

A group of firefighters in full protective gear are standing in front of a large fire at night. The scene is illuminated by the intense orange and yellow light of the flames, which are visible in the background. The firefighters are silhouetted against the bright fire, and their gear, including helmets and reflective stripes, is visible. The overall atmosphere is one of a major emergency response.

Emergency Management in Large Infrastructures (EMILI)

Marco Bettelini, Samuel Rigert, Nikolaus Seifert
Amberg Engineering & ASIT, Switzerland

New Challenges in Emergency Management

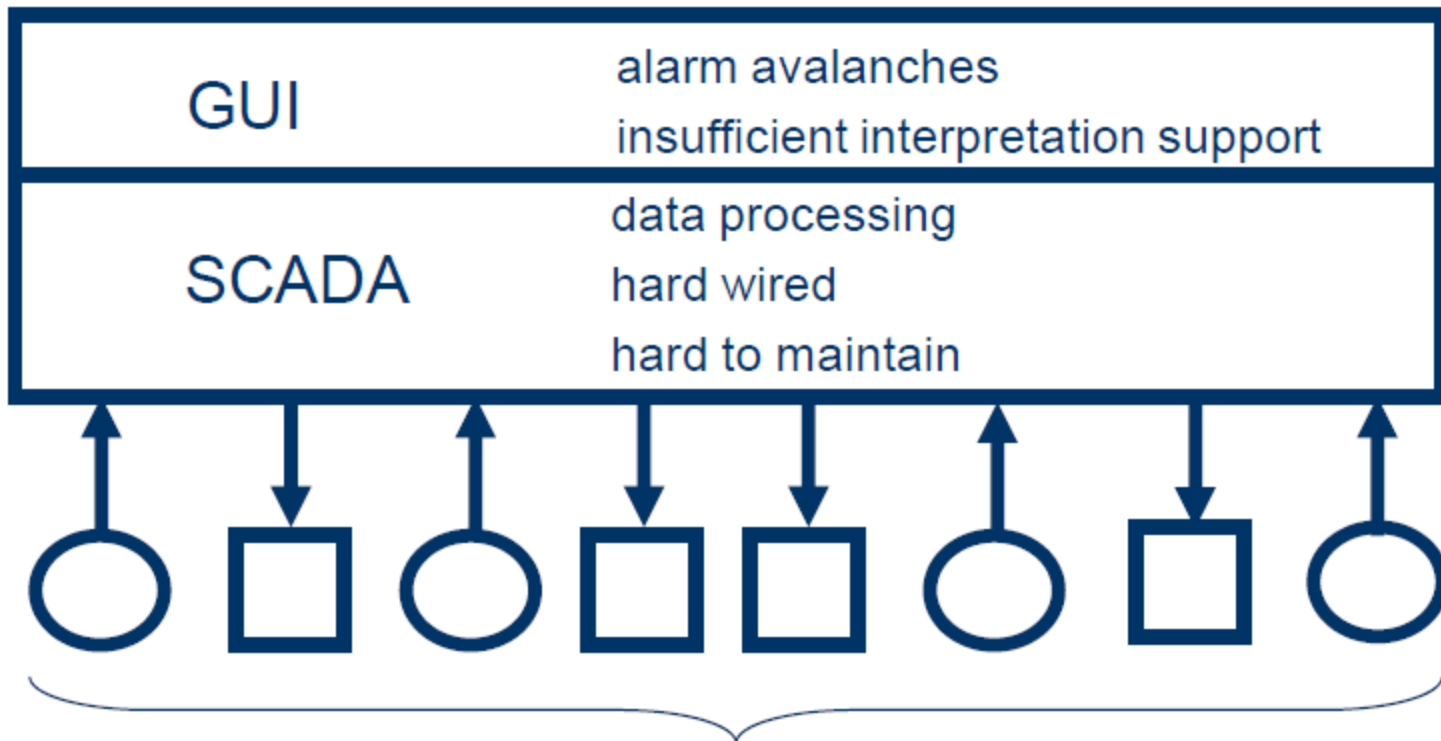
Increasing complexity

- 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.



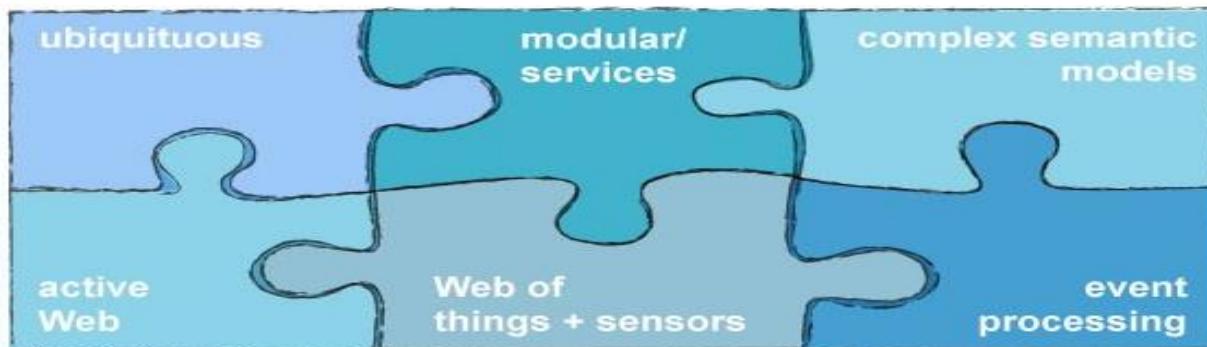
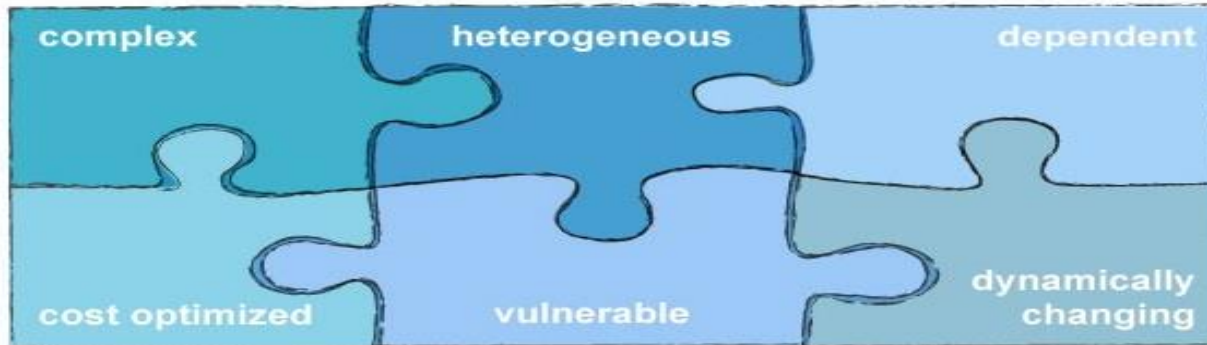
Current Situation



