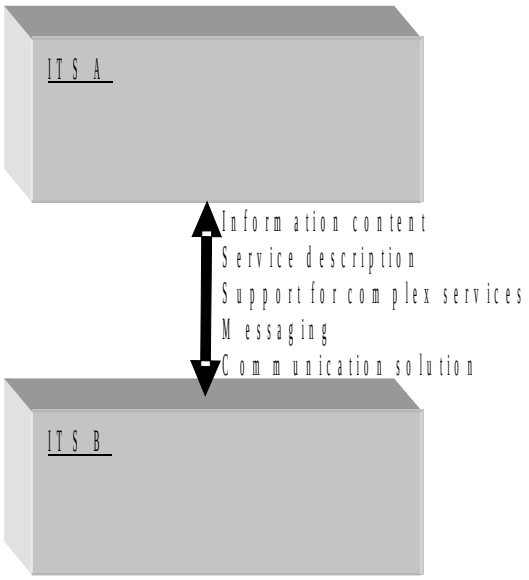


Figure 59 Loosely coupled systems

Characteristic	Measure
The offered business service is designed in such a manner that many consumers can use it, potentially in many different circumstances	Stability
Dependencies on other components or services are minimized. The offered service implementation is highly independent.	Horizon of change is minimized Independence
Mandatory dependencies on other components and services by the consumer are minimized. For example a Flight Reservation service that forces you to also use a specific Car Reservation service, is not loosely coupled in the business sense. Though that dependency could be the result of poor service design, or purely a business decision, either way flexibility for the service consumer is constrained.	Flexibility
Conformance (with eco system, sector, industry, de facto or de jure standards)	Uses de facto or industry standard semantics and rules Applicability
Provider and consumer obligations are formally declared in a contract specification model	Understandability
Upgrade policy is an integral part of the component or service design and contract	Upgradeability

Figure 60 Loose Coupling design characteristics

Start with the current basic standards,
but prepare for adoption to future complex web service standards when mature.
This is a conservative approach to Service Oriented Architecture (SOA). This technology area is rapidly developing. Web services standards and specifications are at the core of SOA. Gartner Group predicts a maturing and adoption timetable of web services standards and specifications . SOAP, WSDL and UDDI is now regarded as established technologies (see Figure 61 and section 16.1. Simple Web Services).

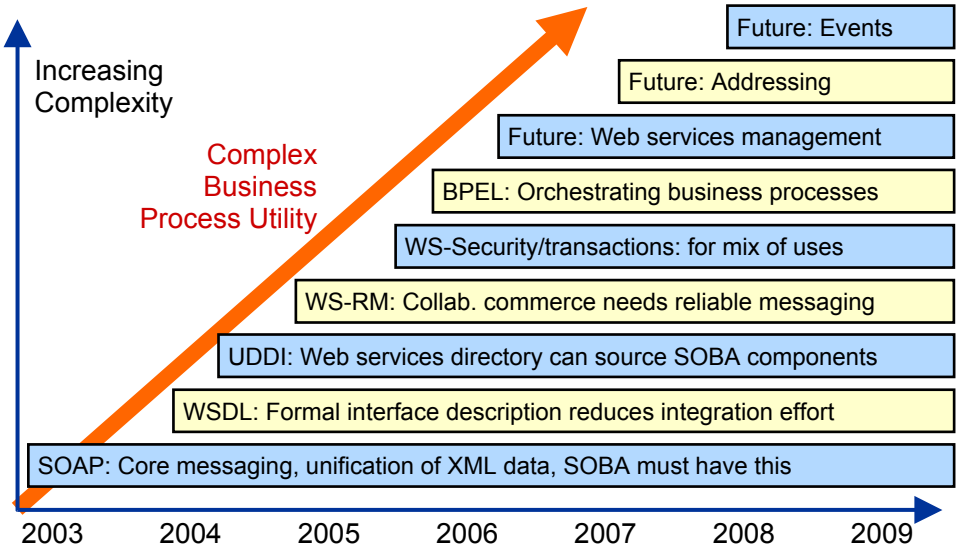


Figure 61 Use of web service standards and specifications in SOA

The approach will enable solutions that can be implemented today, but will evolve in the future to more advanced standards and specifications as these become mature and supported by vendors (see Figure 61. and section 16.2 Complex Web Services)

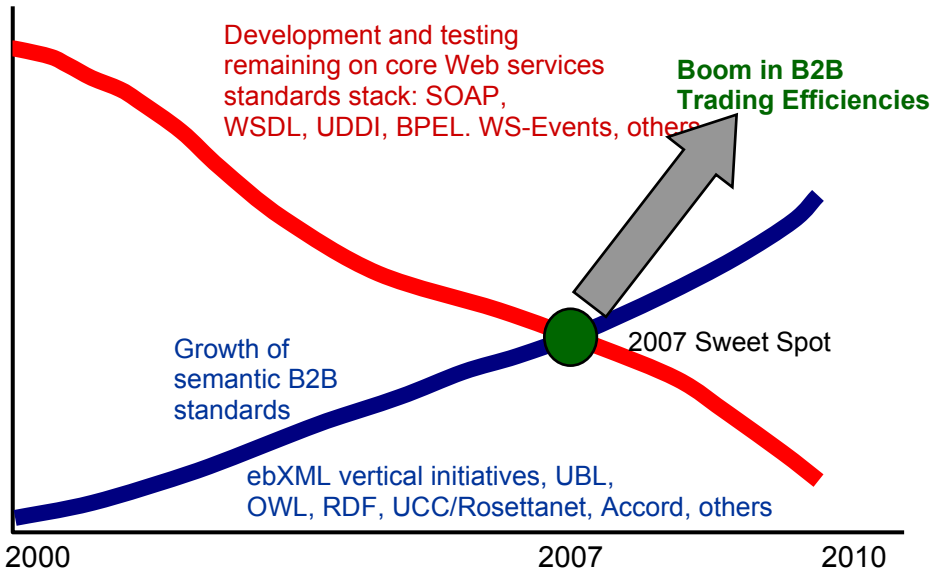


Figure 62 Adoption of advanced standards and specifications

The Gartner report concludes with set of general recommendations that seems valid also for ARKTRANS:

- Understand the limitations of Web services standards and specifications and the high-value scenarios that are possible.

- If you use standards and specifications
  to increase the capabilities and efficiencies of your SOAs,
  be prepared to re-factor and re-architect to gain performance, reliability and security.
- When writing a new SOA application that requires advanced Web services,
  design in layers of abstraction that can map to possible standards.
- Do not consider basic Web services support as a significant differentiator among vendors. Consider vendors that participate in the standards process and help shape new standards as being significantly more credible.
- Participate in standards development activities at OASIS and W3C where you have a vested interest in the outcome. You don't have to be a formal member to track discussions, read minutes and listen in on conference calls.
- Do not expect Web services standards to transform your business;
  use Web services standards to transform your architectures, processes and applications.

Note that web standards are not a stack; they are a web of dependencies. And they are many addressing specific aspects needed for a complete solution.

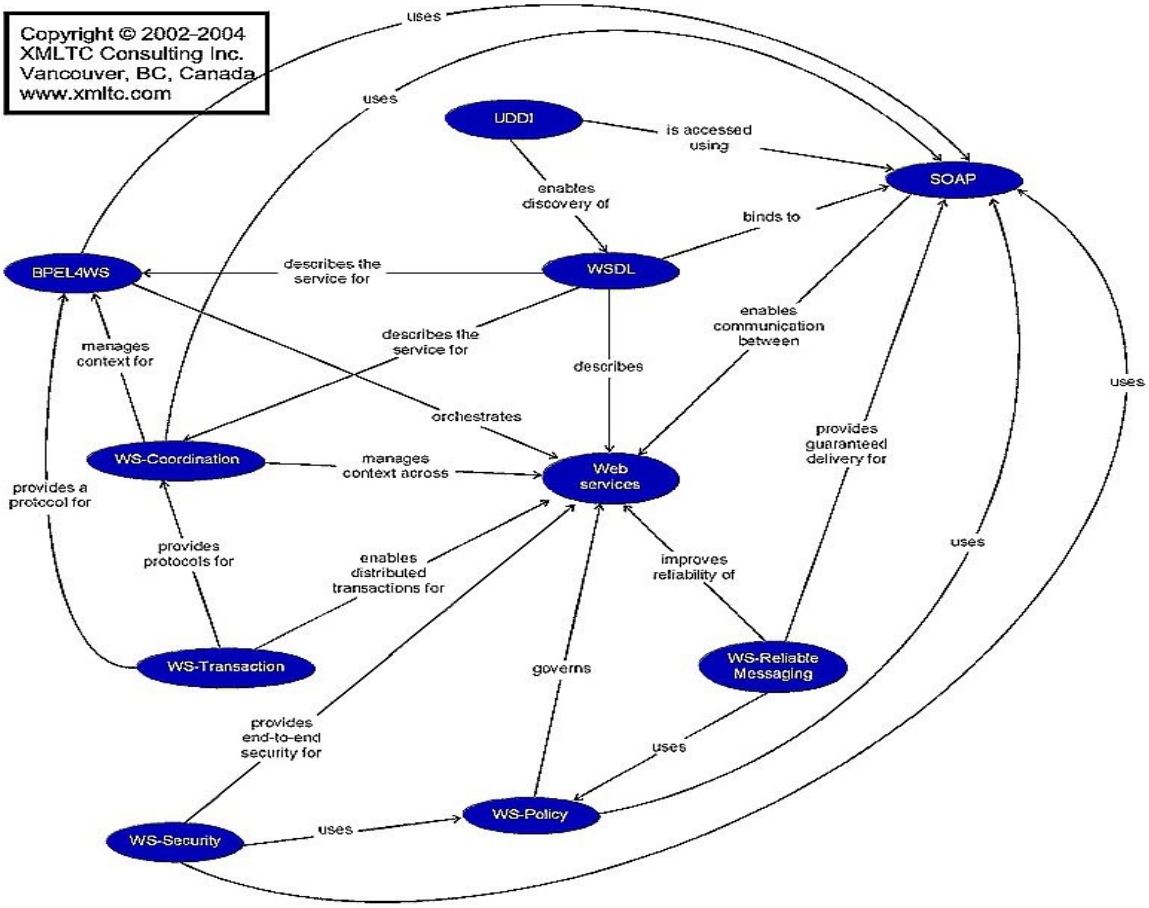


Figure 63 Mind map of XML standards

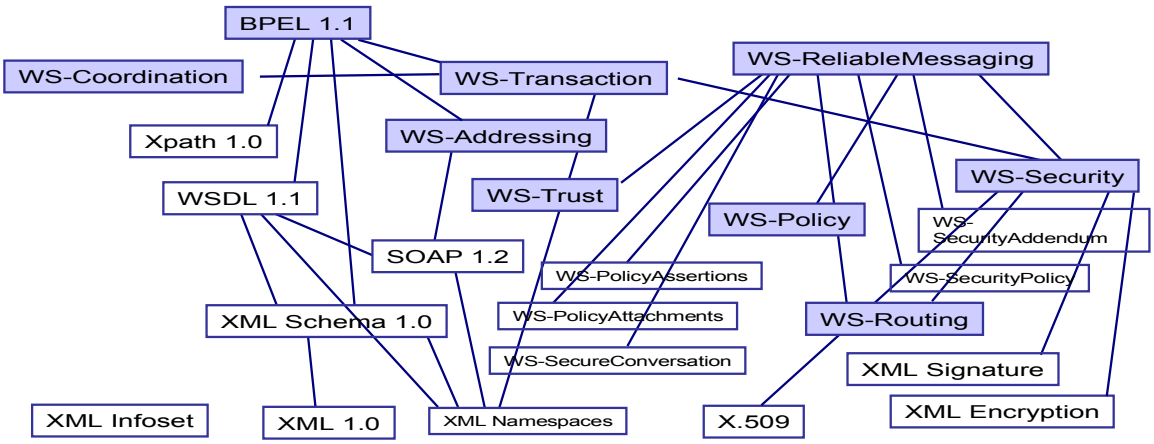


Figure 64 A partial view of current WWW XML standards

16.1Simple Web Services -- State of the Art

XML is the key technology for achieving *platform and language independence* – it is an extensible, human readable, mark-up language for any kind of structured information, and can enclose or encapsulate information in order to pass it between different computing systems which would otherwise be unable to communicate.

The Web service-related protocols described below are XML-based, and they are adequate for simple Web-services requiring a remote procedure-call style of communication.

16.1.1Simple Object Access Protocol (SOAP)

SOAP is simple, has broad industry acceptance, and comes with extensive tool support. SOAP also provides a message format for communicating with and invoking Web services.
Other remote procedure call technologies may also be relevant: Remote Method Invocation (RMI), IIOP (Internet InterOperability Protocol) and XML-RPC (Remote Procedure Call using XML), but SOAP is currently preferred because:

- SOAP is more open than RMI/IIOP and can support a wider spectre of clients
- Exposing a web services interface may be more beneficial
  than exposing an RMI/IIOP interface.
- Web services transport protocols run over HTTP
  and are more firewall-friendly and human readable than RMI.
- XML-RPC is more limited to RPC functionality than SOAP – more low level.

16.1.2Web-service Definition Language (WSDL)

Web-service Definition Language (WSDL) is an XML format that describes how to access Web services. The network services are described as a set of endpoints operating on messages containing either document-oriented or procedure-oriented information. The operations and messages are described abstractly, and then bound to a concrete network protocol and message format to define an endpoint. Related concrete endpoints are combined into abstract endpoints (services). WSDL is extensible to allow description of endpoints and their messages regardless of what message formats or network protocols are used to communicate.

16.1.3Universal Description, Discovery and Integration (UDDI)

Universal Description, Discovery and Integration (UDDI) provide a registry that clients can use to discover available services.

16.2Complex Web Services – Ongoing Work

There is a great deal of interest for more complex Web services, and there are many initiatives providing possible solutions. So far, no solution has proven to be the best, and even though many of the main principles are the same, they fluctuate with respect to the use of terminology.

No final decisions about the ARKTRANS realisation of complex Web services are taken.

16.2.1Web Service Based Initiatives

As shown in Figure 65, the relevant frameworks and initiatives can be put into a proposed stack that use or extend WSDL, have roots in the semantic Web's resource description framework and the DARPA Agent Mark up Language for Services (DAML-S), and include ebXML specifications .

- Network is transport protocols
- XML-based messaging layer decouples messaging from the from the transport protocols. The XML message and procedure calls are encapsulated by a header. SOAP or the ebXML Messaging Solution may be used. The latter builds on SOAP by using its header specification extensibility.
- Service description provides the functional description of the Web service in terms of its interface and implementation by means of description languages like XML Schema. WSDL is commonly used, but ebXML CPP is better on error handling specifications.
- Non-functional description may describe quality of service, cost, geographic location, number of retries, and legal factors. Web service Endpoint Language (WSEL) is the only protocol designed for this purpose; however, it remains in progress.
- Conversations describe the correct data types and message sequences for a Web service.
- Choreography coordinates several Web services into a pattern, e.g. the order in which the operations of each Web service must be involved.
- Transaction facilitates the monitoring of transactions between Web services. The possible transactions between the states are described.
- Business process and workflow describes how to compose higher level services from other services.
- Contracts outline the format of machine-readable contracts that enables automated electronic business relations. Negotiations are supported.
- Discovery publishes details about Web services.

