

A group of people, some in dark clothing and others in lighter clothing, are standing in a dimly lit room. In the background, a large fire is burning brightly, casting a strong orange glow over the scene. The people appear to be observing the fire or engaged in a discussion. The overall atmosphere is one of an emergency or a controlled fire test.

Emergency Management in Large Infrastructures (EMILI)

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Amberg Engineering & ASIT, Switzerland**

New Challenges in Emergency Management

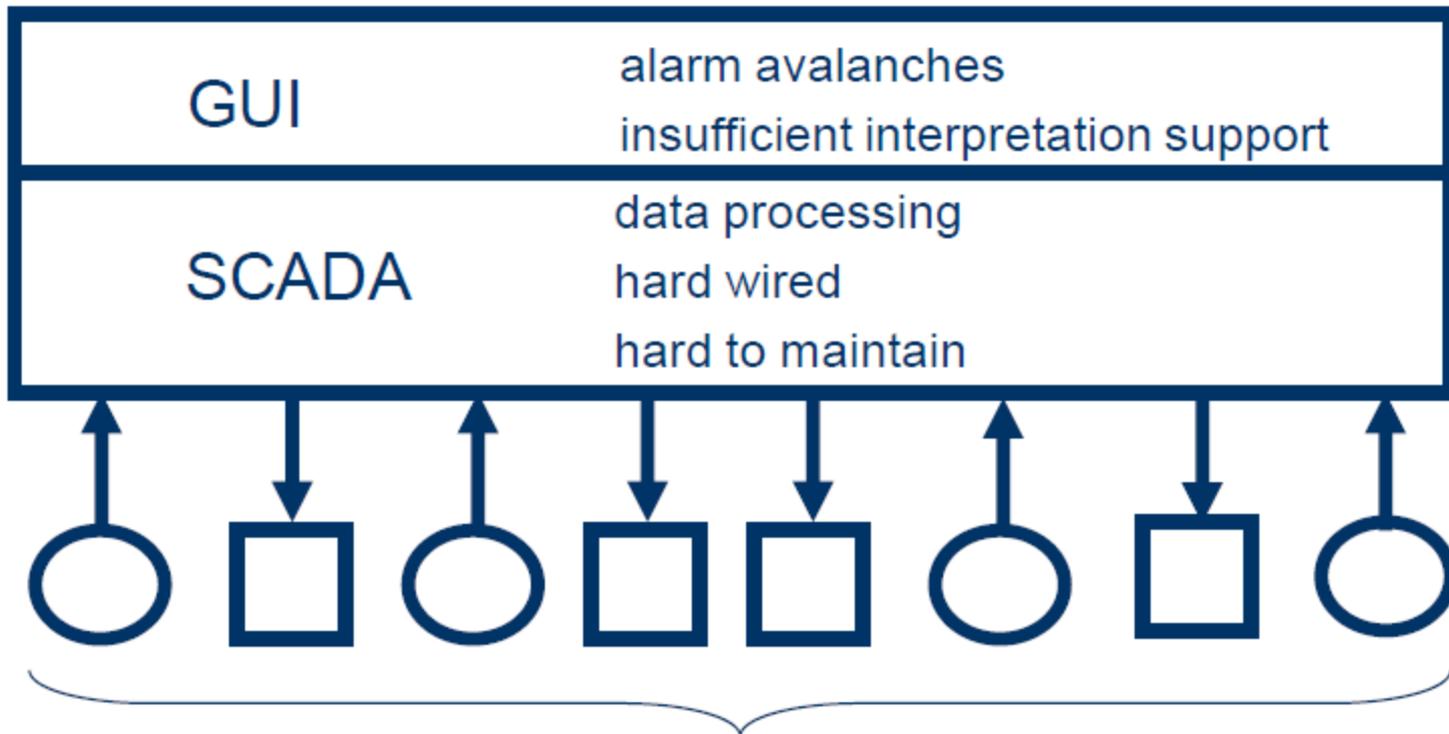
Increasing complexity

- Critical Infrastructures (CI) are large and complex technical systems
- CI have to be managed under normal, exceptional, and emergency conditions
- Emergency Management (EM) in Critical Infrastructures means detecting potentially dangerous events and acting fast on them
- Quick and adequate reactions are key factors for a safe and efficient operation of CIs

The combination of EM concepts and innovative Information and Communication Technology (ICT) can help in this situation.



