eSPONDER

A HOLISTIC APPROACH TOWARDS THE DEVELOPMENT OF THE FIRST RESPONDER OF THE FUTURE

Location, Date

Presenter's Name – Role

Company

- Origin of catastrophic events
  - Natural e.g. Katrina hurricane, Haiti earthquake
  - Technological e.g. Madrid bombing
- Example: natural disasters
  (*International Disaster Database - CRED*)
  - 300 millions of affected people; 80 000 deaths
  - 42 millions of persons moved in 2010
  - Increase of 60% in the last 20 years
  - $ 1 600 billions in 30 years
- Necessity to improve our management of large crises
  - Be prepared for the next disaster
  - Minimizing the uncertainty to minimize the loss of lives and the threatened area
  - Minimizing the costs
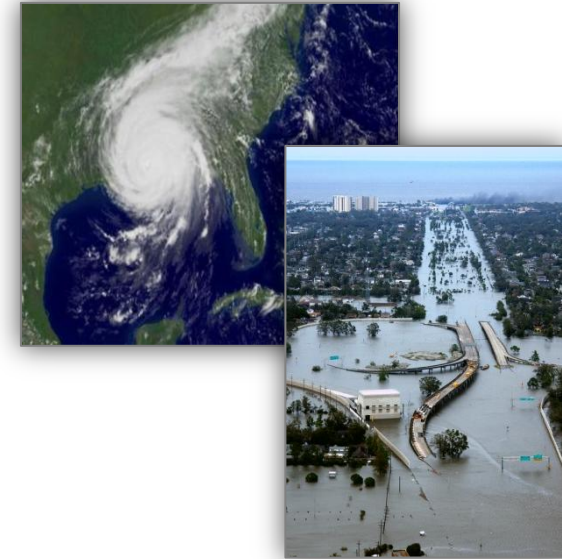
- Lack of interoperability & interchangeability
  - Between systems & equipment
  - At regional, national, European levels
- ICT support systems
  - Limited for FRs on field
  - Low consideration of emergency logistics
  - No or low use for training methods of FRs
- First Responders
  - No information on FR status (health / environment)
  - Lack of their precise localization
- Standardization in First Response Work & Emergency management
  - American literature
  - First steps in Europe

eSPONDER

- **Enhance the effectiveness of FRs operations**
  - Building of an independent and open, adaptable, and extensible platform with individual components put together in a loosely coupled way
    - → *Communications (voice, video)*
    - → *Information (data)*
  - Module of logistics of FR operations
    - → *Real-time*
    - → *Simulations*

- **Ensure the safety**
  - Of any FR
  - During all stages of an operation

- **Recognition of the socio-economic context & its impact**
  - Emerging training needs → *e*-training
  - Standardization & regulation issues → initial framework for FR approach in Europe

Holistic approach

Technology integration
   & development
Logistics
Regulation
Training

FLEXIBILITY

SEVENTH FRAMEWORK PROGRAMME

Characteristics

- 4-year project (01/07/2010 – 30/06/2014)
- Framework: FP7, SEC-2009.4.2.1: FR of the future
- 15 partners from 9 countries
- Budget: € 12 595 983 / EC funding: € 8 791 544