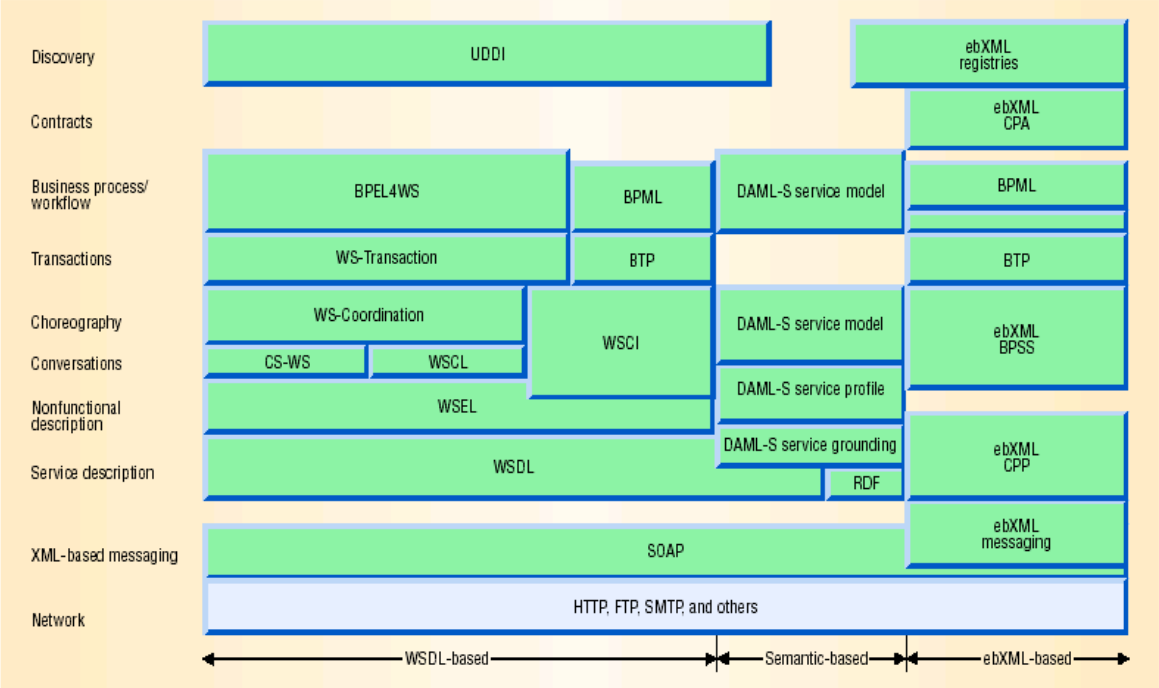


Figure 65 Proposed Web-service stack

The most interesting initiatives are outlined in the following subsections:
(not all standards are described; for a comprehensive list see

16.2.1.1Set of related XML standards by W3C - Chorography

World-Wide-Web Consortium (W3C) has established several standards for the Internet. The Web Service Choreography Working Group addresses the describing linkage and usage patterns between Web-services by means of a common interface and composition language. WSCL (Web Service Conversation Language) and especially WSCI (Web Service Choreography Interface) are relevant submissions in addition to the Web Service Architecture. Also important and related are transaction handling which are covered by two related standards: WS-AtomicTransaction – short duration, ACID transactions, and WS-BusinessActivity – longer running, business transactions standardize service transactions. The first working draft of the Web Service Choreography specification on Web Service Choreography Requirements was published in August 2003, review period ends January 2005.

16.2.1.2Security standards for web services

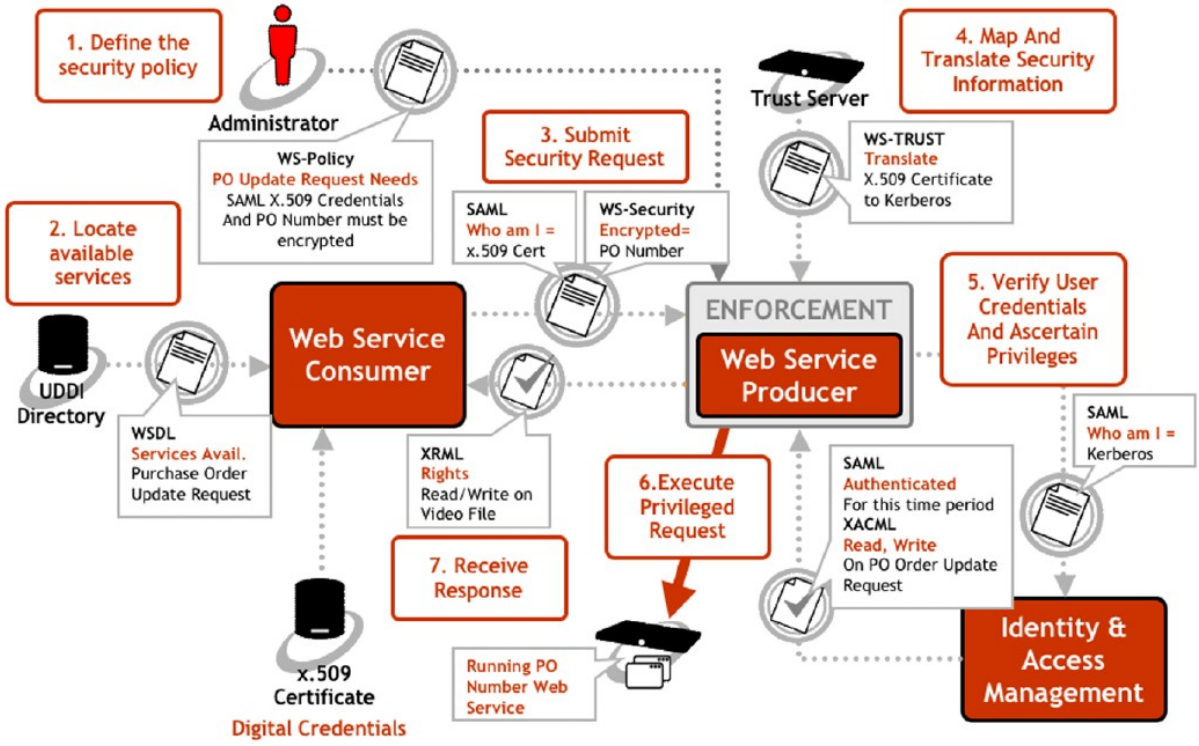


Figure 66 Security standards overview

Security is treated as a separated aspect / protocol layer. It does not come for free. A treat analysis is needed to determine the level of security appropriate to the each service in ARKTRANS. The important standards are:

- SAML -- Security Assertion Markup
  Language is a standard for supporting single sign-on for affiliated sites. SAML assertions communicate security information such as authentication, attributes and authorization-decision statements.
- XACML - eXtensible AccessControl Markup Language
  makes it possible to express and enforce access control policies
  using a single XML based language.
- WS-SECURITY
  a proposed standard for enhancing SOAP messaging in order to authenticate parties and to protect the confidentiality and integrity of Web services messages. Security tokens can include a Kerberos ticket, Username/Password digest, X.509 certificate, XrML tokens, or a SAML assertion.
- WS-I BASIC PROFILES
  The WS-I Organization has set out to create guidelines that describe how specifications will work together. WS-I Basic Profile and WS-I Basic Security Profile are two examples of guidelines that enable interoperability at the wire/message layer and security protocol layer respectively. (See section 16.2.1.3)

16.2.1.3Set of profiles for XML standards use by WS-I

Web Service Interoperability Organization (WS-I) is an open industry organization chartered to promote web services interoperability across platforms, operating systems and programming languages. WS-I profiles define sets of Web services specifications that work together to support specific types of solutions. The new profiles are designed to provide developers with mechanisms for building interoperable, attachment-enabled applications. To date, WS-I has finalized the Basic Profile, Attachments Profile and Simple SOAP Binding Profile. Work on a Basic Security Profile is currently underway.

16.2.1.4BPML (the Business Process Modelling Language)

The Business Process Management Initiative is a non-profit initiative working towards establishing standards for the management of business processes that span multiple applications, corporate departments and business partners. They have specified BPML (the Business Process Modelling Language).

16.2.1.5ebXML

ebXML Joint Co-Ordination Committee is a joint activity of UN/CEFACT (the United Nations body responsible for UN/EDIFACT) and OASIS (Organization for the Advancement of Structured Information Standards). Their charter is to develop an XML-based infrastructure for electronic commerce. Of special interest are BPSS (the Business Process Specification Schema) that is a meta-model for business processes that is part of the ebXML framework, and the CPPA (the Collaboration-Protocol Profile and Agreement Specification).

	Web Services +	**ebXML**
Type	Request/response	Collaboration
Communication	RPC-style synchronous communication between tightly coupled services, Document-style asynchronous communication between loosely coupled services	Synchronous, asynchronous communication
Business Service Interface description	WSDL	CPP, CPA (WSDL within CPP, with CPA also)
Protocol and Formats	SOAP, XML	ebXML Message Service (over SOAP), XML, BPSS (as "business" protocol)
Content Standards	None	Recommended Standards (e.g. OAGI BODs, EDIFACT, UBL)
How to find business partners	UDDI Registry	ebXML Registry (UDDI Registry may point to an ebXML Registry or Registry objects (e.g. CPA))

Figure 67 Comprehensive message delivery with ebXML

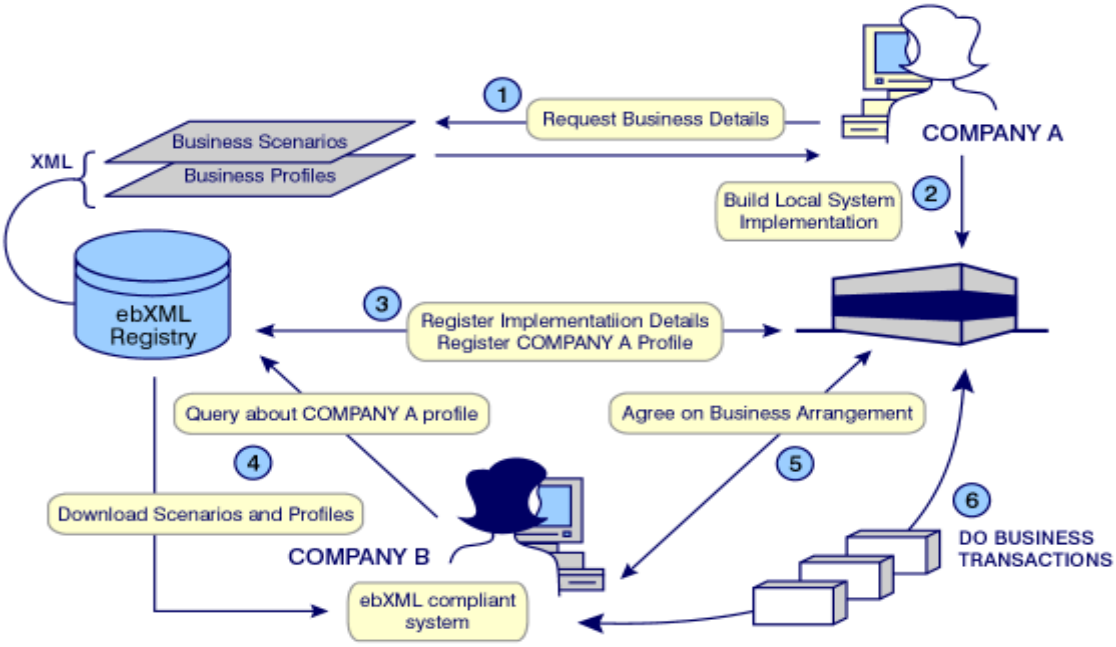


Figure 68 High-level overview of ebXML interaction between two companies

The heart of ebXML's architecture is the idea of interoperable registries and repositories. A common e-business framework, like that offered by ebXML, has to be able to enable businesses to find each other and to create new business relationships. The ebXML Registry model is designed to offer a shared repository that stores business profiles for registered companies, and registries like these are best described as tools for storing company profiles and ebXML specifications for trading relationships (including business process models and message formats and structures). Once connected to an ebXML-compatible registry, your applications will be able to use it to access business process information, as well as the business information models used by your company's prospective partners. You can run your own registry, or use one of several central registries. These are set up to support different types of business, in order to speed up the process of finding an appropriate partner.

Outside the ebXML registry, there are some key components of the ebXML architecture. These are a data communication infrastructure, a 'semantic framework' and a set of tools that enable organizations to find each other.

The data communication infrastructure gives ebXML applications a standard message transport mechanism, so that applications can exchange messages without needing complex interfaces. This mechanism also details how a message is constructed, defining the structure of message headers and bodies. For ebXML to be successful its message transport mechanism must have a delivery model that allows applications to send messages without needing to handle acknowledgements, as well as offering applications an effective security models. It will also need to provide developers with a standard set of interfaces to handle incoming and outgoing messages. Using the ebXML Messaging Service specification, you are able to use any application-level messaging protocol you like, including SMTP and HTTP and the SOAP protocol used to offer web services. In order to ensure your ebXML messages are secure, you can use secure protocols like HTTPS or work with digital signatures to embed ebXML in a Public Key Infrastructure security system.

One of the reasons for the development of XML is the vision of a self-describing semantic web. EbXML takes this approach to heart in its Semantic Framework. In practice this is a common 'business grammar' that gives organizations a common language for defining and describing business processes, as well as the information used within an organization. The ebXML semantic framework also includes reusable business logic components that handle common business

processes and their associated XML vocabularies, and can be used to define the messages used in your business processes. In a similar manner, ebXML's Business Process Models describe how business processes operate and interact, both inside and outside a company. You can think of ebXML's business process models as 'verbs', with its information models 'nouns' and 'adjectives'. Together these can produce a description of a business that can be understood by anyone using ebXML.

16.2.1.6Business Process Execution Language for Web Services (*BPEL4WS*)

A joint activity of BEA Systems, IBM, and Microsoft have established the Business Process Execution Language for Web Services (BPEL4WS) and the companion specifications WS-Coordination and WS-Transaction, etc.

Business Process Execution Language (BPEL) defines a notation for specifying business process behaviour based on Web Services. Business processes can be described in two ways:

- Executable business processes model actual behaviour of a participant in a business interaction.
- Business protocols, in contrast, use process descriptions that specify the mutually visible message exchange behaviour of each of the parties involved in the protocol, without revealing their internal behaviour. The process descriptions for business protocols are called abstract processes.

BPEL is used to model the behaviour of both executable and abstract processes. The scope includes:

- Sequencing of process activities, especially Web Service interactions
- Correlation of messages and process instances
- Recovery behaviour in case of failures and exceptional conditions
- Bilateral Web Service based relationships between process roles

BPEL is a vendor-neutral mechanism for describing the behaviour of business processes. The latest version of this technology is currently being standardized by a larger group working through OASIS. The value of BPEL is based on two fundamental attributes of the technology. First, because BPEL makes no assumptions about the environment in which a business process will execute the technology is completely platform-neutral. The second fundamental attribute that makes BPEL valuable is the language's complete focus on process-oriented abstractions. BPEL's primary value lies more in the interactions it defines than in its execution capabilities. Implementations of business processes depend on capabilities that are specific to a particular execution environment. Because of this, implementing complete business processes in a truly portable way is not one of BPEL's goals.

- Version 1.0 released by IBM, Microsoft and BEA in August 2002
- Accompanied by WS-Coordination, WS-Transaction which remain uncommitted to standards bodies
- Version 1.1 submitted to OASIS April 2003
- XML language for describing business processes based on Web services
- Convergence of XLANG (Microsoft) and WSFL (IBM)
- Unprecedented industry consensus
- IBM, Microsoft, Oracle, Sun, BEA, SAP, Siebel …

Organization for the Advancement of Structured Information Standards (OASIS) is a not-for-profit, global organisation that drives the development, convergence and adoption of e-business standards, among others BTP (the Business Transaction Protocol) and ebXML.

Among the vendors with products supporting BPEL based solutions are: Oracle, IBM, BEA, and also Microsoft (indirectly by import export of BPEL specifications, but internally using the proprietary XLANG).

16.2.1.7OAGIS - Open Applications Group Integration Specification

The Open Applications Group (OAGi) is a non-profit consortium focusing on best practices and process based XML content for eBusiness and Application Integration .