Sensors + actuators: different kinds, distributed, basic data

New Opportunities for Emergency Management

CRITICAL INFRASTRUCTURES



WEB / ICT TECHNOLOGIES

EMILI



Emergency Management in Large Infrastructures

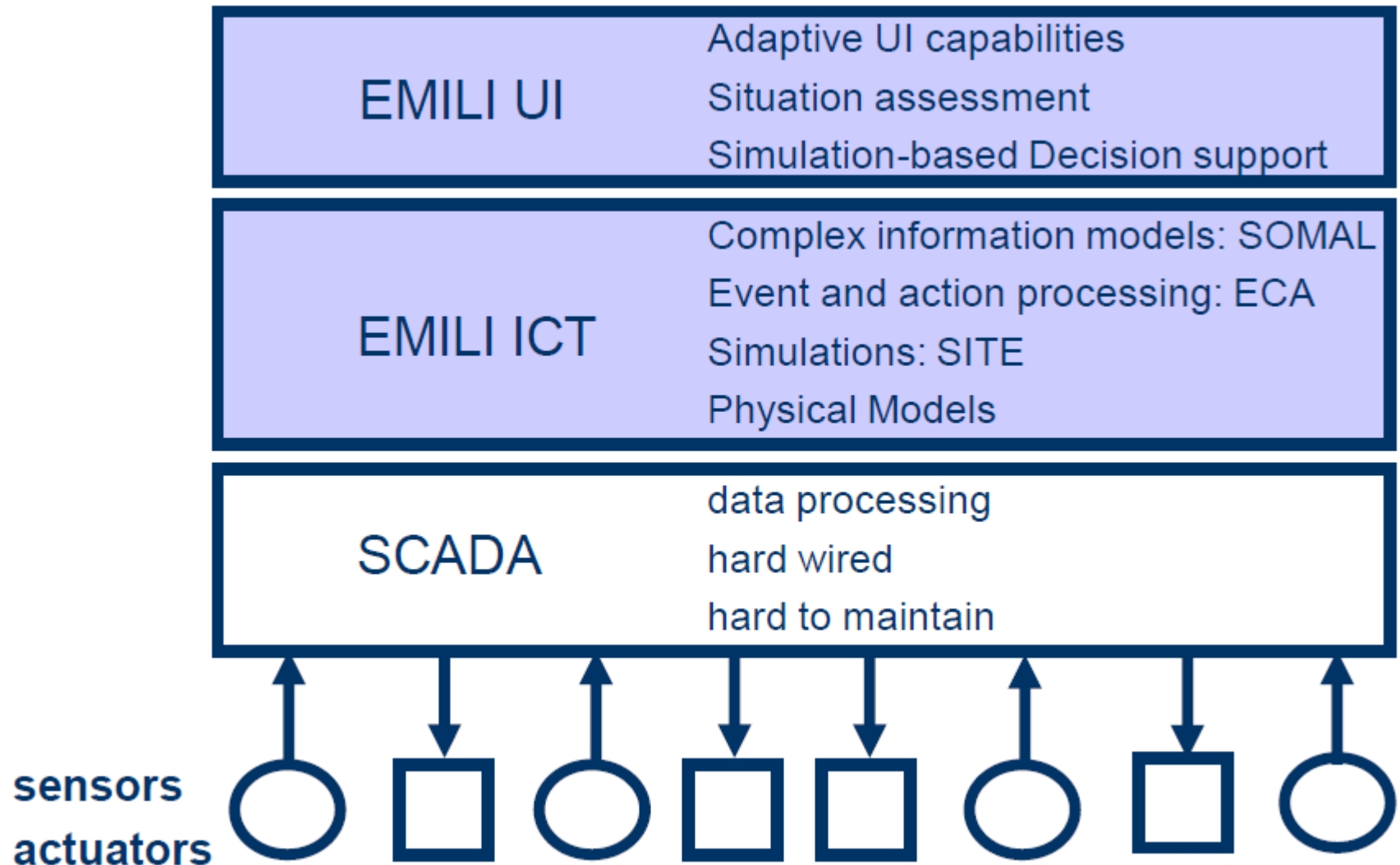
- Project co-funded by the European Commission
- Seventh Framework Programme (2007-2013)
- Project No. FP7-SEC-2009-1
- Period 2010-2012
- Total budget 4'004'055 €

Partners

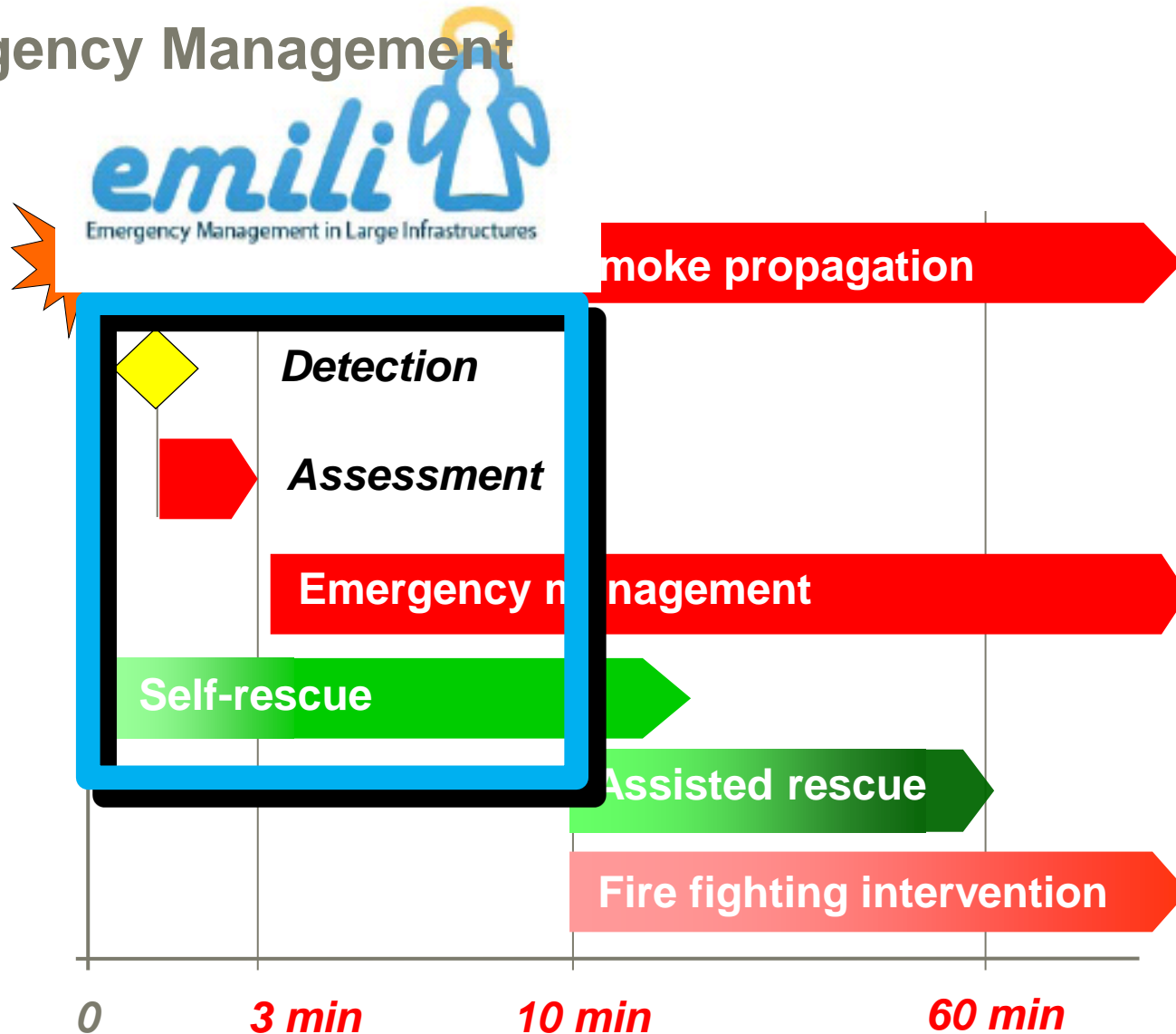
- Fraunhofer IAIS (Germany)
- SKYTEC AG (Germany)
- Amberg Engineering / ASIT AG (Switzerland)
- Stichting Centrum voor Wiskunde en Informatica CWI (Holland)
- Aplicaciones en Informática Avanzada AIA (Spain)
- LMU Ludwig-Maximilians University Munich (Germany)
- Institute Mihailo Pupin (Serbia)



