Demonstration of CLAIRE-SITI and cockpit development

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Architecture

Data providers

- Theoretical data
- Real data
- Measures + events

ClaireSITI

- Universal server
- Exchanges normalised (ex: XML)

- Référentiel
- Geographical DB

Integration

- Diagnosis

Decision

- Actions
- Operations

Observatory

- Modeling
  - Simulation
  - Assignment

Warehouse

Service providers

- New Services
  - Mobility centre
  - Route path calculator
  - Vulnerable user assistance
  - Dynamic map
  - Responsive transport
  - Crisis management system

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DATA MANAGEMENT PRACTICES AND TOOLS FOR EFFICIENT BUS OPERATIONS

Demonstration of ClaireSITI and cockpit development
CLAIRE-SITI : A reference system for intermodality

- A GENERIC MULTIMODAL DATA MODEL
  - Any type of network (road, public transport, alternative modes)
  - Any type of indicator (congestion, time adherence, regularity, availability, reliability, sustainability)
  - Any type of event

- AN ANALYSIS ENGINE WITH FUNCTIONS
  - observatory,
  - monitoring,
  - diagnosis,
  - decision/operation action

- A TOOL THAT
  - Support the development of public policies for a sustainable mobility
  - Can be integrated in service and industrial chains
  - Enhance research on Intermodality
Generic data modeling

Resources & Trip units
Planning

Logical multi-level network
Hierarchical network graph
Interaction graph

Label

Representation space
Topological and geographical forms (GIS)
Indicators
Events

Normalisation CEE:
TRANSMODEL, TRIDENT, SIRI, IFOPT

Normalisation CEE
DATEX, INSPIRE
(conceptual spatial data model)
Structure: hierarchised multi-level & interaction graph

Hierarchical

Level 3  1+2+3+5++

Level 2  1+2+3+ u_{6^1+4^3+5} 5++

Level 1  1+2+3  u_{6^4} 4  u_{5^+} 6+

Level 0  1  3  u_{6^3} 4  u_{5} 5 6

Interaction

v1  v2  v3

u2  u3  u4  u5  u6

Road network

u1 Interaction

PT network

v1  v2  v3

b1  b2

Detailed network: stops

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Demonstration of ClaireSITI and cockpit development
Multi-criteria: Indicators & supervised variables

<table>
<thead>
<tr>
<th>LOGIQUE</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Punctuality</td>
<td>Delay, Advance</td>
</tr>
<tr>
<td>Regularity</td>
<td>Waiting time, Headway/Interval</td>
</tr>
<tr>
<td>Reliability</td>
<td>Commercial speed, Speed variation</td>
</tr>
<tr>
<td>Availability</td>
<td>Ratio Supply</td>
</tr>
<tr>
<td>Passenger Demand</td>
<td>Alighting, Boarding, Passenger volume, Loading,</td>
</tr>
<tr>
<td>Transfer</td>
<td>Transfer time</td>
</tr>
<tr>
<td>Fluidity</td>
<td>Flow, Occupancy, Speed</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Carbon monoxyde, Pollutant Monoxyde (CO, Nox,...)</td>
</tr>
</tbody>
</table>

Node Arc Network Resource Trip unit

Level of Service (LoS)
Interpretation : Supervised or LoS variables

« Supervised» variables allow to monitor the Level of Service (LoS) and to know:
- Time spent in abnormal state
- Percentage length of the disturbance: percentage of the network length in abnormal state
- Volume of the disturbance (temporal cumulative sum of the percentage of the network length in abnormal state)
- Volume of the disturbance weighted by traveller demand (not yet available)
Event modeling

Event(type, sub_type, author, Causes, Effects, start-time, end-time, From, To, ....)