Central in OAGIS is building a content based virtual business object model that enables an enterprise business application to build a virtual object wrapper around itself through the use of OAGI compliant API's. This interoperability is achieved with object oriented advantages without the requirement to implement a software application in a specific object oriented technology.

To communicate with a business software component in this model, events are communicated through the integration backbone in the form of an OAGI compliant Business Object Document (BOD) to a virtual object interface. The integration servers provide services such as publish and subscribe, request and reply, transport mechanisms, data mapping tools, integration routing and logging capabilities .

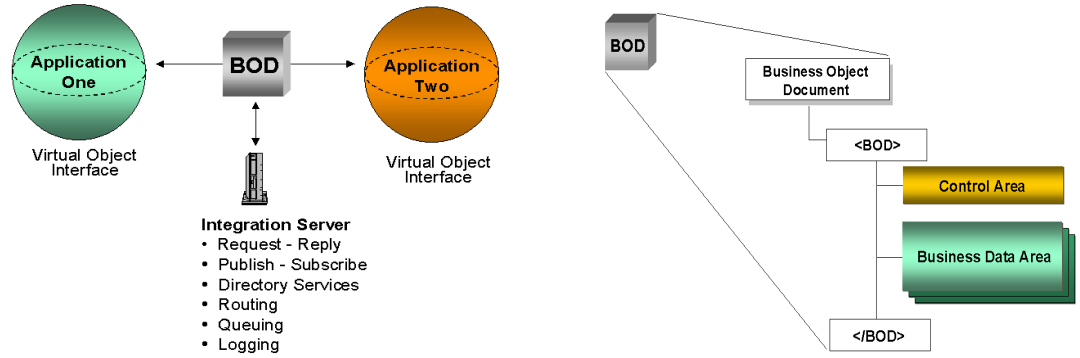


Figure 69 OAGIS Business Object Document (BOD) and the content based virtual business object model

OAGIS fits with ebXML, but is in nature framework independent and can be used with different frameworks. The metaphor for how they work together is that OAGIS is the payload and ebXML the envelope :

- Communication Layer (T&R)
  - ✓ ebXML Transport
- Partner Agreements (CPP, CPA)
  - ✓ Format - ebXML
- Process Definitions (BPSS)
  - ✓ Format – ebXML
  - ✓ Content - OAGIS
- Syntax
  - ✓ OAGIS Tags
- Meaning of Information
  - ✓ OAGIS Dictionary

The Open Applications Group Integration Specification (OAGIS) is an effort to provide a canonical business language for information integration. It uses XML as the common alphabet for defining business messages, and for identifying business processes (scenarios) that allow businesses and business applications to communicate. Not only is OAGIS the most complete set of XML business messages currently available, but it also accommodates the additional requirements of specific industries by partnering with various vertical industry groups.

The Open Applications Group (OAGi) -- the organization that oversees the OAGIS -- was formed in November 1994 in an effort to dramatically ease everywhere-to-everywhere integration (inside and outside of the enterprise, as well as across the supply chain). OAGi has done this by crafting standards where necessary and by recommending standards where they already exist.

The first release of OAGIS was developed in 1995 to address the need for a common business language that would enable business applications to communicate. OAGIS provides the definition of business messages in the form of Business Object Documents (BODs) and example business scenarios that provide example usages of the BODs. The business scenarios identify the business applications and components being integrated and the BODs that are used. The current release, OAGIS 8.0, includes 200 business messages and 61 business scenarios that can be used to integrate business applications.

OAGi also partners with other standards bodies to provide a true canonical business language. OAGi recognizes that no one organization can be all things to all people, however by partnering with industry vertical groups OAGIS provides the means to plug in the additional requirements and constraints that meet the specific needs of each vertical industry.

Because of this long history of delivering quality usable integration standards, OAGIS has support from application vendors and implementation providers, and has been implemented by various customers in over 40 countries worldwide.

OAGIS 8.x is expressed in XML Schema and provides the transactional and operational information needed to support the needs of business and application integration. You can access OAGIS along with all of the resources that OAGi makes freely available from the OAGi Web site.

OAGi have also developed a repeatable process for quickly developing high quality business content and XML representations of that content .

16.2.1.8BizDex – Australian National B2B Registry

The National Office for the Information Economy (NOIE), an Australian federal government agency, has partnered with Standards Australia to develop a national framework to promote and support B2B interoperability throughout Australia. The framework is known as BizDex.

The BizDex position on standards is an example to follow by ARKTRANS
BezDex has assembled a coherent set of mature standards, and also how new standards shall be incorporated as they evolve .
The world of e-business standards is complex and fragmented. BizDex is designed to promote re-use of standards work. Where a suitable standard exists, BizDex will re-use rather than re-invent the standard. However it should be recognised that industry or geography constraints often require international standards to be extended. BizDex provides a methodology and governance framework to develop such extensions. BizDex is committed to the use of de-jure and open standards.

- *ebXML vs. Web Services*
  The ebXML framework was developed by OASIS and UN/CEFACT as the “next generation EDI”. It is specifically targeted at B2B interoperability and comprises an overall architecture and an associated set of protocols and specifications. Web Services are largely vendor driven and have a much broader focus than ebXML. The basic Web Service standards (SOAP, WSDL, UDDI) alone are inadequate for B2B purposes because they lack fundamental business attributes like security & reliability and do not address the process & information parts of the alignment domain. However an emerging set of “extended” Web Services standards (e.g. WSReliable Messaging, WS-Atomic Transaction, WS-Security, WSPolicy, etc) will address the limitations of the basic WS stack and will most likely be much more widely supported in the marketplace than some ebXML protocols. Although the extended WS specification domain is currently confused by a variety of competing vendor specifications, some leading candidates for open standards are emerging. There is also evidence that some ebXML working groups are moving towards harmonization with equivalent WS working groups. For these reasons, the position taken by BizDex is to support the ebXML reference

architecture, but to apply Web Services protocols and standards wherever possible. This rationale is behind the selection of UDDI rather than ebXML as the registry standard.

- *EDIFACT and other legacy standards*
  BizDex must be a practical and usable framework. Accordingly it is important to recognise that the vast majority of B2B transactions today are EDIFACT messages and that BizDex must add value to the existing infrastructure. At this point it is useful to remember that BizDex is focused on automation (and hence cost reduction) of the setup phase of a B2B collaboration. On the other hand, EDIFACT is a library of business messages. Accordingly there is nothing to stop a community from continuing the use of existing EDIFACT MIGs (Message Implementation Guidelines) but using BizDex to reduce the cost of setup for new community members. The table below lists some specific standards supported or preferred by the BizDex framework. The list is non-exhaustive because BizDex is a really an architecture that is designed to support new standards as they evolve.

Layer	Relevant Standards
Alignment domain layers	
Process	Modelling: UN/CEFACT UMM (UML profile) Syntax: ebXML BPSS (BCSS in future) Libraries: RosettaNet PIPs
Information	Modelling: UN/CEFACT CCTS (UML profile) Syntax: XML (UBL /UN naming & design rules) EDIFACT Libraries: UN/CEFACT Core Components UBL, OAGIS (horizontal) EANcom, xbrl, HL7, etc.. (industry)
Security	Trust: ABN-DSC (future – federated domains) Protocol: WS-Security (message), SSL (transport)
Message	Protocol: ebXML MS, EDIINT AS1/AS2, SOAP Extended WS stack (WS-RM/Trans/etc)
Other relevant standards	
Registry	BizDex is built upon and is fully compliant with the UDDI v3.0 standard. BizDex adds some additional interfaces and classifications to support B2B automation.
Profile	Partner profiles in the registry are represented as WSDL and/or ebXML CPP schema
Agreement	Bilateral agreements in the registry are represented as WS-Policy and/or ebXML CPA schema
Identifiers	Public processes will be built upon public identifiers such as ABN (business), EAN GTIN (item), etc.
Private process recommendations	
Orchestration	WS-BPEL (OASIS)
Transform	XSLT (W3C)
User Forms	X-Forms (W3C)

Figure 70 Standards adopted by BizDex

16.2.1.9UN/CEFACT modelling (UMM) and business collaboration framework (BCF)

United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) is engaged in the definition and standardization of the UN/CEFACT Modelling Methodology (UMM):

- Formal description technique for describing Open-edi scenarios
- Concentrates on business semantics
- Provides a procedure similar to a software development process
- Uses UML and is based on a UML Meta Model (UML Profile)

UMM is based on UN/CEFACT Business Collaboration Framework (BCF) for B2B and serves as a meta model for modelling B2B.

(Introductionary references are ,).

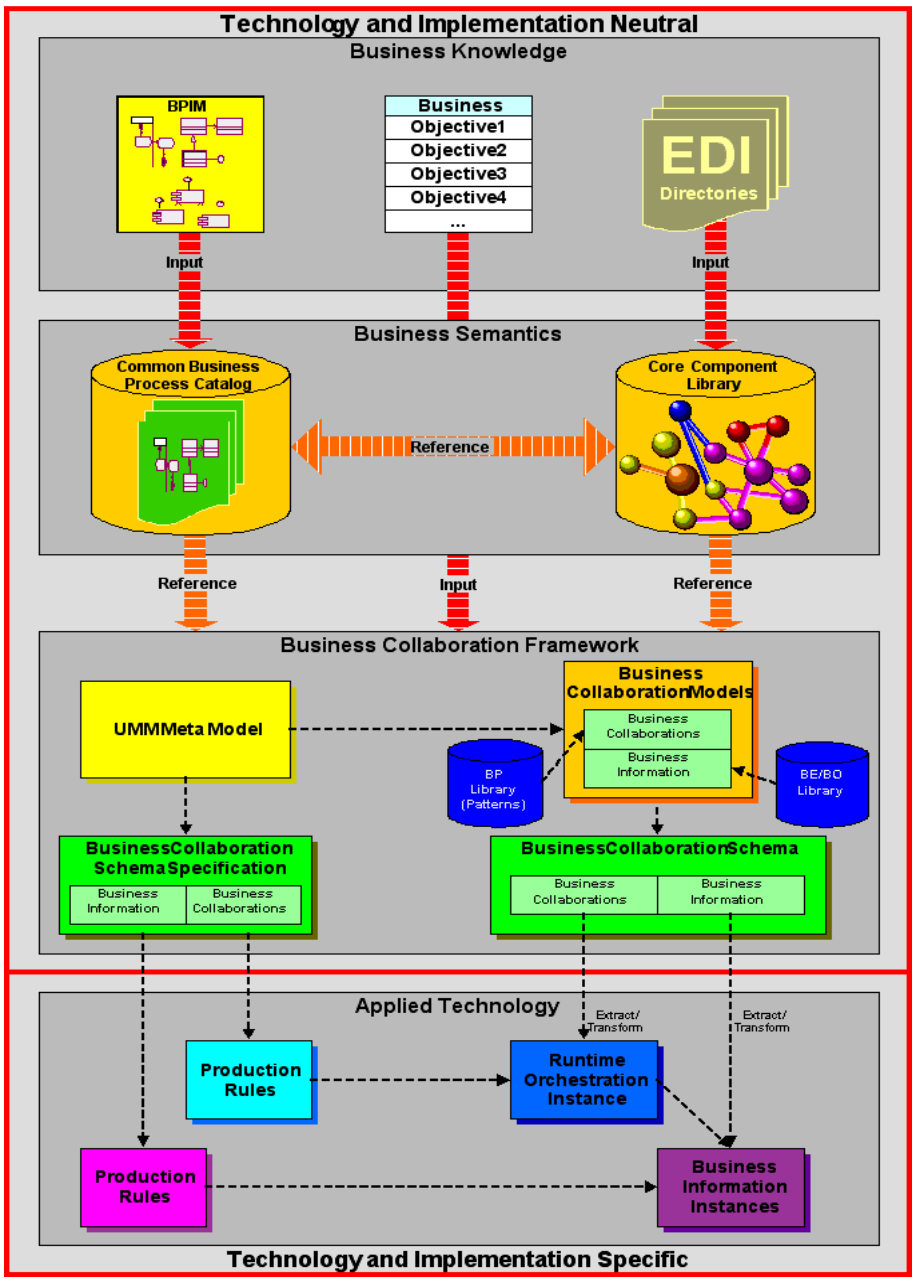


Figure 71 UN/CEFACT eBusiness vision

16.3Messaging Realization

ARKTRANS specification model viewpoints artefacts can be transformed to realization artefacts by a combination of manual and automatic processes.

ARKTRANS provides a high level transport domain specification of the following distributed system model view points:

- Functional view
  functional decomposition into sub domains, sub areas of sub domains and functions
- Behaviour view
  as UML Use Cases described with semi formal business process diagrams (UML Activity diagrams), including information flow between actor roles
- Information view
  as high level (analysis) information models / ontologies represented as UML class models and/or Extended Entity Relationship (ER) models

The ARKTRANS specifications are similar to specifications created by UN/CEFACT Modeling and Methodology (UMM). See Figure 72.

Orchestration specifications may be generated / derived from the behaviour model. Message XML Schemas may be specified and generated based on information model entities and behaviour view information flow specifications.

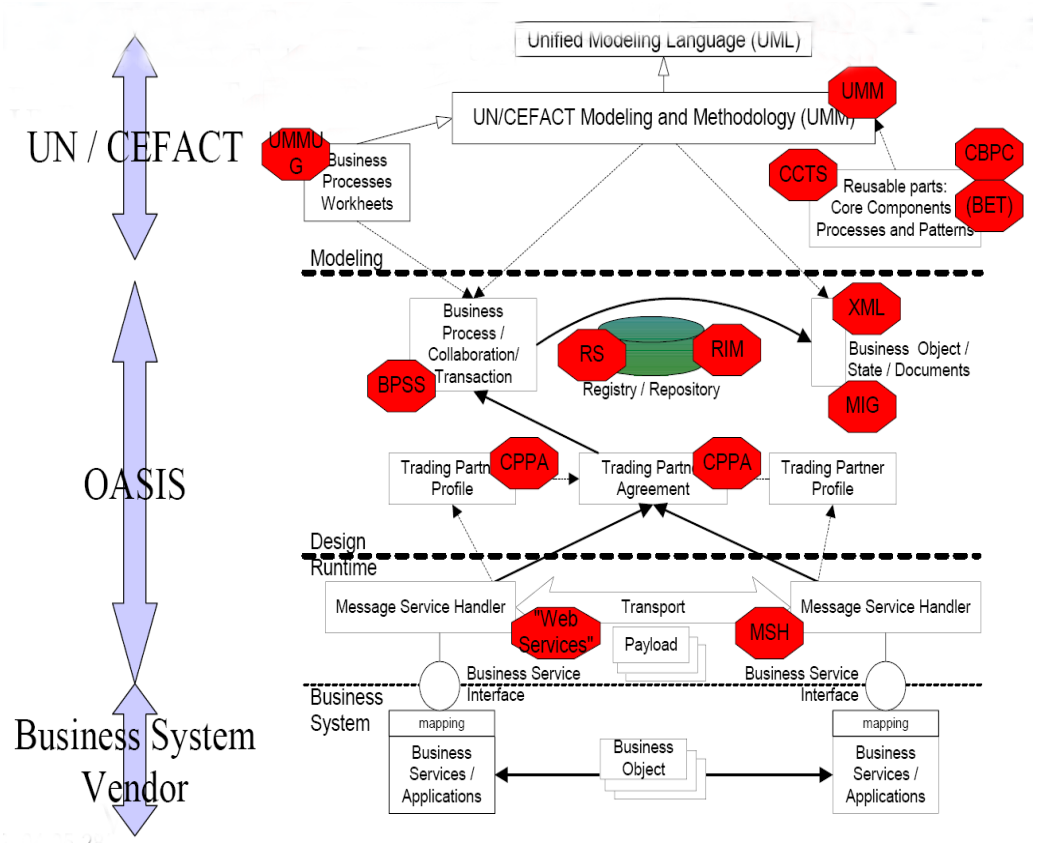


Figure 72 Modelling, design and runtime – UN/CEFACT and OASIS roles

Both WS-BPEL and ebXML are candidate standards for ARKTRANS implementation, at the moment a cautious and staged approach is recommended selecting elements from each standard and preparing for a possible convergence (both approaches are part of the OASIS initiative).

