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TM 2.0 DATEX II for logistics application

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Abstract

The purpose of this paper is to demonstrate the development and implementation of DATEX II for logistics operations. For this purpose, an approach based on data model development is presented for the Port of Trieste, and integration in the DATEX II main model is also examined. The objectives of this work are to engage logistics companies into electronic data interchange, to accelerate the information system development processes as well as to decrease costs of information system integration by adopting a common international recommendation for information exchange. It is expected that the use of universal message standards will eliminate the need of logistics companies to create their own specifications leading to greater efficiency of logistics operations, across transport modes.

Keywords: Traffic Management, UBL, DATEX II, logistics

Introduction

The ERTICO Innovation Platform on interactive traffic management, TM 2.0 [2] was launched at the ITS Europe Congress in Helsinki in 2014. It groups together traffic management stakeholders, such as OEMs, Traffic Information Service Providers, Road Infrastructure providers, Public authorities and Road Operators for cities and regions in Europe responsible for the management of urban as well as interurban traffic, ITS research centres and road-network users associations. The TM 2.0 concept focuses on enabling vehicle interaction with traffic management plans and procedures. By bringing together traffic management stakeholders and other related “enablers”, the TM 2.0 Platform aims to pave the way for the TM 2.0 concept to be implemented in various cities and regions around Europe leading to a win-win situation for all actors. By issuing a series of recommendations, the TM 2.0 Platform serves as a catalyst that accelerates the current traffic management- related activities by both the Industry and the public authorities, towards providing innovative Traffic Management practices.

The 26 members of the TM 2.0 Platform believe in the cooperation among traffic stakeholders and in the adoption of architecture for traffic management to be deployed to the specific region or city in focus. Individualities are important when one aims for functional- tailor-made traffic management. The main issues being tackled by the Task forces of the Platform are the number of minimum datasets required for providing TM 2.0 services to drivers and traffic management centers, as well as the reliability and quality of data. The TM 2.0 Platform members are in the process of agreeing common interfaces which can facilitate the exchange of data and information between the road vehicles and the traffic management centres. This interaction leads to improving the total value chain for consistent traffic management and mobility services as well as avoiding conflicting guidance information on the road and in the vehicles themselves.

Ideally, information about how, when and where people and freight plan to travel or are travelling will form part of the data exchanged between (Traffic Management Centres) TMCs and (Service Providers) SPs, so that the (re)routing options offered to the travellers can meet both the aforementioned TM 2.0 objectives as well as the individual traveller's needs. This concept of evolved traffic management, opens new business opportunities for all the stakeholders involved along with new forms of synergies from the organisational point of view. Extending the approach to link the hinterland transport opens up new horizons for additional stakeholders such as ports to be part of the urban planning of the city and also to involve them more actively in the decision making approach of traffic management.

The objectives of the TM 2.0 task force n links to hinterland are to:

- Analyse the possible needs for new interfaces and communication technologies, standards for next generation Traffic Management systems and links to hinterland (especially Ports)
- Identify urban and peri-urban use cases which will be relevant
- Examine relevant use cases in cooperation with DATEX II and TISA
- Analyse the value proposition, business models and governance patterns (involvement of new stakeholders including ports, in the supply chain)
- Propose a roadmap or a strategy plan for integrated port-road traffic management systems

Current scene in traffic management

Smart Infrastructure can be divided into two different categories: digital and physical smart infrastructure. It is important to distinguish between these two, as they are different in characteristics. The physical smart infrastructure consists of roads, tunnels, ports, warehouses, terminals, distribution centres and similar asset based facilities. Within the physical smart infrastructure context, smart vehicles support a two-way information flow through the ICT systems that belong to the digital smart infrastructure category. In this way, the smart vehicle is connected at all times, providing real time information as needed. On the other hand, the smart digital infrastructure retrieves, manipulates, stores and communicates data and information between the physical smart infrastructure and the smart vehicle using different digital technologies such as sensors, cameras, databases, and positioning technologies. Overall, the smart infrastructure enables information exchange about the goods, vehicles and infrastructure.