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:

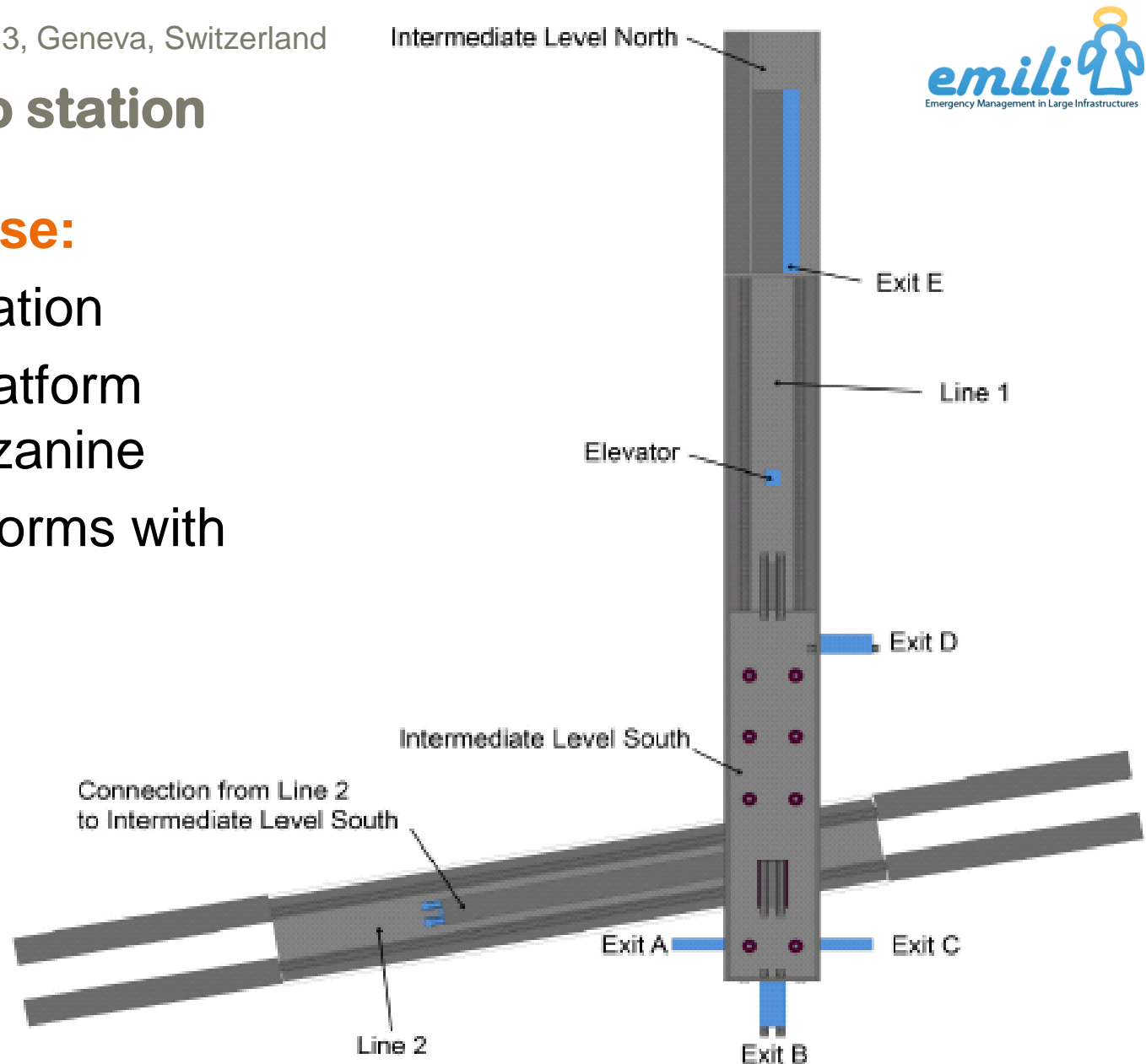
- Metro
- Airport
- Power grid



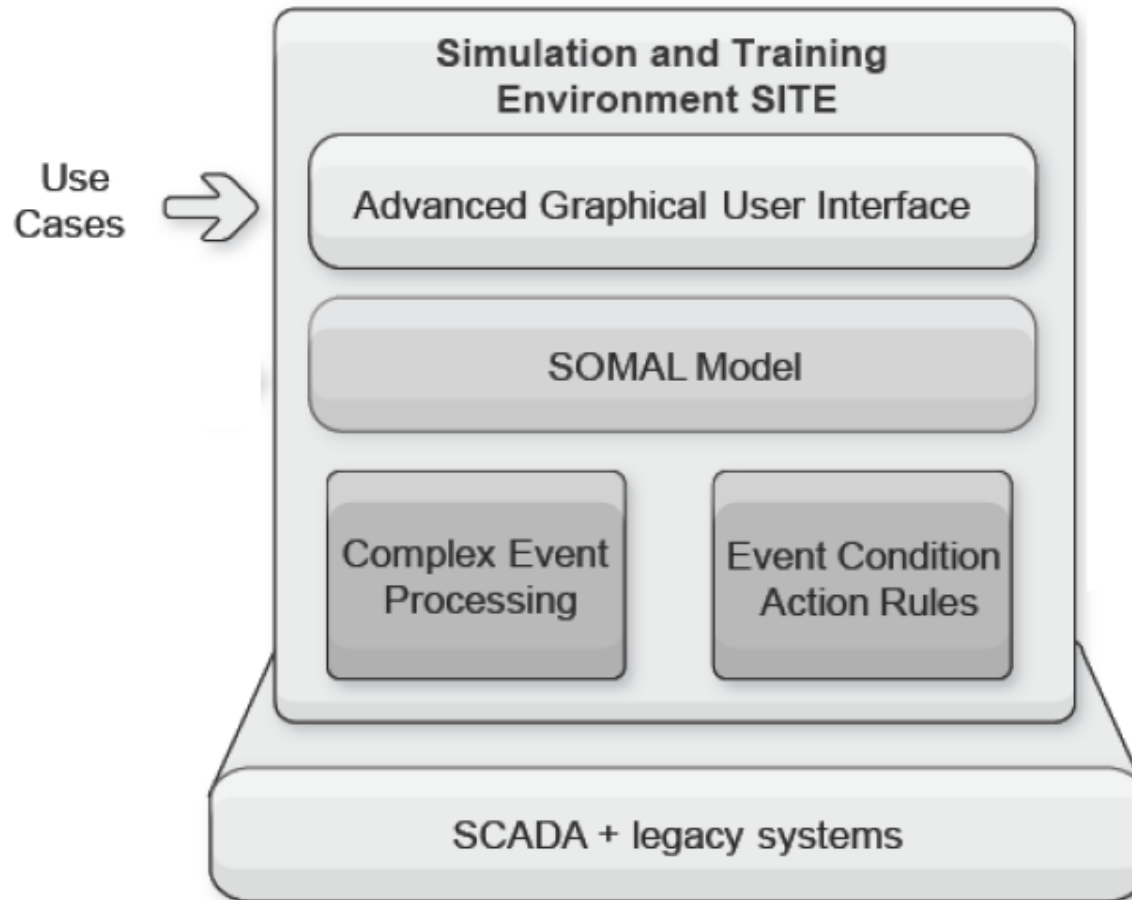