Currently, there are two main approaches proposed for the specification of B2B protocols, the WSDL-based approach (including WS-BPEL) supporting Web Service languages, and the ebXML-based approach supporting languages defined along the ebXML project.

Unfortunately, these approaches are not quite compatible, thus an organization wanting to engage in B2B collaboration needs to decide whether to embark on any of these new approaches, and which ones to use . Or one could carefully select parts of each approach.

ebXML extends the basic web services standards / functionality, but are not a content standard which ARKTRANS aspires to. However, to implement ARKTRANS much of the ebXML functionality may be needed, especially for more advanced scenarios.

The BizDex architecture is an advanced example to be considered by ARKTRANS

BezDex has assembled a coherent set of mature standards, and has a strategy how new standards shall be incorporated as they evolve . (See section 16.2.1.8). It is advisable that ARKTRANS takes a staged approach, and starts with a basic simple architecture.

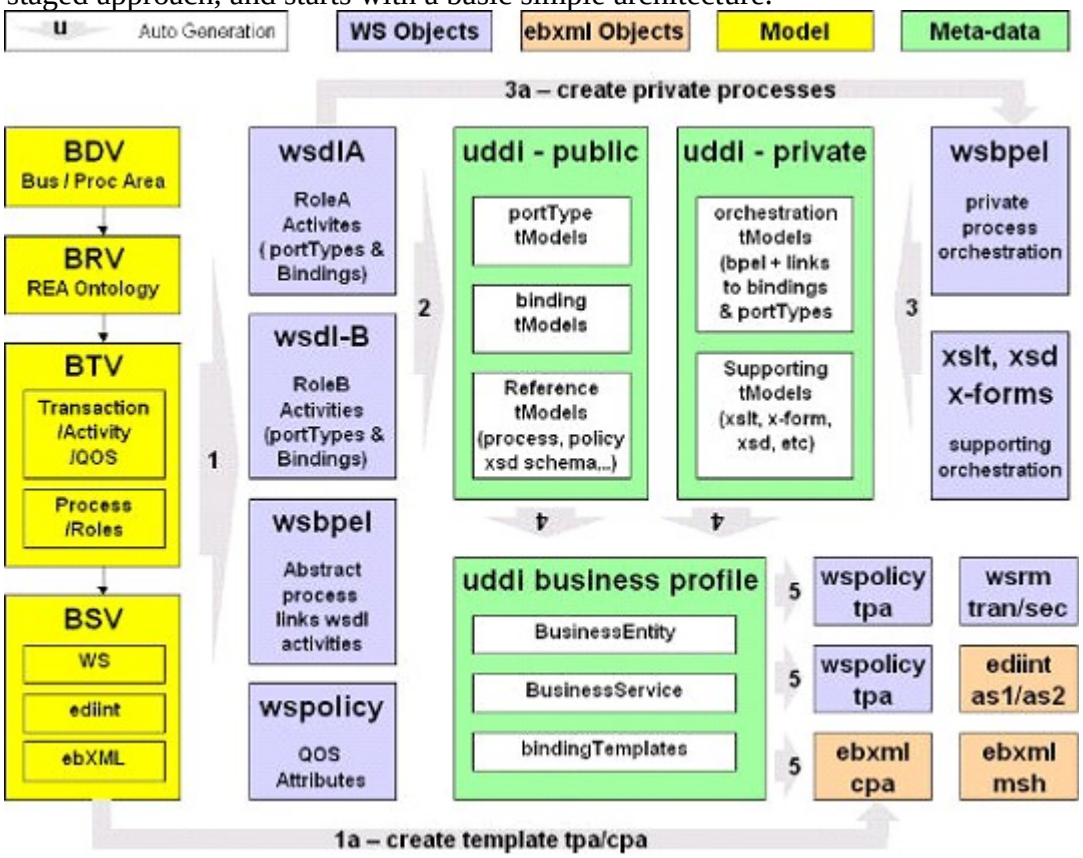


Figure 73 BizDex architecture

16.3.1Messaging

Consider using messaging following the current ebXML Messaging standard v 2.0.
This standard complies with the SOAP specifications:

- Simple Object Access Protocol (SOAP) 1.1 [SOAP]
- SOAP Messages with Attachments [SOAPAttach]

And it provides additional functionality like reliable messaging.

An ebXML Message is a communications protocol independent MIME/Multipart message envelope, structured in compliance with the SOAP Messages with Attachments [SOAPAttach] specification, referred to as a Message Package.

There are two logical MIME parts within the Message Package:

- The first MIME part, referred to as the Header Container, containing one SOAP 1.1 compliant message. This XML document is referred to as a SOAP Message for the remainder of this specification,
- zero or more additional MIME parts, referred to as Payload Containers, containing application level payloads.

The general structure and composition of an ebXML Message is described in the following Figure 74.

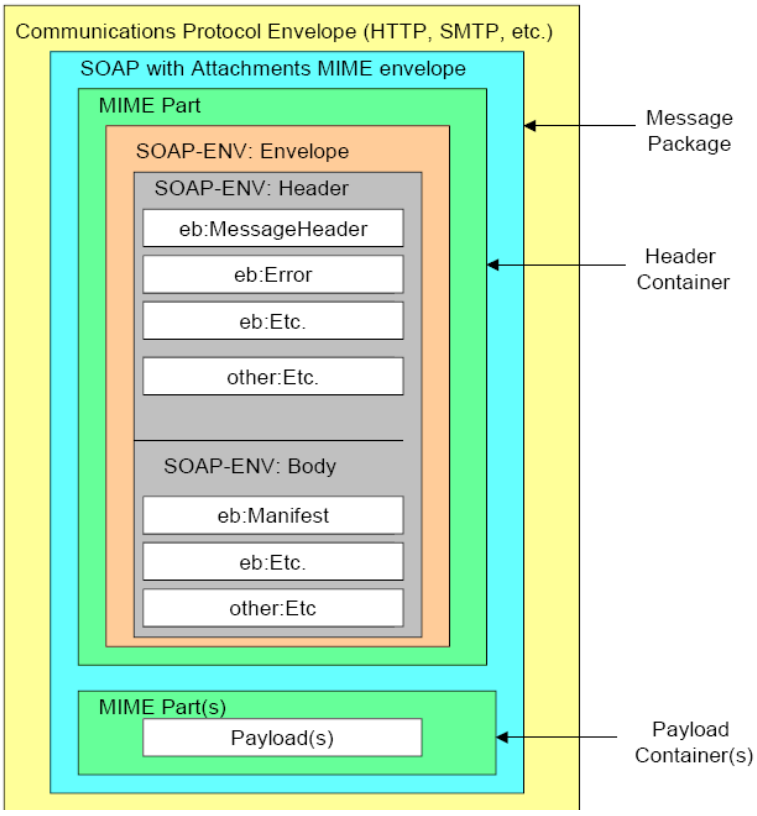


Figure 74 ebXML message structure

ebXML Messaging (also called TRP - Transport Routing & Packaging) specifically focuses on the means to transmit a document (payload) from one party to another, possibly via intermediaries. This protocol is an attempt to standardize the way B2B transactions are transmitted in a manner which includes all sizes of companies from the Large Enterprise (LE) to the Small & Medium Enterprise (SME). ebXML-MS does not define the business processes or the content of the messages being sent. ebXML-MS only concerns itself with the secure and

reliable transmission of the payload. ebXML-MS Message Service Handler (MSH) sits between the network protocol (SMTP, FTP, HTTP, etc.) and the Business Process at each end. In this way, the MSH is independent of both the transport protocol and the higher level Business Processes. ebXML-MS can be used to transmit any payload over any network connection.

ARKTRANS is advised to initially use ebXML-MS as the protocol stack alternative ebXML Minimal in Figure 75.
This is in harmony with the conservative minimal position taken related Business Process Transaction Implementation – see section 16.3.2 below. Note that the message payload standard is the very basic XML standard – see section 16.3.3 Information Content for ARKTRANS position on the implementation of this.

It is advisable to prepare for a evolution of ARKTRANS to more advanced protocol stacks. The Light alternative adds both a specific message content standard (EML EDIFACT) for the message payload plus a Business Process Specification Schema (BPSS) layer on top. The BCF + ebXML alternative shows a complete protocol stack based on ebXML plus UN/EDIFACT Business Collaboration Framework (BCF).

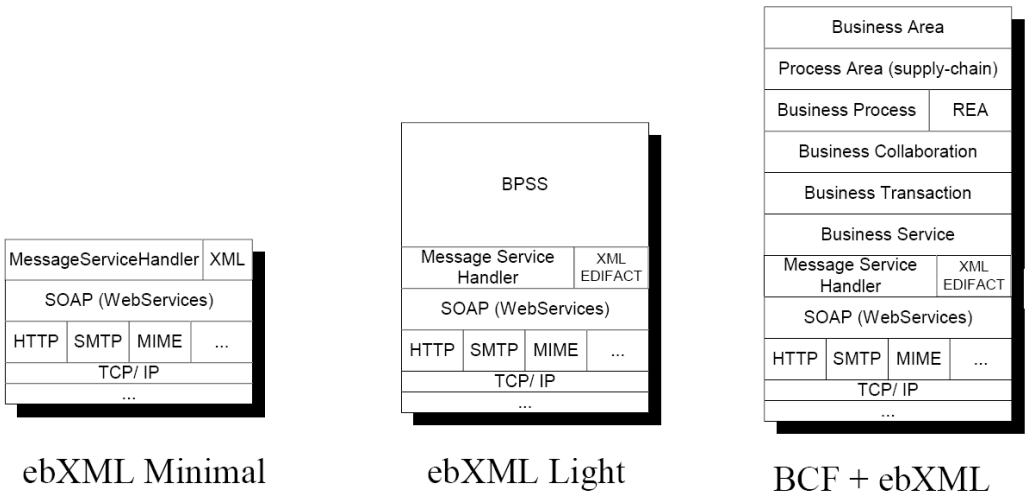


Figure 75 ebXML protocol stack levels extended with UN/CEFACT BCF

16.3.2Business Transaction Implementation

Business transactions should be according to collaboration agreements expressed by a business transaction framework. The business transaction framework may provide:

5. Mechanisms for business transaction choreography:
   - Specification of the possible states, the associated transitions, and the associated messages/information exchange.
   - Specification of logical rules for the transitions as well as for transaction completion including logical rules for exception handling and recovery.
6. Specifications of generic business transactions for handling of business relations.
7. Message templates

ARKTRANS will not need mechanisms that support dynamic establishment of the choreography. The exact rules for generic business transactions related to transport will be defined by ARKTRANS (second alternative above). Exception handling is an important part issue. The business transaction framework must define a set of exception types, e.g. message format error, transmission error, message not sent, and delivery failure.

Business transactions ranges from simple request / response conversations between two parties to complex and long (minutes to days) conversations between multiple parties involving commitment or rollback of entity state changes in multiple sites according to protocol actions or failure conditions.

The implementation of traditional transactions is based on two-phase commitment and two-phase locking, and may for example be realised by means of DBMS services (SQL, RPC). Business transactions may be implemented based on Internet technology like XML, HTTP, SMTP, SOAP, etc. on Web Servers.

Extensions that support business transaction needs have to be added. Some alternatives are described above in section 16.2.1. The Web Services Transactions specifications define mechanisms for transactional interoperability between Web services domains and provide a means to compose transactional qualities of service into Web services applications.

The Web Services Transactions specifications describe an extensible coordination framework (WS-Coordination) and specific coordination types for:

- Short duration, ACID transactions (WS-AtomicTransaction)
- Longer running business transactions (WS-BusinessActivity)

16.3.3Information Content

Basic ARKTRANS implementation requirement:
ARKTRANS messages shall be defined by means of XML Schemas (XML XSD).

The second edition recommendation is described in 3 separate documents providing:
0) an overview and tutorial , **1)** the structure definition ,and **2)** the data type definition .

ARKTRANS message schemas
shall be based on the ARKTRANS domain information model

This is essential to ensure semantic capability and ensure reuse.

Rules and standards how to do this has to be determined – the OASIS OAGI Business Object Document (BOD) approach should be considered .

OAGIS BOD messages make use of today's best practices of object-oriented design by defining a common consistent Noun or object that has Verbs or methods that indicate the action to be performed upon the Noun. By using this construct, it is possible for OAGIS messages -- and the code that reads and produces OAGIS messages -- to leverage this reuse. Once the initial OAGIS BOD can be read or produced, much of the code can then be used to read or produce the next message.

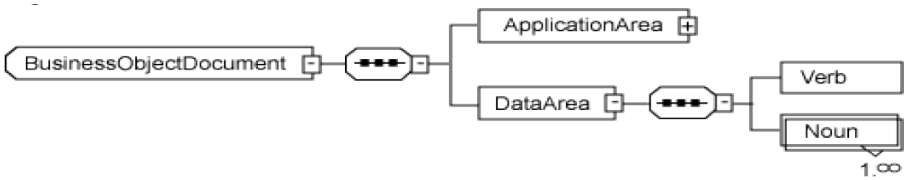


Figure 76 General structure of all BODs

All of the OAGIS BODs use the same general structure:

- The name of the BOD is the VerbNoun combination being applied
  (notice that the Verb and Noun are used as separate elements in the DataArea)
- An Application Area
- A DataArea that contains the Verb and one or more of the Nouns indicated

17Terminology

This chapter defines some terms thet are important to the overall understranding of ARKTRANS. However, the list is not complete as the report itself defines terminology with respect to roles, decomposition of the transport domain, functionality, interactions, information elements, etc.

17.1Deviation

Actual or foreseen deviations with respect to the provision of published transport services such as cancellations, delays, disruptions, early arrivals, transport alterations, stop alterations, reduced service, increased service, etc.
May also be deviations with respect to provision of services or the fulfilment of the Transport Execution Plan.

17.2Handling Instruction

Specifies how the Transport Item shall be handled on a specific transport means or during specific operations (loading, unloading, other terminal operations, etc.).
The handling instruction may be entirely or partly derived from the Transport Item Instructions and from conditions defined by regulations and frameworks (e.g. related to type of Transport Means and type of cargo).

17.3Incident

Abnormal and unplanned situation that may affect safety or the traffic flow in a negative way.
May be:

- Situations that may lead to emergency situations (e.g. accident, regulation violation, error, robbery)
- Specific transport network conditions that may need attention
- Specific weather conditions
- Specific environmental conditions (e.g. pollution)

17.4Loading Information

Specifies where the cargo is or is to be localised on-board the transport means and how it should be loaded or unloaded, specific handling instructions included.

17.5Manifest

A specification of all transport items on board the transport means for official and administrative purposes. May be

- List of passengers that actually have boarded the transport means.
- Information about all cargo on-board the transport means. May also contain *Loading information*

17.6Resource Plan

One for each resource involved in a *Transport Operation*. Specifying the working plan for personnel and transport means.

17.7Route Assignment

Actual assignment of a route to a specific transport means.