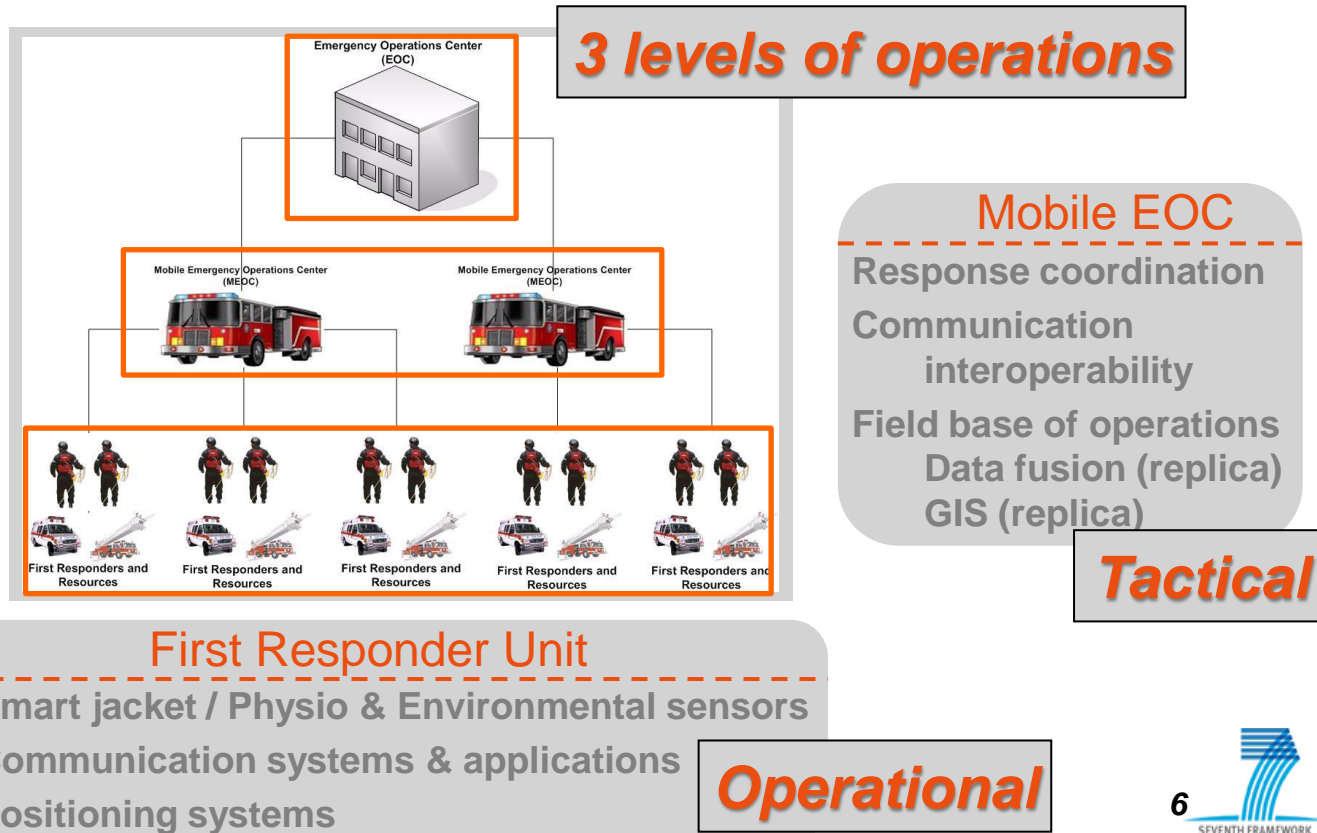*Coordinator:* EXODUS

2 end users

4 research institutes

9 industrial partners

eSPONDER

- Suite of real-time data centric technologies
  - → **Service Delivery Platform, with web portal**
    - Information & communication support to FRs during crisis
    - Improvement of control and coordination, synchronization between field units and command and control centers

3 levels of operations

Emergency Operational Center
- **Response planning, strategic view**
- **Communications**
- **Data fusion**
- **GIS**
- **Data bases**
  - **E-SPONDER portal**

Strategic

Mobile EOC
- **Response coordination**
- **Communication interoperability**
- **Field base of operations**
  - **Data fusion (replica)**
  - **GIS (replica)**

Tactical

First Responder Unit
- **Smart jacket / Physio & Environmental sensors**
- **Communication systems & applications**
- **Positioning systems**

Operational

Emergency Operations Center (EOC)

Mobile Emergency Operations Center (MEOC)   Mobile Emergency Operations Center (MEOC)

First Responders and Resources (×5)

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End users
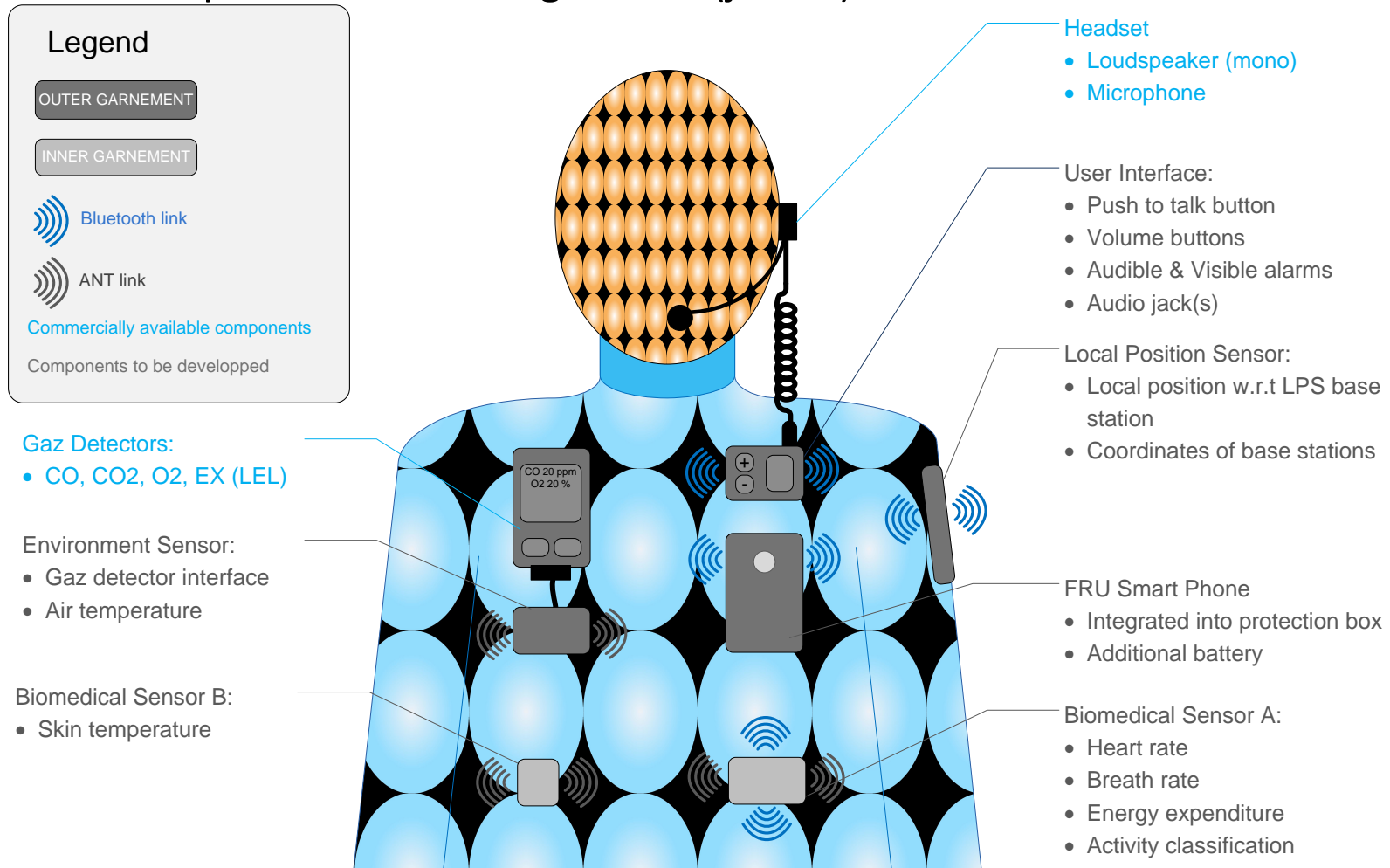
- **2 cores of actions**
  - **Primary core**: fire services, police, medical services
    → Rescue forces
  - **Secondary core**: all actors involved in the crisis resolution (on the field & out-of-theatre)
    - Forensics, NRBC
    - Municipalities, regional authorities
    - Homeland security agencies
    - Crisis management organizations
    - Weather services
    - Public health care, environmental care
    - Private companies with necessary expertise
    - Etc.

