Extended abstract

Objectives and motivation
In this work the authors describe the activities executed during the Modulushca project, for defining a common set of data and information, to be used in handling modular units in a structured logistic network. The inspiring principles for defining the data model have been the Canonical Data Model, an Enterprise Applications Integrations pattern and the e-Freight management of data exchange. The idea is to have a common and shared format which to translate to and from the messages to be exchanged between the participants. Moreover, the authors defined roles and access rights for the participants to the modular logistics scenario. This work covers the issues related to data exchange in order to enable ICT interoperability in the entire supply chain logistics exploiting modular containers. The M-Boxes and the data model are a possible contribution to the definition of an approach for achieving the Physical Internet (Montreil 2013, Montreil et al., 2014). The focus here will be at the operational level, of the logistics, i.e. the handling of the boxes, the shipments/consignments, the related processes and the information needed. Physical Internet consider getting products in and out of cities is a nightmare, in fact most cities are not designed and equipped for easing freight transportation, handling and storage, making the feeding of businesses and users in cities a big problem. Therefore one of the main point the initiative try to address is solving and reorganizing the supply chain network using modular containers (Montreil, 2013). The urban logistics is the last link in the supply chain and involves the major number of stakeholders: the carriers, the citizens, the public administration, public transport operators, retailers, etc. The proposed data model focuses on supporting the IT protocols for handling modular containers movements from source-to-sink, considering the handling of the M-Boxes in the operations of pick-up and drop-off and the reverse logistic for the empty boxes delivered within a business process, using a structured network, with a common carrier approach across multimodal logistics domains. Regarding the handling of modular units, their internal contents and the stacking/order arrangement, we use a black-box approach, considering as driving model the encapsulation principle defined in the physical internet. The encapsulation principle is inspired to the digital internet handling of the information, the internet does not transmit data: simply transmits packets. The information inside the packet is not used during transmission, it is handled by original sender and final receiver of the packets only and are the "payload" of the packet. Packets are routed, through the digital internet, using only the header information. The Physical Internet encapsulates physical objects in physical packets. Similarly to the digital internet, handling of the M-Boxes is realized using the associated data model, which constitutes the "header" of the physical packets. In our proposed approach we aim at only considering nominal declaration of good's type and nature, i.e. the information needed for handling the M-boxes are available, without the need to open them. This approach may be used for addressing an organized and collaborative approach, supported by IT systems, for aiming to a more efficient urban logistics.

General description
Physical Internet Initiative Internet (Montreil 2013, Montreil et al., 2014) is a major supply chain project that has the potential of changing the way we handle, store, package and transport goods across the supply chain. Basically the researchers involved in the PI wondered whether supply chain professionals could use the Internet as a metaphor for a new way to move physical objects through the supply chain (Montreil 2011). In the same way of the seven-layer Open Systems Interconnection model of the Digital Internet, Montreuil (et al., 2012) proposes an Open Logistics Interconnection (OLI) model to structure the interconnected logistics services for easing the conceptualization, the implementation and the deployment of the Physical Internet. The first project to be considered is Modulushca, related to the Physical Internet initiative and aimed at enabling interconnected logistics, using modular container (M-Boxes), digital interconnectivity of systems with modular container. The final goal is to provide a basis for an interconnected logistics system for 2030. The key enabler is the development & use of modular logistics units of sizes adequate for real modal and co-modal flows of fast-moving consumer goods (FMCG). This paper is based on the activities the authors performed in the project.

The e-Freight project represents another interesting work for the modular logistics. e-Freight project has defined the Common Framework, which allow goods tracing in real time, ensures intermodal liability promoting clean freight transport, by creation and deployment of a single transport document in electronic form (electronic waybill), and an appropriate framework for the deployment of tracking and tracing technologies (RFID, etc.).

In order to allow the interaction between the different logistic systems, from an IT architecture pint of view, without the need for each participants of implementing specific adapters to everyone systems we intend to use the Canonical Data Model (CDM) approach, an Enterprise Application Integration pattern (Hohpe 2003). This approach allows minimizing dependencies when integrating applications that use different data formats. The approach is based on the design a of a common data model (the so called Canonical Data Model) that is independent from any specific application. It requires that each application that want to interact with all the others, have only to be able to produce and consume messages in the common format. Sending a message means translating the info from the own system format to the common one. Receiving a message means translating the info from the common format to the own system format. A relevant element of the eFreight Architecture is the EAP: eFreight Access Point (Bento 2012). An EAP is a single point of access (more
than a HUB) with the following characterization: globally addressable; secure; independent from semantics or applications; independent from vendor or provider and simple and easy to use. A message based solution, considering the e-Freight approach, and the Modulushca Common data Model may be enabled using the EAP components. The EAP is aimed at exchanging messages suited for logistics purpose and only with structured and predefined messages. In order to enable the modular logistics and for enabling encapsulation of the goods a data model has been defined, in the frame of the Modulushca project.

The access to the information handled by the Modulushca Common Data Model is connected to the context. In our approach the context, may be considered as a window allowing to see only part of the information, depending on the role of the actor who is accessing to the information and the situation in which this access is performed. The red tagged data are the most reserved while the green tagged data are the totally public, accessible by anyone.

This data model, supporting the collaborative and intermodal approach proposed by the Physical Internet, may be a useful approach for a changing in the way 3PLs and carriers, delivers goods in the urban areas, increasing the loading factor, considering the reverse logistics avoiding empty trip back, combining last mile (consignment) and first mile (picking up), retrieving clean and recyclable waste, etc. The objective is to increase the efficiency of the deliveries while decreasing the number of vehicles involved, decreasing the contribution to the traffic congestion.

Results and conclusions
The proposed Modulushca Common Data Model, identified also as the Coloured Model, has been obtained considering the encapsulation approach, proposed by the Physical Internet and is the base for the definition of interfaces and protocols. The former, in fact, may be defined through a set of operations, usable by the IT systems in order to interoperate one with the other for exchange data as defined in the proposed Modulushca Common Data Model. The latter, is the description of interaction between actors using the defined interfaces and the types proposed in the Modulushca Common Data Model. In the Modulushca project the proposed CDM provide an efficient way of enabling meaningful comparisons across disparate data sources highlight and differences in data capture processes and/or underlying supply chain characteristics that are important for interpreting results produced from each database.

The proposed mode, then, is an important contribution in the direction of defining a model for interoperability of IT Systems. The model has been defined using XML and XSD, in order to be platform independent, extensible, machine processable and human readable. It is based on supporting standards and proposals: the GS1 and EPCIS. Moreover, it is inspired on the results of the eFreight project, for defining and using XML based documents, EAP and inter-operable systems. The proposed model may be further extended and improved but is a valuable and feasible result. In fact it has been used for defining an High Level IT architecture, in the Modulushca project, for realizing the modular logistics. This result may be advantageously applied to urban logistics congestion problems, leveraging on modularity, encapsulation and collaboration.

References

Keywords: Modular logistics, interconnected shared network, intermodal, data sharing, modular logistics.