17.8Route Plan

Includes time schedules for one or more checkpoints on a route. There are several route plans:

Route plan information that will be of interest to Transport Users, Terminals, traffic control centres, and others outside the control scope of the Transporter or Fleet manager. May include the following types of route plans:

- Draft route plan - Preliminary version of the planned route plan. Used for strategic and tactical planning.
- Planned route plan – The public version of the plan on which the transport operation is based. Will be of interest to Transport Users, Terminals, traffic control centres, and others outside the control scope of the Transporter or Fleet manager.
- Actual route plan – Real time information about estimated or occurred arrivals and departures. May be published to a wide spectre of transport users by means of various information services.
- Operational route plan - Contains detailed plans for thee accomplishment of the transport operation. For internal use by the Transporter, Fleet Manger and the Driver/Crew. Specifies the route for the transport operation (departure and arrival locations, time schedules, how to get between the locations, specific attention that is required, etc.).

17.9Safety Related Information

Information that is provided to the crew ahead of a *Transport Operation* about issues that may influence on the safety. E.g.:.

- Type and Quantities of Dangerous Goods
- Fire extinguishers onboard
- First Aid Skills of Crew
- Emergency Preparedness Means
- Onboard Contingency
- Contingency Plans
- Contact/Key-personnel
- Condition of Transport Means

17.10Security Violation Report

- Information about violation of security regulations.

17.11Service

See Appendix C.

17.12Tracking Information

Information about the localisation of a transport means or a Transport Item and in many cases also information like the speed, direction and heading of the transport means.

17.13Traffic Condition (Trafikkforhold)

Total assessment of the situation in the transport network that may affect safety and efficiency. If possible, several types of information such as *Traffic Flow Information, Transport Network Information* and *Transport Network Condition* should to be considered.

17.14Traffic Flow Information (Informasjon om trafikkflyt)

Dynamic information about the traffic flow, such as traffic density, speed and delay.

17.15Traffic Image (Trafikkbilde)

Information about the transport means in an area with respect to position, speed, direction, and in some cases also the destination they are heading for. Used by transport means (especially air and sea transport) when they plan their operations.

17.16Transport Item Instruction

The transport item instruction specifies specific treatment conditions for transport and terminal operations on transport items, e.g. fragile cargo, handicapped travellers, unaccompanied children, food, animals, etc. The instructions are provided by the Transport User or the Transport User Agent, and the instructions will together with conditions defined by regulations and frameworks (e.g. related to type of Transport Means and type of cargo) influence on the establishment of handling instructions related to transport and terminal operations.

17.17Transport Network Condition (Ferdselsforhold)

Dynamic information about abnormal and unplanned conditions in the transport network (slippery road, turbulence, high waves, obstructions, restricted view, air pollution, oil spill, etc.) due to situations that cannot be controlled (weather, incidents, accidents, etc.).

17.18Transport Network Information

Static as well as dynamic information about planned situations in the transport network infrastructure and regulations valid in the transport network (e.g. closes roads, platooning, speed limitations, restrictions, constraints, and diversions). The information may be used for route planning.

17.19Transport Execution Plan

The basis for a transport order. The content of a transport execution plan depends on the viewpoint and on the phase (during the transport preparations and planning vs. during an ongoing transport operation). The transport execution plan as seen from the Transport User's point of view (in the Transport Demand sub-domain) will encompass the whole transport chain and may consist of several legs, as shown in A of Figure11. However, a Transporter will just need the transport execution plan for the leg or legs accomplished by this Transporter (see B in the Figure).

17.20Transport Operation

A trip executed by one transport means according to a more or less detailed *Transport Operation Plan* and an Operational Route Plan (see *Route Plan*). Several *Transport Task*s may be accomplished by one transport operation as the transport operation may pick up and deliver several Transport Items at several locations. The Transport Items have to be handled according to the Handling Instructions derived from the Transport Item Instructions and related frameworks (depending on type of transport means and type of transport item).

17.21Transport Operation Plan

Specifies the tasks to be accomplished by a transport operation. The Transport Items that are to be transported as well as their departure and destination locations (specified in the Operational Route Plan) and their seat or space allocation are specified.

17.22Transport Task

A transport task is defined by means of a *Transport Execution Plan*. The content of the task depends on the viewpoint. The task may encompass a transport chain (as seen from the transport user's point of view), or the task may correspond to one leg in the final transport chain (as seen from the actual transporter's point of view). The latter is accomplished by one transport means as a part of a *Transport Operation*.

17.23Waybill

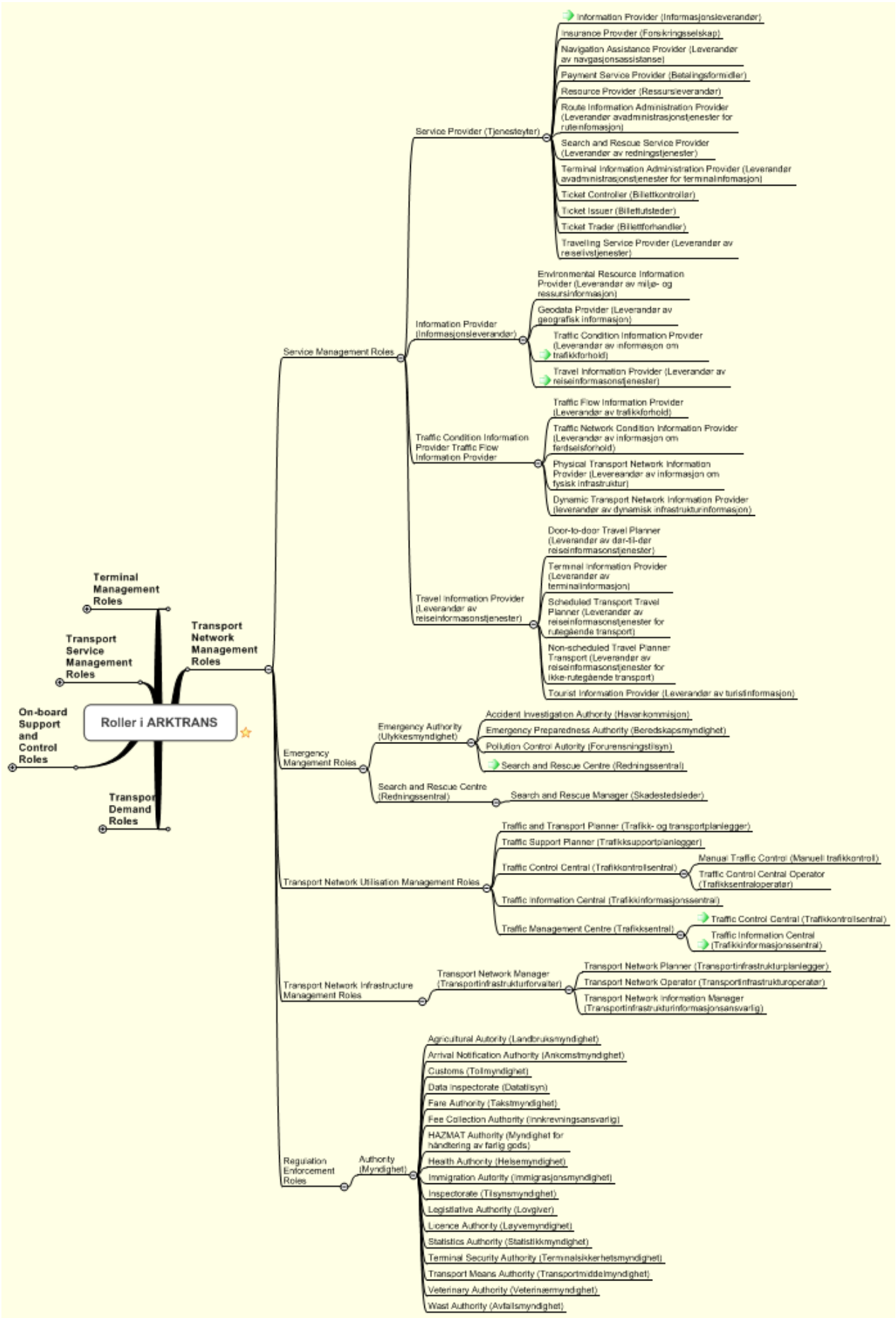
The waybill specifies the cargo transported for a customer to a specific recipient (also called consignment note).

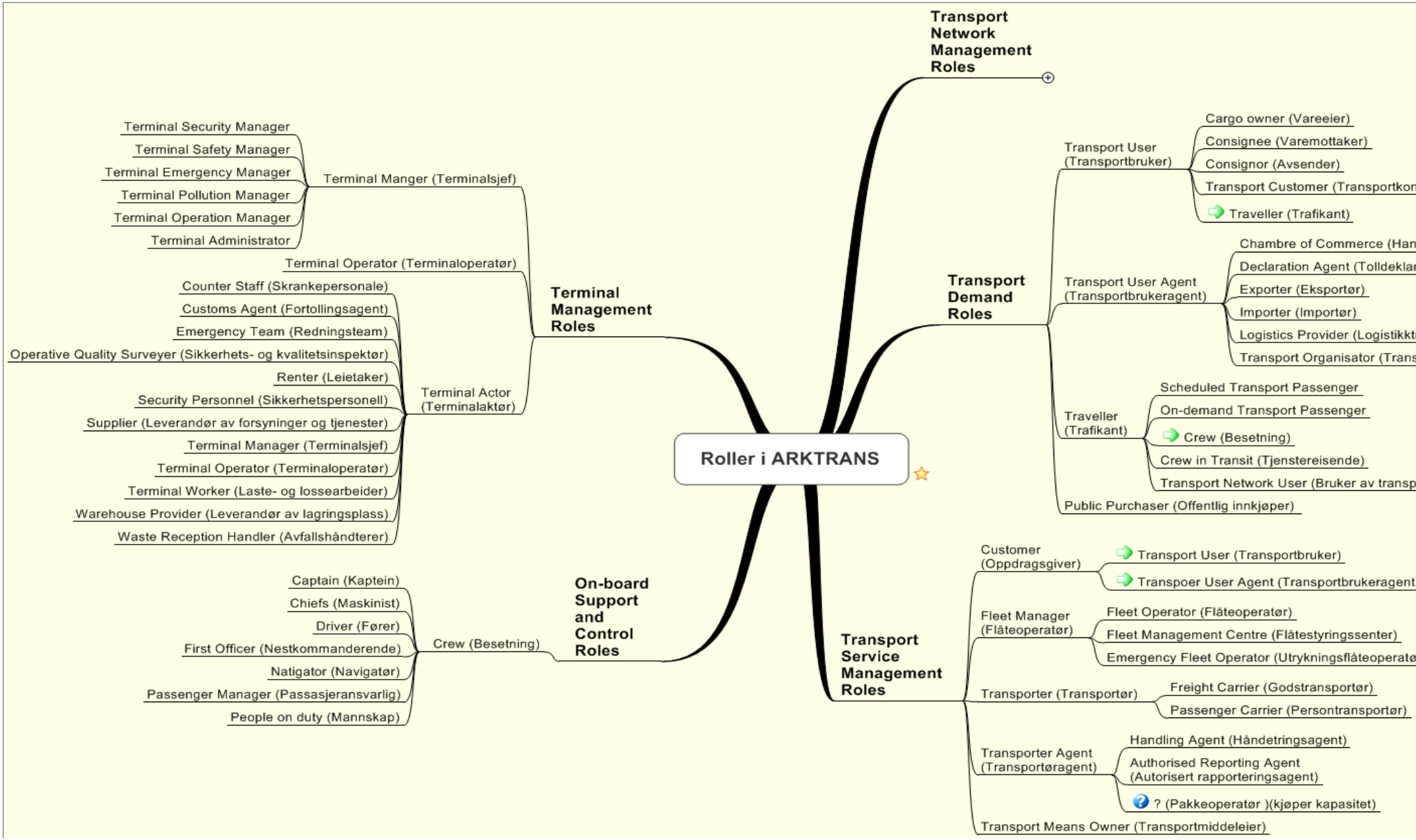
The waybill is issued by those who are organising the transport ((the Transport User or Transport User Agent) according to directions given by the transporters that are involved. In some cases the waybill is not issued until the check in.
One waybill may, if possible according to the waybill customs for the transporters involved, encompass several transporters. However, in many cases new waybills have to be issued for each leg.

References

Appendix A – Mind Maps showing Roles

The following mind map shows the structure of all the roles defined in ARKTRANS.