- **Key issue: *MODULARITY***
  - on the field → *mobile units*
  - at the back offices → *applications, systems, services*

First step
**Determination of the
*user requirements***

→ *Interviews of users from*
-Both cores
-Different countries

- Set of sensors for real-time measurements
  - Embedded in underwear
  - Adapted to the outer garment (jacket) → Rescue forces

Legend

OUTER GARNEMENT

INNER GARNEMENT

Bluetooth link

ANT link

Commercially available components

Components to be developped

Gaz Detectors:
- CO, CO2, O2, EX (LEL)

Environment Sensor:
- Gaz detector interface
- Air temperature

Biomedical Sensor B:
- Skin temperature

CO 20 ppm
O2 20 %

Headset
- Loudspeaker (mono)
- Microphone

User Interface:
- Push to talk button
- Volume buttons
- Audible & Visible alarms
- Audio jack(s)

Local Position Sensor:
- Local position w.r.t LPS base station
- Coordinates of base stations

FRU Smart Phone
- Integrated into protection box
- Additional battery

Biomedical Sensor A:
- Heart rate
- Breath rate
- Energy expenditure
- Activity classification

- Wearable computer

- Communication
  - Bluetooth
  - Wi-Fi
  - 3G/UMTS
  - GSM/GPRS
  - WiMax

FLEXIBILITY

- Positioning system
  - GPS/DGPS
  - LPS

- Specific applications
  - Maps & navigation (POI)
  - Data view (images, videos, etc)
  - Messaging & alerts
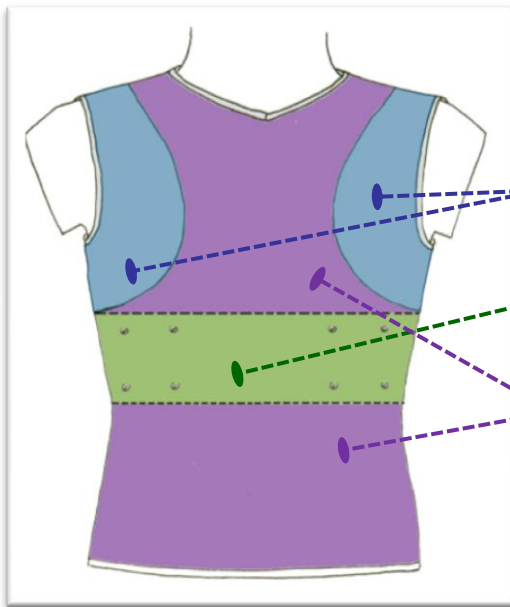 - Voice & video conferencing

Example of interface

FRU Menu

Alarms/ Notifications	Sensor Data
Navigation	Maps
Video	Audio
Emergency	Settings
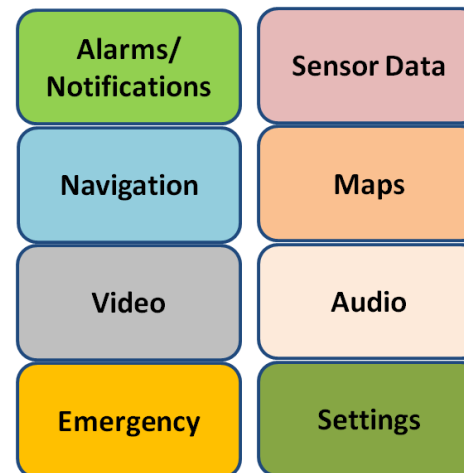
PROGRAMME
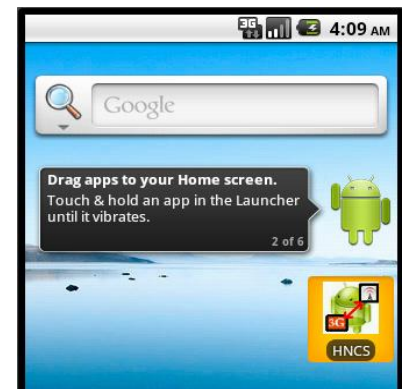
- ## Different fabrics for different functionalities