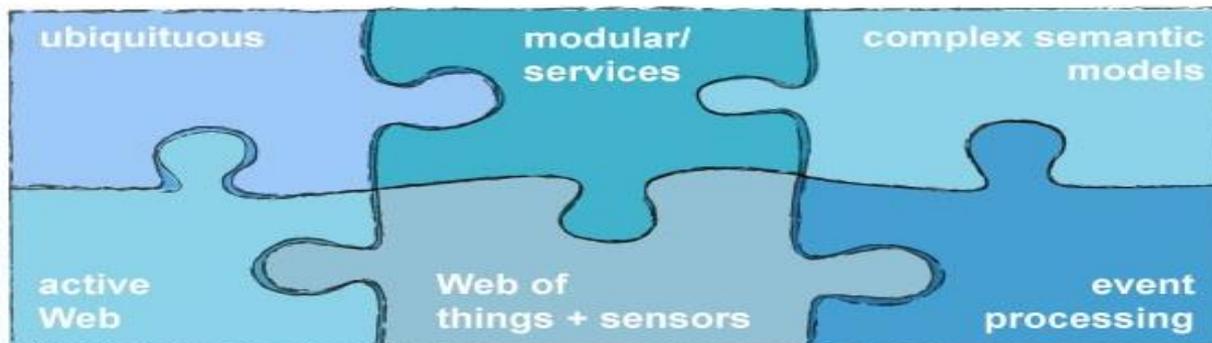
Current Situation



Sensors + actuators: different kinds, distributed, basic data

New Opportunities for Emergency Management

CRITICAL INFRASTRUCTURES



WEB / ICT TECHNOLOGIES

EMILI



Emergency Management in Large Infrastructures

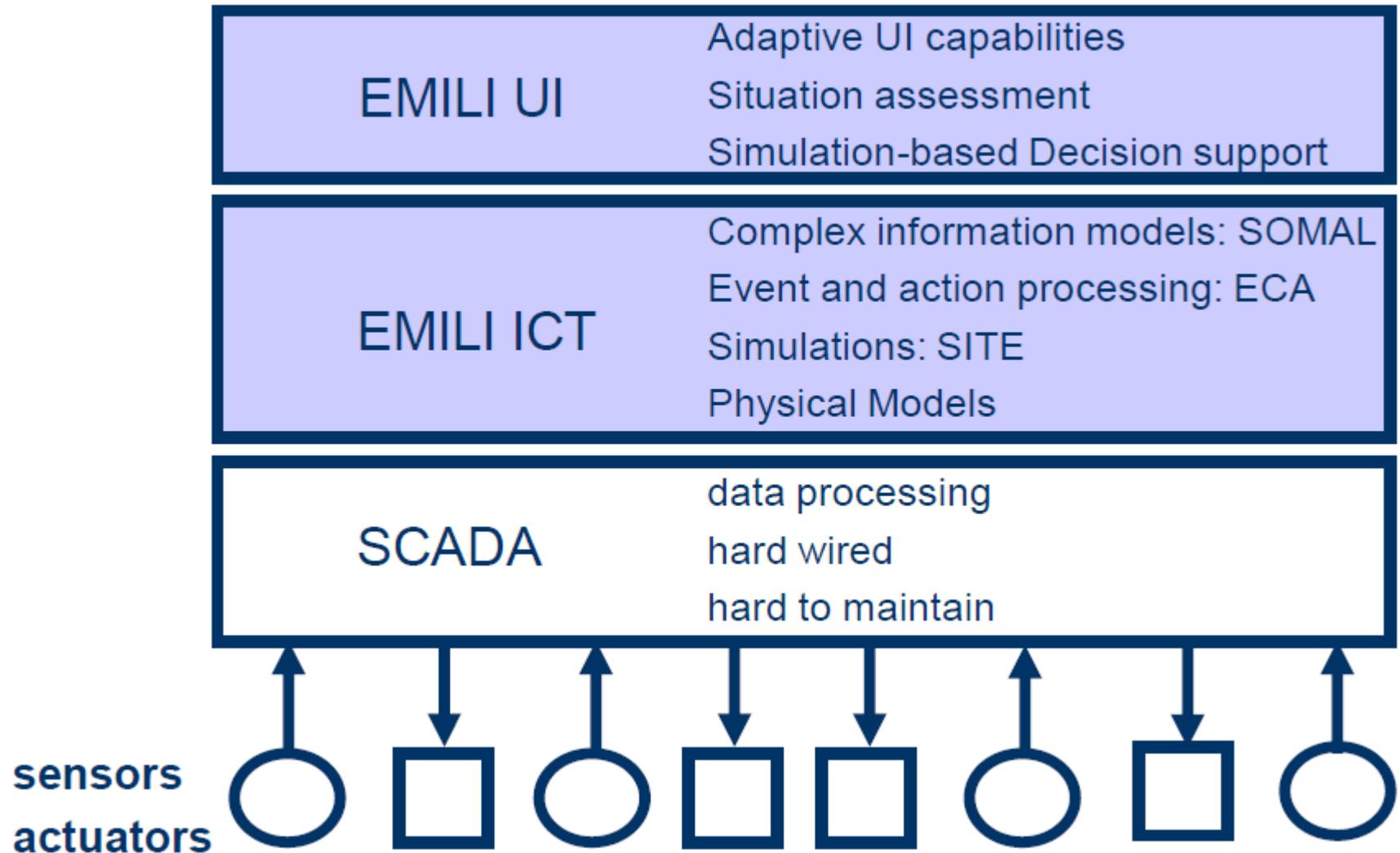
- Project co-funded by the European Commission
- Seventh Framework Programme (2007-2013)
- Project No. FP7-SEC-2009-1
- Period 2010-2012
- Total budget 4'004'055 €

Partners

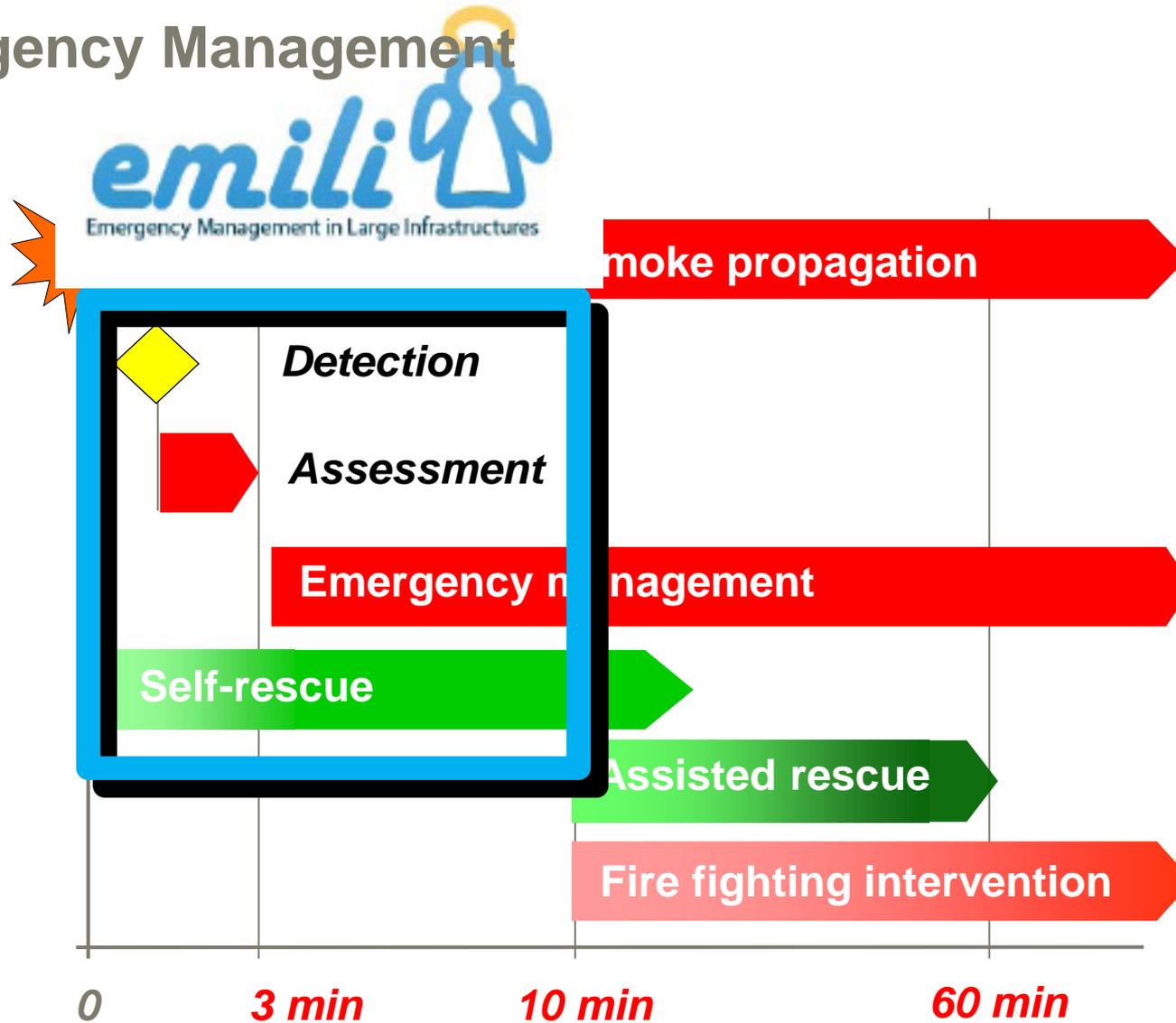
- Fraunhofer IAIS (Germany)
- SKYTEC AG (Germany)
- Amberg Engineering / ASIT AG (Switzerland)
- Stichting Centrum voor Wiskunde en Informatica CWI (Holland)
- Aplicaciones en Informática Avanzada AIA (Spain)
- LMU Ludwig-Maximilians University Munich (Germany)
- Institute Mihailo Pupin (Serbia)



