# A reference architecture for freight transport management systems

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## Background

Intelligent Transport Systems (ITS) utilise information and communication technologies (ICT) to support transportation. Traditionally the notion of ITS has been used in relation to private cars, traffic flow and road infrastructure. However there is a growing interest in including also freight transport and intermodality to the ITS notion. An indicator for the broader interest can be found when viewing the focus of the annual world congresses on ITS. The current trend is to include in ITS freight transport related issues, with a focus on systems more than on technology components (Gustafsson, 2007).
System architectures are important when different organisations are to cooperate around different information services and when different systems are to work together. Regarding the freight market, a common transport system architecture is required to overcome the problems of lacking interoperability and compatibility of systems. Widely adopted, freight transport systems architecture would allow a common approach to develop new systems and applications for freight transport, and in principle the following advantages can be reached (Giannopoulos, 2004):

- interoperability of equipment with different infrastructures;
- compatibility and consistency of information delivered to end users through different media;
- better integration and co-ordination of services;
- solutions that meet the wider needs of the community;
- greater choice for users;
- multiple use of data and infrastructure;
- reduced risks for industry by developing products against national and international standards;
- a wider (world) market offering economies of scale in production.

Also, efficient freight transport systems are cornerstones of the European economy and a prerequisite for further economic development. Freight transport is also connected to a number of negative impacts, not only the severe threat of global warming, but also issues like congestion, accessibility, safety and security have to be acknowledged and addressed. We are challenged to find solutions that respond to the demand for transports and at the same time allow a sustainable development, where possible through the optimal use of a combination of transport modes. In fact, as a result of recognising the necessity for specific measures in restricting the constant growth of road freight transport, the European Commission presented a series of initiatives directed toward ensuring effective and reliable freight transport. The measures include: make more efficient the use of the different freight transport modes (co-modality concept); facilitate the establishment of freight logistics chains (green logistics); simplifying the administrative procedures (internet for cargo); and improving the quality in the freight logistics (European commission, 2001).

One obstacle to efficient intermodal transport is the increased complexity due to the number of players and processes involved. To overcome this complexity, efficient information exchange is required. This is a challenge due to the heterogeneous nature of the players involved in the business: a transport chain can include both major companies with sophisticated information systems as well as small and medium sized players with much less developed usage of information technology. The main innovation aimed by the European Commission is the integration of already existing technologies to create new services in every transport mode (road, rail, air, water) involving the largest number of actors (European Commission, 2008). The recent ITS Action Plan of the European Commission aims to accelerate and coordinate the deployment of Intelligent Transport Systems (ITS) in road transport, including interfaces with other transport modes, and it helps combine the resources and instruments available to deliver a substantial added value for the European Union.
In this context, the FREIGHTWISE European project (European Commission, 2006-2010) in which the authors are involved, focuses on the freight transport market and the fundamental need to balance the use of the different transport modes in Europe. This requires a reference architecture to make logistics operations more cost-effective and with a more efficient use of transport resources so that intermodal transport chains are actually implementable. The economical, political and technical solutions identified are to be agreed at European level.

## Objectives

The main objective of this paper is to introduce the Freightwise Architecture as a reliable and practicable solution for the actual implementation of freight transport systems. Freightwise is building a well structured and formalised framework containing both technical and organisational aspects. It is technically focused on creating a common framework architecture that comprehensively covers all elements and processes of an intermodal transport chain, from load units and types of cargo to actors, interchanges, transport services, schedules, messages and documents.
Inspired by ARKTRANS (Sintef, 2004), the Freightwise Framework Architecture deals with the following issues:

- Roles to be performed in efficient intermodal transport chains.
- Generic business processes describing interaction between the roles.
- Mode independent mechanisms for simplified information exchange in intermodal transport.
- Establishing transport networks on the Internet.

This framework architecture is intended to serve as a reference point for transport management system development, making available generic data models, process specifications and message schemes.
The Freightwise framework architecture covers a set of common definitions and solutions which provide:

- easy message exchange between the partners in the intermodal chain;
- mechanisms for automating intermodal transport management decisions based on business rules;
- enabling technology for efficient exchange of scheduled information which can develop into automated mechanisms for establishing new chains in a network;
- integration of intermodal planning systems with the commercial environment;
- interfaces to traffic management systems for shipment planning and incident management.