- Event
  - Trafic PC operator
  - Accident
    - Event
      - Expert-Diagnosis
        - Congestion
          - Event-control action
            - Expert-decision
              - Favoring re-routing path
    - Event
      - Police operator
        - Lane closure
          - Event-control action
            - Bus operator
              - Bus line deviation
    - Event
      - Expert-diagnosis
        - Delays at stop
          - Event-Intervention
            - PC-Operator
              - Emergency vehicle

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Dimensions of the Analysis

**Entity:**
- Network, Route, Link, Node
- Vehicle, Driver, Traveller

**Diagnosis:**
- Disturbance, Event

**Indicators:**
- Punctuality,
- Regularity,
- Reliability,
- Fluidity,
- Sustainability

**Time:**
- hour:mn; day, type of day, month, year
WP1 – Data Interfaces

**DIMTS AVL data**
- Stops location
- Road line (LineString)
- Trip details (scheduling at terminus only)
- Bus GPS location (Lon, Lat coordinates each 10 s)

**DIMTS ETM data**
- Fare stage collection
- Passenger OD flow between fare stage stops

**Claire SITI**

- Data Interfaces

**Structural**
- Logical graphs (nodes as stops, links between two stops)
- Physical graphs (Point, Poly line)

**Vehicle monitoring**
- Matching algorithm on vehicle tracking along the links

**Time performance indicators at vehicle, stop and link levels**
- (travel time, delay, headway)

**Passenger demand indicators**
- (Boarding, Alighting, PassengerVolume, Loading)

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## Operation LoS indicators in the ClaireSITI platform

<table>
<thead>
<tr>
<th>Logic of Operation</th>
<th>LoS indicators</th>
<th>LoS threshold</th>
<th>Disturbance duration threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regularity</td>
<td>Interval (Headway)</td>
<td>Real Interval/theoretical interval &lt;50 or &gt; 150%</td>
<td>Duration &gt; 2 * theoretical interval</td>
</tr>
<tr>
<td>Punctuality</td>
<td>Delay</td>
<td>Predicted delay &lt; = -4mn</td>
<td>Duration &gt; 2 * theoretical interval</td>
</tr>
<tr>
<td>Punctuality</td>
<td>Advance</td>
<td>Predicted advance &gt; 2mn</td>
<td>Duration &gt; 2 * theoretical interval</td>
</tr>
<tr>
<td>Reliability</td>
<td>Speed</td>
<td>Real speed /Theoretical speed &lt; 50% or &gt;150%</td>
<td>Duration &gt; 2 * theoretical interval</td>
</tr>
<tr>
<td>Regularity</td>
<td>Coefficient of variation of the speed during the last hour</td>
<td>Coefficient Variation = Standard deviation/Mean &gt;20%</td>
<td>Duration &gt;= 0</td>
</tr>
<tr>
<td>Vehicle supply</td>
<td>Vehicle supply during the last hour (rolling horizon)</td>
<td>Ratio = real vehicle count / theoretical count &lt; 50%</td>
<td>Duration &gt;= 0</td>
</tr>
<tr>
<td>Passenger demand at Fare stops</td>
<td>Loading during the last hour (rolling horizon)</td>
<td>Ratio PassengerVolume/Real vehicle count during the last hour&gt; 90</td>
<td>Duration &gt;= 0</td>
</tr>
</tbody>
</table>
LoS indicators monitoring (percentage of abnormal states)
Cockpit (On/Off Line)

Dynamic Spatial map

CLAIRE-SITI Cockpit

Temporal Graph chart editing

LOS monitoring

Reporting
Cockpit configuration
Cockpit replay Demo
Speed/Loading lines reporting 06:00-10:00
Speed difference reporting

| Time  | 05:50 | 06:00 | 06:10 | 06:20 | 06:30 | 06:40 | 06:50 | 07:00 | 07:10 | 07:20 | 07:30 | 07:40 | 07:50 | 08:00 | 08:10 | 08:20 | 08:30 | 08:40 | 08:50 | 09:00 | 09:10 | 09:20 | 09:30 | 09:40 | 09:50 | 10:00 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|       | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    |