SEMANTIC TRANSFORMATION FOR RAIL TRANSPORTATION

Building an Interoperability Framework for Attractive Railway Services

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European Policy Objective

- By 2020, establish the framework for a European multimodal transport information, management and payment system

- EC White Paper for Transport 2011
Establish an Interoperability Framework that will support:

- a “semantic web of transportation” which offers ways to automate translation between existing standards.
- access to data: timetables, prices, links with other modes, specific information related to traveler preferences, real time information on the journey, etc.
- new semantic technologies that allow a more controlled environment than an “open data” approach (data access, usage control, business rules)
- improved Life Cycle Costs / Competitiveness
The Interoperability Framework

- overcomes the fragmentation of multiple data formats and communication protocols;
- connects multi-modal providers and the services sectors;
- lowers the cost of accessing data that is openly discoverable but of low quality or availability;
- maximises growth potential for the development of new products and services by removing ICT system incompatibility.
The IP4 Transport Ecosystem

- Semantic Web: Interfaces and Engines
- Ontologies: Identification and Ontological Model
- Interoperability Framework
- Automate Discovery
- Cloud: Self-service Interface

- Travellers
- Retailers
- Operators
Semantic Transformation for Rail Transportation (ST4RT)

- Develop cost-reducing translator technology drawing from the Ontology repository and the service registry hosted by the Interoperability Framework.

- Analysis of availability and maturity of semantic transformation tools and technologies;
- Design of methodologies for annotation/mapping between legacy data models and ontologies;
- Development of extensions to the IT2Rail reference ontology;
- Development of mapping between the IT2Rail reference ontology and legacy data models;
- Development of KPIs and Metrics for the transformation evaluation.
- S2R Open Call
- Coordinated by UNIFE
  - CEF
  - DAPP BE
  - HITRAIL
  - OLTIS
  - POLIMI
  - TRENITALIA
  - UIC

- Grant Agreement Pending

- Close Coordination with IT²Rail [www.it2rail.eu](http://www.it2rail.eu)
Present Situation

- Railways exchange ticket and reservation info using the UIC 918 messages, partly corresponding to TAP TSI ones defined in TD B.5
- Railways use different versions and have different capabilities (e.g. to accommodate travelers’ preferences)
- Railway ticketing is opening up to the outside world
  - On-line Travel agencies
  - GDSs
  - Other transport modes
Current Situation

- Different organisations use different formats and channels
- Conversion services exist (Hit Rail’s HEROS), but must be configured for each connection
Conversion Specifications

- **Semantics:**
  - What is a “seat”? 
  - What is “adjacent”? 
  - What is a “party”? 

- **Structure:**
  - One or more parties per reservation? 
  - Is passport number mandatory? 

- **Format:**
  - 918 or XML (what dialect)? 

- **Channel:**
  - MQ or WS?
Ontology Approach

- **Old approach:**
  - Develop each interconnection as a separate software development project.
  - Knowledge “disappears” in the programming code and needs to be regenerated for each subsequent project

- **New approach:**
  - Develop one, shared, extensible ontology
  - Use tools to generate conversion software from that ontology
  - Knowledge is reused, productivity is boosted
ST4RT Ontology

- ST4RT will build a “reference ontology” in which the semantics of all business terms, used in ticket and reservation sales are defined and stored:
  - Formal definitions
  - Relations between concepts
  - Business rules

- ST4RT will demonstrate the feasibility of this approach by developing a converter that uses the ontology in a specific use case (e.g. cancellation of a booking)
An ontology consists of:

- **Concepts:**
  - Train – Wagon – Seat – Route – Station – Passenger

- **Properties (relations between concepts):**
  - A Passenger occupies a seat in a train at a route

- **Business rules:**
  - “A passenger occupying a seat cannot also occupy another seat in the same train at the same route”

All concepts, properties and rules are formally defined in a mathematical language and referred to from existing message definitions by means of annotations.
ST4RT Ontology

An ontology is a machine-readable fragment of first-order predicate logic and consists of:

- **Concepts:**
  - Train – Wagon – Seat – RailRoute – Station – Passenger

- **Quantifiers and restrictions**
  - some, only

- **Properties** (relations between concepts):
  - A Passenger physically-occupies some Seat
  - A Wagon has Seats
  - A Train has Wagon
  - A Train operates-on only RailRoute (any thing a Train operates-on is a RailRoute)

- **Axioms** (“true” statements of the domain):
  - “If p is a Passenger, p physically-occupies Seat x and p physically-occupies Seat y, then x ≡ y

- **Inference** (added by machine-reasoning to the ontology)
  - «Passenger physically-occupies at most one Seat in a given Wagon of a given Train that operates-on a specific RailRoute
ST4RT Interoperability Framework
ST4RT Interoperability Framework Block Diagram

Ontology Editor

Assets Manager

External Sources (the web)

DBpedia

FactForge

WIKIDATA

Annotations Editor

Assets Lifecycle

Linked data

Publish & link

Deploy

Triple Store (repo & registry)

Interoperability web services
Summary

ST4RT will:

1. build an Ontology of travel and ticketing

2. develop tools that draw from the Ontology and automate generation of conversion specifications to interconnect legacy and modern systems

3. open the railway world to new ticket vendors, web based services, modality integrators
QUESTIONS?

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