Identification of Stakeholders

On the private entity side, several stakeholders arise that can provide traffic management data from their services and/or can benefit from using data as provided by public entities. Below, some of these

entities are presented and general service characteristics, business cases and possible benefits that could be reaped by being involved in traffic management data exchange, are also demonstrated.
The most dominant private parties involved in traffic management data exchange at this moment, are content service providers. More specifically, content service providers with high numbers of active users, have a broad and real-time data source for monitoring the status of the road infrastructure and (given the amount of trips that are pre-planned), even know where traffic is to be expected. Currently, these service providers provide their navigation based on a combination of their own monitoring and use of publicly provided open data on travel times, congestions, roadwork, etc.

Regarding the road infrastructure providers, we distinguish between public entities (Traffic and Transport authorities and administrations) and private road operators. Within the same geographic region, public entities are interacting in several forms and on several levels (with corresponding policies) and with private road operators (e.g. a toll tunnel or toll road). The complexity of traffic management when it comes to road infrastructure in a certain geographic region is that there is one common road network however, the road infrastructure providers involved all have different needs and issues to manage. For a motorway operator these include a smooth and safe traffic flow over the motorway 'pipelines'. For urban road infrastructure providers these also involve balancing flows of motor cars, trucks over the same streets and intersections in the city centre. For inter-urban road infrastructure providers, these entail the link to the hinterland transport such as ports.

For a port operator, the main objectives are to optimise port accessibility, increase safety, reduce emissions as well as develop sustainable and efficient traffic management by separating local traffic from truck traffic. Nowadays, the only way drivers can get information on port traffic, bridge use, and parking, is through the message boards posted throughout the port. Outside the port area, the truck drivers usually have very limited access to information, even with the advent of mobile devices. Standard traffic apps and internet searches cannot provide real-time information related to actions inside the port. In addition, many trucks make multiple stops at the port and to various destination cities in Europe to load and unload. The increasing truck traffic in the vicinity of the port gates can have an impact not only in terms of congestion in the vicinity of the terminal but also on the surrounding roadway network, causing congestion problems and reducing the terminal/port performance and that of the shippers' as well.

The use of innovative, IT-based traffic information systems and an integrated port traffic control center is expected to improve traffic flows and make optimum usage of the port routes. There is an opportunity to use a port-wide traffic management system that constantly records, processes and distributes transport and traffic information to all interested parties including service and content providers and also trucks drivers. "Unplanned" parking is an inevitable negative side effect in areas around airports and ports. Truck drivers are moving in long-distance trips, moving cargo from origin to a logistics destination as the (air)port logistics hub. The fleet operator is managing the fleet in real-time and access to the parking area information available in the truck route and offers the driver the best place to rest or wait before arriving to the hub. Based on adequate sample fleets GPS data from smart phones or fleet management systems can monitor standstill, travel time and time losses for the truck waiting for the required customs clearance. Such data can be used to set-up a dynamic park guidance and slot booking system for future development along with improved management of rest times required for truck drivers (deployment and business operation). In fact, some of them use an access system based on a paper ticket given at the truck entrance moment in the parking area. The same ticket is used for a manual payment at the checkout moment. In specific, no access monitoring and control is performed, as no related electronic payment systems are available. Dry-port managers can have interest in installing new monitoring systems, linked to ICT platforms able to provide new services like the electronic payment. In this way, the dry-port manager can achieve more data on truck flows, can use them to establish fares policies and, mainly, can better manage the cash flow. The customers (transport operators) will benefit of the availability of a new payment service, receiving all the payment documents electronically. The truck drivers will not be obliged to pay manually, wasting time for the checkout in queues. Finally, software developers and technology providers will find new business development opportunity in dry-ports area, adapting existing platforms to the dry-port manager IT system or developing new products.

