Service Systems & Big Data: the IRMIS case study

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Pavia Big Data Day - July 1st, 2014
Foreword

• Our perspective is functional
• We address the data layers and the issue of Internet of Data (Web of Data) in the paradigm of a Service System for Smart Citizen

• Specifically we illustrate the issue in a Service System called IRMIS (Integrated Real Time Mobility Information and Services)
IRMIS’s vision: a smart and green city

**The Service Systems Perspective**

<table>
<thead>
<tr>
<th>Mobility Profile</th>
<th>Small city (E.G. Pavia)</th>
<th>Midsize city (E.G. Clermont Ferrand)</th>
<th>Metropolitan area (E.G. Barcelona)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rings</td>
<td>&lt; = 2</td>
<td>2 - 3</td>
<td>&gt;3</td>
</tr>
<tr>
<td>Bus &amp; Train &amp; Motorways</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tramways &amp; surface rails</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Underground transport Subways)</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
IRMI’s goal: mobility for ALL in a sustainable city

Our focus: mobility of citizens (user systems)
IRMIS’s Releases

1st SEM 2014
- Trip Planner
- Alert Manager

2nd SEM 2014
- City Feed Mobility Analyzer Indoor Guide

2015
- Smart Elderly
- Smart Chair

2016
- Urban Planner Short Term Planner Pollution Control

Proposal H2020

Current development in Pavia
IRMIS: 5 pilot cities

Universities & Municipalities are developed a proposal for Horizon 2020 – Call 7.1 Connectivity & information sharing for intelligent mobility

The project proposes 4 service groups
1. Smart Citizen
2. Smart Chair
3. Smart Municipality
4. Web of Data

The proposal is on 5 pilot cities, with the participation of: 7 universities and municipality bodies with ATOS as Project Manager

Universities: Pavia, Politecnica Cataluna, Blaise Pascal, Athens, Milano Bicocca, Federal UFCG (Campinhas), HIT (Harbin, China)
IRMIS: The SS perspective

- SSs are made of Business Services (IOB) and Web of Data (IOD)

- IOB are value propositions to individuals and enterprises: e.g. Patient Data, Indoor Mobility, Support to Disabled People, Services to Citizens etc.

- IOD stores semantically linked information that is being used in IOB and therefore provides a kind of Web of Data
IRMIS: overall architecture

**Web of Data (IOD)**

- **Smart Citizen**
  - Trip Planner
  - City Feed
  - Alert Manager
  - Indoor Guide

- **Smart Municipality**
  - Mobility Analyzer
  - Short Term Planner
  - Urban Planner
  - Pollution Control

- **Smart Chair**
  - Elderly Guide
  - Disabled Guide

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**THE SERVICE SYSTEMS PERSPECTIVE**

**SERVICES SYSTEMS & INFORMATION ENGINEERING**

**SERVICES SYSTEMS & SOFTWARE ENGINEERING**

**CONCLUSIONS**

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**Service Engineering Lab**
IRMIS: IOD Information Layers

- Each layer includes
  - Intra-layer relations (e.g. Street-Map)
  - Inter-layers links (e.g. Event-Maps-Twitters)

- To link layers:
  - Ontology that models relations and links
  - Big Data technology that deploys huge volumes in a distributed cloud
IRMIS: IOD Information Layers: Indoor Guide

Maps and Indoor Navigation

Complex buildings:
- Universities
- Hospitals
- Stations

Anchors network (WIFI)

THE SERVICE SYSTEMS PERSPECTIVE

SERVICES SYSTEMS & INFORMATION ENGINEERING

SERVICES SYSTEMS & SOFTWARE ENGINEERING

CONCLUSIONS
IRMIS: IOD Information Layers: Mobility Analyzer

- Performance Indicators
- Real-time analysis and simulation of mobility flows
- Services to Municipality
- Developed by Barcellona & Pavia
IRMIS: IOD: approach to open & linked data

From a universal boundless approach (Open Linked Data) to a more manageable and specific domain of Urban Mobility
IRMIS: IOD : sources & requirements of Web of Data

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
<th>Urban Mobility Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publicity</td>
<td>Information open to all stakeholders</td>
<td>Public underground transport timetable</td>
</tr>
<tr>
<td>Access</td>
<td>A public API to access</td>
<td>Public API to underground time table</td>
</tr>
<tr>
<td>Reference</td>
<td>An engine to link information sources</td>
<td>Public search engine that links transport information sources</td>
</tr>
<tr>
<td>Interpretation</td>
<td>A specification of the meaning (semantic) of the information</td>
<td>GTFS (General Transit Feed Specification)</td>
</tr>
</tbody>
</table>

Open Data
- Time tables of transport
- Maps

Social data
- Tweets and feeds about the transport systems
- Forum

Crowd data & sensor data
- Real time position of transports

Web data
- Articles and other information on transports
SS & Information Engineering

- SS have a drastic impact
  - (a) theoretical: ontology
  - (b) technological: Big Data - Hadoop, JSON etc.

- “Meta-ontology” (by stakeholder)
  - Information types.
    - Structural Data (e.g. Timetables in a City)
    - Event data (e.g. RT position of buses)
    - Analysis Data (e.g. clustered preferences of passengers).
  - Information domains e.g.:
    - stakeholders (e.g. passengers)
    - geography (e.g. map)
    - ....

- New data analysis approaches e.g. heterogeneous graphs, fuzzy proximity
SS & Layered Services

- Business services are built on lower level services
- Business Services use Open Software with a Lego logic

The Trip Planner application accesses Open Street Map (master data) and GTFS files and RT data (events) by a set of Open Software
SS: a new development cycle

- The SS architecture implicates a top design and a bottom up implementation
Conclusions

• Service Systems (SS) are a new generation of systems based on a layered architecture with:
  – Layers of information
  – Layers of services
  – Top down design & bottom up development

• These characteristics imply a framework with top down analysis and bottom up implementation

• Such framework is successfully used in IRMA (Integrated Real Mobility Time Assistant), a project by University of Pavia, Comune di Pavia with the cooperation of HIT.

• IRMA is the base of IRMIS, a short-listed proposal for H2020 call 7.1
References

• Applications (Beta version)
  – Web app: http://tripplanner.unipv.it

• Prototypes
  – http://mobilitymap.unipv.it
  – http://mobiboston-robolab.rhcloud.com

• Web sites
  – Service Engineering lab: http://camellia.unipv.it