EMILI – Beyond SCADA



Emergency Management



EMILI - Emergency Management in Large Infrastructures

A new generation of data management and control systems is needed:

- More flexible data management and control capabilities extending current SCADA systems
- Ability of handling complex events
- Capacity of analysis and aggregation
- Ability of handling complex actions
- “Intelligent” decision and decision support through simulation
- Comprehensive simulation for training purposes
- Advanced User Interface



Use Cases

The role of use cases:

- Drive the development of real-life, generally applicable and realistic structures
- Implement real-life emergency-management principles

Three use cases:

- Metro
- Airport
- Power grid



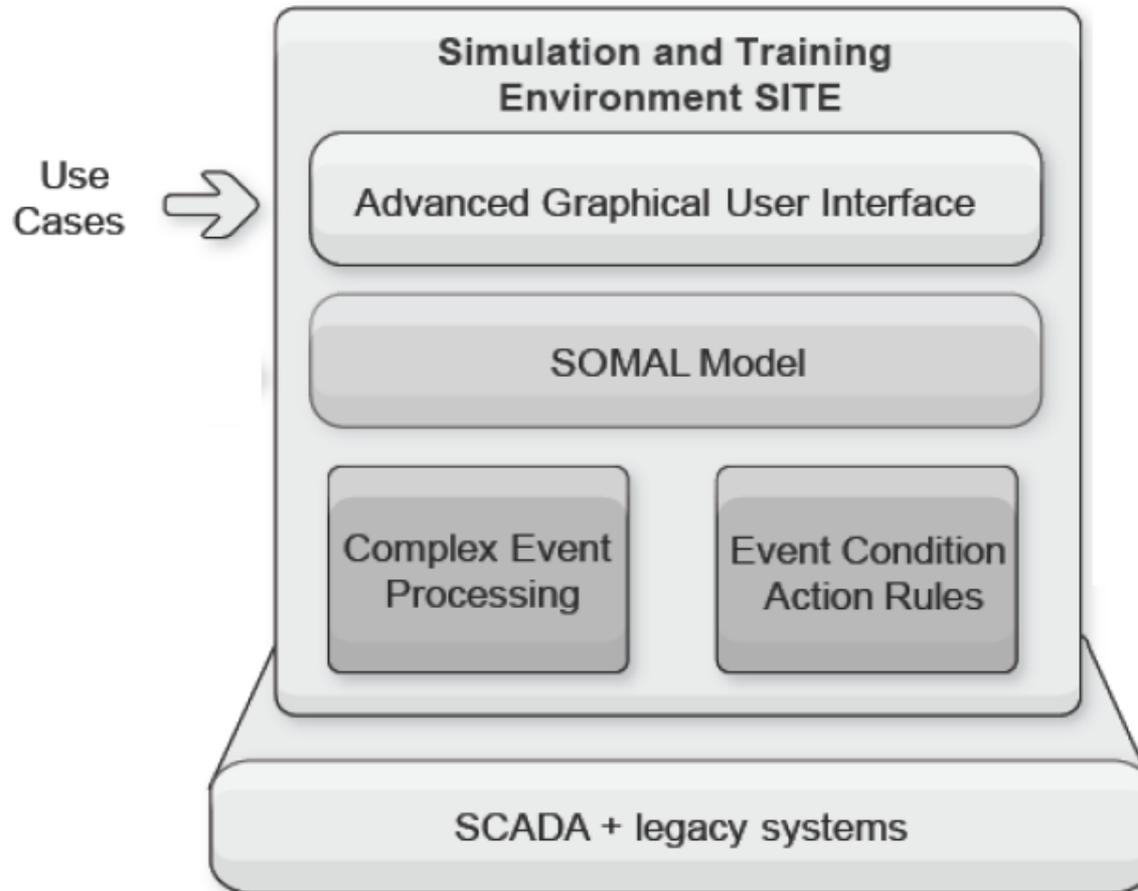
Layout Metro station

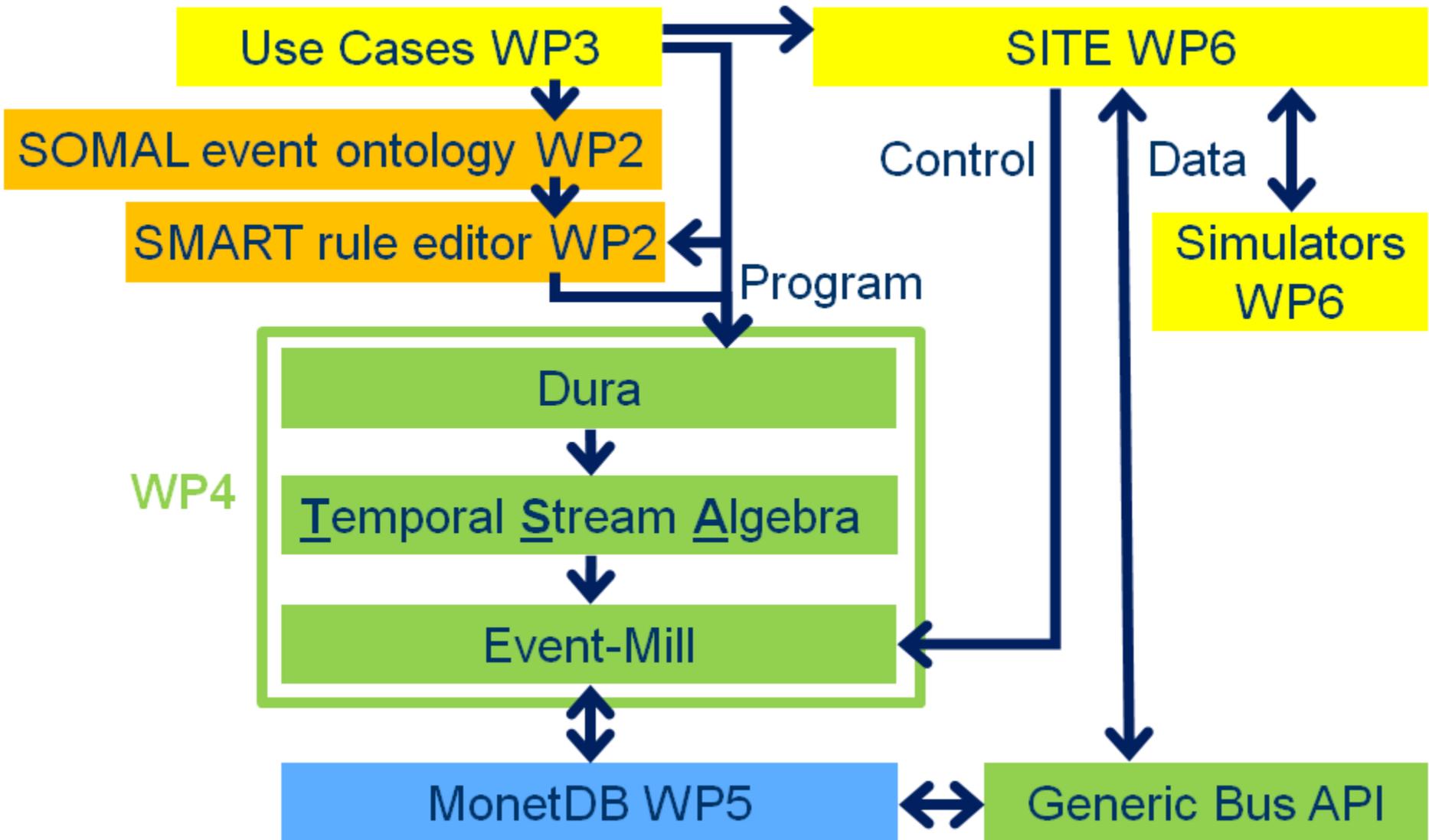
Metro use case:

- Crossing station
- 2 lines, 2 platform levels, mezzanine
- central platforms with 2 tracks



The EMILI Architecture





EMILI's Achievements