  - Electrodes integration functions of their shape and size

  - Signal quality functions of the electrodes location

Breathable zones
→ **improvement of climate comfort (for example net fabric)**

Elastic zone
→ **support of sensors, contact with skin**

Loose zones
→ **improvement of comfort (e.g. sponge fabric to drive sweat)**

Breathability
Elasticity
Climate comfort
Moisture handling

Example of sensors integration & underwear

- ## Different electrodes

  - Shape

  - Composition

  - Dimension
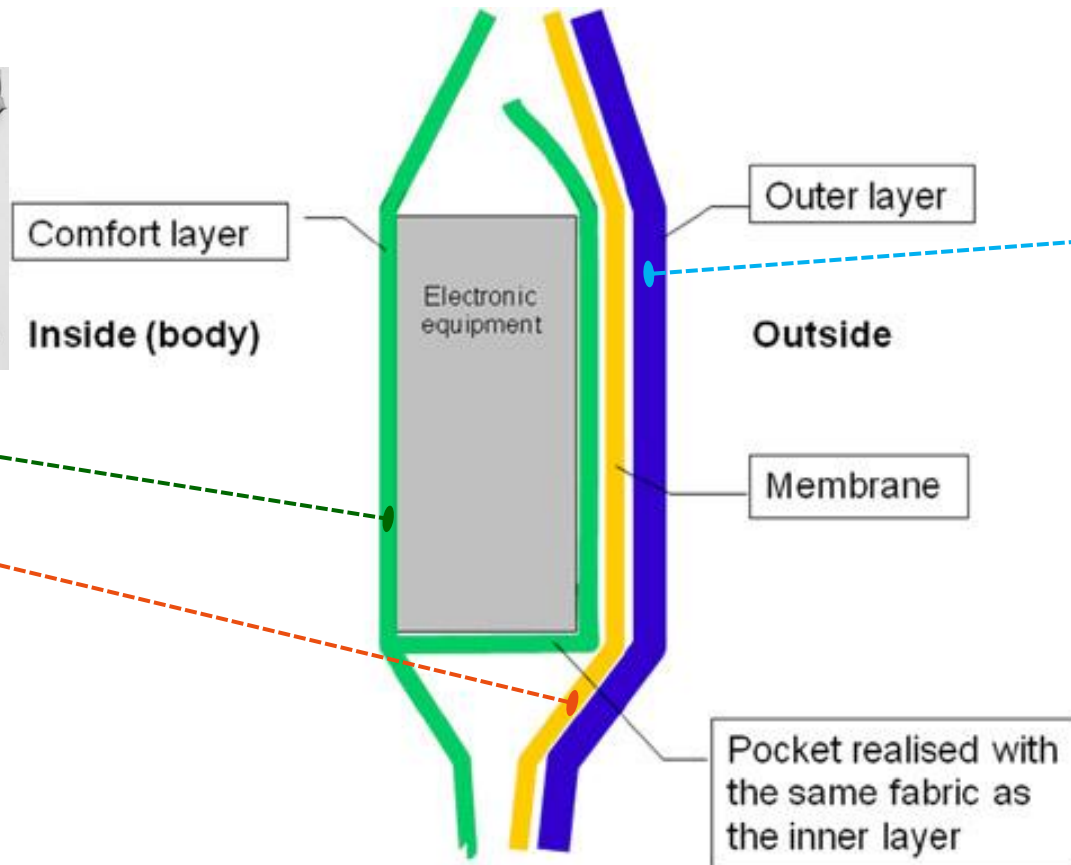
Examples of sensors

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- Multi-layer integration
- Recognition of
    - Encumbrance of standard instrumentation
    - User requirements

Comfort layer

Inside (body)

Electronic equipment

Outer layer

Outside

Membrane

Pocket realised with the same fabric as the inner layer
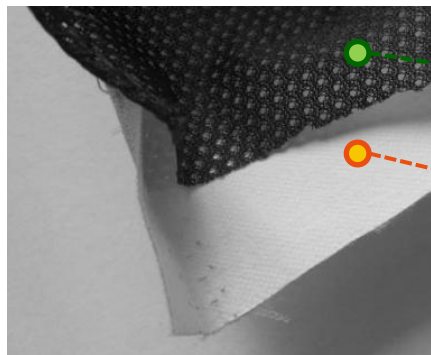
Laminated membrane

eSPONDER

Objectives

- Development of indoor localization of FRs
- Seamless integration with outdoor localization using GPS
- Monitoring of FRs at all times in all crises fields

> *Local Positioning System – LPS –*

Design and construction

- Deployment of LPS base stations (BS) on the field
- Equipping of FRs with mobile localizable sensors

