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FREIGHTWISE

Management Framework for Intelligent
Intermodal Transport

Integrated Project (IP)

Sustainable surface transport - Rebalancing and integrating different transport modes.

Deliverable D13.1
Harmonisation Strategy

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List of abbreviations

AIS	**Automatic Identification System**
CCS	**Cargo Community System**
D	**Delivery**
DG	**Dangerous Goods**
DoW	**Description of Work ("Technical Annex" or "Annex I" to the contract)**
ebXML	**Electronic Business XML**
EPC	**Electronic Port Clearance. Related terms that describe the same concept are "One Stop Shopping" and "Single Window Concept" [FAL31] facilities.**
EPIRB	**Emergency Position Indicating Radio Beacon**
ETSF	**Electronic Trading Standard Format (based on EDIFACT)**
FWF	**the FREIGHTWISE Framework**
OASIS	**Organization for the Advancement of Structured Information Standards. Has established a joint committee with UNCEFACT to migrate EDIFACT to XML.**
SoA	**State of the Art**
UN/CEFACT	**United Nations Centre for Trade Facilitation and Electronic Business, see also OASIS.**
VTM	**Vessel Traffic Management**
XSD	**Style sheet**
WCO	**World Customs Organisation**
WP	**WP – Work Package**

1 Introduction

The EU Commission continues its drive for making European logistics operations more cost-effective, and for achieving a more efficient use of the transport resources and a better balance in the use of transport modes.

The project FREIGHTWISE, financed by EU under the 6th Framework Programme for Research and Technological Development is one of the many projects that are part of the Commission's ambition to establish a platform for the development of open, interoperable ICT systems that will support the Commission's policy.

This deliverable describes the strategy on how to harmonize the definition of transport services and the information exchange process across transport modes and stakeholders by means of a framework architecture. The deliverable describes the rational behind the structure and content of the FREIGHTWISE framework architecture (FWF). The content of the architecture is further specified in Deliverable D13.2.

WP13 addresses architectural issues and will contribute to standards development in the transport field. Through consultation of the FREIGHTWISE user community and the development of a framework architecture, specific and strategic standardisation recommendations can be derived.

The objectives of WP13 are:

- Promote a common understanding of the issues (and a common vocabulary to address these) with generic specifications of roles, functionality, information and work processes
- Contribute to harmonisation across transport modes by specifying a multimodal architecture. By multimodal we mean common to all transport modes.
- Enable interoperability and co-ordination between stakeholders and ICT solutions by means of well defined message-based interfaces
- Contribute to the development of a Pan-European multimodal framework architecture
- Develop input to definition of virtual transport services by defining building blocks which can be assembled for desired services

2 Setting the Scene

2.1 The Traffic solutions vs the transport solutions

The scenery in Freightwise is to focus upon the transport solutions and not the traffic solutions. But we will identify how traffic information are used in the different stages of a transport performance; in the planning stage, in the execution stage. We are realising that the transport services are dependent on the traffic operations.

2.2 Internet for Passenger Transport

Most of us know the use of internet for transport through booking air tickets and hotels. One of the key applications for booking air tickets is the Amadeus system, where almost all airlines have agreed to publish their services in a central database, using standard names for airports to connect air services when required to go from origin to destination.

A similar initiative is OpenTravel[1]; whose mission is to engineer specifications that make data transmission flow smoothly throughout travel, tourism and hospitality. OpenTravel creates, expands and drives adoption of open universal data specifications, including but not limited to the use of XML, for the electronic exchange of business information among all sectors of the travel industry. OpenTravel is comprised of companies representing airlines, car rental firms, hotels, cruise lines, railways, leisure suppliers, service providers, tour operators, travel agencies, solutions providers, technology companies and distributors.

Error! Reference source not found. illustrates the architecture that is used as a basis for the OpenTravel activities.

[1] http://www.opentravel.org/AboutUs/Default.aspx

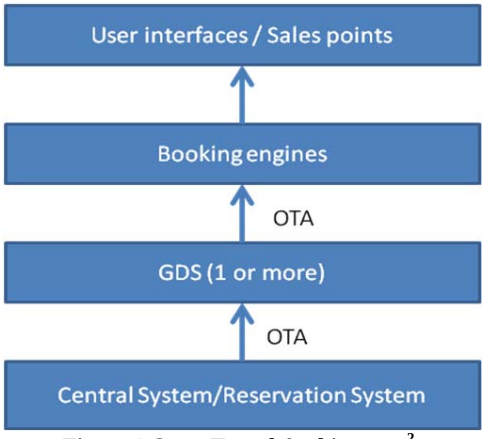

Figure 1 Open Travel Architecture[2]

Crucial to this approach, in Amadeus and other similar applications, is the use of a Central System or database where all services are known.

2.3 What about Cargo?

In principle, there is no reason why similar capabilities should be offered for freight transport. A number of portals are offering similar services, but many of them are either offered by large transport operators and are only to be used for transport operations offered by these, or they are limited to a geographically area and a special type of transport services. The observations are that they are not operated on an open interface.

Furthermore, the freight transport market is characterised by large numbers small freight operators to the extent that it seems completely unrealistic to assume that a “central reservation system” can be established for this purpose.

[2] GDS = Global Distribution System

Consequently, the Freightwise project has asked the question: It is possible to achieve the capabilities offered for transport of passengers in the area of freight transport without providing a central system for freight transport management?

The hypothesis that has been formed in Freightwise that this is possible if “all” transport service providers are publishing their services on the Internet in a standardised format and that the essential interaction between transport users and transport service providers are being performed using a small set of well defined information objects (that may be implemented as messages). **Error! Reference source not found.** illustrates the change where the centralised system has been replaced by a decentralised system where the individual service providers are handling all bookings and interactions.

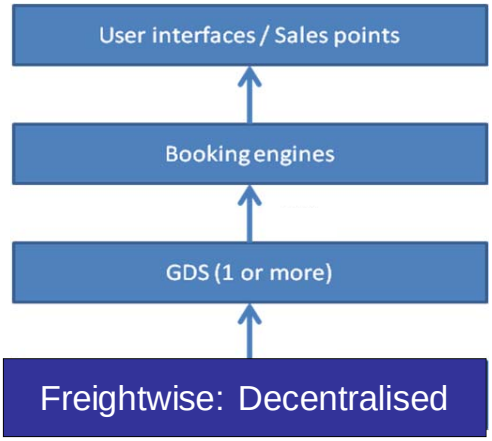

Figure 2 OpenTravel architecture modified to suit the Freightwise hypothesis

2.4 Interoperability is the Key

In order to support the vision of enabling the possibility of booking and managing freight operations, FREIGHTWISE acknowledges the fact that in a number of situations a number of transport services need to be linked in order to transport cargo from origin to destination. One consequence of this fact is that a number of transport service providers need to interact in order to provide an efficient end to end transport operations.

It is not the intention of FREIGHTWISE to constrain the internal operations of any transport service company. Hence, it is not the intention of FREIGHTWISE to devise any form of architecture that will bind the development of legacy systems in the transport sector.

The focus of FREIGHTWISE is to ensure that the interoperability of such legacy systems is cost effective and simple and that the cost of entering into a network of interacting transport service providers doing electronic exchange of information shall be as low as possible. The latter is important for small and medium sized companies.

A wider definition of the term architecture often includes the design of the total built environment, from the macro level of how a building integrates with its surrounding man made landscape (see town planning, urban design, and landscape architecture) to the micro level of architectural or construction details and, sometimes, furniture. Wider still, architecture is the activity of designing any kind of system.
In order to avoid any form of misunderstanding, FREIGHTWISE will not use the work architecture about its development. This term may lead to the interpretation that if any system is “FREIGHTWISE compliant” it needs to be designed in a certain way.

In FREIGHTWISE the term “framework” will be used in order to describe that the FREIGHTWISE focus is to build an environment, a framework, where legacy systems can interact efficiently during freight transport planning, execution, and completion.

3 Requirements Regarding the FREIGHTWISE Framework

The focus of FREIGHTWISE is multimodal freight transport. Hence, the framework to be used and further developed in FREIGHTWISE needs to include all aspects related to multimodal freight transport. This holds true even in the light of the revised EU transport policy where the concept of multimodality has been introduced. All transport modes should be used to the best of their ability, alone or in combinations.

In all forms of freight transport a number of actors are involved (one or more logistics terminals are typically also involved in road only transport operations typically one or more logistics terminals are involved). Efficient cooperation between actors is mandatory in order to secure smooth and effective operations. Each actor performs a set of functions, or, in other words, plays one or more roles during a door-to-door transport operation. In order to ensure commonality between modes, as much as possible, the architecture should focus on the roles in multimodal transport and interaction between roles.

FREIGHTWISE is about freight transport management. This means selecting the most appropriate transport alternative (chain) and ensuring that the cargo moves smoothly from origin to destination. Should deviations occur, then corrective actions should be possible. In the light of this, FREIGHTWISE is not about managing or optimising the resources to be used for transport. This is the responsibility of the service providers (fleet managers of transport companies ensure the best possible use of vehicles and terminal managers ensure the best possible use of equipment and space). As a consequence, the FREIGHTWISE framework should not have fleet- or terminal equipment management as a core, but need to deal with these issues in order to ensure that the service providers are given sufficient information form other roles such that they may be able to use their resources efficiently.

The FREIGHTWISE architecture should enable all stakeholders involved in freight transport to have complete freedom to decide internal operations and to design information and communication systems. The focus of the FREIGHTWISE framework should ensure the best possible cooperation between the relevant stakeholders to ensure efficiency and control. Furthermore, the framework needs to be open such that it may be developed in concert with possible changes in the need for services and it needs to be technology independent.

The requirements and decisions with respect to the framework in FREIGHTWISE can be summarized as follows:

1. The framework should support multimodal transport. By multimodal we mean that the framework is common to all transport modes.
2. The framework must have significant focus on the overall, generic issues enabling interoperability and efficiency in multimodal transport chains (efficient procedures, efficient information exchange and coordination between stakeholders, etc.). The objective is to simplify procedures and information exchange between stakeholders.
3. The focus should be on the generic roles of the stakeholders taking part in multimodal transport and interaction between these roles.
4. Fleet- or terminal resource management is not focused, but the service providers must be given sufficient information form to be able to use their resources efficiently.
5. The internal solutions in the systems of separate stakeholders are not focused.
6. The framework architecture shall form a basis for a future European Directive for multimodal freight transport.

The FREIGHTWISE project description identifies the domains governing logistics solutions as shown in **Error! Reference source not found.**. As a consequence, the framework need to cover all these aspects, in a way that visualises only those elements that are required at all times, dependent upon “who is looking”.