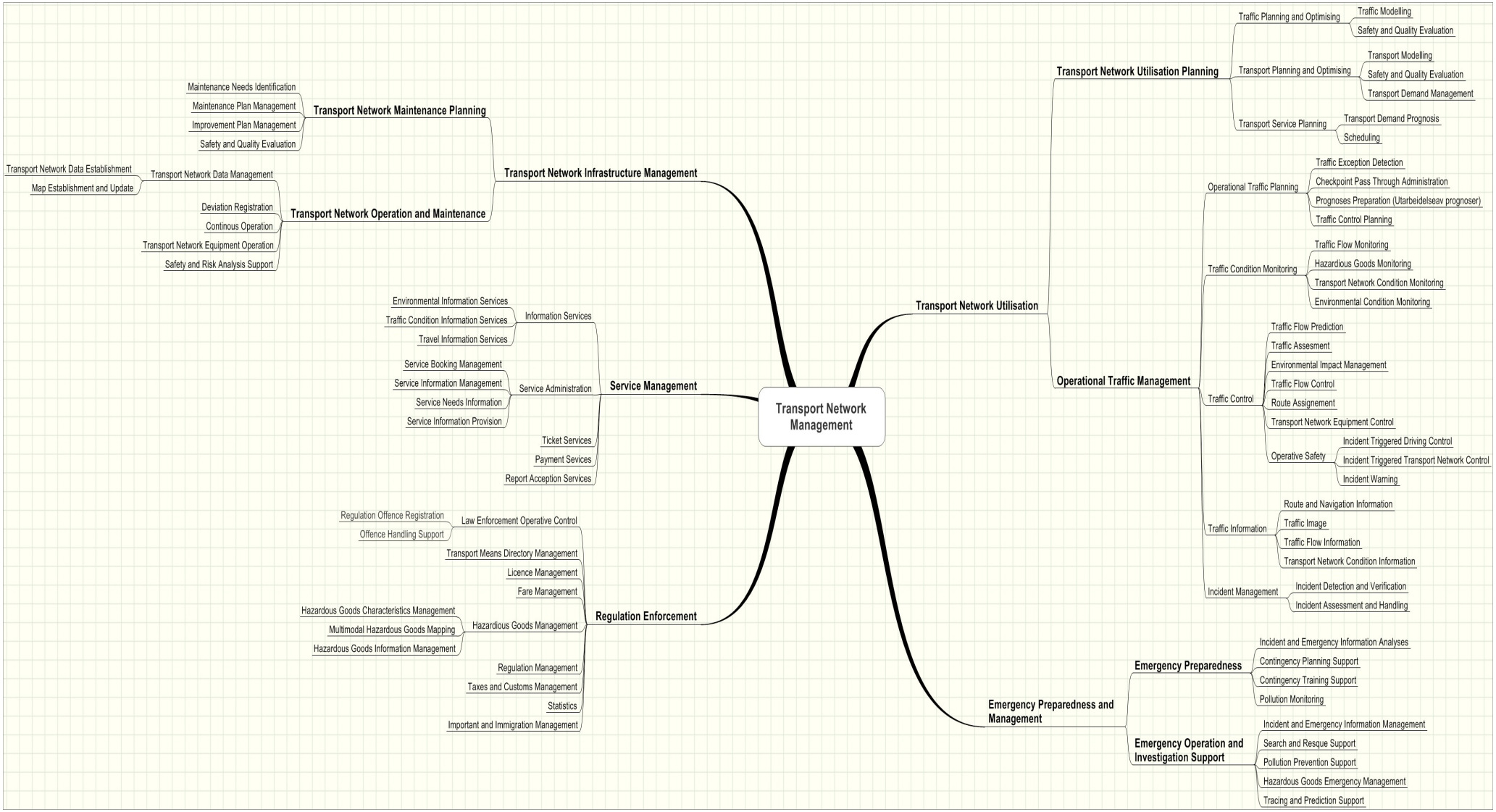

Roller i ARKTRANS
Terminal Management Roles
Transport Service Management Roles
Transport Network Management Roles
On-board Support and Control Roles
Transport Demand Roles
Service Management Roles
Service Provider (Tjenesteyter)
Information Provider (Informasjonsleverandør)
Insurance Provider (Forsikringsselskap)
Navigation Assistance Provider (Leverandør av navigasjonsassistanse)
Payment Service Provider (Betalingsformidler)
Resource Provider (Ressursleverandør)
Route Information Administration Provider (Leverandør avadministrasjonstjenester for ruteinfomasjon)
Search and Rescue Service Provider (Leverandør av redningstjenester)
Terminal Information Administration Provider (Leverandør avadministrasjonstjenester for terminalinfomasjon)
Ticket Controller (Billettkontrollør)
Ticket Issuer (Billettutsteder)
Ticket Trader (Billettforhandler)
Travelling Service Provider (Leverandør av reiselivstjenester)
Information Provider (Informasjonsleverandør)
Environmental Resource Information Provider (Leverandør av miljø- og ressursinformasjon)
Geodata Provider (Leverandør av geografisk informasjon)
Traffic Condition Information Provider (Leverandør av informasjon om trafikkforhold)
Travel Information Provider (Leverandør av reiseinformasonstjenester)
Traffic Condition Information Provider Traffic Flow Information Provider
Traffic Flow Information Provider (Leverandør av trafikkforhold)
Traffic Network Condition Information Provider (Leverandør av informasjon om ferdselsforhold)
Physical Transport Network Information Provider (Levereandør av informasjon om fysisk infrastruktur)
Dynamic Transport Network Information Provider (leverandør av dynamisk infrastrukturinformasjon)
Travel Information Provider (Leverandør av reiseinformasonstjenester)
Door-to-door Travel Planner (Leverandør av dør-til-dør reiseinformasonstjenester)
Terminal Information Provider (Leverandør av terminalinformasjon)
Scheduled Transport Travel Planner (Leverandør av reiseinformasonstjenester for rutegående transport)
Non-scheduled Travel Planner Transport (Leverandør av reiseinformasonstjenester for ikke-rutegående transport)
Tourist Information Provider (Leverandør av turistinformasjon)
Emergency Mangement Roles
Emergency Authority (Ulykkesmyndighet)
Accident Investigation Authority (Havarikommisjon)
Emergency Preparedness Authority (Beredskapsmyndighet)
Pollution Control Autority (Forurensningstilsyn)
Search and Rescue Centre (Redningssentral)
Search and Rescue Centre (Redningssentral)
Search and Rescue Manager (Skadestedsleder)
Transport Network Utilisation Management Roles
Traffic and Transport Planner (Trafikk- og transportplanlegger)
Traffic Support Planner (Trafikksupportplanlegger)
Traffic Control Central (Trafikkontrollsentral)
Manual Traffic Control (Manuell trafikkontroll)
Traffic Control Central Operator (Trafikksentraloperatør)
Traffic Information Central (Trafikkinformasjonssentral)
Traffic Management Centre (Trafikksentral)
Traffic Control Central (Trafikkontrollsentral)
Traffic Information Central (Trafikkinformasjonssentral)
Transport Network Infrastructure Management Roles
Transport Network Manager (Transportinfrastrukturforvalter)
Transport Network Planner (Transportinfrastrukturplanlegger)
Transport Network Operator (Transportinfrastrukturoperatør)
Transport Network Information Manager (Transportinfrastrukturinformasjonsansvarlig)
Regulation Enforcement Roles
Authority (Myndighet)
Agricultural Autority (Landbruksmyndighet)
Arrival Notification Authority (Ankomstmyndighet)
Customs (Tollmyndighet)
Data Inspectorate (Datatilsyn)
Fare Authority (Taksmyndighet)
Fee Collection Authority (Innkrevningsansvarlig)
HAZMAT Authority (Myndighet for håndtering av farlig gods)
Health Authority (Helsemyndighet)
Immigration Autority (Immigrasjonsmyndighet)
Inspectorate (Tilsynsmyndighet)
Legislative Authority (Lovgiver)
Licence Authority (Løyvemyndighet)
Statistics Authority (Statistikkmyndighet)
Terminal Security Authority (Terminalsikkerhetsmyndighet)
Transport Means Authority (Transportmiddelmyndighet)
Veterinary Authority (Veterinærmyndighet)
Wast Authority (Avfallsmyndighet)


Roller i ARKTRANS
Terminal Management Roles
Terminal Manger (Terminalsjef)
Terminal Security Manager
Terminal Safety Manager
Terminal Emergency Manager
Terminal Pollution Manager
Terminal Operation Manager
Terminal Administrator
Terminal Operator (Terminaloperatør)
Terminal Actor (Terminalaktør)
Counter Staff (Skrankepersonale)
Customs Agent (Fortollingsagent)
Emergency Team (Redningsteam)
Operative Quality Surveyer (Sikkerhets- og kvalitetsinspektør)
Renter (Leietaker)
Security Personnel (Sikkerhetspersonell)
Supplier (Leverandør av forsyninger og tjenester)
Terminal Manager (Terminalsjef)
Terminal Operator (Terminaloperatør)
Terminal Worker (Laste- og lossearbeider)
Warehouse Provider (Leverandør av lagringsplass)
Waste Reception Handler (Avfallshåndterer)
On-board Support and Control Roles
Crew (Besetning)
Captain (Kaptein)
Chiefs (Maskinist)
Driver (Fører)
First Officer (Nestkommanderende)
Natigator (Navigatør)
Passenger Manager (Passasjeransvarlig)
People on duty (Mannskap)
Transport Network Management Roles
Transport Demand Roles
Transport User (Transportbruker)
Cargo owner (Vareeier)
Consignee (Varemottaker)
Consignor (Avsender)
Transport Customer (Transportkon
Traveller (Trafikant)
Transport User Agent (Transportbrukeragent)
Chambre of Commerce (Han
Declaration Agent (Tolldeklar
Exporter (Eksportør)
Importer (Importør)
Logistics Provider (Logistikkt
Transport Organisator (Trans
Traveller (Trafikant)
Scheduled Transport Passenger
On-demand Transport Passenger
Crew (Besetning)
Crew in Transit (Tjenstereisende)
Transport Network User (Bruker av transp
Public Purchaser (Offentlig innkjøper)
Transport Service Management Roles
Customer (Oppdragsgiver)
Transport User (Transportbruker)
Transpoer User Agent (Transportbrukeragent
Fleet Manager (Flåteoperatør)
Fleet Operator (Flåteoperatør)
Fleet Management Centre (Flåtestyringssenter)
Emergency Fleet Operator (Utrykningsflåteoperatø
Transporter (Transportør)
Freight Carrier (Godstransportør)
Passenger Carrier (Persontransportør)
Transporter Agent (Transportøragent)
Handling Agent (Håndetringsagent)
Authorised Reporting Agent (Autorisert rapporteringsagent)
? (Pakkeoperatør)(kjøper kapasitet)
Transport Means Owner (Transportmiddeleier)

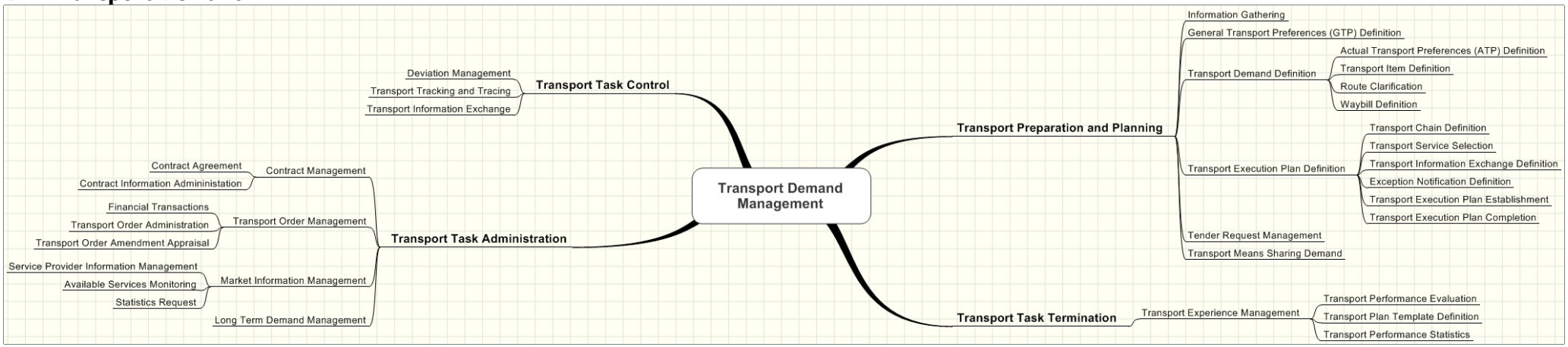
Appendix B – Mind Maps showing the functional breakdown

The following mind maps show the functional breakdown within each of the sub domains in the reference model. The complete functional description can be found in chapter 6, 7, 8, 9 and 10.