Use in/as a commercial product:

- 1) iSEM (AE / ASIT)**
- 2) EMILI emergency advisor prototype (SKYTEC)**
- 3) MonetDB DataCell (CWI)**
- 4) Intelligent alarm interpretation module prototype (AIA)**
- 5) Decision support system for airport emergency management including generic EMILI SITE infrastructure (PUPIN)**

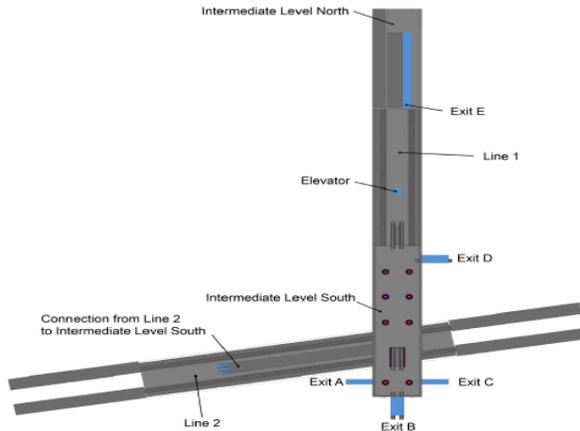
Use in R&D:

- 1) DURA complex external actions (LMU)**
- 2) EventMill (LMU)**
- 3) Personal training environment (PUPIN)**
- 4) Airport ontology (PUPIN)**
- 5) iSEM (FhG)**
- 6) SMART prototype (FhG)**
- 7) SOMAL ontology (FhG)**

iSEM - Optimum EM Through Physical Simulation

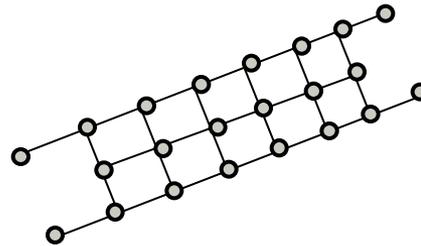
iSEM's Simulation Approach

- Network-based approach for
 - Person movement (egress)
 - Aerodynamics and smoke
 - Thermal model
 - Vehicle motion
- Model simple and robust
 - well tested
 - high reliability level
 - short simulation times
 - very high flexibility

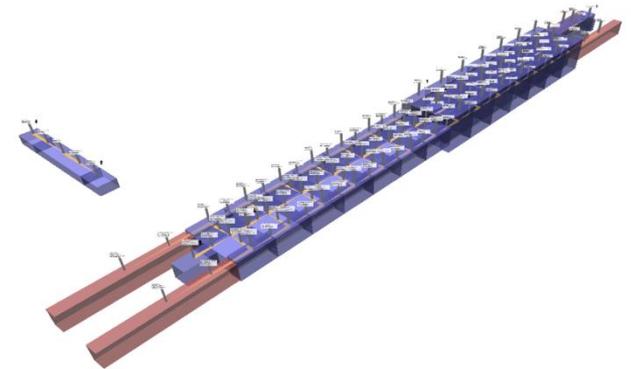


Real Model (Metro station)