Using the AEOLIX project platform to demonstrate the data exchange among the stakeholders

AEOLIX [3] aims to develop a digital ecosystem that will enable various actors at different levels, sizes, and with different systems and platforms or even without their own in-house systems, to better manage, (re-)plan and/or synchronise freight and logistics operations across Europe. The AEOLIX digital ecosystem will improve data visibility across the supply chain, enabling more sustainable and efficient transport of goods across Europe. The AEOLIX pan-European logistics platform is expected to reduce energy consumption, reducing greenhouse gas emissions by at least 30% compared to the current situation. The AEOLIX digital ecosystem will be tested, validated and implemented in 11 living labs representing logistics business communities across Europe (Austria, France, Germany, Greece, Italy, the Netherlands, Romania, Sweden, Spain, and the UK). The AEOLIX project connectivity engine is responsible for providing the connectivity and interoperability services and supporting seamless data exchanges between organisations and services. These technical services provide the architectural setup; (1) connecting the end-user with its many business partners and systems in their networks; (2) allows for interoperability and governance services; the information exchange between different systems; partner/ system interactions and data sharing management rules. Currently the project has been doing an extensive research on EU standards and also project results in identifying the appropriate data model for its data transformations service. An approach based on data model development was developed and demonstrated in one of the living labs - the Port of Trieste, based upon DATEX II extension to logistics.

Port of Trieste – The Challenges

Located in the heart of Europe, the Port of Trieste is an international hub for overland and sea trade with the dynamic market of Central and Eastern Europe. Within the Trieste port-city, there are many specific challenges regarding the implementation of C-ITS solutions for efficient traffic management. Below we present some challenges that relevant port stakeholders are currently facing. The main challenge for the Port Network Authority of the Eastern Adriatic Sea - Port of Trieste, is to monitor the length of the queue on the Trieste Port gates. Terminal operators on the other hand, would like to know if and when a truck to be loaded on current ship is arriving, as well as to monitor truck movements on the motorway and the queue on the Trieste Port gates. Since the parking lots in the Trieste Port are limited in number, it is important to distinguish between trucks destined for immediate embarkation and trucks waiting for a ship that has not yet arrived. In the latter case, traffic management measures have to be applied to avoid port congestion, i.e. waiting trucks should be redirected to the local dry port, Fernetti that is located approximately 20 km from the Port. Autovie Venete motorway is interested in knowing in advance flow of trucks that leave the Interport of Trieste - Fernetti and the Terminals at Trieste Port to predict possible congestions. Trieste Municipality is interested in reducing track queue waiting to enter at Trieste Port gates, also for safety reasons. The motorway congestion is also of interest for the Interport of Trieste, for planning the hour of departures of trucks. Furthermore, several cruise ships are departing /arriving in Trieste at Stazione Marittima, a Trieste Port area in the city centre. This affects vehicle movements and parking in a critical area in the Trieste city centre.

Port of Trieste – The Solution

Within the AEOLIX project, the Living Lab 4 is the Trieste port system, which includes the commercial port and the Fernetti dry-port, located at about 30 minutes by road from the port. Most of the main stakeholders in the port system are partners or associated partners or actively involved in the project: shipping agencies, Fernetti Interport, Port Authority, Highways' management company and Customs agency. All operators in the port have, by law, to manage operations and documents transmission through the Port Community System (PCS): "Sinfomar". This PCS is a very advanced platform, giving access in real time to all current updated information about ships, trains and trucks awaiting for embarking. Moreover, it gives access to information about current traffic situation in the roads from dry-port to port and on the highway leading to Trieste and allows for statistical analysis of various kinds. Within the Living Lab in AEOLIX project, the aim was to make part of the information present in the local PCS available on the AEOLIX platform. Presently, a set of scenarios and use-cases is selected and all the related information is published on the AEOLIX platform. In future a complete export of all the available information in the Trieste PCS on the AEOLIX platform is foreseen. In particular, the information shared on the platform so far deals with:

- Lists of ships arriving or departing port (with their expected time of arrival/departure).
- Trucks expected in port for embarking, which may share on the platform their expected time of

arrival (ETA) thanks to advanced services of traffic-aware routing made available in AEOLIX by PTV Group.