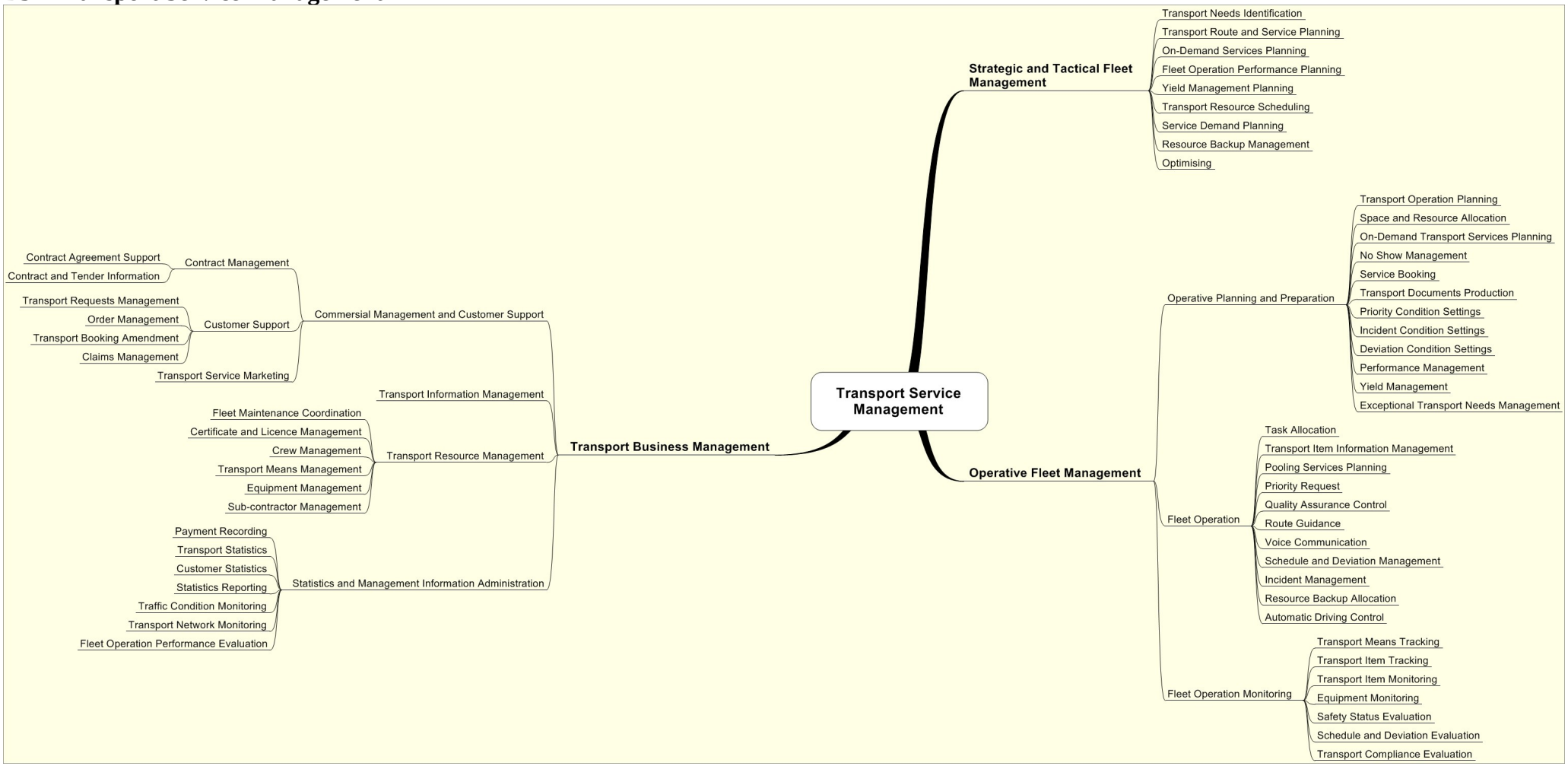
B1 - Transport Network Management



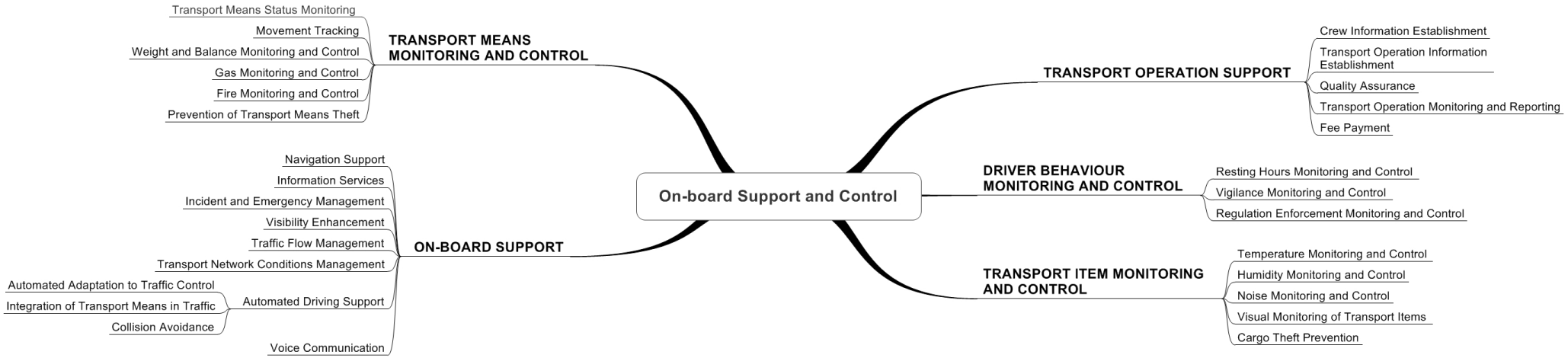
B2- Transport Demand



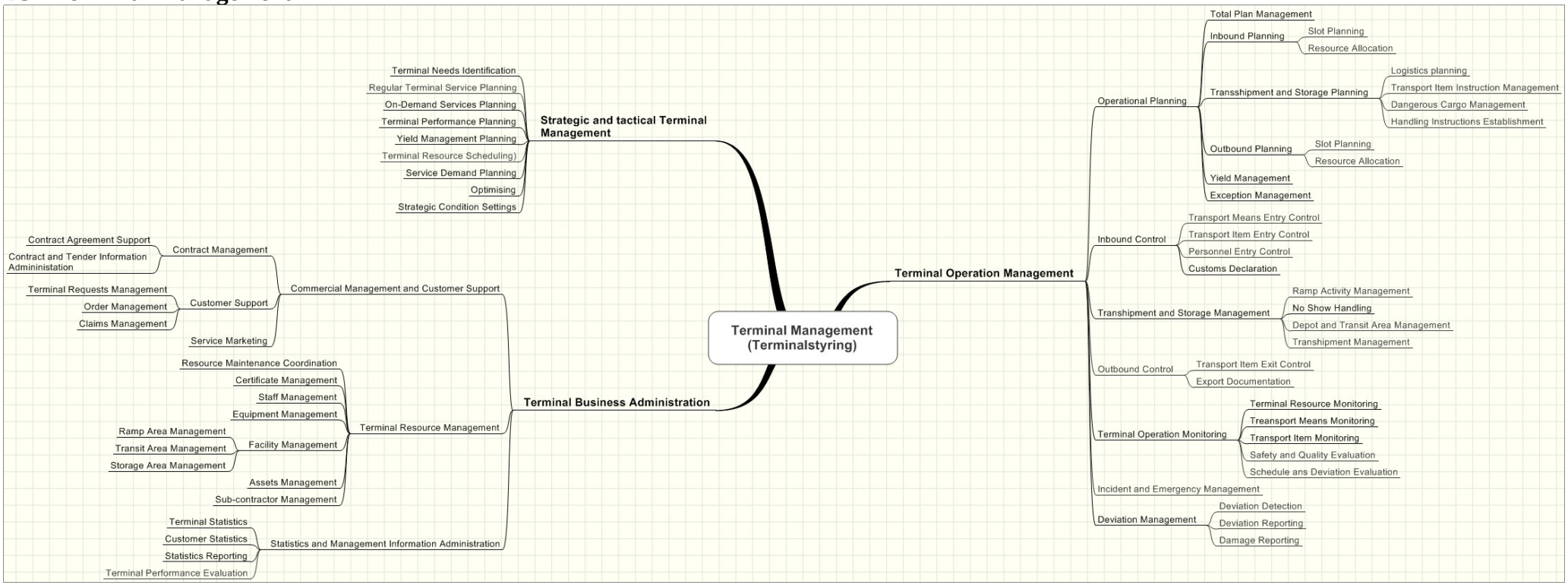
B3 - Transport Service Management



B4 - On-board Support and Control

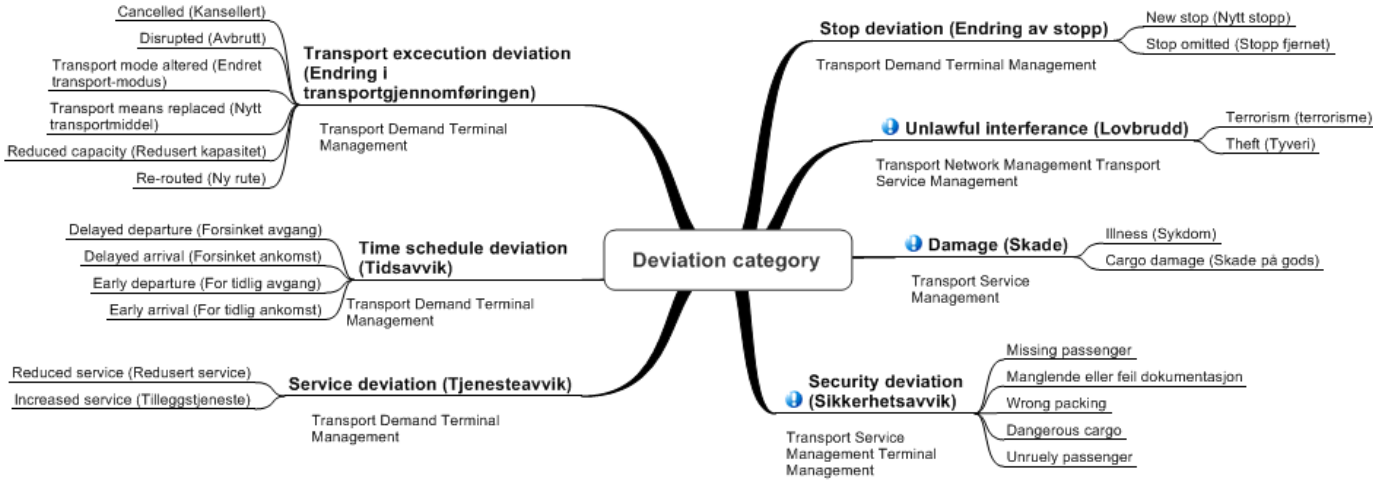


B5 - Terminal Management

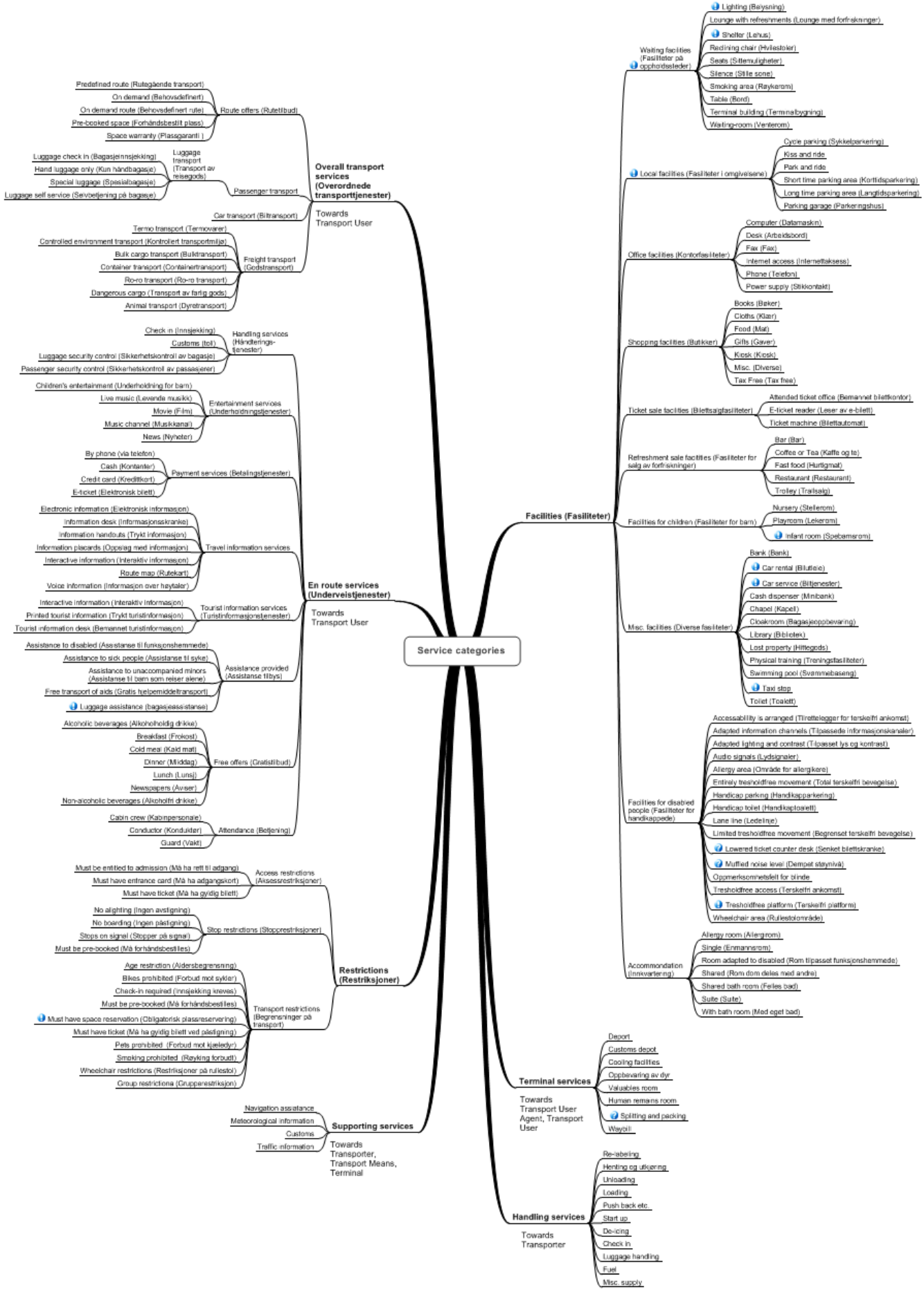


Appendix C – Mind maps showing deviations and services

C1- Deviations



C2 – Services


Service categories
Overall transport services (Overordnede transporttjenester)
Towards Transport User
Route offers (Rutetilbud)
Predefined route (Rutegående transport)
On demand (Behovsdefinert)
On demand route (Behovsdefinert rute)
Pre-booked space (Forhåndsbestilt plass)
Space warranty (Plassgaranti)
Passenger transport
Luggage transport (Transport av reisegods)
Luggage check in (Bagasjeinnsjekking)
Hand luggage only (Kun håndbagasje)
Special luggage (Spesialbagasje)
Luggage self service (Selvbetjening på bagasje)
Car transport (Biltransport)
Freight transport (Godstransport)
Termo transport (Termovarer)
Controlled environment transport (Kontrollert transportmiljø)
Bulk cargo transport (Bulktransport)
Container transport (Containertransport)
Ro-ro transport (Ro-ro transport)
Dangerous cargo (Transport av farlig gods)
Animal transport (Dyretransport)
En route services (Underveistjenester)
Towards Transport User
Handling services (Håndterings-tjenester)
Check in (Innsjekking)
Customs (toll)
Luggage security control (Sikkerhetskontroll av bagasje)
Passenger security control (Sikkerhetskontroll av passasjerer)
Entertainment services (Underholdningstjenester)
Children's entertainment (Underholdning for barn)
Live music (Levende musikk)
Movie (Film)
Music channel (Musikkanal)
News (Nyheter)
Payment services (Betalingstjenester)
By phone (via telefon)
Cash (Kontanter)
Credit card (Kredittkort)
E-ticket (Elektronisk billett)
Travel information services
Electronic information (Elektronisk informasjon)
Information desk (Informasjonsskranke)
Information handouts (Trykt informasjon)
Information placards (Oppslag med informasjon)
Interactive information (Interaktiv informasjon)
Route map (Rutekart)
Voice information (Informasjon over høytaler)
Tourist information services (Turistinformasjonstjenester)
Interactive information (Interaktiv informasjon)
Printed tourist information (Trykt turistinformasjon)
Tourist information desk (Bemannet turistinformasjon)
Assistance provided (Assistanse tilbys)
Assistance to disabled (Assistanse til funksjonshemmede)
Assistance to sick people (Assistanse til syke)
Assistance to unaccompanied minors (Assistanse til barn som reiser alene)
Free transport of aids (Gratis hjelpemiddeltransport)
Luggage assistance (bagasjeassistanse)
Free offers (Gratistilbud)
Alcoholic beverages (Alkoholholdig drikke)
Breakfast (Frokost)
Cold meal (Kald mat)
Dinner (Middag)
Lunch (Lunsj)
Newspapers (Aviser)
Non-alcoholic beverages (Alkoholfri drikke)
Attendance (Betjening)
Cabin crew (Kabinpersonale)
Conductor (Konduktør)
Guard (Vakt)
Restrictions (Restriksjoner)
Access restrictions (Aksessrestriksjoner)
Must be entitled to admission (Må ha rett til adgang)
Must have entrance card (Må ha adgangskort)
Must have ticket (Må ha gyldig billett)
Stop restrictions (Stopprestriksjoner)
No alighting (Ingen avstigning)
No boarding (Ingen påstigning)
Stops on signal (Stopper på signal)
Must be pre-booked (Må forhåndsbestilles)
Transport restrictions (Begrensninger på transport)
Age restriction (Aldersbegrensning)
Bikes prohibited (Forbud mot sykler)
Check-in required (Innsjekking kreves)
Must be pre-booked (Må forhåndsbestilles)
Must have space reservation (Obligatorisk plassreservering)
Must have ticket (Må ha gyldig billett ved påstigning)
Pets prohibited (Forbud mot kjæledyr)
Smoking prohibited (Røyking forbudt)
Wheelchair restrictions (Restriksjoner på rullestol)
Group restrictions (Gruppérestriksjon)
Supporting services
Towards Transporter, Transport Means, Terminal
Navigation assistance
Meteorological information
Customs
Traffic information
Facilities (Fasiliteter)
Waiting facilities (Fasiliteter på oppholdssteder)
Lighting (Belysning)
Lounge with refreshments (Lounge med forfriskninger)
Shelter (Le/hus)
Reclining chair (Hvilestoler)
Seats (Sittemuligheter)
Silence (Stille sone)
Smoking area (Røykerom)
Table (Bord)
Terminal building (Terminalbygning)
Waiting-room (Venterom)
Local facilities (Fasiliteter i omgivelsene)
Cycle parking (Sykkelparkering)
Kiss and ride
Park and ride
Short time parking area (Korttidsparkering)
Long time parking area (Langtidsparkering)
Parking garage (Parkeringshus)
Office facilities (Kontorfasiliteter)
Computer (Datamaskin)
Desk (Arbeidsbord)
Fax (Fax)
Internet access (Internettaksess)
Phone (Telefon)
Power supply (Stikkontakt)
Shopping facilities (Butikker)
Books (Bøker)
Cloths (Klær)
Food (Mat)
Gifts (Gaver)
Kiosk (Kiosk)
Misc. (Diverse)
Tax Free (Tax free)
Ticket sale facilities (Billettsalgfasiliteter)
Attended ticket office (Bemannet billettkontor)
E-ticket reader (Leser av e-billett)
Ticket machine (Billettautomat)
Refreshment sale facilities (Fasiliteter for salg av forfriskninger)
Bar (Bar)
Coffee or Tea (Kaffe og te)
Fast food (Hurtigmat)
Restaurant (Restaurant)
Trolley (Trallsalg)
Facilities for children (Fasiliteter for barn)
Nursery (Stellerom)
Playroom (Lekerom)
Infant room (Spebarnsrom)
Misc. facilities (Diverse fasiliteter)
Bank (Bank)
Car rental (Bilutleie)
Car service (Biltjenester)
Cash dispenser (Minibank)
Chapel (Kapell)
Cloakroom (Bagasjeoppbevaring)
Library (Bibliotek)
Lost property (Hittegods)
Physical training (Treningsfasiliteter)
Swimming pool (Svømmebasseng)
Taxi stop
Toilet (Toalett)
Facilities for disabled people (Fasiliteter for handikappede)
Accessability is arranged (Tilrettelegger for terskelfri ankomst)
Adapted information channels (Tilpassede informasjonskanaler)
Adapted lighting and contrast (Tilpasset lys og kontrast)
Audio signals (Lydsignaler)
Allergy area (Område for allergikere)
Entirely thresholdfree movement (Total terskelfri bevegelse)
Handicap parking (Handikappparkering)
Handicap toilet (Handikaptoalett)
Lane line (Ledelinje)
Limited thresholdfree movement (Begrenset terskelfri bevegelse)
Lowered ticket counter desk (Senket billettskranke)
Muffled noise level (Dempet støynivå)
Oppmerksomhetsfelt for blinde
Thresholdfree access (Terskelfri ankomst)
Thresholdfree platform (Terskelfri platform)
Wheelchair area (Rullestolområde)
Accommondation (Innkvartering)
Allergy room (Allergirom)
Single (Enmannsrom)
Room adapted to disabled (Rom tilpasset funksjonshemmede)
Shared (Rom dom deles med andre)
Shared bath room (Felles bad)
Suite (Suite)
With bath room (Med eget bad)
Terminal services
Towards Transport User Agent, Transport User
Depot
Customs depot
Cooling facilities
Oppbevaring av dyr
Valuables room
Human remains room
Splitting and packing
Waybill
Handling services
Towards Transporter
Re-labeling
Henting og utkjøring
Unloading
Loading
Push back etc.
Start up
De-icing
Check in
Luggage handling
Fuel
Misc. supply

Appendix D – Route Information Message Examples

These examples are currently refined by the MultiRIT project. Thus, the examples do no reflect the most recent versions and should not be used. Please contact MultiRIT for further information (marit.natvig@sintef.no).