Example of functioning
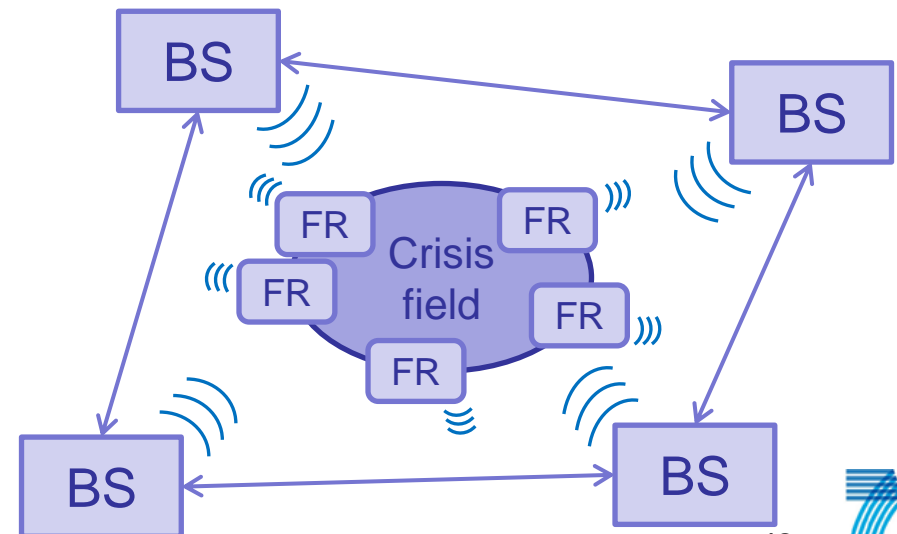
- Base of operations on field → partial replica of EOC
  - Mobile vehicle
  - Integration of necessary ICT components

- Communication interoperability
  - 3G/UMTS
  - Wi-Fi/WSN
  - WiMax
  - WPAN
  - VHF/UHF
  - TETRA
  - Satellite

INTEROPERABILITY AUTONOMOUS SYSTEM

- Specific tools
  - 3D interface
  - Sensors monitoring

The EOC

- **Base of operations** out of field
  - Integration of necessary ICT components

- **Communication**
  - 3G/UMTS
  - Wi-Fi
  - WiMax
  - VHF/UHF
  - TETRA
  - Satellite