$$\frac{d}{dt} Q_{ij} = \sum_k Fluxes_{ijk}$$



iSEM Network Model

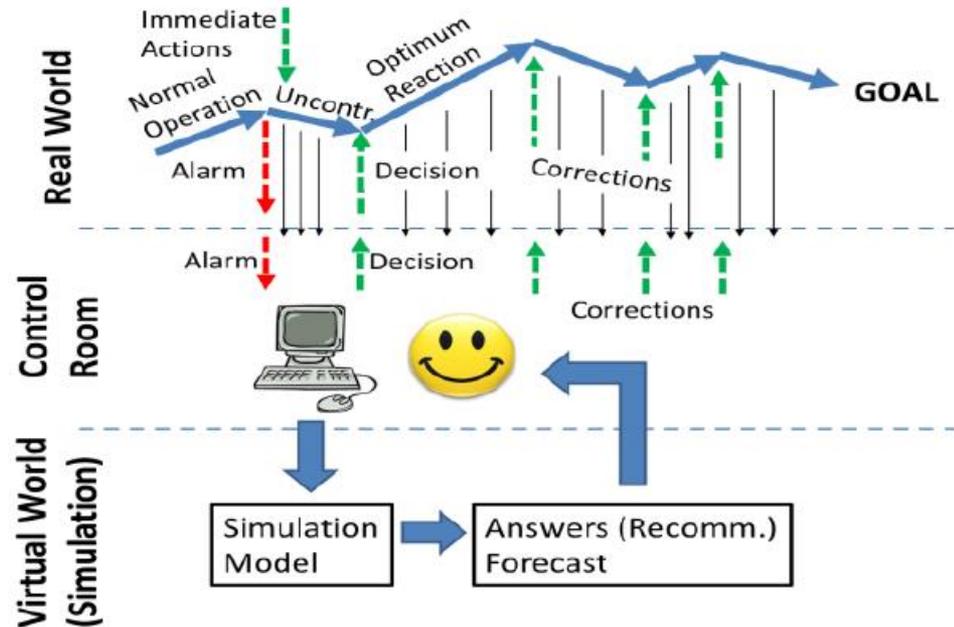


iSEM Visualization of Model

iSEM - Optimum EM Through Physical Simulation

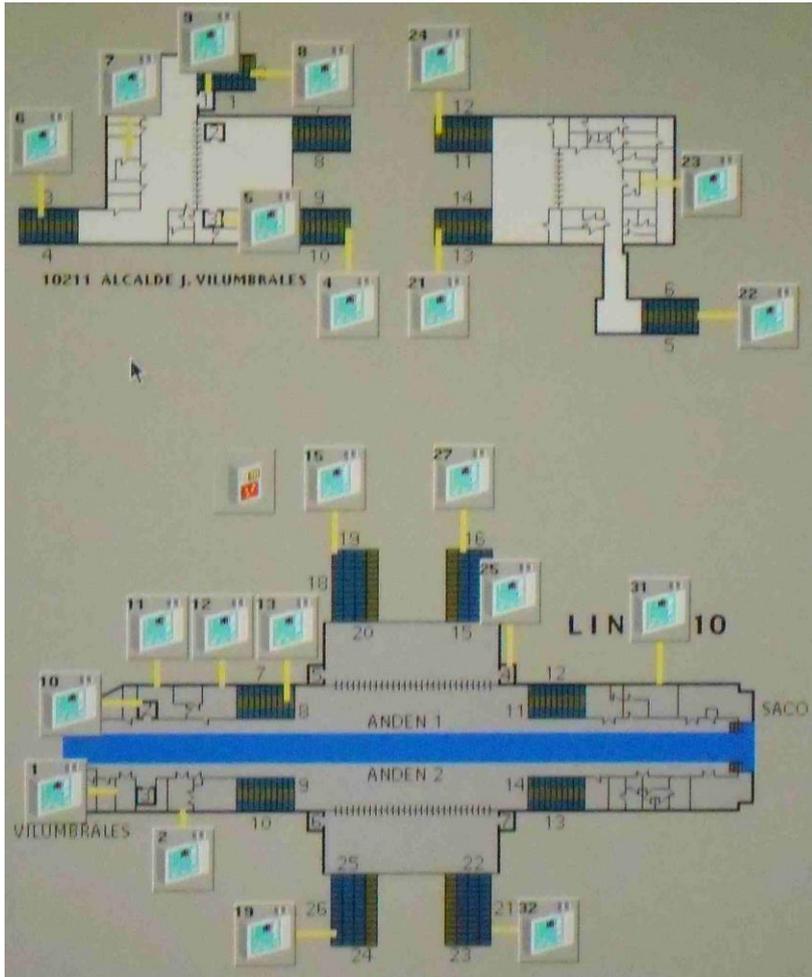
Objectives and Approach

- **Objectives**
 - Optimum support of personnel in control rooms
 - Enhanced readiness through Training
- **Approach**
 - “what-if” analysis (= forecast and validation), in real time, of different reaction strategies
 - identification and proposition of best reaction strategy
- **Solution**
 - Development iSEM* for executing comprehensive “what-if” analysis in real time



***iSEM = intelligent Simulator for Emergency Management**

iSEM for Decision Support



Fire Reaction:

47%

Basic

[Info](#)

85%

Alternat. 1

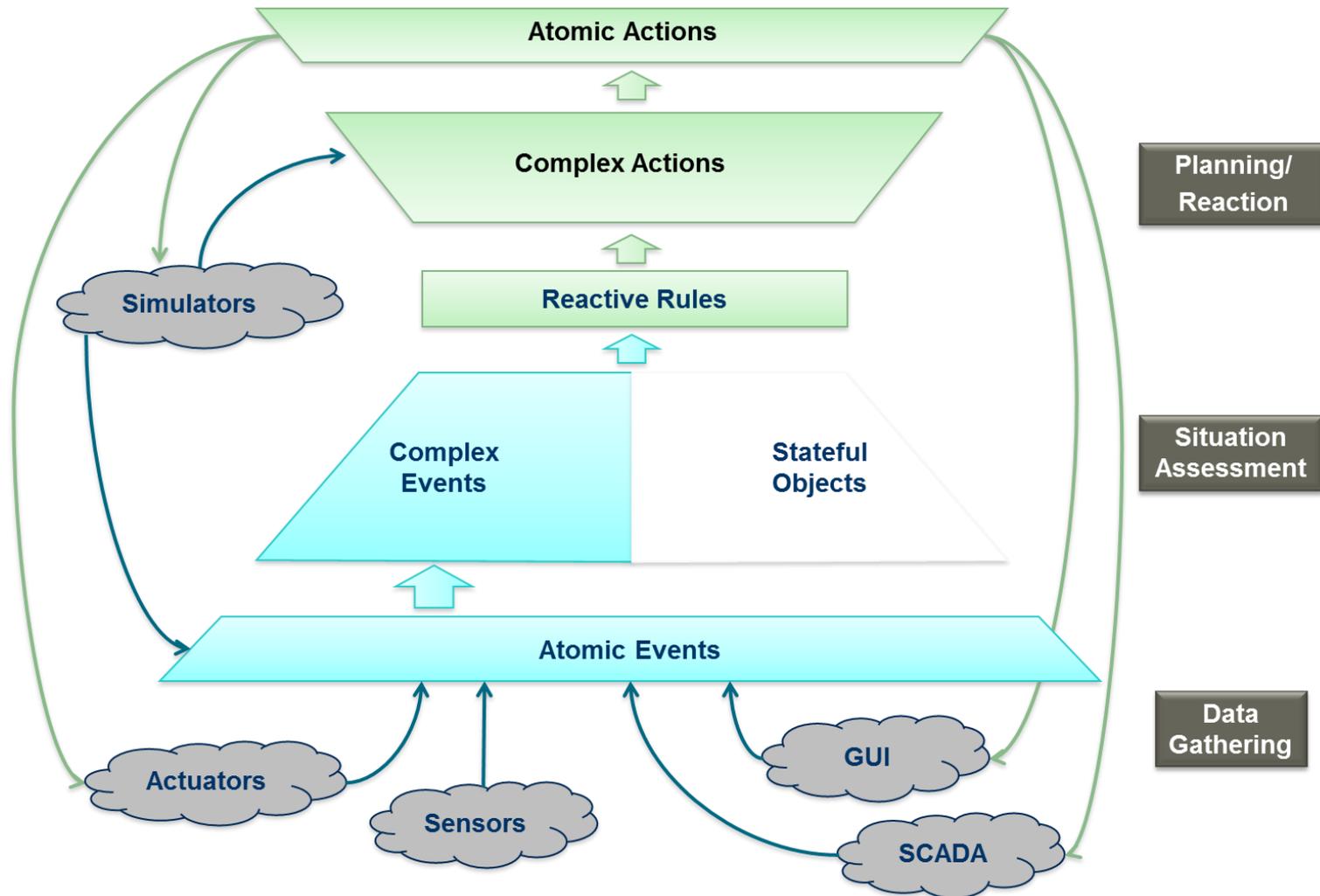
[Info](#)