Freightwise should therefore focus upon the Transport demand and transport management, where the infrastructure including traffic management and regulations are supporting activities

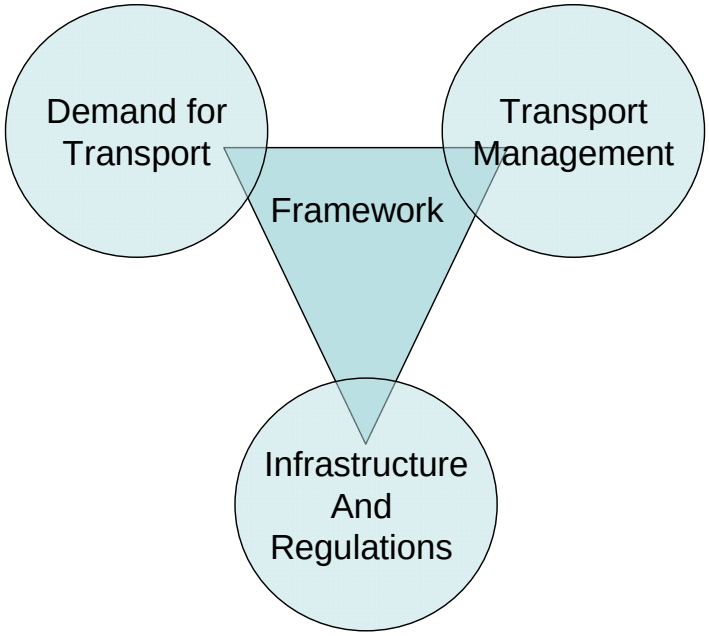

Figure 3 - Domains governing logistics solutions

4 FREIGHTWISE Background

After the White Paper on Transport Policy was published in the beginning of the 1990s, several EU projects have been dealing with applying ICT in transport and logistics. Another initiative is the "The Electronic Freight Management Initiative" by the U.S. Department of Transportation/Federal Highway Agency[i]. As soon as the need to move freight transport from road to other modes was recognised, the complexity of dealing with multimodal transport became apparent. Hence, during the first decade of this development, and in a number of projects still, the focus has been on attempting to understand the complexity of the issue and to live with it.

4.1 Architectural Issues

Even though the term “architecture” does not give rise to the right associations regarding the FREIGHTWISE activities, some background is required. One interpretation si that an Architecture provides a systematic mechanism for ensuring the systems can be fully integrated and for understanding the needs of all those involved. There are two “schools” in the area of architectures for transport:

1. The one represented by the KAREN/FRAME[3] initiative, where the focus is to provide guidelines for the planning, design or implementation of an ITS[4] application. FRAME concentrates on the use of advanced telematic technologies in modern transport systems, their increasing complexity and the importance of ensuring integration and interoperability between systems and covers not only the technical elements, but also organisational, legal and business aspects. FRAME is, in practice, architecture for ITS solutions in the road transport sector. SeveralSeveral national architectures such TelemArk in Finland and Actif in France interact with and derive from KAREN/FRAME.

[3] www.frame-online.net
[4] ITS – Intelligent Transport Systems

2. Another approach to architecture was developed in the EU project THEMIS[5]. THEMIS aimed to develop a common multimodal architecture, covering business and transport chain management, terminal management, and fleet management. The result was the Freight Functional Framework (FFF). The FFF was a comprehensive description of all aspects of multimodal transport, the best available at the time of its development. However, in hindsight, two aspects of the FFF could be improved. First of all, the FFF was not "aware" of the need of defining roles and responsibilities associated with roles. This aspect will be covered later. As a consequence, the FFF model included complexity that could have been avoided. Secondly, even though the presentation of the FFF model is hierarchic, the inherent complexity in the approach made it difficult to utilise outside the Themis project. The overall data flow diagram FFF is shown in Figure 5 - FFF interactions

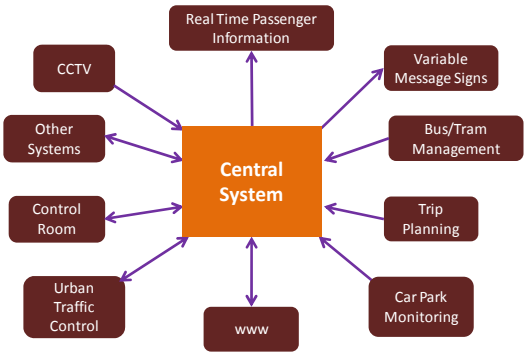

Figure 4 - Frame target

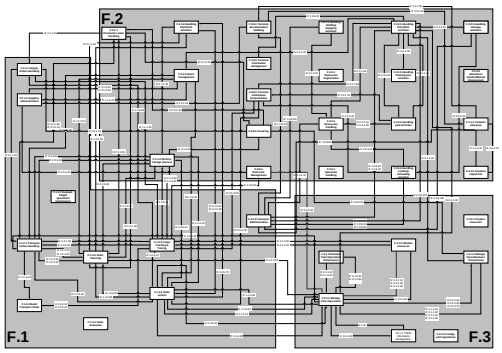

Figure 5 - FFF interactions

[5] THEMIS - THEMATIC NETWORK ON INTELLIGENT FREIGHT TRANSPORT SYSTEMS (2000-2004)

4.2 Freight Transport Management

After all the years of research and development there is still a need to balance the use of the different transport modes in Europe. However, if a transport user wants to find all freight transport services that are available for example for transporting freight from an origin to a destination, there is no easy way of obtaining this information. Such information is normally proprietary information with forwarders and other logistics operators or it is published on internet in non-standard formats.

This is quite similar to the situation in air transport some years ago, where the only possible way of getting an air ticket was to use a travel agent (ref. Section 2). Today most of us have experienced using the internet for booking air tickets. One of the reasons that this is possible is that all airlines have agreed to use a common definition of the air transport service (and a common ICT system - Amadeus) such that these services may be easily combined so that anyone may create their own travel plan.

In general, the use of the internet in passenger transport is more advanced than in freight transport. Web-based services are available to persons planning to travel or wanting to buy tickets, while the same capabilities can hardly be found for the freight sector.

With the previously discussed issues in mind, the starting point for FREIGHTWISE was the following:

- It is not enough to learn to live with the complexity of multimodal intertransport. Simplification is a must.
- It must be easy for transport users and/or transport organisers (freight integrators) to find all available transport services available for a given type of cargo and combine them into a suitable transport chain.
- Managing multimodal transport must be easy, the transport processes transparent, and interaction between the actors must be efficient and cost effective.

5 Methodology Used

5.1.1 Input to the work in WP13

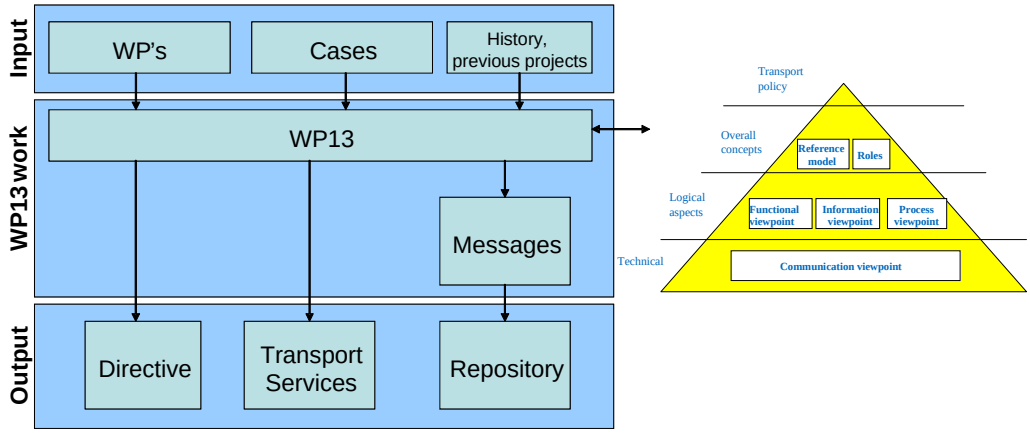

Figure 6 - Methodology WP13

The work on the framework architecture did not start from scratch. It was based on

- Input from and cooperation with related project like D2D, MarNIS and ShortSeaXML
- Evaluations of and input from existing framework architectures like KAREN/FRAME, ARKTRANS, TELEMARK and THEMIS.
- Input from the market assessment and requirements from WP11[ii]
- Input from the reviews of previous RTD project findings and EU policy from WP12iv
- Input from the high level formal model from WP12

- Input from the business cases studied in WP21 – 26

- The re-use of existing results and the coordination with related activities are emphasised. The re-use of results depends on the fulfilment of the strategically requirements to the architecture framework:

This document is also aligned with the The FREIGHTWISE Approach to Intermodal Freight Transport Management, by Dr.ing. Jan Tore Pedersen, Marlo a.s, Heer, Norway[iii]

5.2 WP-13 Work

The WP-13 work will use the reference model approach and firstly focus on the policy level that is the overall concept of the FREIGHTWISE architecture. The main purpose of the architecture is to gain common understanding between both readers (humans and computers) such that information can easily be understood and exchanged between them. There are three main objectives to follow when specifying the architecture; to give input to an multimodal freight directive, to be able to develop a transport service in a standardised way, and finally to develop messages that can be used in multimodal freight operations. The logical aspects cover a functional viewpoint, an information viewpoint, as well as a process viewpoint.

5.3 Output from WP13

Expected outcome of the WP 13 work will be input to a multimodal directive, a definition of a transport service with detail description of the information elements as well as messages to a service, and a set of messages (XML) that can be used in a door-to-door transport operation.

5.4 The Framework Description

The content of the framework is inspired by the generic guidelines in IEEE 1471-2000 (Institute of Electrical and Electronics Engineers - Recommended Practice for Architectural Description of

Software-Intensive Systems) and the Reference Model for Open Distributed Processing (RM-ODP) specified in ISO/IEC 10746-1.

The framework establishment process and the viewpoints are inspired by RUP6,[7], RM-ODP8[9] and Converge – Guidelines for Development and Assessment of Intelligent Transport System Architectures (TR 1101 Deliverable DSA2).

It is decided to use UML diagrams to specify the different viewpoints in the architecture.

[6] Jacobson, I., Brooch G., Rumbaugh J., *The Unified Software Development Proces*
[7] Jacobson, I., Brooch G., Rumbaugh J., *The Unified Software Development Proces*
[8] ISO/IEC JTC1, ISO/IEC 10746-1, *Open Distributed Processing – Reference Model: Overview*
[9] ISO/IEC JTC1, ISO/IEC 10746-1, *Open Distributed Processing – Reference Model: Overview*

5.5 Building on Previous Initiatives, like ARKTRANS

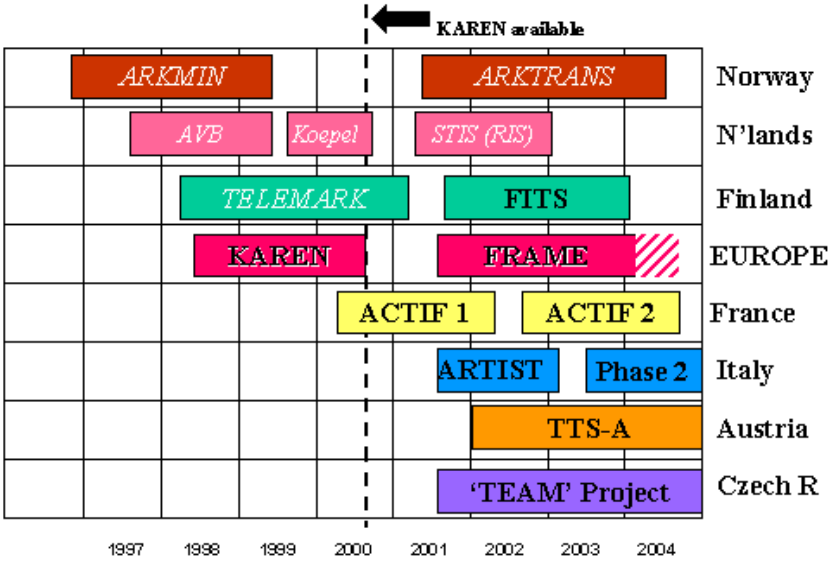

Figure 7 - Architecture initiatives[10]

With the numerous architecture projects that have been going on in the past, there is no reason for FREIGHTWISE to start from square one. Consequently, a number of architecture projects have been

[10] The figure is from http://www.frame-online.net/NationalArchs.htm. The work on the ARKTRANS, Telemark, KAREN/FRAME, ACTIF, ARTIST, TTS-A and TEAM initiatives is continued also after 2004.

investigated and analysed[11]. Analysis of pervious architectures has also been done in the D12.1 [iv]delivery in FREIGHTWISE.