- **Specific tools**
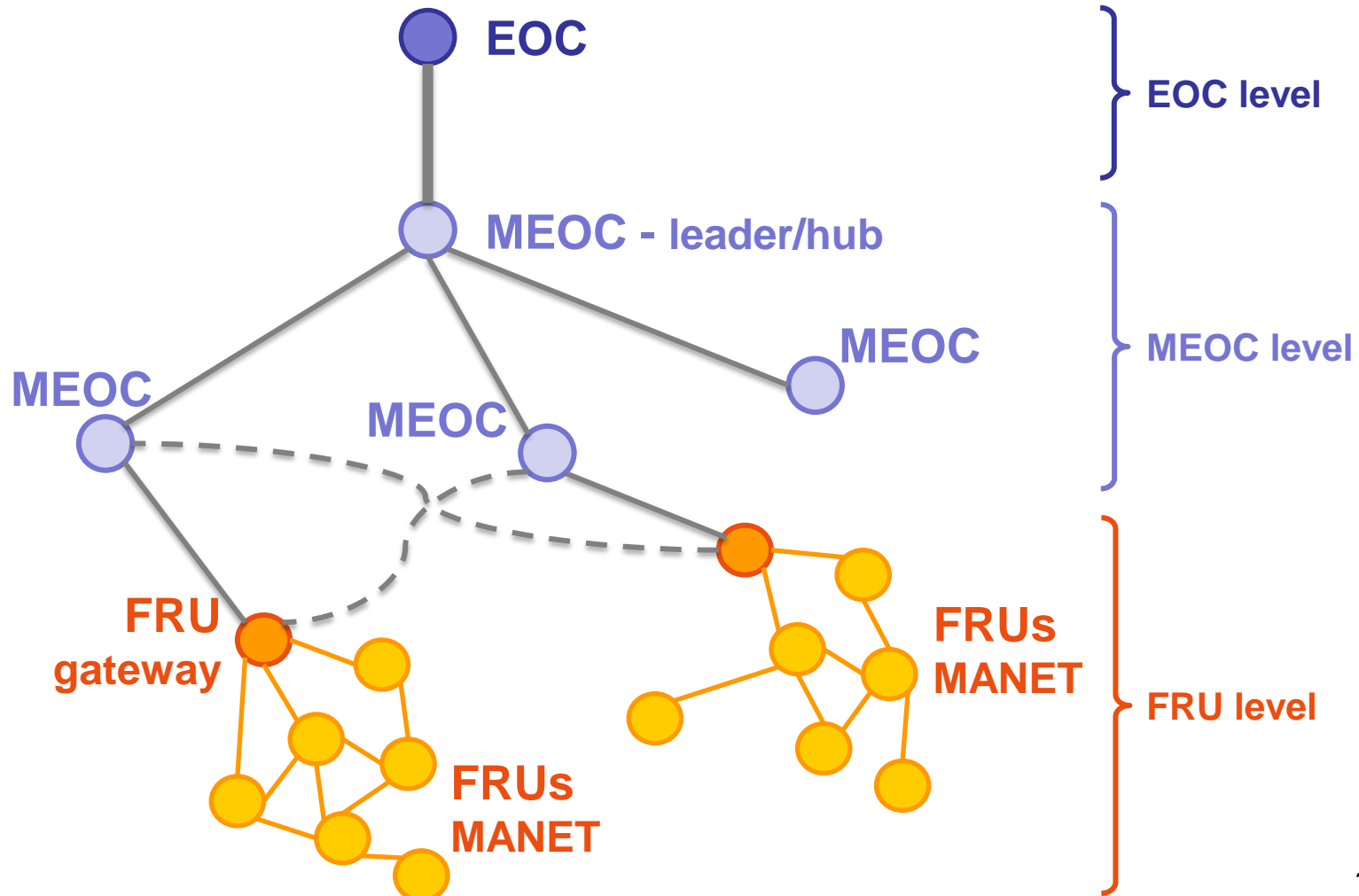 - 3D interface
  - GIS platform
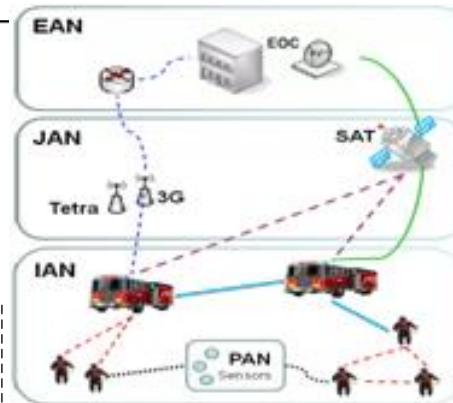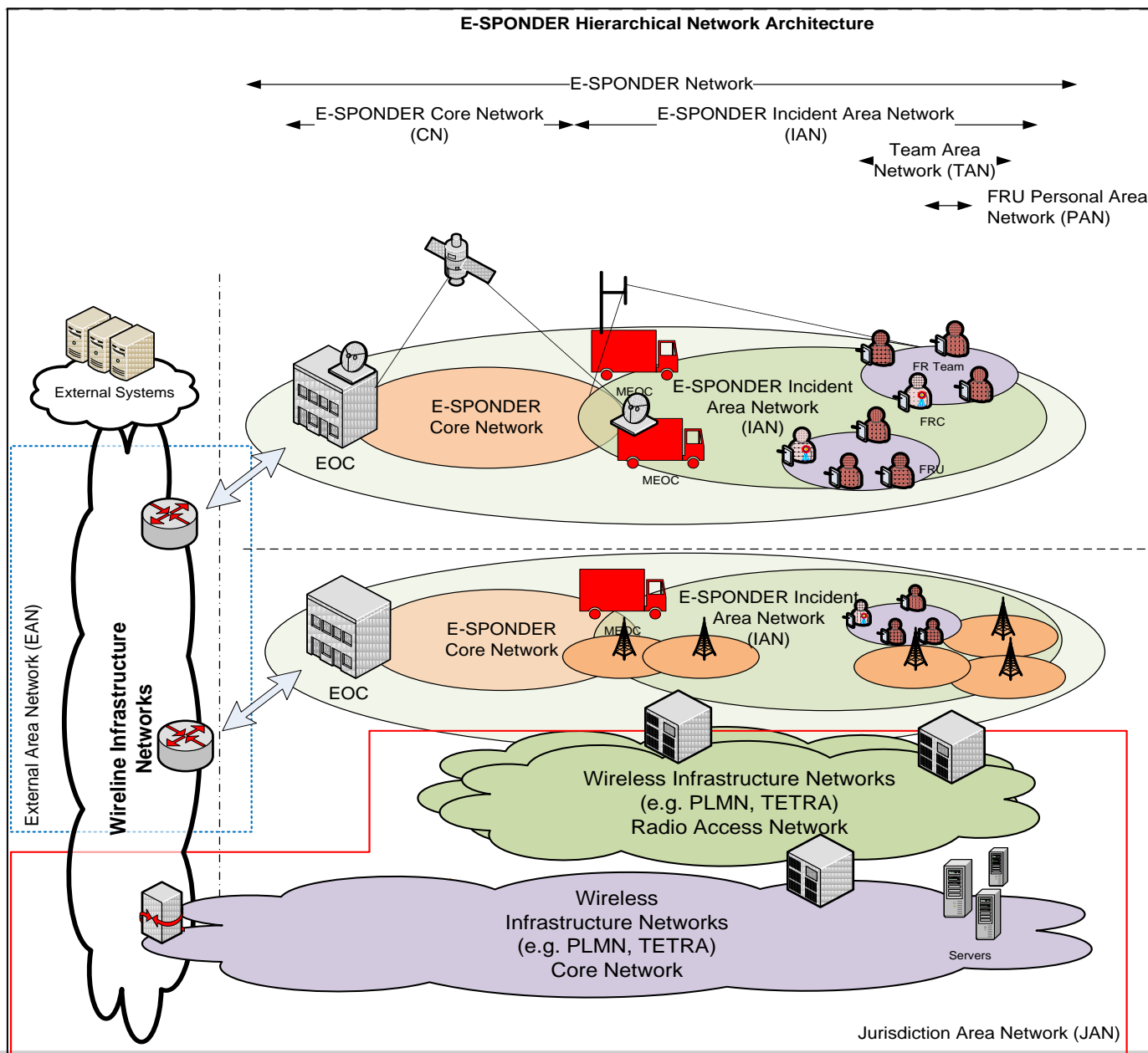 - Data fusion