Time schedule information

Time schedule information

- Timestamp (1)
- Line schedule (1..*)
  - *Line (1)* - for specific line
    - selected attributes
  - Trip pattern time schedule (1..*) - for all relevant trip
    - *Date* (1) - one specific departure
      - selected attributes
    - *Trip pattern reference* (0..*)
      - selected attributes
    - *Trip* schedule(1)
      - selected attributes
      - *Operator* (0..*)
        - selected attributes
      - *Contact* (0..*)
        - selected attributes
      - *Remark* (0..*)
        - selected attributes
      - Route - ordered sequence of
        - *Stop schedule*(1..*)
          - selected attributes
          - *Terminal reference*(1)
            - selected attributes
          - *Stop point* (0..*)
            - selected attributes
          - Arrival (0..1)
            - *Time schedule* (1)
              - selected attributes
              - *Remark* (0..*)
                - selected attributes
          - Departure (0..1)
            - *Time schedule* (1)
              - selected attributes
              - *Remark* (0..*)
                - selected attributes
          - Next stop in case of boarding (0..*)
            - *Terminal reference* (1)
              - selected attributes

Trip details

Trip details

- Timestamp (1)
- Line information (1..*) - Time table for specific trip/trips
  - *Line (1)*
    - selected attributes
  - Trip information (1..*) - all relevant dates/departures
    - *Date* (1)
      - selected attributes

- *Trip pattern reference* (0..*)
  - selected attributes
- *Trip* (1)
  - selected attributes
  - *Operator* (0..*)
    - selected attributes
  - *Contact* (0..*)
    - selected attributes
  - *Remark* (0..*)
    - selected attributes
  - *Transport means* (0..*)
    - selected attributes
  - *On-board service* (0..1)
    - On-board en-route service (0..1)
      - Handling service type (0..1)
        - Check in (0..*)
          Service attributes
        - Customs (0..*)
          Service attributes
        - Luggage check in (0..*)
          Service attributes
        - Luggage security control (0..*)
          Service attributes
        - Passenger security control (0..*)
          Service attributes
      - Entertainment service type (0..1)
        - ....
      - Payment service type (0..1)
        - ....
      - Travel information service type (0..1)
        - ....
      - Tourist information service type (0..1)
        - ....
      - Assistance service type (0..1)
        - ....
      - Free offers service type (0..1)
        - ....
      - Attendance service type (0..1)
        - ....
    - On-board facility (0..1)
      - Waiting facility type (0..1)
        - ....
      - Office facility type (0..1)
        - ....
      - Shopping facility type (0..1)
        - ....
      - Ticket sale facility type (0..1)
        - ....
      - Refreshment sale facility type (0..1)
        - ....
      - Children adaptation facility type (0..1)
        - ....
      - Misc. facility type (0..1)
        - ....
      - Disabled people adaptation facility type (0..1)
        - ....
      - Accommodation facility type (0..1)
        - ....

- On-board restriction (0..1)
  - Transport restriction type (0..1)
    - ....

- *On-board deviation* (0..1)
  - *Transport execution deviation* (0..1)
    - Cancelled deviation type (0..*)
      - deviation attributes
    - Disrupted deviation type (0..*)
      - deviation attributes
    - Transport mode altered deviation type (0..*)
      - deviation attributes
    - Transport means replaced deviation type (0..*)
      - deviation attributes
    - Reduced capacity deviation type (0..*)
      - deviation attributes
    - Re-routed deviation type (0..*)
      - deviation attributes
  - *On-board service deviation* (0..1)
    - Reduced service deviation type(0..1)
      - deviation attributes
      - *On-board service (0..1)*
        - On-board en-route service (0..1)
          - Handling service type (0..1)
          - Entertainment service type (0..1)
          - Payment services (0..1)
          - Travel information service type (0..1)
          - Tourist information service type (0..1)
          - Assistance provided service type (0..1)
          - Free offers service type (0..1)
          - Attendance service type (0..1)
        - On-board facility (0..1)
          - Waiting facility type (0..1)
          - Office facility type (0..1)
          - Shopping facility type (0..1)
          - Ticket sale facility type (0..1)
          - Refreshment sale facility type (0..1)
          - Children adaptation facility type (0..1)
          - Misc. facility type (0..1)
          - Disabled people adaptation facility type (0..1)
          - Accommodation facility type (0..1)
        - On-board restriction (0..1) (consider to remove this)
          - Transport restriction type (0..1)
    - Increased service deviation type (0..1)
      - deviation attributes
      - *On-board service (0..1)*
        - On-board en-route service (0..1)
          - Handling service type (0..1)
          - Entertainment service type (0..1)
          - Payment services (0..1)
          - Travel information service type (0..1)
          - Tourist information service type (0..1)

        - Assistance provided service type (0..1)
        - Free offers service type (0..1)
        - Attendance service type (0..1)
    - On-board facility (0..1)
        - Waiting facility type (0..1)
        - Office facility type (0..1)
        - Shopping facility type (0..1)
        - Ticket sale facility type (0..1)
        - Refreshment sale facility type (0..1)
        - Children adaptation facility type (0..1)
        - Misc. facility type (0..1)
        - Disabled people adaptation facility type (0..1)
        - Accommodation facility type (0..1)
    - On-board restriction (0..1)

      (consider to remove this)
        - Transport restriction type (0..1)

- Route - ordered sequence of
    - *Stop* (1..*)
        - selected attributes
        - *Terminal reference*(1)
            - selected attributes
        - *Stop point* (0..*)
            - selected attributes
        - Arrival (0..1)
            - *Time schedule* (1)
                - selected attributes
                - *Remark* (0..*)
                    - selected attributes
            - *Time schedule deviation* (0..1)
                - *Delayed deviation type* (0..1)
                    - deviation attributes
                - *Early deviation type* (0..1)
                    - deviation attributes
            - *Combined service* (0..*)

              - with another, departing trip
                - selected attributes
                - *Line* (1)

                  - the other line
                    - selected attributes
                - *Trip pattern reference*(1)

                  - the other line
                    - selected attributes
                - *Trip reference* (0..1)

                  - the other line
                    - selected attributes
                - *Time schedule* (1)

                  -departure of the other line
                    - selected attributes
                    - *Remark* (0..*)
                        - selected attributes
                - Time *schedule deviation* (0..1)
                    - *Delayed deviation type* (0..*)
                    - deviation attributes
                    - *Early deviation type* (0..*)

- deviation attributes

- Departure (0..1)
  - *Time schedule* (1)
    - selected attributes
    - *Remark* (0..*)
      - selected attributes
    - *Time schedule deviation* (0..1)
      - *Delayed deviation type* (0..*)
        - deviation attributes
      - *Early deviation type* (0..*)
        - deviation attributes
  - *Combined service* (0..*)

    - with another, arriving trip
    - selected attributes
    - *Line* (1)

      - the other line
      - selected attributes
    - *Trip pattern reference*(1)
      - selected attributes
    - *Trip reference* (0..1)
      - selected attributes
    - *Time schedule* (1)

      -arrival of the other line
      - selected attributes
      - Remark (0..*)
        - selected attributes
      - Time *schedule deviation* (0..1)
        - *Delayed deviation type* (0..*)
          - *deviation attributes*
        - *Early deviation type* (0..*)
          - *deviation attributes*
  - *Leg* (0..*)

    - description of next leg
    - selected attributes
    - served by (0..*)

      - in case leg differs from trip
      - *Transport means* (1)
    - provided by (0..*)
      - *Transport means* (1..*)
    - On-*board service* (0..1)

      - in case leg differs from trip
      - *On-board en-route service (0..1)*
        - Handling service type (0..1)
          - ....
        - Entertainment service type (0..1)
          - ....
        - Payment services (0..1)
          - ....
        - Travel information service type (0..1)
          - ....
        - Tourist information service type (0..1)
          - ....
        - Assistance provided service type (0..1)
          - ....

        - Free offers service type (0..1)
            - ....
        - Attendance service type (0..1)
            - ....
    - *On-board facility (0..1)*
        - Waiting facility type (0..1)
            - ....
        - Office facility type (0..1)
            - ....
        - Shopping facility type (0..1)
            - ....
        - Ticket sale facility type (0..1)
            - ....
        - Refreshment sale facility type (0..1)
            - ....
        - Children adaptation facility type (0..1)
            - ....
        - Misc. facility type (0..1)
            - ....
        - Disabled people adaptation facility type (0..1)
            - ....
        - Accommodation facility type (0..1)
            - ....
    - *On-board restriction (0..1)*
        - Transport restriction type (0..1)
            - ....
- *On-board deviation* (0..1)
  (in case leg differs from trip)
    - *Transport execution deviation* (0..1)
        - Cancelled deviation type (0..*)
            - *deviation* attributes
        - Disrupted deviation type (0..*)
            - deviation *attributes*
        - Transport mode altered deviation type (0..*)
            - deviation *attributes*
        - Transport means replaced deviation type (0..*)
            - *deviation* attributes
        - Reduced capacity deviation type (0..*)
            - *deviation* attributes
        - Re-routed deviation type (0..*)
            - deviation *attributes*
    - *On-board service deviation* (0..1)
        - Reduced service deviation type(0..1)
            - *deviation attributes*
            - *On-board service (0..1)*
                - …
        - Increased service deviation type (0..1)
            - *deviation attributes*
            - *On-board service (0..1)*
                - …

- Duration (0..1)
    - calculated value (1)
- *Stop Service* (0..1)
    - Stop en-route service (0..1)

- Assistance provided service type (0..*)
- Attendance service type (0..*)

▪ Stop facility (0..1)
- Disabled people adaption facility type (0..*)

▪ Stop restriction (0..1)
- Stop restriction type (0..*)

○ *Terminal stop deviation* (0..1)

▪ *Stop deviation* (0..1)
- New stop deviation type (0..*)
  - deviation attributes
- Stop omitted deviation type (0..*)
  - deviation attributes

▪ *Stop service deviation* (0..1)
- Reduced service deviation type(0..1)
  - deviation attributes
  - *Stop service* (0..1)

▪ Stop en-route service (0..1)

▪ Assistance provided service type (0..1)

▪ Assistance to disabled (0..*)

▪ Service attributes

▪ Assistance to sick people (0..*)

▪ Service attributes

▪ Assistance to unaccompanied minors (0..*)

▪ Service attributes

▪ Free transport of aids (0..*)

▪ Service attributes

▪ Luggage assistance (0..*)

▪ Service attributes

▪ Attendance service type (0..1)

▪ Stop facility (0..1)

▪ Disabled people adaptation facility type (0..*)

▪ Accessibility is arranged (0..*)

▪ Service attributes

▪ Adapted information channels (0..*)

▪ Service attributes

▪ Adapted lighting and contrast (0..*)

▪ Service attributes

▪ Audio signals (0..*)

▪ Service attributes

▪ Allergy area (0..*)

▪ Service attributes

▪ Entirely tresholdfree movement (0..*)

▪ Service attributes

▪ Handicap parking (0..*)

▪ Service attributes

▪ Handicap toilet (0..*)

▪ Service attributes

▪ Lane line (0..*)

        - Service attributes
      - Limited tresholdfree movement (0..*)
        - Service attributes
      - Lowered ticket counter desk (0..*)
        - Service attributes
      - Muffled noise level (0..*)
        - Service attributes
      - Oppmerksomhetsfelt for blinde (0..*)
        - Service attributes
      - Tresholdfree access (0..*)
        - Service attributes
      - Tresholdfree platform (0..*)
        - Service attributes
      - Wheelchair area (0..*)
        - Service attributes
    - *Stop restriction* (0..1)
      - Stop restriction type (0..1)
        - No Alighting (0..*)
          - Service attributes
        - No boarding (0..*)
          - Service attributes
        - Stops on signal (0..*)
          - Service attributes
        - Must be pre-booked (0..*)
          - Service attributes
- Increased service deviation type (0..1)
  - deviation attributes
  - *Stop service* (0..1)
    - Stop en-route service (0..1)
      - Assistance provided service type (0..1)
        - Assistance to disabled (0..*)
          - Service attributes
        - Assistance to sick people (0..*)
          - Service attributes
        - Assistance to unaccompanied minors (0..*)
          - Service attributes
        - Free transport of aids (0..*)
          - Service attributes
        - Luggage assistance (0..*)
          - Service attributes
      - Attendance service type (0..1)
    - Stop facility (0..1)
      - Disabled people adaptation facility type (0..*)
        - Accessibility is arranged (0..*)
          - Service attributes

- Adapted information channels (0..*)
  - Service attributes
- Adapted lighting and contrast (0..*)
  - Service attributes
- Audio signals (0..*)
  - Service attributes
- Allergy area (0..*)
  - Service attributes
- Entirely tresholdfree movement (0..*)
  - Service attributes
- Handicap parking (0..*)
  - Service attributes
- Handicap toilet (0..*)
  - Service attributes
- Lane line (0..*)
  - Service attributes
- Limited tresholdfree movement (0..*)
  - Service attributes
- Lowered ticket counter desk (0..*)
  - Service attributes
- Muffled noise level (0..*)
  - Service attributes
- Oppmerksomhetsfelt for blinde (0..*)
  - Service attributes
- Tresholdfree access (0..*)
  - Service attributes
- Tresholdfree platform (0..*)
  - Service attributes
- Wheelchair area (0..*)
  - Service attributes

- *Stop restriction* (0..1)
  - Stop restriction type (0..1)
    - No Alighting (0..*)
      - Service attributes
    - No boarding (0..*)
      - Service attributes
    - Stops on signal (0..*)
      - Service attributes
    - Must be pre-booked (0..*)
      - Service attributes

- Next stop in case of boarding (0..*)
  - *Terminal reference* (1)
    - selected attributes

- Replaced by (0..*)
  - *Trip reference* (1..*)
    - selected attributes
- Replaces (0..*)
  - *Trip reference* (1..*)
    - selected attributes

Appendix E – Use of ARKTRANS in the D2D project

See file ARKTRANS_50_alfa-D2D-annex.doc

Appendix F – Papers and articles presenting ARKTRANS

The following papers and articles can be consulted for more information about ARKTRANS:

- Christiansen, I. and M. Natvig, ARKRANS - nytt rammeverk for IKT i transportsektoren, in Samferdsel. 2004. p. 24-25
- Christiansen, I., M.K. Natvig, and H. Westerheim. ARKTRANS Multimodal ITS Framework Architecture. In The 5th European Congress and Exhibition on Intelligent Transport Systems and Services. 2005. Hannover, Germany: ERTICO
- Natvig, M., Transporten må gå samme vei, in Computerworld. 2004
- Natvig, M., I. Christiansen, and H. Westerheim. "Multimodal ITS Framework Architecture - ARKTRANS. in accepted for ITS In Europe. 2005. Hannover: ERTICO
- Natvig, M. and H. Westerheim. Joint effort in establishment of ARKTRANS - A system framework architecture for multi-modal transport. In 10th World Congress and Exhibition on Intelligent Transport Systems and services. 2003. Madrid, Spain: ERTICO
- Natvig, M. and H. Westerheim. ARKTRANS - The Norwegian system framework architecture for multi-modal transport. In 10th World Congress and Exhibition on Intelligent Transport Systems and Services. 2003. Madrid, Spain: ERTICO
- Natvig, M.K. and H. Westerheim. A Comparasion of the Multimodal System Framework Architecture ARKTRANS and Related Work. in ITS In Europe - Moving Towards an Integrated Europe. 2004. Budapest, Hungary: ERTICO
- Natvig, M.K. and H. Westerheim. The ARKTRANS Multimodal Route and Travel Information. In The 11th World Congress and Exhibition on Intelligent Transport Systems and Services. 2004. Nagoya, Japan: ERTICO .
- Westerheim, H. and M.K. Natvig. Functional Decomposition Based on the ARKTRANS Reference Model. In ITS in Europe - Moving Towards and Integrated Europe. 2004. Budapest, Hungary: ERTICO

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