Table 1

Initiative description	FREIGHTWISE value
Norwegian initiative. ARKTRANS is a multimodal framework architecture, i.e. a common architecture for all modes (road, sea, air and rail). The whole transport domain is addressed, including the needs of the transport user, transport chain management, traffic management, etc.	The ARKTRANS structure will be followed by the FREIGHTWISE architecture initiative mainly due to: o Multimodality o Focus on interoperability o An approach that facilitates abstractions and simplifications See section 10.1 for details.
Initiatives in the Netherlands: Koeple is an ITS Reference Model, developed in 1999/2000 - the initial phase for developing a national ITS Architecture, but no initiatives have been taken to develop it further. AVB is an Inter-Urban Traffic Management_Architecture developed 1997-2000 by Netherlands Ministry of Transport. STIS is a national architecture for waterborne transport (developed from the European RIS).	The initiatives address Traffic management. No focus on traffic chain management. No or limited value for FreightWise.
Finish initiative.	Primarily focused on travel information

[11] TRIM, INTACT, KAREN/FRAME, ARKTRANS, TelemArk, D2D, GIFTS, THEMIS, COMPRIS, MARNIS and MultiRIT.

Initiative description	FREIGHTWISE value
Telemark/FITS follows a functional decomposition scheme similar to FRAME, but also incorporates the organisational aspect. It introduces the concepts of: actor for each function, the 'actors' responsible for various tasks are identified.	systems in a multimodal context. Language problems – models etc. in Finish. The traffic part are valuable input to FREIGHTWISE.
European initiative: KAREN, Frame is for road transport. Provides a comprehensive functional decomposition and data flow study of a wide spectre of issues related to road transport. Suitable for system design (due to detailed data flow diagrams).	Not multimodal. However, KAREN was used as input to the work on ARKTRANS. Thus, ARKTRANS covers the KAREN aspects. However, ARKTRANS has a focus on interoperability (as requested by FREIGHTWISE) whilst KAREN addresses the specification of the inner parts of the systems.
French intiative. ACTIF is based on KAREN.	Mainly road transport, but some work on interfaces towards other transport modes. Not multimodal in the way required by FREIGHTWISE, and not focused on the management of multimodal transport chains. Partly translated to English, but models etc. in French..
Italian initiative. ARTIST is based on KAREN. Supports applications for: Emergency Calls Management; Monitoring and Management of Hazardous Goods Transport; and Platforms for B2C e-commerce delivery in urban areas	Mainly road transport. The focus on transport chain management is as far as we know limited. Language problems.
Austrian initiative. TTS_A addresses multimodality (for example regarding public transport and river traffic).The aim is to achieve integration, not only a bilateral approach.	
Czech initiative. The TEAM Project, the "ITS in conditions of the transport and communication environment of the Czech national ITS architecture" is intended to cover all modes (road, rail and waterborne transport) and it is created through 'process analysis'.	

On the basis of the requirements and scope, and on the insight obtained form analysing available architectures, the decision has been taken within FREIGHTWISE to build upon ARKTRANS [2][v]. ARKTRANS is the only available alternative that has multimodality as its focus (common specifications for all transport modes) when looking at the whole transport sector. The ARKTRANS approach also focuses on interoperability.

Furthermore, ARKTRANS has adopted the approach of adopting levels of abstractions so that specific issues may be discussed and handled without being distracted by involving unnecessary details (which are not forgotten, but hidden). ARKTRANS has, as described in Section 10, a focus on interoperability whilst KAREN also addresses the specification of the inner parts of the systems.

ARKTRANS was established based on input from KAREN/FRAME, the US National Architecture, the architectural work in ISO/CEN and THEMIS. The approach in ARKTRANS is however different (see section 10.1) due to the focus on interoperability and multimodality. Among others, the architecture is organised according to a responsibility centric reference model. Despite of the differences, it should however be possible to map between ARKTRANS and the other architectures.

Comment [JTP1]: Hvilken referanse skal brukes her?

ARKTRANS is also used in other European projects like the MarNIS [12] project, and ARKTRANS is also updated based on input from MarNIS and previous European projects like D2D.

[12] **MarNIS** is an Integrated Research Project in the 6th Frame Work Programme, http://www.marnis.org/

6 Architecture Content

The FREIGHTWISE Framework Architecture (FWF) content work will be organized as illustrated in following figure.

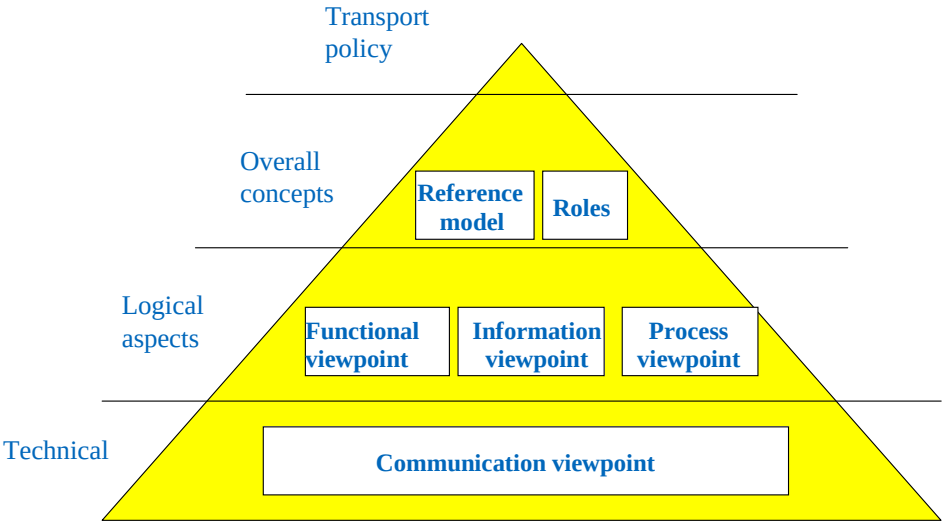

Figure 8 – The content of the FREIGHTWISE framework architecture (FWF)

The overall concepts and the logical aspects will be specified in a technology independent way. The technology will not be introduced before the technical aspects are specified.

This report describes the premises for the different parts of the architecture description – i.e. why do we need this part of the architecture, what is to be specified and what are the relations to other parts of the architecture. In addition, preliminary content is specified for the overall parts of the architecture.

The conceptual approach presented in Figure 8 is adopted directly from ARKTRANS. On top of the pyramid is the transport policy, which means strategically documents and decisions that will inflect the transport segment. Next is the overall concepts that is used to build common understanding in form of a reference model telling what main topics will be covered in the framework, as well as the roles which indicates whom will be part of the framework. The logical aspects describes the functional, the informational, and the process viewpoints. In the framework this is where the processes diagrams and the information packages are described and where the main development with the FWF framework occurs. The last part is the technical aspects that describes how the framework can be implemented.

7 Overall concepts

The overall concepts include the Reference model and the Roles.

7.1 Reference model

7.1.1 Introduction

The reference model provides an overview of the transport domain. As the domain is extensive and complex, a division into manageable parts is necessary.

The definition of the reference model is based on the following objectives:

- *Commonality:* The reference model must contribute to the establishment of a common conceptual model of the transport domain.
- *Simplicity*: Such a model must be simple and easy to be interpreted. In that way the reference model can provide a common context providing simple solutions for all involved processes.
- *Stability*: The reference model must last through changes in user needs, user requirements, organisational structures and technology.
- *Independence*: The reference model must be independent of organisational issues as well as the physical realisation of the technical solutions.
- *Usability:* It must be easy to map activities, projects, systems, stakeholders and challenges into the model, and thus to find those parts of the architecture that is of relevance.

A *responsibility centric model* is considered to be the best alternative. Thus, the reference model divides the transport domain into responsibility domains and presents the relations between them. Related responsibilities belong to the same domain.

The reference model provides the overall structure for the architecture description. By means of the reference model it shall be easier for the stakeholders to find the relevant parts of the architecture descriptions.

7.1.2 ARKTRANS before the Start of FREIGHTWISE

At the start of FREIGHTEISE, the ARKTRANS reference model looked as presented in Figure 9.

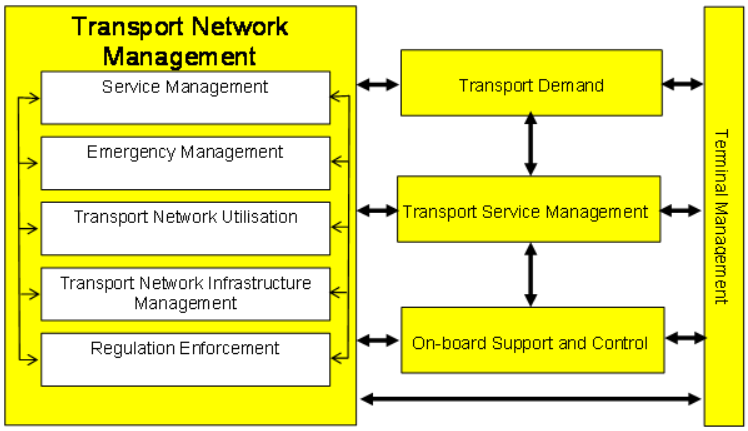

Figure 9 ARKTRANS reference model at the start of the FREIGHTWISE project

This 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 Section 7.3
- Objectives – as seen from the associated roles
- Responsibilities – as seen from the other parts of the reference model

7.1.2.1 Transport 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 Section 7.1.2.2).

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

7.1.2.2 Terminal 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 9, 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

7.1.2.3 Transport 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.

7.1.2.4 Transport 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

7.1.2.5 On-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

7.1.3 Relations Towards and Between the Sub-domains

ARKTRANS defines a set of roles defined by multimodal terms, see Section 7.3, 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.

7.2 FREIGHTWISE Contributions

When starting the process of adapting the ARKTRANS framework to the FRIGHTWISE requirements, it turned out that a number of changes nedded to be made in order to satisfy the FREEIGHTWISE need for simplicity.

One example on the need for simplification is that in Figure 9, there is a distinction between Terminal Management and Transport Service Management. From a logical viewpoint, this distinction is artificial. Services offered by terminals are just one type of transport service performed with special equipment and not vehicles. Hence, the Terminal management domain was merged with Transport Service Management.

Development work in both Freightwise and MarNIS, as well as the ongoing development in ARKTRANS, led to a common reference model, coveringthe whole transport sector, and highlighted for the needs fof Freightwise, as showed in next figure.