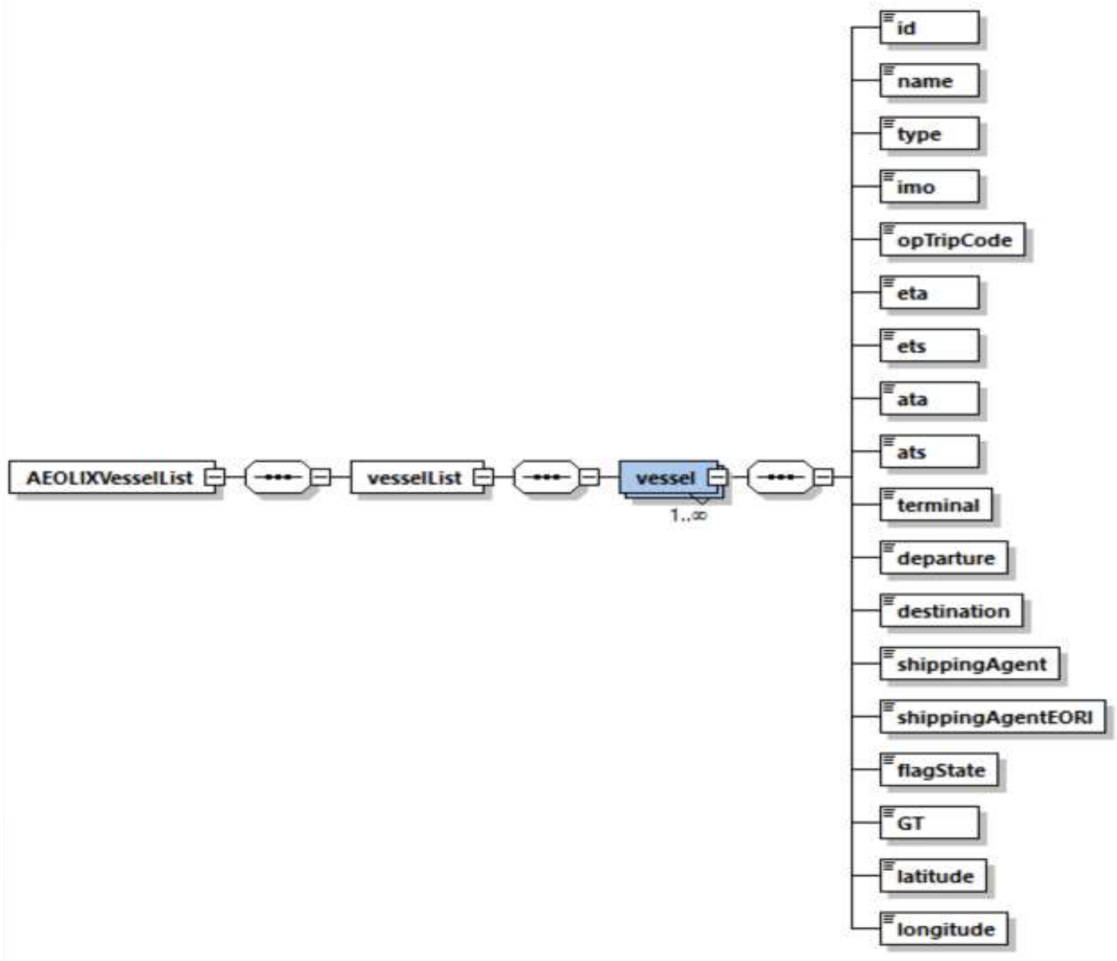

Figure 1: XML format for the Ship Arrival List at the Trieste Port.