French EOC

Dutch EOC

- Point-to-point or -multi-point communication (group)
- 3 levels

Network architecture
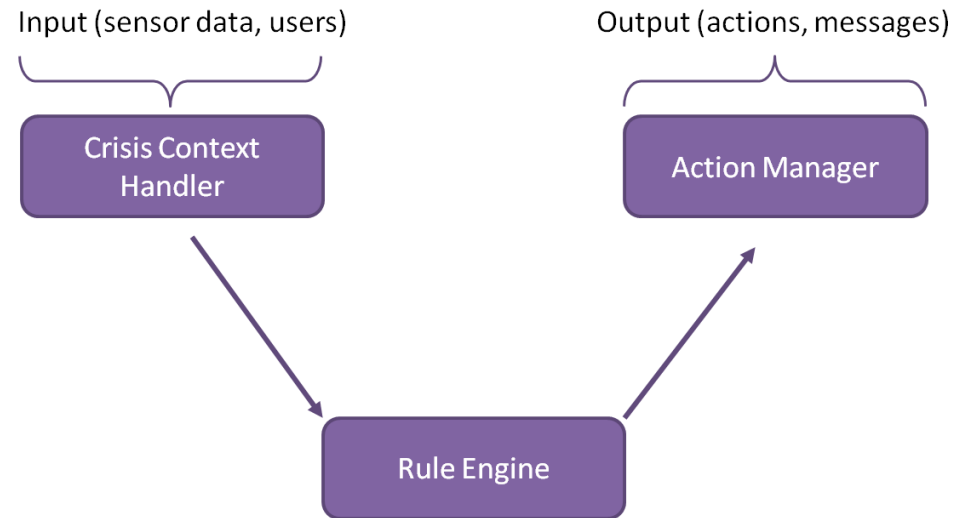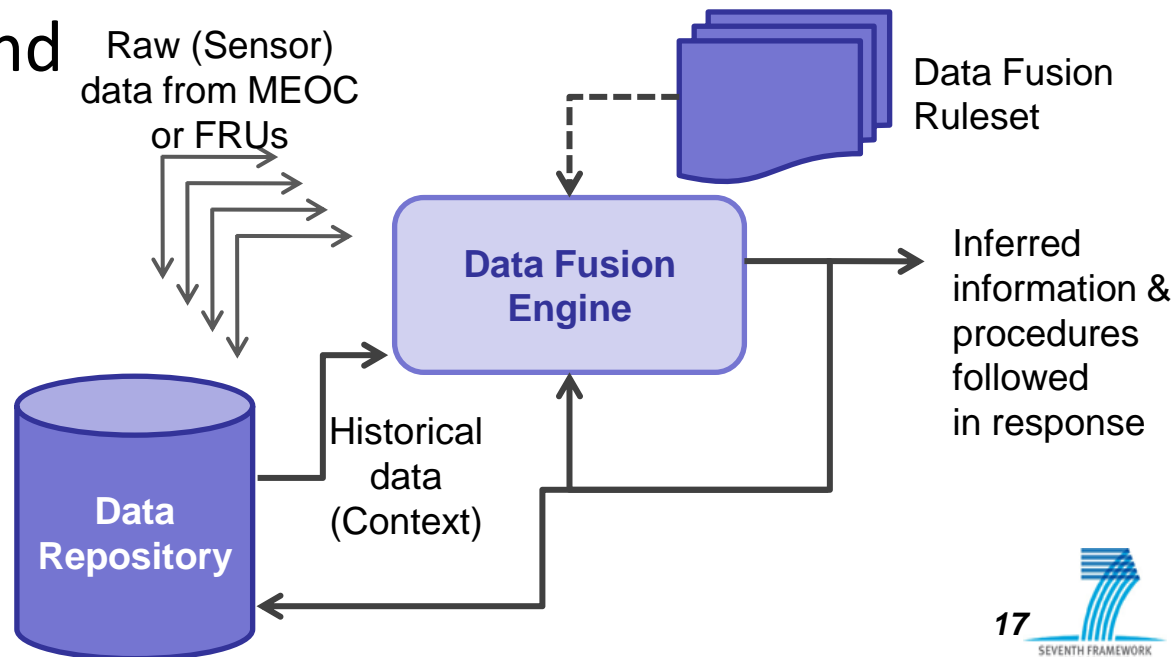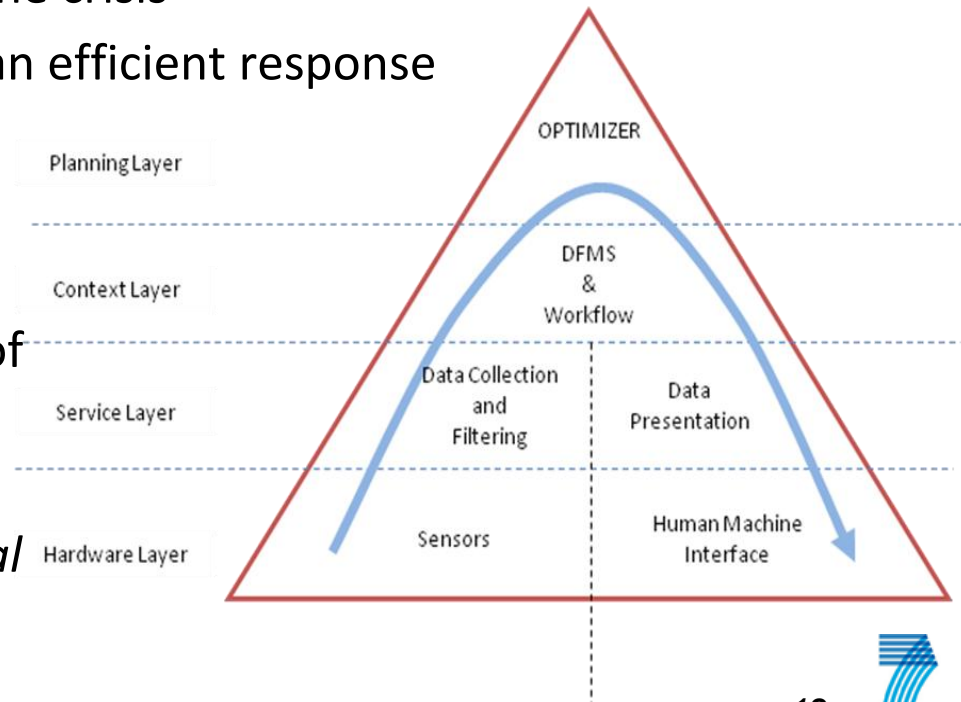
Data fusion