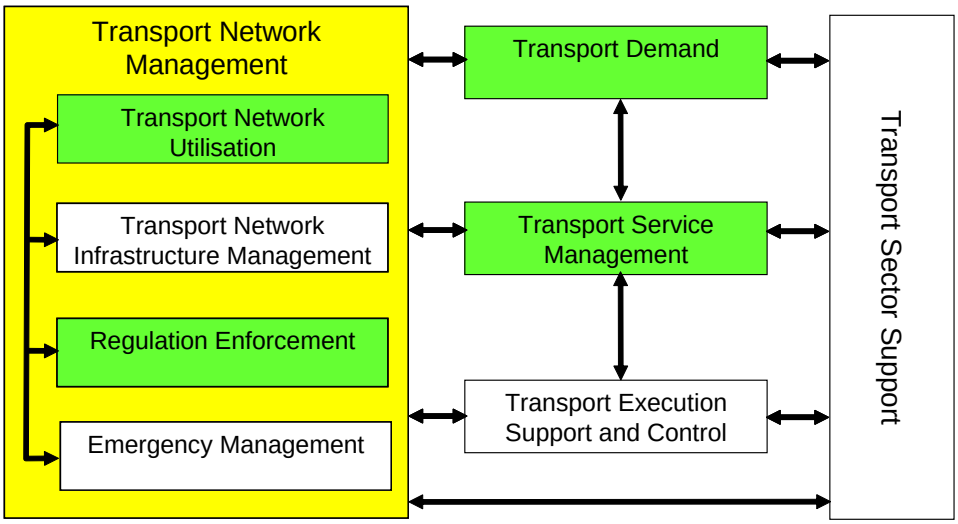

Figure 10 the FWF reference model

The focus in FREIGHTWISE is the *multimodal transport chain* as seen from the transport user's point of view. The transport user needs information about all the possible transport services that can be used to build a complete transport chain. If the choices to be made by the transport user shall be based upon the qualities of the transport services themselves, and not by which transport mode is used, the description of the transport services, and the distribution of information about the services must be simple and common.

The reference model must support this simple and common approach to transport services and information about transport services. This simplification must however be understood within the actual complexity in the freight transport sector. The reference model shows the complete picture of the freight transport sector, but focuses on the sub-domains actual for FREIGHTWISE. These sub-domain are green in the FREIGHTWISE reference model, and the sub-domains are Transport Demand and Transport Service Management. From the Transport Infrastructure Management, Terminal Management, Transport Infrastructure Utilisation Management and Transport Network Management are picked out as important for FREIGHTWISE. From the sub-doman Transport Regulation and Support, Regulation Enforcement is picked out as important for FREIGHTWISE.

Comment [JTP2]: Her må vi inn med forklaringen på de endringer vi har gjort og så gjøre en oppdatert beskrivelse av hvert domene, på linje med det som er indikert ovenfor.

7.3 Roles

7.3.1 Introduction

In the reference model each responsibility domain and its sub-domains provide a top level view upon the architecture description. A role belongs to just one sub-domain or sub-area and represents all stakeholders with the same set of responsibilities. Thus, the 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 Transport Service Provider instead of the name of the transport company.

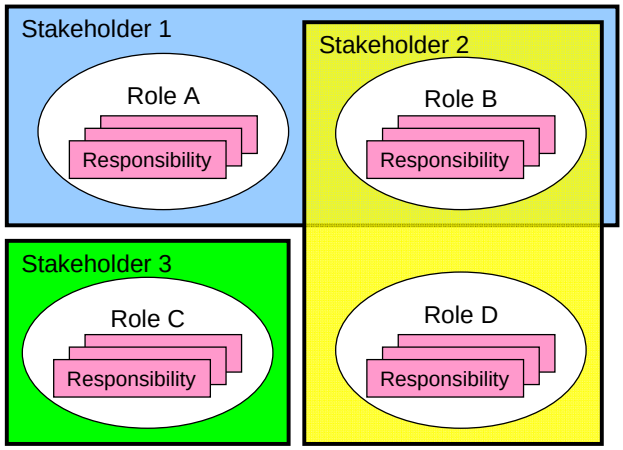

Figure 11 - Stakeholders – Roles – Responsibilities

The roles are related to the stakeholders via the responsibilities. A stakeholder can have one or more roles. One role can also be shared by more stakeholders.

Some important principals taken are:
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.
A role belongs to just one responsibility domain or sub-domain in the reference model.
Stakeholders can fulfil one or more roles.
Stakeholders with identical responsibilities will implement the same set of roles.

The role also ensures flexibility and simplicity and enables the establishment of a generic framework architecture:
Stakeholders that implement multiple roles can be handled by focusing on each role separately. A forwarder may, for example, be a Transport User who books transport services. The same forwarder may also "play" the Transport Service Provider role if the forwarder receives transports bookings from a Transport User.
Roles support dynamic changes and organisational structure diversities. They are independent of organisational issues and will persist through organisational changes (stakeholders may change, differences in different countries, etc.).
Roles support changing level of automation. A role may for example be implemented by human beings, systems of by both at the same time.

The roles are also valid across all the transport modes. In order to cope with multimodal complexity, the roles are valid across all the transport modes and in some cases also for both freight and personnel transport.

7.3.2 The ARKTRANS Starting Point

Even though this paragraph repeats some of the previous text, it has been included to clearly specify the "state-of-the-art in ARKTRANS before the start of FREIGHTWISE.

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.

The detailed description of all roles identified n ARKTRANS may be seen in ARKTARNS version 5, which can be found at (http://www.arktrans.no/ARKTRANS_5/). The following examples illustrate the level of detail and “complexity” in the ARKTRANS definitions.

English		Continuously updated			
Superior roles	**Detailed roles**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Traveller	Scheduled Transport Passenger	– Passenger – Public transport traveller	– Passenger	– Passenger	– Passenger
	On-demand Transport Passenger	– Taxi passenger	–	–	–
	Crew	–	–	–	–
	Crew in Transit	–	–	–	–
	Transport Network User	– Road User – Pedestrian – Cyclist – Professional driver – Private driver	– Captain	– Train driver	– Pilot
Public Purchaser	Public Purchaser	– County Administration – Ministry of Transport and Communications[17] – The parlament og Ministry of Transport and Com. (toll stations) –	– County Administration (ferries in one county) – Ministry of Transport and Communications (ferries on classified roads – state highways) –	– County Administration – Ministry of Transport and Communications –	– County Administration – Ministry of Transport and Communications –
Transport User	Consignee	–	–	–	–
	Consignor	–	– shipper	–	–
	Traveller	–	–	–	–
	Cargo owner	–	–	–	–
	Transport Consumer	– Company – Private persons	– Company – Private persons	– Company – Private persons	– Company – Private persons

English		Continuously updated			
Superior roles	**Detailed roles**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Transport User Agent	Transport Organiser	– 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 – WEB-services – Tour operator – Transporter	– Travel agency – Forwarder ordering transport services – Postal administration – WEB-services – Tour operator – Transporter
	Importer	–	–	–	–
	Exporter	–	–	–	–
	Chamber of Commerce	–	–	–	–
	Declaration Agent	–	–	–	–
	Logistics Provider	–	–	–	–

Table 3, Table 3, and Table 4 show how the roles related to the Transport Demand, Transport Service Management, and Terminal Management (ref Figure 9) domains were documented in ARKTRANS at the start of FREIGHTWISE.

Table 2 Roles related to Transport Demand

English		Continuously updated			
Superior roles	**Detailed roles**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Traveller	Scheduled Transport Passenger	– Passenger – Public transport traveller	– Passenger	– Passenger	– Passenger
	On-demand Transport Passenger	– Taxi passenger	–	–	–
	Crew	–	–	–	–
	Crew in Transit	–	–	–	–
	Transport Network User	– Road User – Pedestrian – Cyclist – Professional driver – Private driver	– Captain	– Train driver	– Pilot
Public Purchaser	Public Purchaser	– County Administration – Ministry of Transport and Communications[17] – The parlament og Ministry of Transport and Com. (toll stations) –	– County Administration (ferries in one county) – Ministry of Transport and Communications (ferries on classified roads – state highways) –	– County Administration – Ministry of Transport and Communications –	– County Administration – Ministry of Transport and Communications –
Transport User	Consignee	–	–	–	–
	Consignor	–	– shipper	–	–
	Traveller	–	–	–	–
	Cargo owner	–	–	–	–
	Transport Consumer	– Company – Private persons	– Company – Private persons	– Company – Private persons	– Company – Private persons

English		Continuously updated			
Superior roles	**Detailed roles**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Transport User Agent	Transport Organiser	– 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 – WEB-services – Tour operator – Transporter	– Travel agency – Forwarder ordering transport services – Postal administration – WEB-services – Tour operator – Transporter
	Importer	–	–	–	–
	Exporter	–	–	–	–
	Chamber of Commerce	–	–	–	–
	Declaration Agent	–	–	–	–
	Logistics Provider	–	–	–	–

Table 3 Roles related to Transport Service Management

English		Continuously updated			
Superior roles	**Detailed roles**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Transporter	Freight Carrier	– Forwarder accepting orders – Forwarder managing several Transporters – Taxi company – Bus company – Road transport company – Parcel carrier – Postal service – Transport service centre	– Forwarder accepting orders – Forwarder managing several Transporters – Ship owner/operator – Trampline – non-scheduled services – Freight liner services – Ferry company	– Forwarder accepting orders – Forwarder managing several Transporters – Rail passenger services – Rail freight services – Linx – Airport Express train	– Airline company – Helicopter company –

English		Continuously updated			
Superior roles	**Detailed roles**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
	Passenger Carrier	– Taxi company – Bus company – Bus tour company – Transport service centre – Public transport company – Tramway company	– Shipowner/operator – Non-scheduled shipping services – Regular shipping services – Ferry company – Public transport company	– Railway services – Metro- and tram services – Airport Express train	– Airline company – Helicopter company – Public transport company
Fleet Manager	Fleet Operator	– Bus company – Road transport company – Taxi owner	– Ship owner/operator – Operator company	– Railway's operational centre (DROPS) – Cargonet – Airport Express train – Dispatcher	– Air traffic controller
	Fleet Management Centre	– Taxi central – Fleet management office – Traffic management office	– Shipping office	– Operators – NSBs materiellenhet – "JBVs strategisk ruteplankontor"	– Airlines' operationsl centrese
	Emergency Fleet Operator	– Emergency central – Police – Rescue organisations – Red Cross	– Norwegian Society for Sea Rescue – Police – Coast Guard – Ambulance vessel operators	– Joint Rescue Coordination Centres	– Air Ambulance – Joint Rescue Coordination Centres
Transport Means Owner	Transport Means Owner	– Taxi owner – Truck owner	–Shipowner	–	–
Transporter Agent	Handling Agent	–	– Ships agent	–	– Handler
	Authorised Reporting Agent	–	–	–	–
	???	–	–	– Vacation travel operators	–
Customer	*Transport User*	–	–	–	–
	Transport User Agent	–	–	–	–