At first, all the relevant information collected from the PCS through ad hoc web services, was simply translated into XML format and into English language, both for fields and contents. For each one of the data sets to be published on the AEOLIX platform an adequate XML schema with all the relevant information was created. An example is seen in figure 1, showing the structure for the list of next incoming vessels in port. This work of translation of data into XML format allows internationalization of the information but not yet standardization or interoperability. The AEOLIX platform comprises twelve different living labs, so an important objective is to identify standards that could allow a common data format and nomenclature for all the ports and logistics hubs involved. A first candidate standard for this task was Universal Business Language (UBL) in its version 2.1. UBL 2.1 is an open library of standard electronic XML business documents for procurement and transportation, such as purchase orders, invoices, transport logistics and waybills. It includes specifications for 65 document types. The common library of XML objects that supports them has a total of over 4000 business objects all described as XML elements. The UBL 2.1 documents and library support a range of different business processes, such as

- Procurement
- Transportation
- Intermodal freight management
- Freight status reporting
- International trade

A preliminary analysis is performed in order to verify whether UBL 2.1 is adequate to be used as a common standard for all the data exchanges in the AEOLIX platform, regarding the Trieste living lab and all the other living labs. The results of such analysis show positive elements but also some limits. UBL 2.1 is a huge effort, with documents and XML objects well capable of covering most of the needs regarding logistics. However UBL, as its name states, is a standard that covers mostly the "business" aspects, so it is mostly focused on aspects like bills, tendering, orders, quotations, catalogues. The logistics aspects are present but are somewhat "marginal", at least in its current level of development.
An example of the possibilities offered by use of UBL in the logistics field is represented by the XML objects describing "shipment" and "consignment". These refer to two different ways of looking at the same (possibly very complex) situation. "From the contractual or logical point of view, a shipment is the contractual arrangement whereby an identifiable collection of goods items is to be transported from one party (the shipper) to another party (the recipient). In UBL, the party originating the shipment is usually a supplier, and the party receiving the shipment is usually a buyer." [1] "From the physical or logistical point of view, a consignment is the transportation of an identifiable collection of goods items from one party (the consignor) to another (the consignee) via one or more modes of transport." [1] The "shipment" and "consignment" XML objects in UBL can cover a huge variety of situations. A simple fulfilment sees one contract and one transport of freight. A split fulfilment is related to one contract with separate transports of freight. An intermediary fulfilment (one shipment, many consignments) happens when a freight forwarder is involved. Finally it is possible a consolidated fulfilment where many shipments and many consignments are involved, with several freight forwarders consolidating in one transport orders for various buyers. So, for what regards logistics, the "consignment" object in UBL 2.1 is an excellent tool, as it can contain nested information regarding several sub-consignments/shipments and is capable of fully describing in a single XML object even complex situations like a ship with trucks and/or containers onboard, or a train with freight, trucks and containers.

Another object in UBL schemas of interest for logistics aspects is the TransportProgressStatus document, which includes elements like transport schedule (planned/estimated/actual departure/arrival, current location) and description of transport means. The above described UBL objects seem capable of covering most of the needs regarding a common standard for logistics, yet a deeper analysis shows there are still some important elements missing. Apart from the fact that a platform focused on logistics has probably no need to use all the huge amount of data structures encoded in UBL, the point is that UBL is focused on the processes that involve the Consignee and the Consignor and does not cover fully all the logistic processes or regulatory notifications required to physically move the goods. The descriptions for Customs declarations are barely descripted in UBL. Also, the descriptions of transport means are not sufficient for the logistic needs. As an example: the UBL description for a Road Transport only includes one field, for licence plate. In logistics much more information than this is needed, like, in case of a truck, fields for: owner company, driver, tractor license plate, trailer license plate etc. Limits as the above ones led Trieste living lab to choose not to rely exclusively on UBL 2.1 in order to map the information exchanged with the other living labs into a common standardized nomenclature with the objective of achieving interoperability.

The methodology proposed by the Trieste living lab for AEOLIX considers the data objects already defined in all the living labs of the project as the starting point for defining the new UBL 2.1 based description of logistics operations. In this vision, UBL 2.1 in mainly used as a dictionary of data fields, needed to have an harmonized description among different living labs in order to reach interoperability. In the case of Trieste living lab, we consider data structures that are typically used in logistics to manage Customs status and ETA of a vehicle, where a vehicle can be a ship, a train, a truck, etc. Interoperability must rely on well accepted and widely used standards. Sometimes, when a single standard is not sufficient to cover all the aspects of a field it is necessary to rely on more than one standard, deciding which one is more apt for the different information. In particular, the choice for another standard to be used in AEOLIX focused on DATEX II, as it is the most mature and widely accepted standard capable of describing pieces of information important for logistics but not present or not well described in UBL, such as traffic situation, congestions, road vehicle description. DATEX II has been developed to provide a standardised way of communicating and exchanging traffic information between traffic centres, service providers, traffic operators and media partners. The specification provides for a harmonised way of exchanging data across boundaries, at a system level, to enable better management of the European road network. DATEX II will play a strong role for the implementation of integrated ITS in Europe.