32%

Alternat. 2

[Info](#)

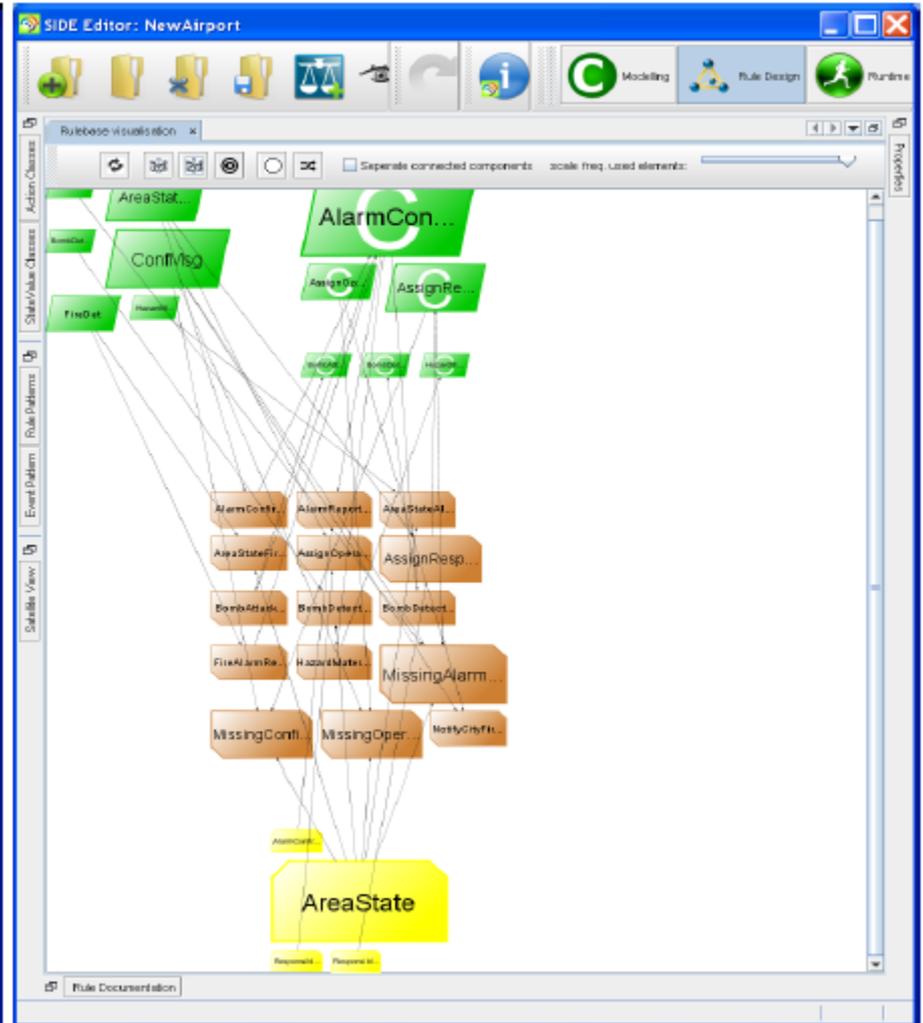
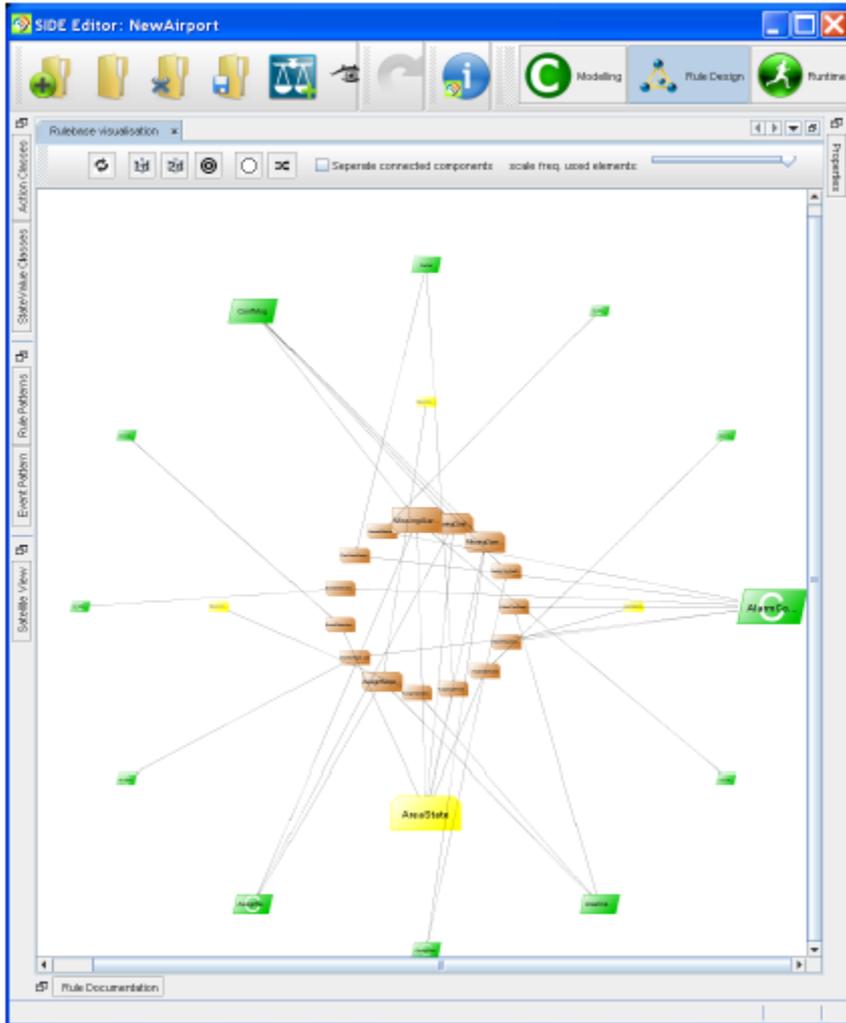
DURA – Rule-Based Emergency-Management Language