Layout Metro station

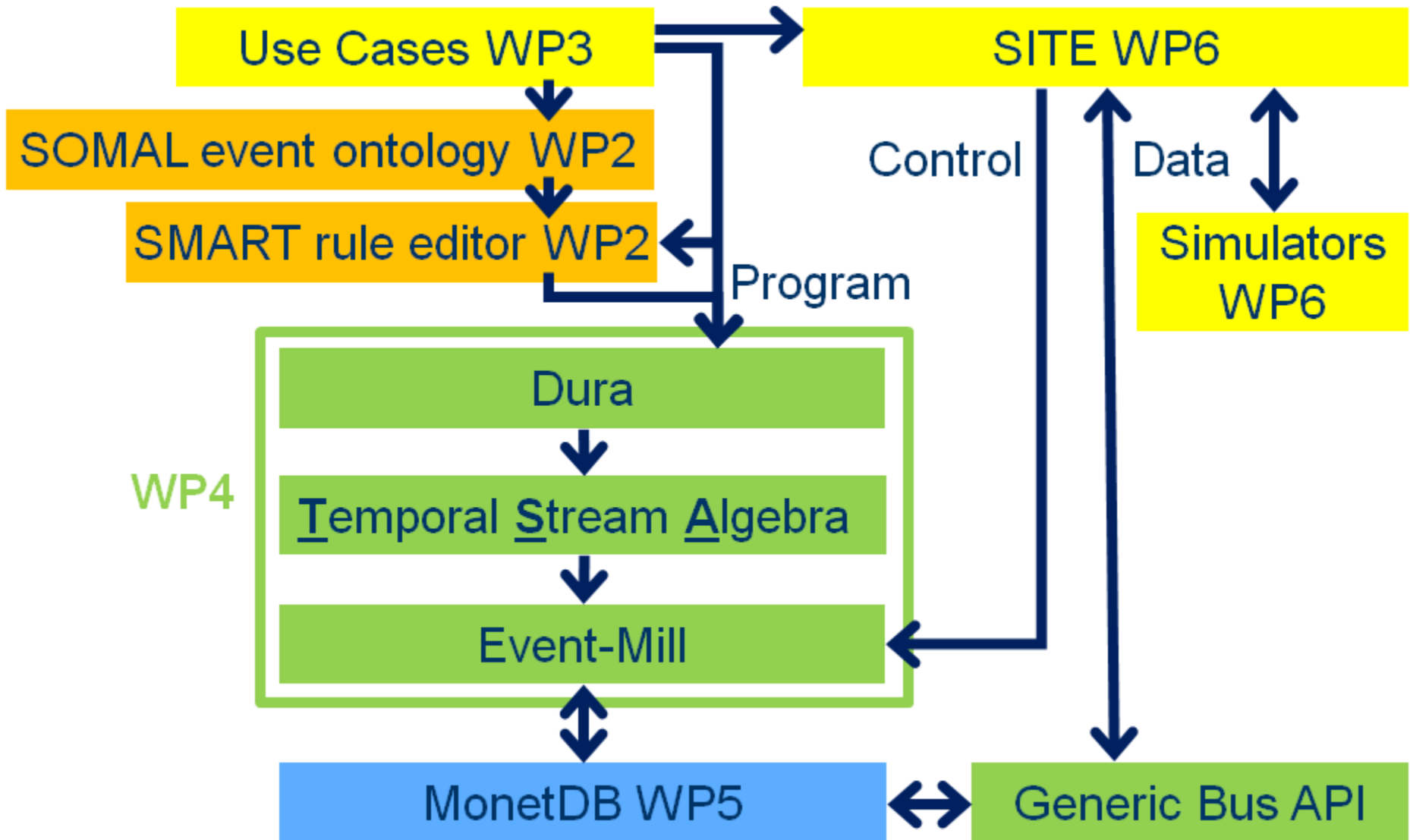
Metro use case:

- 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)**

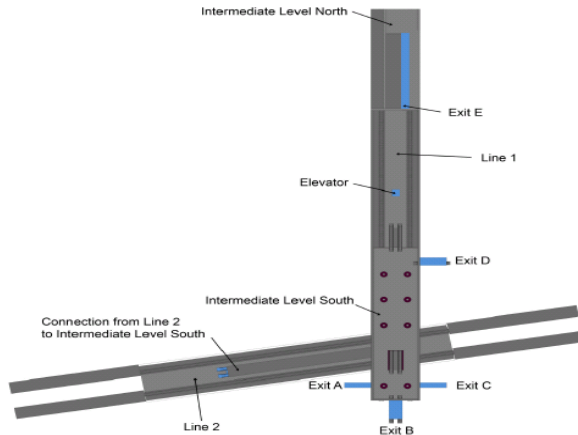
Use in R&D:

- 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

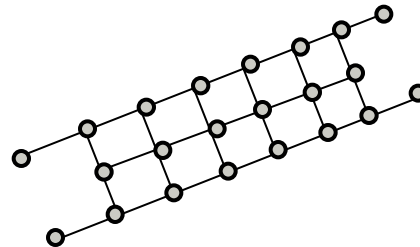
iSEM's Simulation Approach

- 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

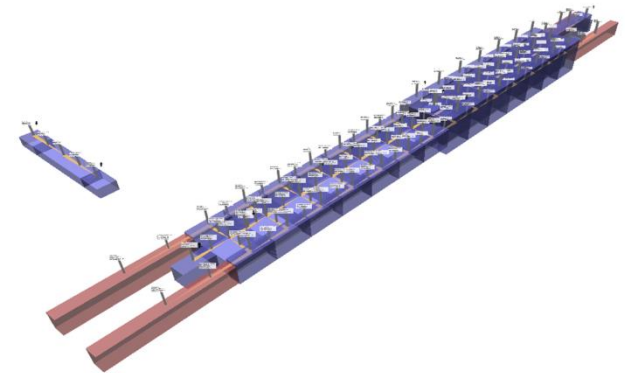


Real Model (Metro station)

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



iSEM Network Model

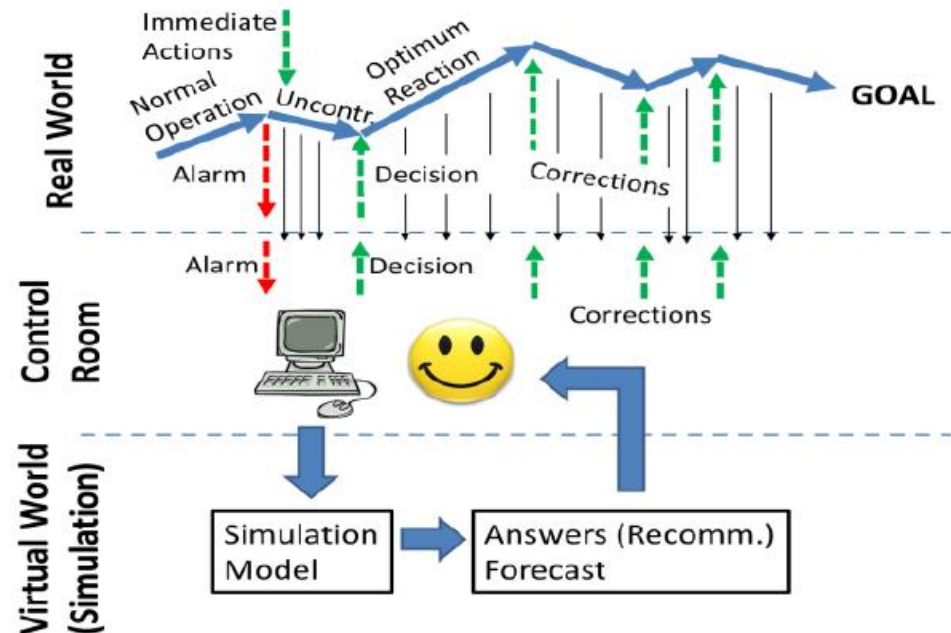