Table 4 Roles related to Terminal Management

English		Continuously updated			
Superior roles	**Detailed roles**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
Terminal Manger		– Terminal owner –	– Port authority – Harbour master	– Rail Administration – Rail company	– Airport authority
	Terminal Security Manager	–	– Harbour master	– Rail Administration – Rail company –	– Airport authority
	Terminal Safety Manager	–	– Harbour master	– Rail Administration – Rail company –	– Airport authority
	Terminal Emergency Manager	–	– Harbour master	– Rail Administration – Rail company –	– Airport authority
	Terminal Pollution Manager	–	– Harbour master	– Rail Administration – Rail company –	– Airport authority
	Terminal Operation Manager	–	–	–	–
	Terminal Administrator	–	–	–	–
Terminal Operator		– Transporter	– Port terminal operator – Stevedore	– Terminal opertor – Transportation company – Management company	–
Terminal Actor	Terminal Worker	– Terminal operator	– Stevedore – Crane operator – Feeder Sevice	– Stevedore – Crane operator – Security services	– Airline – Airlines' operational centre
	Customs Agent	–	–	–	–
	Warehouse Provider	– Terminal authority – Shipping agent – Warehouse operator – Parking authority	– Terminal authority – Pollution Control Authority	– Terminal authority	– Terminal authority
	Supplier	– Catering company – Oil company – Warehouse provider	– Terminals – Oil companies – Marine store dealers – Warehouse provider	– Catering company – Oil company – Technical service provider – Equipment provider – Warehouse provider	– Catering company – Oil company

English		Continuously updated			
Superior roles	**Detailed roles**	**Terms used in road transport**	**Terms used in maritime transport**	**Terms used in rail transport**	**Terms used in air transport**
	Renter	– Store – Restaurant – Bank/post	– Store – Restaurant – Bank/Post	– Store – Restaurant – Bank/Post	– Store – Restaurant – Bank/Post
	Counter Staff	– Counter staff	– Counter staff	– Counter staff	– Stevedore –
	Emergency Team	–	– Fire team – Rescue team	– Train held in rediness	–
	Security Personnel	– Watchmen	– Gate control personnel – Security Personnel – Watchmen	– Watchmen	–
	Operative Quality Surveyor	–	– Inspectors	– Traffic safety manager	–
	Waste Reception Handler	–	–	–	–

7.3.3 Freightwise Development

Even though ARKTRANS facilitated the introduction of levels of abstraction, the focus of ARKTRANS, up until the start of FREIGHTWISE had been to ensure that all relevant terms and sum-roles were included in the ARKTRANS environment logically. The label “continuously updated” in the tables above supports this focus.

From this, the FREIGHTWISE team concluded the following:

- The approach taken in AKTRANS using levels of abstractions is sound and should be exploited in the FREIGHTWISE development.

- The substance in the ARKTRANS documentation provides a good basis for further refining and simplifying the concept of roles in such a way that the FREIGHTWISE may define generic roles at a higher level, with the generic definition being supported by the substance in the ARKTRANS documentation.

The process in FREIGHTWISE comprised iteration between the development of the reference model and the roles, staying true to the concept of levels of abstractions. An intermediate result of this process is presented in Figure 12.

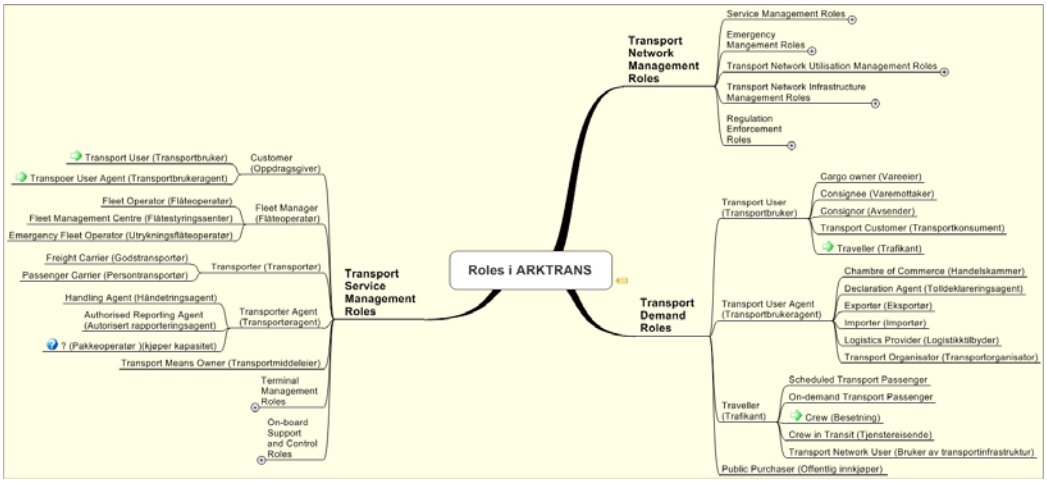

Figure 12 Roles in FREIGHTWISE on the way to conclusion

Figure 12 illustrates how the detailed roles documented in the previous tables are being “placed in the hierarchy representing the different levels of abstractions.

7.3.4 FREIGHTWISE Conclusions

The end result of this iterative process showed that there are four superior roles that are basic to freight transport; see Figure 13:

- The *Transport User* is the role of anyone that needs to have cargo transported.
- The *Transport Service Provider* is the role that ensures transport of cargo from origin to destination (in the case of handling service in a terminal and similar services, the origin and destination may be the same location). A Transport Service Provider may also be the one that is performing administrative services required for moving the cargo. Cargo inspection, when required, is such an example. Customs handling is another.
- The *Infrastructure Information Provider* is the role that extracts all information available regarding the infrastructure (static or dynamic) related to planning and executing transport and makes this information available to Transport Service Providers.

- The *Transport Controller* is the role that receives all mandatory reporting (and checks if reporting should have been made) in order to ensure that all transport services are performed within the boundaries of current rules and regulations.

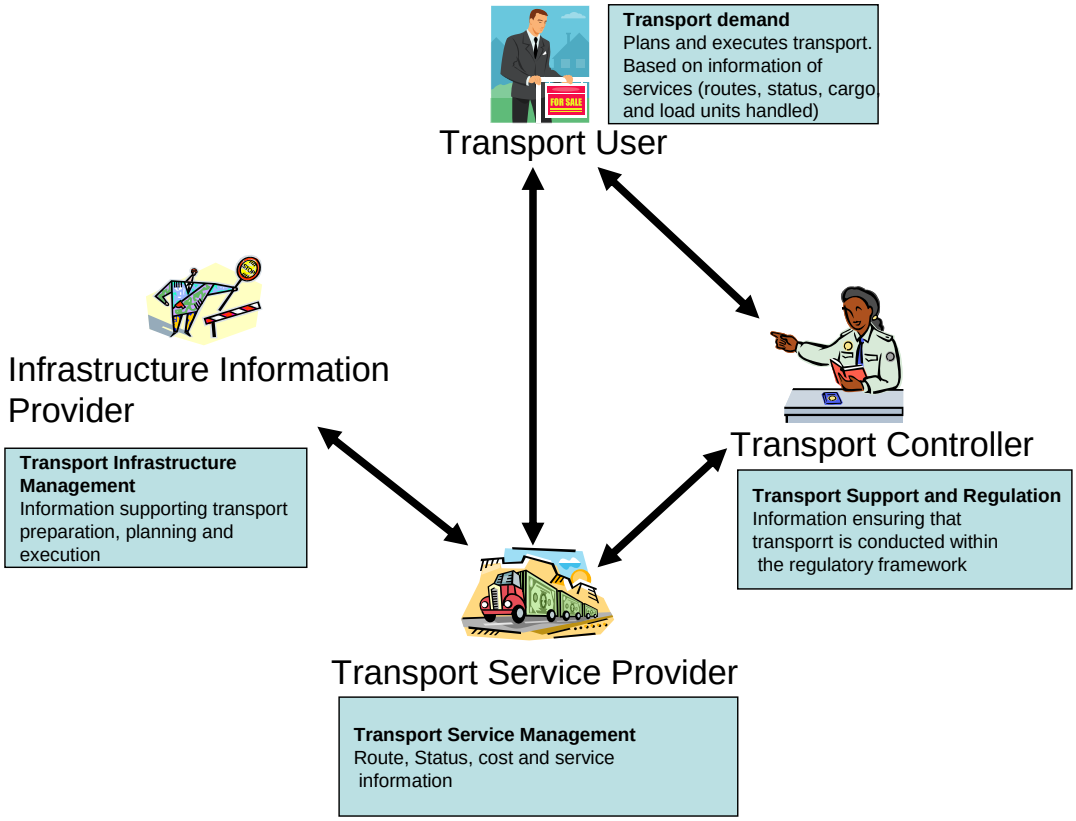

Figure 13 - Key (superior) roles in transport

The roles are further described in deliverable D13.2.

8 Logical aspects

The principals for the work on the logical level is inspired by ARKTRANS as well as by the work done in MarNIS and other relevant architect project (both EU and national projects).

The logical level of the framework architecture contains functional, informational and process viewpoint.

- The functional viewpoint describes the tasks or activities to be performed by the roles. Those activities are linked with the roles described above. To perform an activity, information may be required as input and an activity may also provide information as output.
- The information viewpoint addresses information that is exchanged between activities belonging to different roles (not information exchange between the activities belonging to the same roles as they are considered as an internal issue).
- The process viewpoint shows the information exchange between the activities belonging to the individual roles.

8.1 Functional viewpoint

For a role to accomplish its responsibilities it must execute one or more activities. In order to execute an activity intelligently, a cognitive process consisting of four steps has to be followed.

- Information is to be acquired.
- Then, the information must be put and interoperated into a wider context.
- Then, based on the situational awareness established, decisions about prospective actions must be made.
- Finally, actions can be undertaken based on the decisions and planning that has been made.

The activities are identified below. They are further described in deliverable D13.2.

8.1.1 Planning

8.1.1.1 Selecting Transport Chains

The first and crucial task in planning multimodal transport is to select the transport chain to be used. In principle, the ”only” way to do this today is to leave this selection to a freight forwarder or others that are performing the function of being a travel bureau for freight. Some of such companies may be using ICT systems for choosing, many are using their already established networks of contacts and communicate with them using e-mail, phone, fax, etc.

A prerequisite for making it possible for many transport users to select the transport chains for freight is that all the available transport chains for the intended combination of origin/destination can be easily found. In air transport, the airlines (transport service providers) have agreed that the potential gains outweighed the potential losses associated with transparency of their services and have defined all available services in the common Amadeus system. The success of this system means that all transport users or travel agencies use Amadeus for selecting among the single- or multi-leg flight alternatives defined between the given origin and destination.

In the freight transport (and passenger transport in general) information about available services is being published in the internet by the individual transport services (if at all) in formats of their own choice. Hence, there is no general transparency of services, schedules and cost.

The FREIGHTWISE project holds no illusions of copying the Amadeus solution of establishing a centralised database for all available transport services.

The alternative chosen in FREIGHTWISE is to support the setting where each transport service provider publishes information about the services in the internet. FREIGHTWISE has investigated

which information that should be published. A standard format for such publishing will be defined to arrange for recognition and retrieval of the relevant information.

8.1.1.1.1 The Selection Process

Assuming that a significant number of transport service providers have published their services in the internet using the standard specification described in Section 8.2.1, the process of selection becomes as follows (part of which may be automatic or computer assisted).