SMART – Graphical Rule Editor

The screenshot displays the SMART Graphical Rule Editor interface. The main workspace shows a rule diagram for a 'Fire' event. The rule is defined as a complex event 'Fire' (id: c3) with attributes 'tempValue' (float), 'smokeValue' (float), and 'area_id' (integer). The condition for this event is a condition block containing the expression '(event e5_event e4) within 10 sec'. This condition is connected to an AND connector, which is further connected to four atomic events: 'Sensor_area' (id: s7, state), 'Temperature' (id: e5, atomic event), 'Sensor_area' (id: s6, state), and 'Smoke' (id: e4, atomic event). Each event has its own set of attributes: 'Sensor_area' (area_id, sensor_id), 'Temperature' (tempValue, sensor_id), and 'Smoke' (smokeValue, sensor_id). The interface includes a toolbar with icons for file operations, a palette with logical operators (OR, AND, NOT, Condition Block, Statement, AND, OR, NOT, Function: Avg, Max, Min, Mean, Count), and a properties panel for the selected 'Fire' event. The properties panel shows general information (Classname: class de.fraunhofer..., name: Fire), attributes (tempValue, area_id, smokeValue), and additional settings (input, output, log). A satellite view in the bottom right corner provides a zoomed-out overview of the rule diagram. The documentation pane at the bottom contains the text: 'Complex event **fire**. It should be derived when both **smoke** and **temperature** events appears at runtime.'

SMART – Graphical Rule Editor



SMART – Graphical Rule Editor

The screenshot displays the SMART Graphical Rule Editor interface, which is divided into several functional areas:

- Code Editor:** Contains a script for a rule named `Temperature`. The script includes a `SimpleFire` event definition and a `DETECT` condition that checks for a `Smoke` event and a `Temperature` event. The `ON` clause is currently empty.
- INSTANCE BROWSER:** Lists the classes available in the scenario, including `atomic_action`, `concurrent_action`, `event_cascading`, `single_ce_with_state`, `single_complex_event`, and `state_query`.
- INSTANCE EDITOR:** Provides a detailed view of the selected `single_complex_event` instance. It shows the instance name, a list of `HasEvents` (e.g., `smoke: 10.0 time: 1 sensorId: 1`), `HasInitStates`, `Input Pattern` (Smoke, Temperature), and `Output Pattern` (SimpleFire).
- Output Console:** Displays the execution log, showing the process of switching to the test scenario, starting the simulation, and the successful compilation of the rule.

The interface also features a top toolbar with icons for Modelling, Rule Design, and Runtime, and a bottom status bar indicating the current page (10 | 23) and the user (INS).