iSEM Visualization of Model

iSEM - Optimum EM Through Physical Simulation

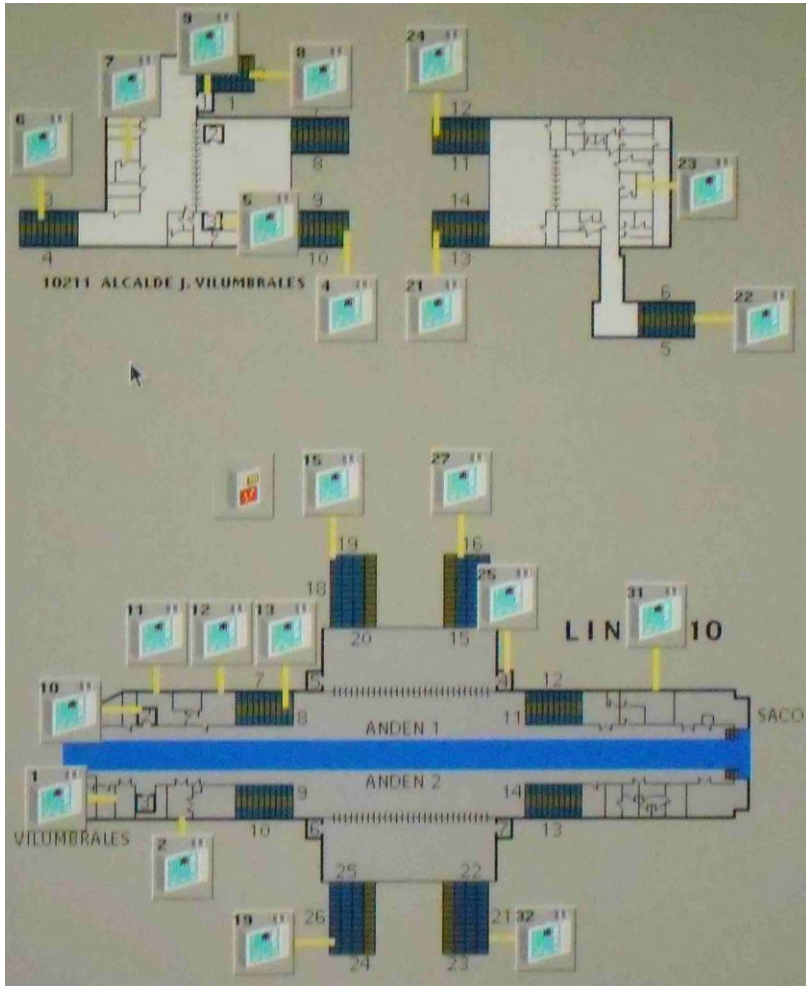
Objectives and Approach

- *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

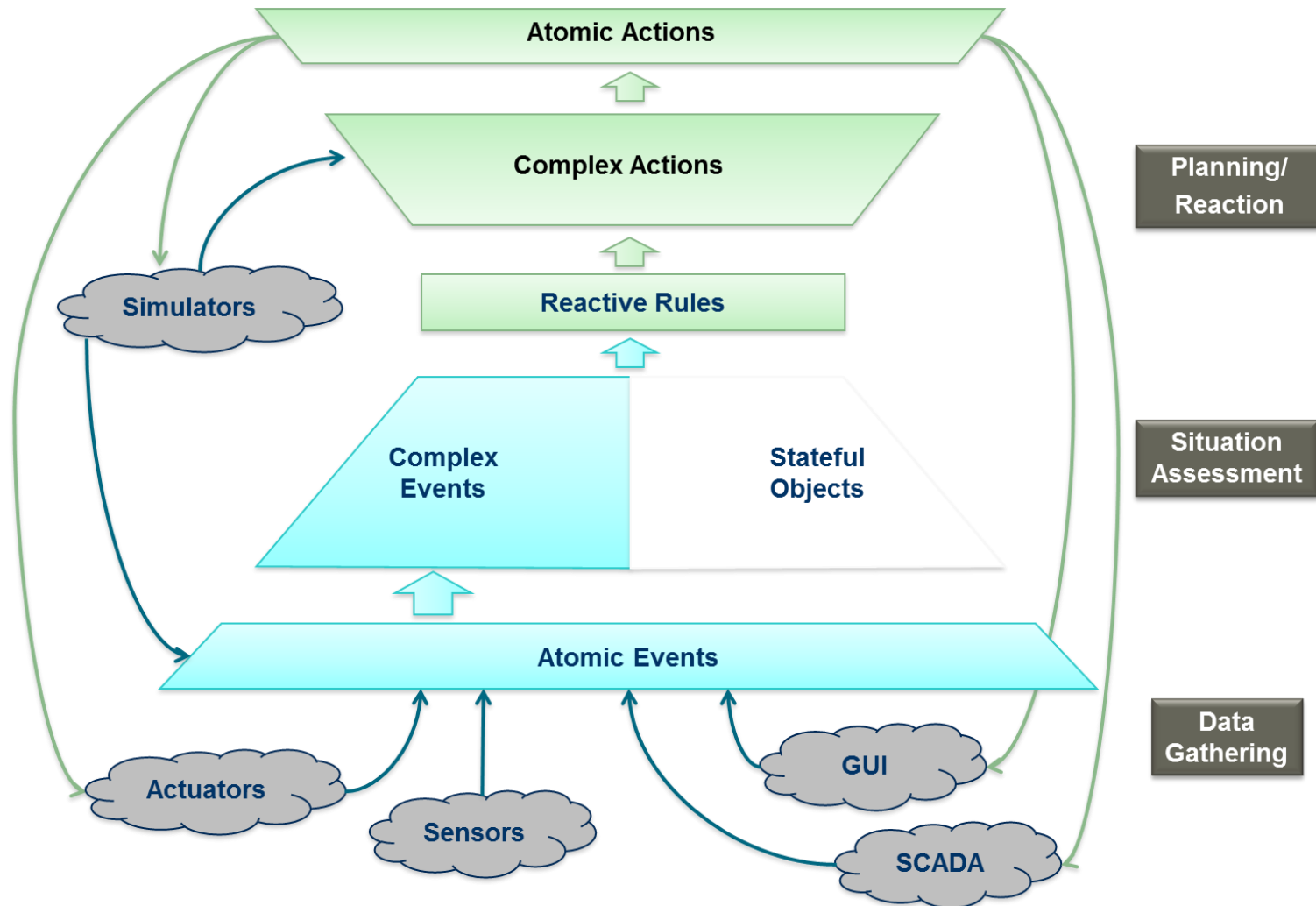
Info

32%

Alternat. 2

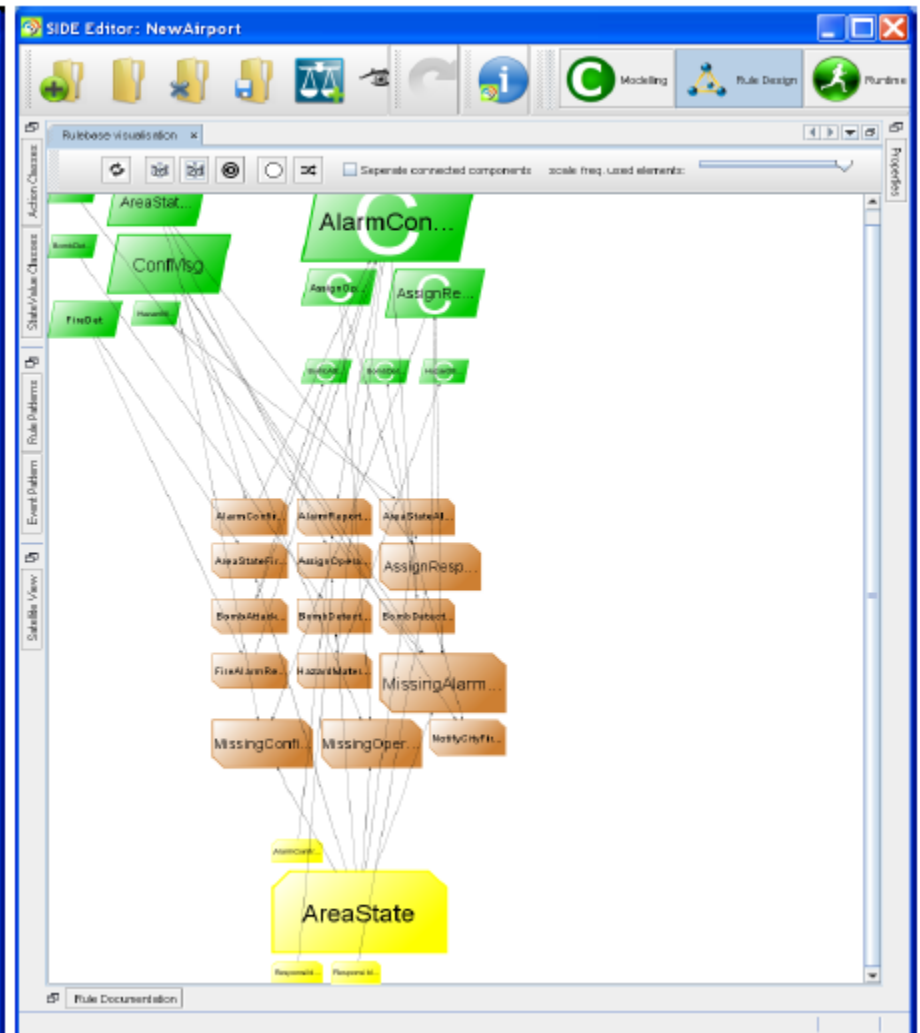
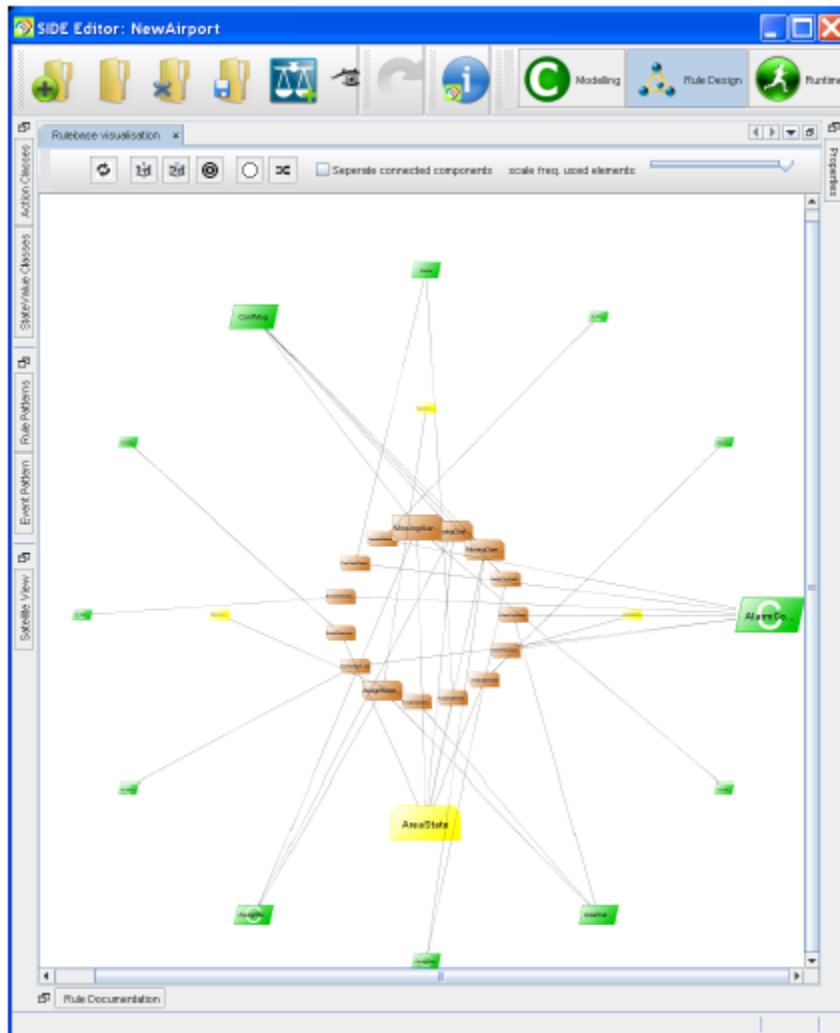
Info