1. Find all potential services that (either directly or linked) may move the relevant cargo from origin to destination.
2. Link these services into a network of transport services.
3. Find the tentative paths through the network (chain) based on certain selection criteria for the transport in question (specified pick-up time, specified delivery time, delivery time reliability, etc).
4. Make the final selection based on a dialogue with the service providers to ensure that all conditions are cleared (including cost).

8.1.1.1.2 Finding the Alternatives

Once transport services are published in the internet using the standard specification of the services, they may be detected manually or automatically by searching through the net. FREIGHTWISE will demonstrate a simplified search, using a register of those services that are being used in the business cases. In the longer term, a more general searching mechanism will be developed (potentially using input from the area of the internet search engines).

During the search process, the services will be selected based on their ability to carry the relevant cargo or loading unit, their connectivity (that they are using the same transshipment points), and that their schedules match (within limits that should be specified).

The result of the search process is a network of services that may be connected and transport the cargo from origin to destination. A very simplified example for transport between Hamburg and Paris is shown in Figure 14. The yellow circle around Dotmund means that there are service providers that operates in the Dortmund district and therefore might specify their services to have a From-To code only from and to Dortmund. A typical example on such a service is the trucking company that only operates in a local district.

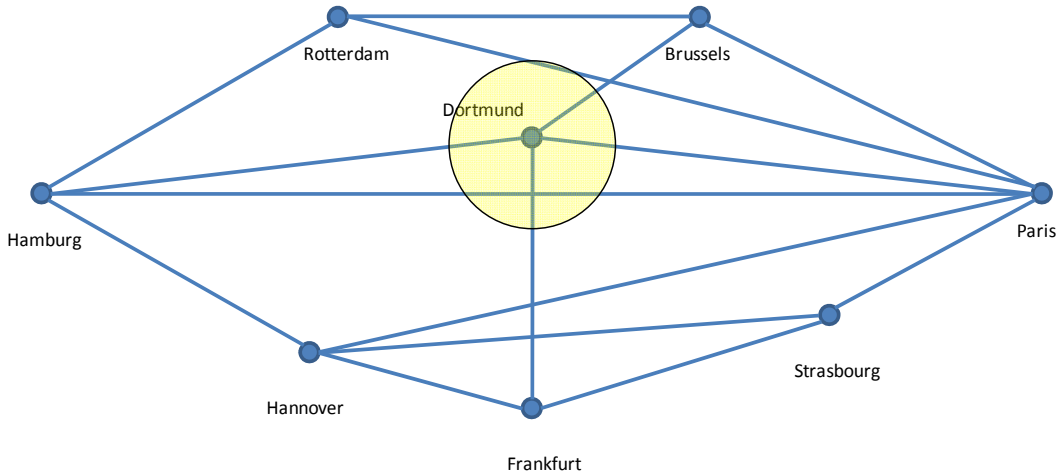

Figure 14 Simplified transport network between Hamburg and Paris for a given cargo at a given time

Finding the available network is only the staring point for making the selection. The task now is to find the ”best” path through the network. For this we need an optimisation tool. Optimisers have been used for quite some time for route planning in truck transport, also in areas where ferries with fixed time schedules are available. One such alternative is available from Spider Solutions in Norway[13].

Such solutions need to be adapted to the situation of finding the best possible path through the network (where some of the potential services have schedules associated with them), based on the information already available (cost may not be available at this time).

After the second step in the selection process (the initial phase of optimisation), the network of alternatives has been simplified; see the example in Figure 15.

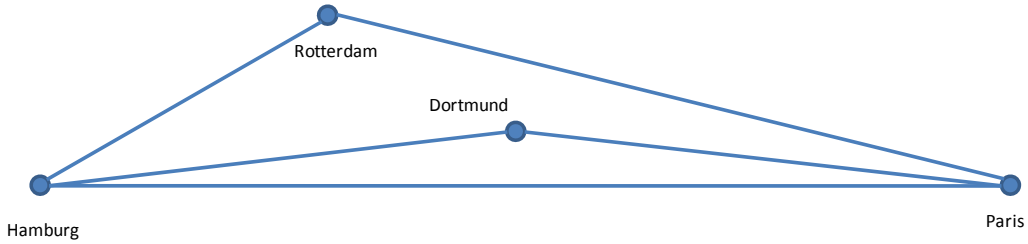

Figure 15 Result after second step in selecting transport chain

As indicated in Section 8.2.1, the transport services are described by static and negotiable (dynamic) information. Up until this point, the selection process has been made on the basis of static (and possibly previously negotiated dynamic information – price is one such example).

It may be necessary to interact with the individual service providers in order to negotiate the terms and conditions before the final decision can be made.

[13] http://www.spidersolutions.no/index.html

The negotiation takes place through exchange of information. Exchanging messages is one way to achieve this.

8.1.1.2 Organise Transport

Once the dialogue (negotiation) with the transport service provider is successfully completed (the terms and conditions are OK and the space is reserved), the final organisation of the transport can take place through the firm booking of the services (establishing binding agreements between transport user and transport service providers.

This is also a dialogue which uses the message(s) for booking and booking confirmation.

8.1.2 Transport Execution

8.1.2.1 Issuing Transport Instructions

The dialogue between the Transport User and the Transport Service provider continues throughout the execution of the transport. This part of the dialogue is initiated by the issue of the ”Transport Instruction”. This is information relating to goods being loaded. The information is sent to the Transport Service Provider(s).

The content of this information should satisfy the need of the Transport Service Provider(s) (some of which may be administrative only, like the customs). This information will also be used as the basis for reporting about the transport to the authorities (dangerous cargo reporting is one example).

8.1.2.2 Monitoring Transport

Throughout the transport execution, the dialogue continues through the exchange of status information. This information is sent form the Transport Service provider(s) to the Transport User either regularly, upon request, or if deviations occur.

Should deviations not be acceptable by the Transport User, the transport planning process need to be repeated, after cancelling the current plans (and bookings).

When the transport reaches its destination, the Transport Service Provider issues a ”proof of delivery”.

8.1.3 Transport Completion

8.1.3.1 Managing Payments

To complete the transactions related to the transport operations, invoices and payments need to be exchanged. Hence the dialogue between the Transport User and the Transport Service Provider continues until the payment is completed.

8.1.3.2 Handling Claims

It may happen that the transport is not being performed as planned, and that the cargo is damaged. In this case, a claims procedure is required. This includes documenting the “incident” and informing the appropriate parties about it, plus a procedure for handling it.

8.2 Information viewpoint

The exchange of information is essential for coordinated actions between roles to perform activities. Therefore, the information flows have to be defined as well as other aspects such as ownership (responsibility for validity and quality) of the information elements.

The FREIGHTWISE project will specify *a standard transport service* which contains the static information needed published a transport service. Secondly FREIGHTWISE will specify a set of standard messages which contain *dynamic* negotiable information to be exchanged between the involved stakeholders.

The FREIGHTWISE project will also specify a set of messages common to multimodal transport.

8.2.1 Standard Specification of Transport Services

Since there is no common database for freight transport services, all transport service providers that want to visualise their services to a large group of potential clients should publish information about their services in a standardised format, making it easier to find the information automatically.

The transport service contains only static information, which deals with the origin and the destination for the service, the type of cargo that can be transported, etc. This is information that is fixed in relation to the service and cannot be "negotiated" between the transport user and the transport service provider.

The dynamic information is not suited for general publications, and is not included in the standard specification of transport services. The dynamic information will be exchanged in step 4 in the process described in Section 8.1.1.1.1. The FREIGHTWISE project will also deal with dynamic information in the form of mode independent messages.

Before looking at the static attributes, it is important to note that not only the services that actually move or handle goods need to be described (published). Also those services that influence the movement of goods (customs, inspections, etc) need to be described so that they may be included in the transport chain, if needed.

The static attributes that so far have been identified for proper description of the transport services are (this will be further processed and documented in deliverable D13.2):

- The *route*
  - *The start location* - or the origin - for the transport service.
  - *The end location* - or the destination for the transport service.
  - The *duration/schedule* – which indicates the time it will take to complete the service (whether it is a non-scheduled service that can take place when needed or a scheduled service (liner service in shipping) with pre-defined schedule between origin and destination*)*
- The *service category* – which may indicate the mode of transport to be used or to indicate that this is a supporting service in the form of customs handling, inspection, etc.
- The *cargo type*
- The *load unit type* – specifying, if the service supports containers, pallets, cartons or any other load unit type.
- The *service owner*
- The *price*

The completeness of these attributes will be tested in the FREIGHTWISE business cases that cover a geographic area indicated in Figure 17 . The cases cover a multitude of mode combination and cargo types.

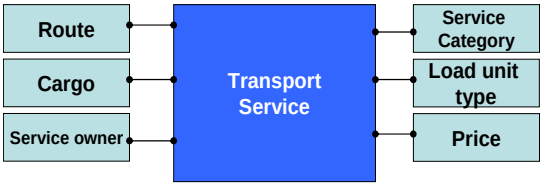

Figure 16 Static attributes of transport (and related) services

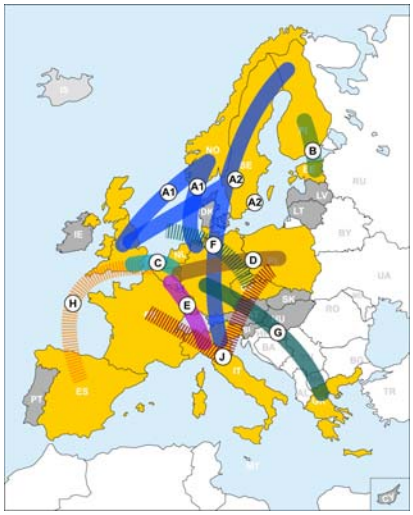

Figure 17 Geographical coverage of the FREIGHTWISE business cases

8.2.2 Messages

The architecture must also consider messages to be used in the three defined phases; planning, execution and complete. Those messages will be dynamic and contain information about the booking process, the status reporting process, as well as the finalisation of the transport. The FREIGHTWISE approach is to compose those messages by means of generic information objects which define the relevant information building blocks.

A message being input to or output from a task is defined by means of:

- A unique information flow name (message name)
- Definition of the information content by means of information objects

The UN EDIFACT[14] standard is a commendable initiative to try to standardise formats for the information exchange. However, EDIFACT is not a proper standard, since it leaves many information fields open for individual interpretation. As a result, in transport, a variety of EDIFACT "dialects" have been developed. An example is that booking for land transport uses the IFTMMP or IFTMBF messages, while waterborne transport uses COPRAR for the same purpose. Both messages transmits the same information, but in different formats.

Furthermore, even companies that are both using the "same" messages need to harmonise these in order to communicate properly. This is too costly and limits the use of multimodal alternatives, particularly among SMEs.

8.2.3 Information objects

Information object may consist of
One or more information objects
These may be common to more information flows (a variety of structures may used)
The content of the information objects
- Other information objects (in case of composed information elements)
- Codes and information content

Other aspects of the information elements
- Level of detail
- Quality (timeliness, accuracy, etc.)
- Ownership
- Legality and authorisation to send such information
- Etc.

[14] EDIFACT - the international EDI standard developed under the United Nations. "United Nations/Electronic Data Interchange For Administration, Commerce, and Transport".

The information flows and information elements (i.e. the messages) are identified and described in deliverable D13.2.