A secondary objective of the paper is to show how the Freightwise architecture can be input for an European standard framework for the development and integration of ICT systems and ITS architectures in intermodal freight transport management. Standardisation is a crucial issue. In fact,

although the development of the ICT is rapidly increasing and facilitating communication on a technical level, there are a number of additional aspects which have to be addressed if the communication along the intermodal chains is to be efficient. One is the need for common definitions and a common architecture. Another is the more complex issue of rules for co-operation between the partners in the chain. The lack of common definitions, data dictionaries and architectures is well known, but there are also wider problems related to the applicability, scope, and commercial acceptance of standardisation efforts. There is a large demand for standards and open solutions that can support the information requirements for the complete management of transport chains (Källström, 2003).
Also, Freightwise aims to make the new standards coming from the project as well as new concepts and technologies applicable to the most common solutions adopted in the market (the 'real business world'). In fact, in one business case (steel shipping from Spain to other EU countries) the project is developing compliant interfaces to INTTRA, an important e-commerce solution for ocean carriers. In this way Freightwise addresses also the deep sea shipping services. Further links are being explored worldwide, such as the possible interaction with US freight transport projects (one is for instance the 'Columbus Electronic Freight Management') focused on the Internet for Cargo concept. This with the aim to contribute to the harmonisation of systems at international level.
The implementation of a common framework and the standardisation of processes and messages allows high degree of interoperability between the systems of the organisations involved (also with authorities such as customs, coast guard and other bodies providing traffic information). The resulting architecture makes the implementation of complex intermodal transport chains practicable. It is clear that information access and communication possibilities are key elements in this context. In fact, efficiency of transport solutions requires well functioning information flows running in parallel with the physical transportation, and therefore there is a window of opportunity for creating more efficient and sustainable freight transport systems through improved interaction and information sharing. Open connections, standard data sets, harmonised databases and data framework are returning notions when discussing how to improve information exchange.

## The Freightwise Framework added value

The framework architecture is based on a close interaction between theory and practice. It has drawn as much as possible on successful domain models, message repositories and standards, some of which have been developed and implemented in previous EU-funded projects. Examples are the TRIM data model and the Transport Chain Management System (TCMS) that were developed within the INFOLOG and D2D projects, or the Freight Functional Framework (FFF) that was developed in the context of the THEMIS project.
Many ITS architectures have been defined, such as SESAR for air transport, RIS for inland waterways, European Rail Traffic Management System (ERTMS) and Telematics Applications for Freight (TAF-TSI) for railways. Shipping has also introduced SafeSeaNet and Vessel Traffic Monitoring and Information Systems (VTMIS) and is progressing towards an Automatic Identification System (AIS) and Long-Range Identification and Tracking (LRIT). However, until now there has been no similar coherent European framework for interconnection between road and the other transport modes. The role of Freightwise is to provide this architectural framework to make intermodality accessible and usable. In this sense,, it aims to provide an European architecture applicable to the real business world using common technologies and efficient standards, and providing interfaces to companies' legacy systems in order to also allow the implementation of ITS architectures on a large scale.
To achieve this, Freightwise follows a very definite hands-on philosophy by engaging a wide range of commercial and institutional/public stakeholders in the context of 9 business clusters and case demonstrations. Grounding the work in business cases helps assess the utility of existing architecture building blocks, prepare their harmonisation and validate technical implementation

activities.

The project will end on April 2010 and will result in a tool that allows Transport Users to search among the transport services published in a standard format by the Transport Service Providers, and to combine them into transport chains. This produces higher accessibility to information and enlarge the companies' business opportunities as well as it creates more effective transport chains (both quantitatively and qualitatively such as reliability of the information flows, lower delays etc). The involvement of entities such as Transport Regulators and Traffic Managers permits a more efficient control of the cargo through the use of standardised messages (the Information Packages).
Moreover, such improvement of the information access makes it possible to create a freight market booking system that partially reproduces the current air transport for passengers. At the moment, the proposed ICT architecture is based on the P2P technology. The network must permit the centralised functions of publishing and searching transport services over the internet while a software will be provided to the actors to make their legacy and proprietary systems interoperable. Such an architecture wants to represent a standard for freight transport in Europe and it aims to make the implementation of intermodal transport chains more effective and easier.
If FWF becomes a standard, the availability of interoperable software solutions will be significantly improved, and so will the competitiveness of intermodal transport. As a result, European industries will be able to reduce costs and become more competitive, and at the same time develop more environmentally friendly solutions by promoting the integration of rail transport into competitive intermodal chains. That way Freightwise can facilitate an increase in rail transport and generate new business opportunities for rail transport companies in Europe.

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