DURA – Rule-Based Emergency-Management Language





SMART – Graphical Rule Editor



SMART – Graphical Rule Editor

The screenshot displays the SMART Graphical Rule Editor interface. The main window is titled "SIDE Editor: test". The top toolbar includes icons for file operations, a help icon, and tabs for "Modelling", "Rule Design", and "Runtime". The "Rule Design" tab is active, showing a rule editor with the following code:

```
17 Temperature {
18   sensor_id ( int ),
19   tempValue ( int )
20 }
21 END
22
23 output
24 EVENT
25   SimpleFire {
26     sensor_id ( int )
27   }
28 WITH
29   DETECT
30     SimpleFire {
31       sensor_id ( var var1 )
32     }
33   ON
34   and {
35     event e1 : Smoke {
36       sensor_id ( var var1 ),
37       smokeValue ( var e1_smokeValue )
38     },
39     event e3 : Temperature {
```

The right sidebar contains the "INSTANCE BROWSER" and "INSTANCE EDITOR". The "INSTANCE BROWSER" shows a list of instances for the "Scenario" class, including "atomic_action", "concurrent_action", "event_cascading", "single_ce_with_state", "single_complex_event", and "state_query". The "INSTANCE EDITOR" shows the details for the "single_complex_event" instance, including its name, events, description, rules, and states.

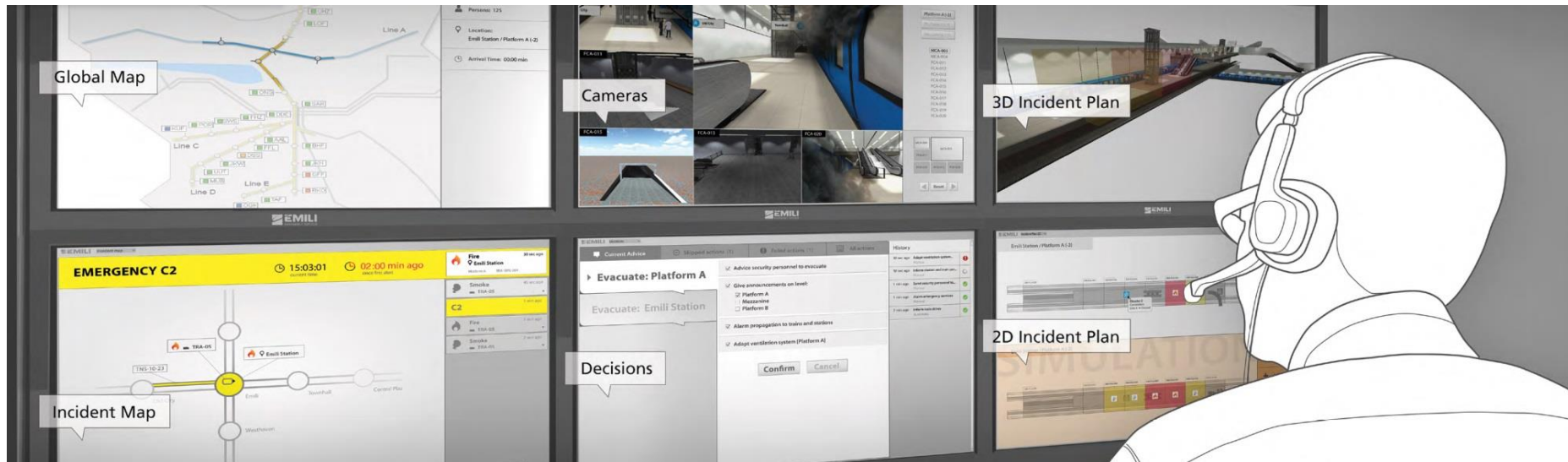
The bottom panel shows the "Output" console with the following text:

```
Running single_complex_event x Running error single_complex_event x Code Emition x
Switching to: example.single_complex_event:test1
For leaving type "quit"
Proposed step: "init", "start"
>start
Initialized
Started
Possible step: "stop", "quit"
>Compilation is successful.
```