8.2.3.1 Locations

In order for two services to be connected efficiently, the end location for one service needs to be the start location of another. In order to simplify communication (and to make it possible to link transport services automatically), relevant locations need to be uniquely identified precisely enough to facilitate that when one service has delivered the cargo at the specified destination, the next service easily can pick it up, and, at the same time, make the solution practical. Relevant locations in this case are the transshipment points for goods (port terminals, logistics centres, etc).

There is no general concept of a location that facilitates this. As a consequence, all developers of systems for multimodal freight transport management are handling this in different ways. As an example, in the multimodal planner developed in the project ECO4LOG[vi] an internal list of transshipment points was established by those operating the tool. This is an approach, however, not general enough for the FREIGHTWISE purpose and will violate the concept of letting each individual service provider to maintain the description of the transport service.

Hence, FREIGHTWISE needs to develop a practical definition of location that can ensure efficient transhipment between services in freight transport.

One possible inspiration may come from rail transport, where each rail station is identified through a unique numbering system. Another possible inspiration is the airports, where all of them have been given a unique airport code.

The solution proposed by FREIGHTWISE is to establish a global register of transshipment points (TP-reg).

The TP-reg is not meant to be discriminative in any shape or form. All transshipment points that are asking to be registered will be registered. The one prime ambition is to associate one, unique code name to each transshipment point.

In addition to the unique code name, the register also needs to provide references to existing names for the transshipment points (e.g. rail stations), such that those who know the existing code names may use these for fining the new, globally unique name provided by the register.

A similar initiative was taken in the Norwegian project MultiRIT[vii] (developing a multimodal route planner for passenger transport) for defining transshipment points (stops) for the passengers. The diagram in Figure 18 is an extract form of the data model for a passenger stop in MultiRIT, and it can be used as a starting point for developing similar capabilities in FREIGHTWISE.

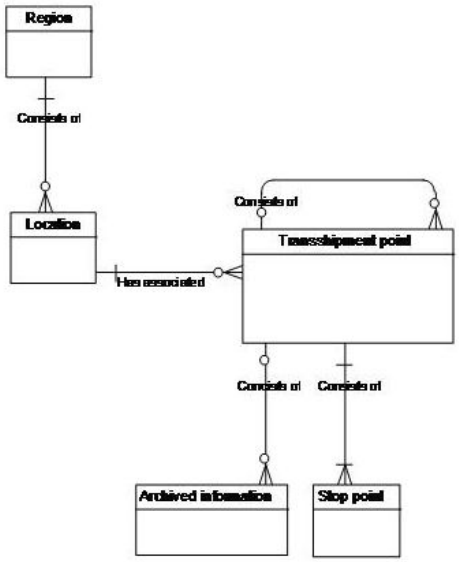

Figure 18 Transhipment point identification extracted from MultiRIT

8.2.3.2 Cargo and Loading Unit Terminology

Another area where precision is needed for efficient search of available transport services is related to describing the cargo and the loading units in which the cargo may be transported.

FREIGHTWISE will make recommendation of such a terminology based on available standards.

These standards will not include the level of Retail Unit, but will concentrate on:

- Trade Unit (Carton) and
- Logistical Unit (pallets and boxes)

These units are reflected in bar code and other identification systems.

8.3 Process viewpoint

A process is defined as a collaboration of roles to achieve one or more goals. A process emerges when different roles at the activity level start using and providing information from and to each other.

A process description defines the relation between activities and the exchange of information between the tasks. The processes are described by means of UML activity diagrams in swim lanes as shown by the example in Figure 20 - Activity diagram showing information flows between different roles. Each swim lane (or column) represents a role. UML notations are used to define the processes:

- The activities are represented by the rounded rectangles.
- The arrows between the activities *within one swim lane* represent the control flows between the activities and show the sequence in which the activities are executed.
- The arrows between the activities *in different swim lanes* represent the flow of information objects (information flows).
- There is *no* depiction of the information flows within one single swim lane (between the activities of one single role). Just the information flows to and from other roles (i.e. other swim lanes) are depicted.
    - We assume that all information possessed by the associated role is available to all activities of the role, i.e. all activities (belonging to this role) within the same swim lane. This includes information established at process initiation as well as updates to this information and new information established throughout the process.

- Additional notations can be used to express the details regarding the process execution and control flow, e.g. conditional executions and time dependencies.
  - Processes are split into parallel branches by means of the fork symbol (line with one control flow in and more than one out).
  - Parallel executions are synchronized by means of the join symbol (line with more than one control flow in and equal or less control flows out).
  - Decisions can be depicted by means of the diamond symbol. However, the decision step in the task control cycle may also be used for this purpose. In general decisions that influence on the process flow should be illustrated by means of the diamond symbol. In addition, such decision may also be described as a part of the control cycle of the task prior to the diamond symbol.

In order to specify the interactions between these superior roles, a set of generic business processes need to be established; see Figure 19.

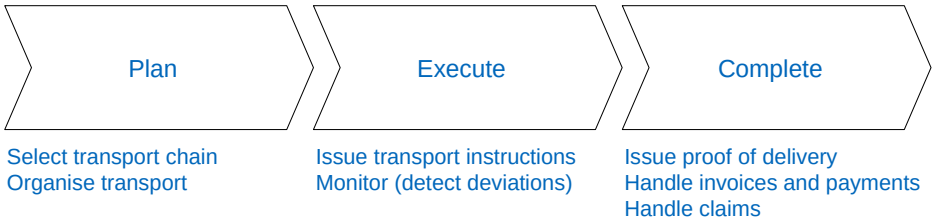

Figure 19 FREIGHTWISE generic business processes

. These business processes will have to cover:

- *Plan transport* – this includes investigating which transport (and related) services are available and can be connected into transport chains satisfying the needs of the transport users.
  When the best chain alternative has been identified, preliminary bookings are being sent to the relevant transport service providers to verify that there is space available and that other conditions can be met. Should there be a problem in reserving space throughout the chain, another needs to be identified, and another set of preliminary bookings are being issued.
  During planning, information about infrastructure may be used
  When the dialogues between the transport user and the transport service provider(s) that are initiated by the preliminary bookings have been concluded positively, firm bookings are issued (if required) to firm up the business arrangements and schedules, etc.
- *Execute Transport* – follows when transport has been successfully organised.
  This includes issuing the instructions to the transport service providers and sending the information to the Transport Controller about the cargo to be transported (if required).
  Once transport is in motion, its status is monitored, to ensure that agreements between sender and receiver etc. are being honoured. Should anything go wrong, the necessary corrective actions need to be taken, unless early warnings are given so that the preventive actions are possible.
- *Complete Transport* – which, in addition to issuing a proof of delivery, also deals with invoicing and payment between the transport users and the transport service providers. Should cargo have been damaged or should there be any other anomaly, handling of the claims also needs to be handled as part of this business process.

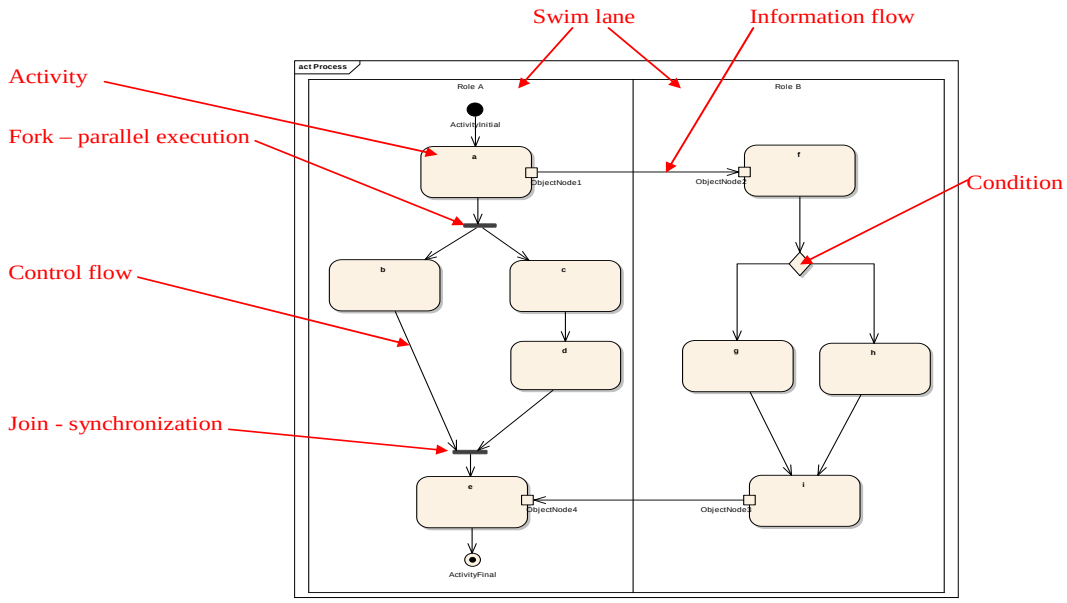

Figure 20 - Activity diagram showing information flows between different roles

Describing a process requires detailed knowledge about activities, information requirements and (time related) dependencies between tasks.

The processes are described on a high level to enable generalisation and independency from local procedures. However, these process descriptions may be used as a template for harmonisation and local customisation.

The processes are identified and described in deliverable D13.2.

9 Technical aspects

The technical realisation of the interactions identified and specified in Chapter 8 are to be specified.
The best suitable technology will be used (e.g. Web-services).

10 Related work

10.1 Use of existing architectures

The work on the FREIGHTWISE framework architecture did not start from scratch. Existing architectures were assessed against the requirements to the FREIGHTWISE architecture. The following architectures were considered:
KAREN/FRAME – framework architecture for road transport
The US National Architecture
ARKTRANS – multimodal[15] framework architecture for transport
THEMIS – European Thematic Network on freight transport (in particular the FFF)

It was decided to build on ARKTRANS (see 5.5). This section describes the background for this decision.

10.1.1 Reference model vs. functional areas

KAREN as well as the US National Architecture organise the architecture according to functional areas reflecting key functionality within the transport domain. Functionality supporting one type of operation is specified in the same functional area and may encompass functionality used by a variety of roles. One role may have to relate to more than one functional area.

An amalgamation of functionality supporting several roles into one functional area may be favourable in an architecture addressing one transport mode, as all affected stakeholders belong to the same "transport community". The approach may promote an understanding of operations or processes, as all relevant functionality is grouped together. However, multimodality puts specific challenges to the approach. An organisation into functional areas that relate to a large number of roles and stakeholders from different "transport communities" is probably not the best strategy as the stakeholders have to collaborate and communicate to be able to contribute to the establishment of the architecture.

[15] Common to all transport modes

Stakeholders from different transport modes indeed have to be confronted with each other, but these should preferably be stakeholders with similar roles. Thus, a role-centric organisation like the one represented by the sub-domains of the ARKTRANS reference model is required.

To cope with the complexity introduced by multimodality, an abstraction of the transport domain that provides simplicity and tidiness is a necessity. The overall picture of the transport domain must be easy to understand and remember during the work on the architecture, and it must be easy for the stakeholders to relate issues to a common picture of the domain. The ARKTRANS reference model provides such a simple depiction of the transport domain. Each sub-domain relates to a limited set of multimodal roles, and each role relates to just one sub-domain. The five sub-domains and the relations between them are ordered in a simple pattern, and our experience is that the stakeholders are able to remember and understand the model. It is also quite easy for the stakeholders to map their activities, projects and products into the model, and the reference model is used as a point of reference during the work.