ITA COSUF, 4 June 2013, Geneva, Switzerland

Metro – Emergency Advisor



Global Map

Cameras

3D Incident Plan

Incident Map

EMERGENCY C2 15:03:01 02:00 min ago

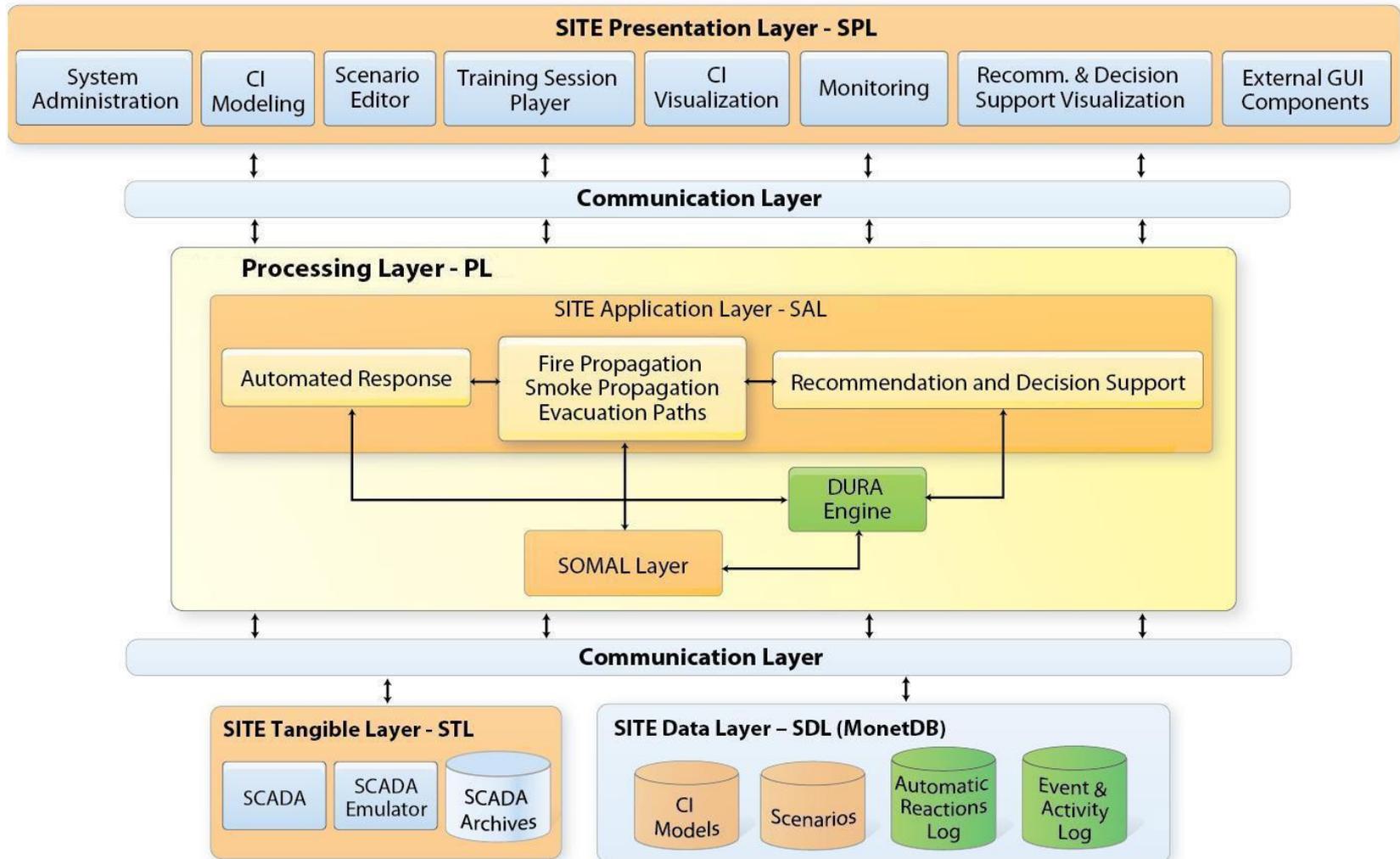
Decisions

- Evacuate: Platform A
- Evacuate: Emili Station

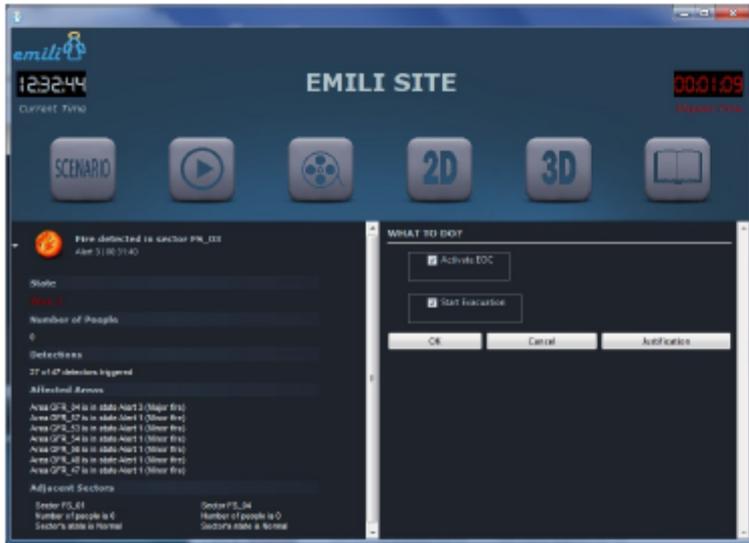
2D Incident Plan

AMBERG ENGINEERING

EMILI - SITE for Training



EMILI - SITE for Training



EMILI Training support

session for: **userid**
scenario type: **fire**

Interaction

- Warden response
- EM Coordinator response
- System malfunction
- Simulator related events
 - Fire spread prediction
 - predictions about evacuation routes

Trainee



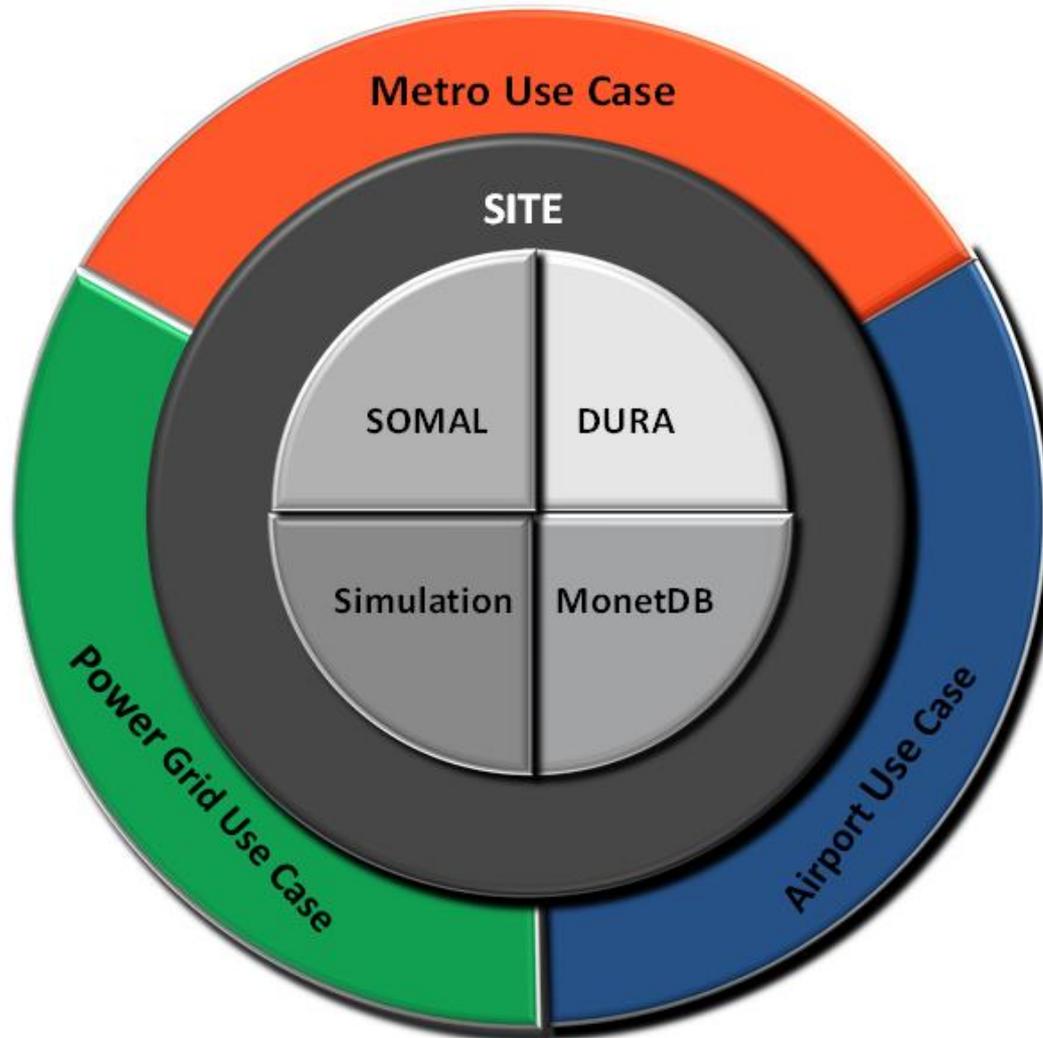
1. Approve / disapprove actions
2. Ask for explanations / justifications

Trainer



1. Add complications in scenarios in order to assess student decision making

EMILI



EMILI - Summary

- Duration: 01.01.2010 – 31.12.2012
- Total R&D budget with 3.139.228 € funded and 4.004.055 € overall costs
- 7 EMILI Partners from 5 European countries
- 40+ deliverables
- 5 commercial products, 7 R&D building blocks
- ~ 20 publications including 1 poster award
- 5+ commercial dissemination events
- 1 PhD thesis finished
- 2 doctoral thesis under construction
- 1 Bachelor thesis at SKYTEC
- 2 FP7-2013 project proposals

Information and Resources

Full documentation available on <http://www.emili-project.eu>

Results

Software

Deliverables

Technical documentation

Publications

Tutorials

Direct information from the project team: mbettelini@amberg.ch