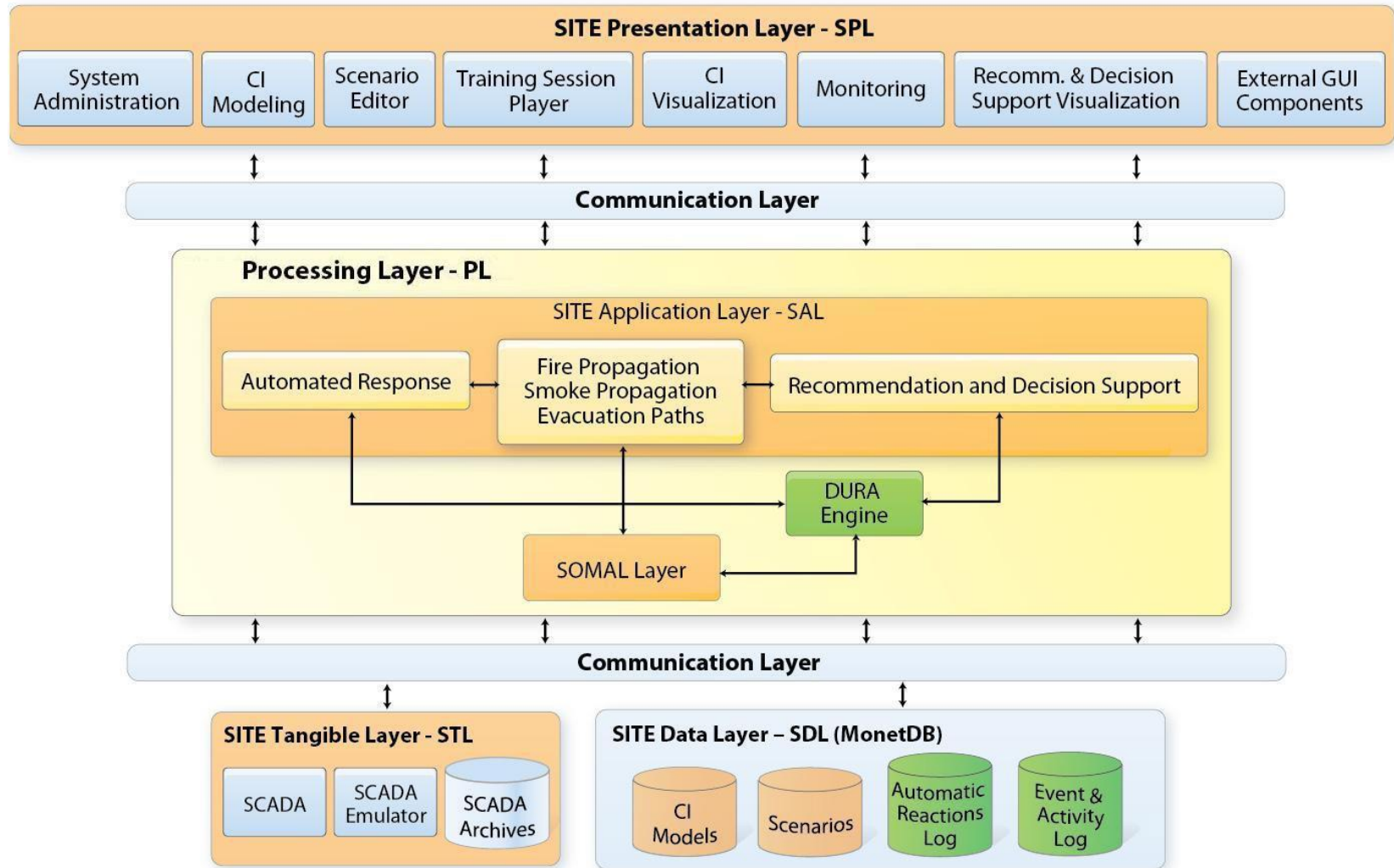
The status bar at the bottom right indicates "10 | 23 | INS".

ITA COSUF, 4 June 2013, Geneva, Switzerland

Metro – Emergency Advisor



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



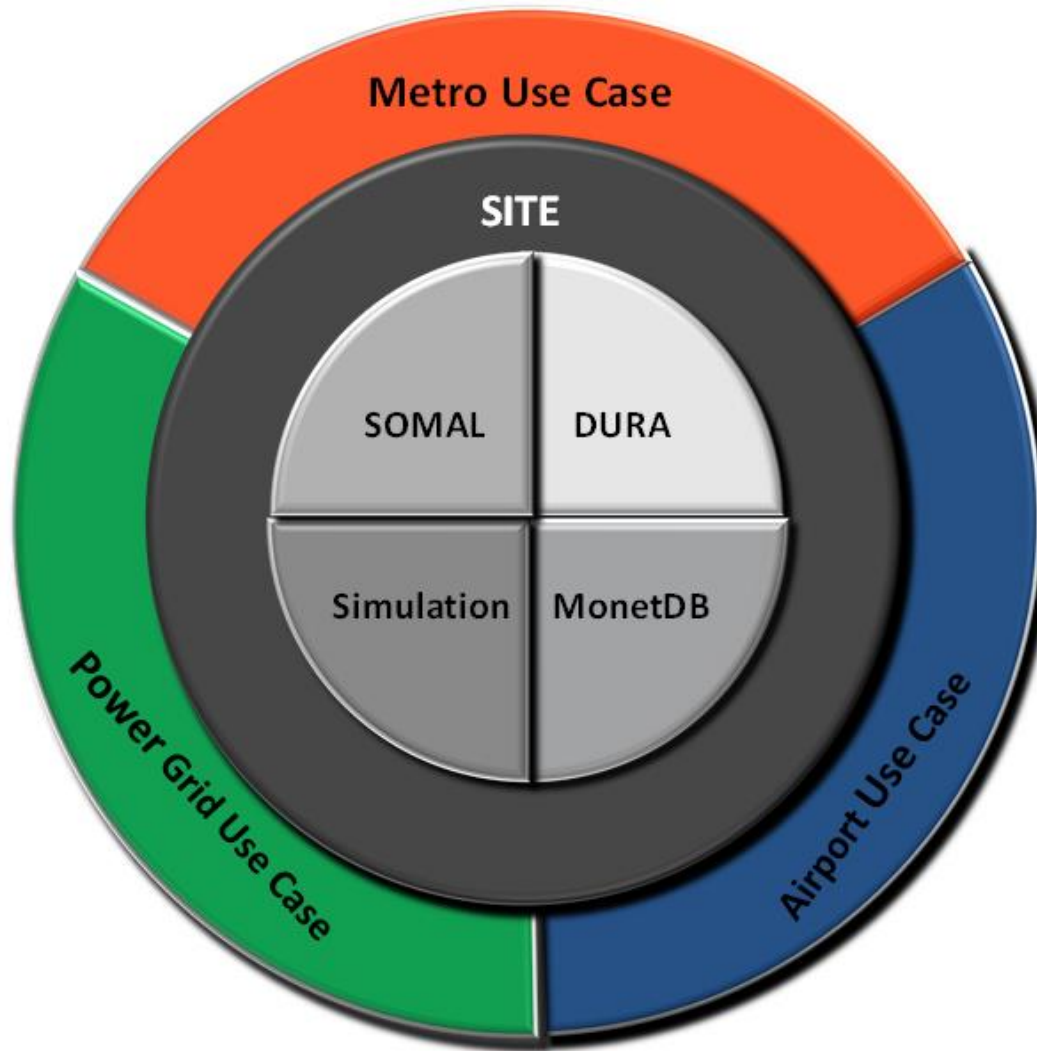
1. Approve / disapprove actions
2. Ask for explanations / justifications

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