It has been confirmed that the reference model benefits user involvement. During the work on ARKTRANS, work groups are composed according to the reference model, with one work group for each sub-domains, and participants from all transport modes within each group. Due to the role-centric organisation, the number of roles possessed by the stakeholders within each work group is limited, and the stakeholders have been able to discuss and to see similarities between the transport modes, and the complexity caused by multimodality can be managed. In the same way, freight and passenger transport are harmonised within the sub-domains by stakeholders possessing related roles. The relations towards stakeholders possessing other roles, which in a multimodal approach may be quite many, are managed by interfaces between the sub-domains of the reference model.
The work process aspect is handled by the process view in which scenarios embrace several sub-domains. The reference model also simplifies this work as the stakeholders have a common depiction of the transport domain in their minds during the work.

10.1.2 Multimodality vs. modal architectures

Multimodality can be achieved at different levels. The transport modes may have common concepts, common logical specification, and common technical solutions. ARKTRANS provides conceptually and logically harmonisation across all transport modes for the whole transport domain. Thus ARKTRANS is multimodal. A technical harmonisation across the is however just required for parts of the transport domain to enable interoperability. In the reference model such interoperability is mainly required towards the Transport Demand sub-domain. The transport user, or more correctly the systems and services that serve the transport user, should be able to interact with all transport mode in the same way.

The ARKTRANS approach is to harmonise and coordinate whatever can be harmonised and coordinated into a common, multimodal framework architecture for all transport modes (sea, road, rail, air) and for freight and personnel transport. An alternative to the ARKTRANS approach is to establish separate architectures for each transport mode and to define the interfaces between them. It is our belief that such an approach will complicate interoperability, and thus the establishment and management of optimal multimodal transport chains. The lack of common concepts and the lack of common logical specifications of functionality and interactions will probably cause problems. Many interpretations of the interfaces may occur.

10.1.3 Interoperability vs. system specification

ARKTRANS addresses interoperability and improved information exchange between ITS solutions. Openness is a prerequisite. Systems from different vendors, and systems that are owned or operated by different stakeholders, must be able to interact.

The ARKTRANS reference model divides the transport domain into sub-domains that are strictly related to different roles. These sub-domains are likely to be realised in separate ITS solutions, and ARKTRANS specifies the interactions between these ITS solutions. The information exchange between multiple ITS solutions within one sub-domain is not specified. It is impossible to predict all

possible organisations into physical systems, and thus all possible interactions. However, to some extent the information flows between and inside the sub-domains may be the same.

The realisation of the inner parts of ITS solutions is not an issue of ARKTRANS. The required functionality is indeed specified in the functional view, but the aim is not to dictate the realisation, but to establish a logical view upon required functionality by defining a multimodal terminology and the functional concepts represented by this terminology. In contrast, the functional architectures of KAREN and the US architecture specify detailed data flow diagrams that depict the information flows between all functions. KAREN/FRAME also has tools that support the specification of physical systems, but the detailed specifications of the information flows that arrange for interoperability are missing. It is up to those who adopt the architecture to specify these flows. This also counts for information flows between functions that obviously will belong to separate systems operated by stakeholders possessing different roles.

10.1.4 Summing up

ARKTRANS was motivated by the need for a multimodal architecture. To cope with the challenges caused by multimodality, the ARKTRANS approach differs from other initiatives on ITS architectures.

A far as we know, ARKTRANS is the only multimodal framework architecture. Common concepts for roles and functionality, and common information models are defined as well as interactions that enable interoperability between ITS solutions (however, the information flows for freight transport is so far not defined).

ARKTRANS is organised according to a reference model that divides the transport domain into manageable role-centric sub-domains. The reference model also visualise the needs for interoperability between the sub-domains. The reference model simplifies and accommodates the understanding of and the communication about transport issues. The stakeholders have been able to discuss and decide upon the functionality within each sub-domain as well as the interactions between the sub-domains.

ARKTRANS specifies terminal management and how the terminal interacts with the other parts of the transport domain. The terminal is crucial to efficient multimodal transport. Information exchange with the terminal and coordination of terminal operations has to be improved if multimodal transport involving sea and rail transport shall be more competitive.

Despite of the differences, it is possible to draw relations between ARKTRANS and related work. ARKTRANS was based on results from other architectural initiatives, and a mapping from the reference model to the upper levels of the other architectures can be done. It is our belief that further mappings will be possible, but the mapping is not trivial since the other architectures do not clearly define the roles related to each function. A mapping will probably require collaboration between people with detailed knowledge about the architectures.

ARKTRANS and the other architectures may supplement each other. ARKTRANS may be used to promote interoperability, and the other architectures may be used when specifying the inner parts of the ITS solutions. In FREIGHTWISE the focus is on interoperability, and thus the decision to build on ARKTRANS has been taken.

10.2 Co-operation with other projects

10.2.1 ShortSeaXML

WP 13 have a close cooperation with the ShortSeaXML based on an agreement between the project coordinators of FREIGHTWISE (Lars Källstrøm, BMT) and the ShortSeaXML project (Mariann Sundvor, NorStella, Project manager). Norske Skog, as is the owner of one of the busines cases in FreighWise,also participates in the ShortSeaXML project and plays as a coordinator between the projects where applicable.

10.2.2 D2D

EU project specifying and demonstrating work processes and message exchange. The D2D system is made up of three interoperable system components:

- A system for overall management of the transport chain, the TCMS, short for Transport Chain Management System
- A system for recording detailed information about transport activities and progress, the FTMS, short for Freight Transport Monitoring System
- A communication platform for facilitating efficient communication

10.2.3 MultiRIT

MultiRIT is a Norwegian project on multimodal travel information services in which ARKTRANS in the architectural work. In contrast to FREIGHTWISE, passenger transport is addressed. A passenger and cargo is however conceptually the same in ARKTRANS. As in FREIGHTWISE the interoperability between the stakeholders and the provision of service information is addressed. MultiRIT provides input to FREIGHTWISE both with respect to architectural description methodologies and use of ARKTRANS.

10.2.4 MarNIS

MarNIS is a European project on Pan-European solutions for maritime transport. The architecture work in MarNIS has built on ARKTRANS and COMRIS. The use of the reference model and the roles as well as the specification of activities and processes has been successful. FREIGHTWISE will use the experience gained in and the results from MarNIS.

Both MarNIS and FREIGHTWISE address different parts of the transport domain (traffic management and safety in MarNIS and transport chain management in FREIGHTWISE). Both architectures are based on ARKTRANS and provide input to the different parts of the Reference Model. Thus it should be achievable to combine the results.

In contrast to FREIGHTWISE, the terminology used in MarNIS is maritime. The knowledge gained in MarNIS will however be used in the refinement of ARKTRANS.

11 Conclusions

The reference model, roles, functional viewpoint, information viewpoint, process viewpoint and communication viewpoint provides the required aspects for the FREIGHTWISE framework architecture. Multimodality and abstractions that provides simplicity are emphasized.

In order for the FREIGHTWISE approach to be possible and practical, a number of issues need to be resolved:

- The Transport Services need to be properly specified such that they can be published by the Transport Service Providers in a unified format.
- A register needs to be established for providing unique code names to the transshipment points, and to provide referenced to other naming systems
- An unambiguous terminology needs to be established for the description of the Trade Units (cartons) and the Logistical Units (pallets and boxes), based on available standards.
- A mechanism for searching the internet for transport services needs to be developed (in the FREIGHTWISE project, this will be done as simply as possible, taking into account that the business cases only involve a limited number of services).
- A mechanism for finding the best possible path through a network of the transport services (some of which are scheduled) needs to be developed or applied.
- A limited set of standard messages needs to be developed (in cooperation with the Transport XML and ShortSea XML projects) to ensure a well defined, standard set of multi modal messages for transport. A subset of the messages will be composed by means of generic information objects which define the relevant information building blocks.

The conceptual basis for resolving these issues is in defining the architecture and the roles that are involved. ARKTRANS is a good basis for establishing this architecture, or the FREIGHTWISE Framework, which, in the future, will be termed ArcTrans.

12 Comments on the remarks from the EU-review:

Following observations was given from the commission after a document review: "Rather light - what has been developed beyond the pre-existing knowledge should be clarified"

This document version has been updated based on the comments and we would specific point out following remarks, from each of the chapters that hopefully points out the new knowledge gathered in this report.

2. Setting the scene

- Chapter 2 is used to identify pre-existing knowledge and other possible solutions suitable for an efficient and reliable exchange of information between stakeholders
- Chapter 2 should set the scene of the relationship between *traffic* and *transport*
    - In Freightwise we are not focusing on the traffic operations, but on the transport services only, realising that the transport services are depend on the traffic operations
- The new main idea is the idea of *simplification* together with interoperability
- The chapter uses the passenger transport area (the flight industry) for comparison and also to say why we cannot simply follow the development from that industry when working with freight industry
    - It is not necessary possible, or desirable, to adopt the use of a centralized register in the freight industry
- It is *very important* to point out that solutions we are working with in Freightwise shall be well suited for the smaller and medium sized freight companies

3. Requirements regarding the FW Framework

- We are identifying the needs for a new framework
- We are specifying a *multi modal* framework where the transport services from all the different transport modes are specified in exactly the same way
- The three main areas covered by FW is the demand for transport, the provision of transport services and the infrastructure and legislations opening possibilities and setting limits for the planning and execution of transport services
    - The new approach in FW is that the three areas are linked together by the FWF, and only the FWF

4. Background

(Check that the document is "one")

5. Methodology used

- The main new development in the method of working is that ARKTRANS for the first time is used from the start of the work with information modelling in the freight transport sector

6. Architecture content

- The new thing is not that a framework, such as FWF, consists of overall and logical concepts
- The new thing in Freightwise is that for the first time the freight transport business is described by means of such a framework, consisting of overall and logical concepts

7. Overall concepts

- Development work in both Freightwise and MarNIS, as well as the ongoing development in ARKTRANS, led to a common reference model, covering the whole transport sector, and highlighted for the needs of Freightwise
- Based on the identified actors in previous projects, a questionnaire among the Freightwise business cases, and compared with the set of generic roles in ARKTRANS we managed to define four overall roles in the FWF
- The role of the *transport chain manager* was excluded from Freightwise

- The work with the FWF was concentrated on individual point to point services
    - Handling the functional complexity of transport chain management is left as an internal issue inside organisations
    - A real life transport manager is playing two roles in Freightwise; as a Transport User and as a Transport Service Provider

8. Logical aspects

- The functional viewpoint
    - The identified and specified processes was grouped in to three different phases; planning, execution and completion:
        - The FWF has stressed the importance of presenting information and services in a standardised way
- Information viewpoint
    - The need to simply and to reduce the number of "messages" led to a radical shift in the organisation of information
        - No existing messages were used as building blocks, but information elements from existing messages were used
    - Identified groups of information objects were organised as information packages
- Process viewpoint
    - The activity diagrams developed in Freightwise show generic interactions between the roles leaving the practical implementation outside the FWF
        - E.g. a booking process in real can have one or many steps but in the FWF the information is exchanged only once at the logical level

9. Technical aspects

No specific

10. Use of existing architectures

No specific

13 References

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