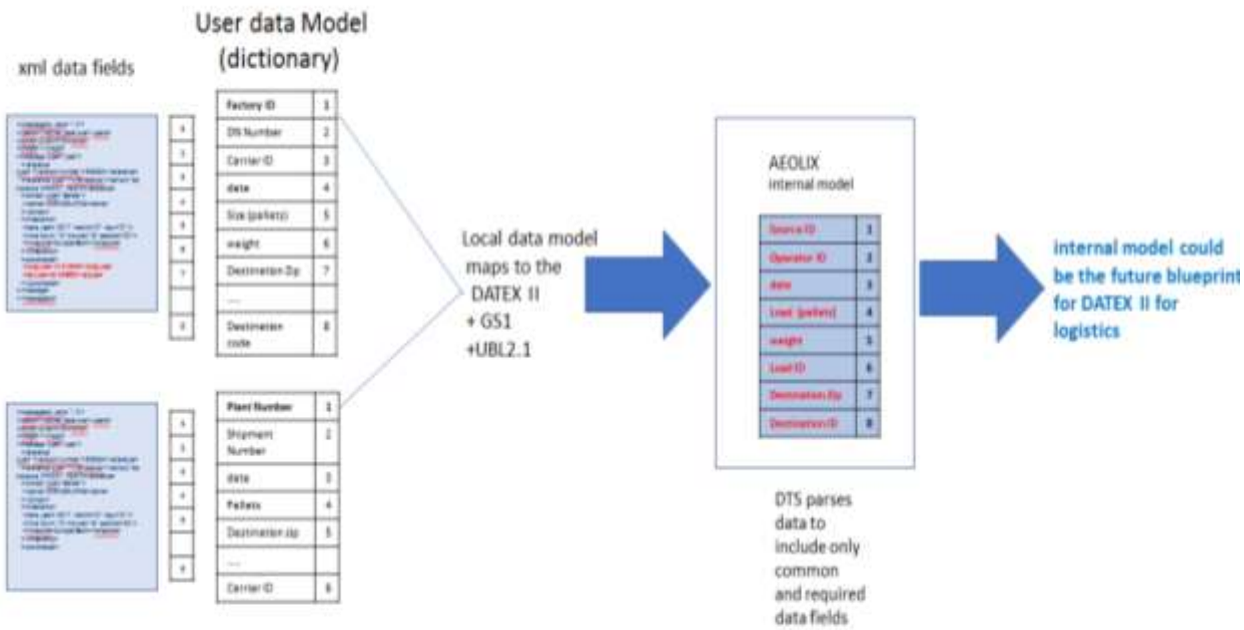

Figure 2: DATEX II for logistics mapping

Used together, deciding when it is more appropriate the use of one or the other, and possibly with AEOLIX consortium working together with the standards' developers in order to help in the evolution of their languages to this end, UBL and DATEX II have a promising chance of allowing information interoperability in the huge, complex field of logistics. DATEX offers useful information for the traffic management plan. A first mapping has achieved and is expected that the same exercise will also be done for the 11 living labs under the guidance of DATEX II community. The cities have to integrate to the standard protocol. Autovie Venete S.p.A. uses DATEX II, the Port of Trieste plan to implement DATEX II and the Commune di Trieste is interested in adopting it. The next steps are for AEOLIX and TM 2.0 to liaise and work together with DATEX II community to explore ways how this extension of DATEX II in the hinterland connections will take place. Initially, the possible needs for new interfaces, communication technologies and standards for next generation Traffic Management systems and link to hinterland (especially Ports) were analyzed.

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