- Multi level data fusion
  - Collection & gathering of data
  - Filtering
  - Combination
  - Analyze
  - Use in applications

- Integrated end-to-end decision support system

Input (sensor data, users)

Output (actions, messages)

Crisis Context Handler

Action Manager

Rule Engine

Raw (Sensor) data from MEOC or FRUs

Data Fusion Ruleset

Data Fusion Engine

Inferred information & procedures followed in response

Data Repository

Historical data (Context)
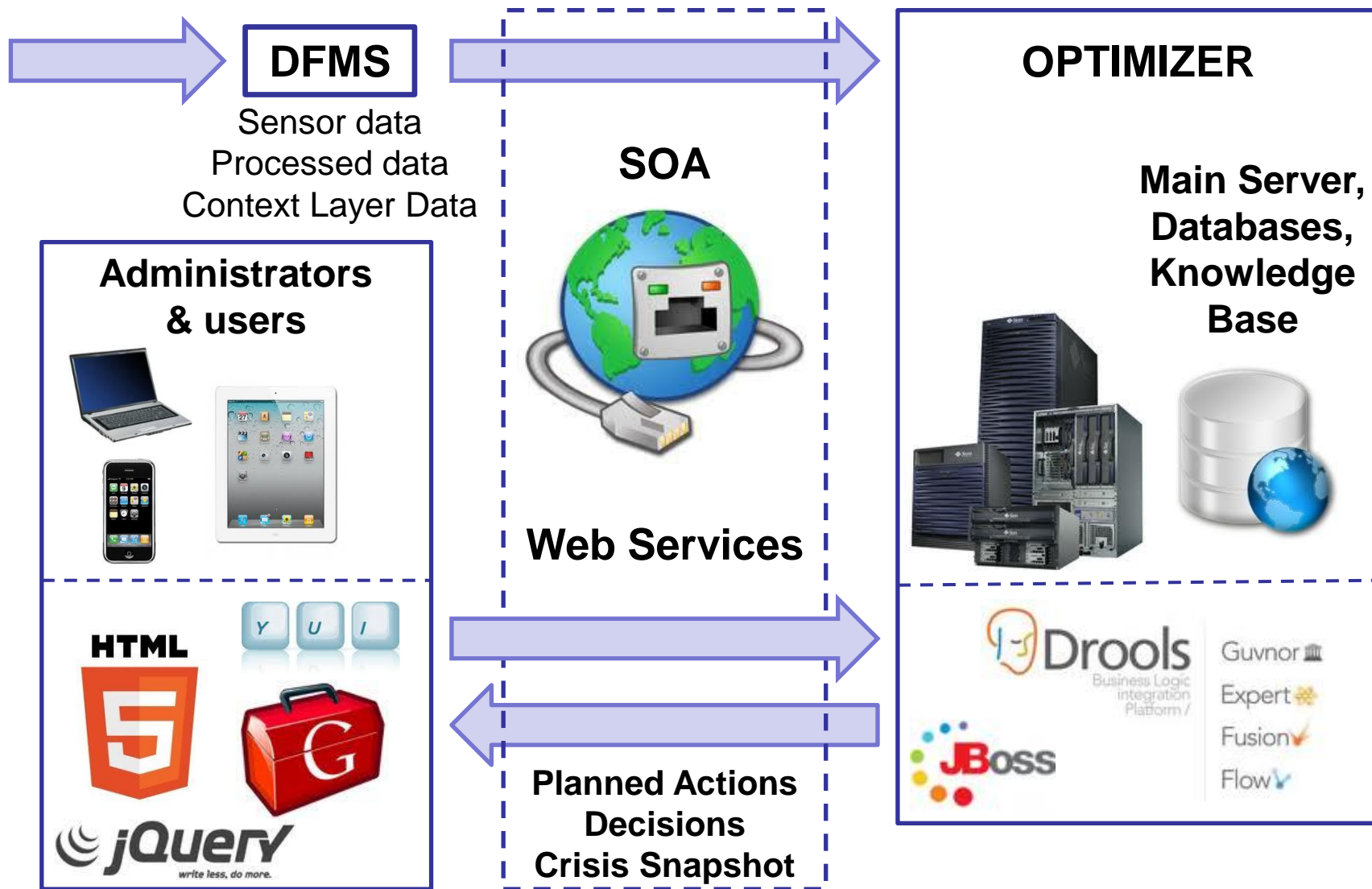
SEVENTH FRAMEWORK PROGRAMME

- Set up of the OPTIMIZER tool for Emergency Logistics
  (OPTIMIZation of Resources and Logistics for Emergency and Recovery First Operations)

- Building of the Crisis Snapshot or situation awareness
  - Quick location of affected areas
  - Gathering of information on the crisis
  - Consolidation of it to ensure an efficient response

- Production of the Action Response Plan
  - Organization & optimization of humanitarian aid missions

  e.g. list of operations to be executed in a timely sequential order and optimizing the available resources

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OPTIMIZER architecture

eSPONDER

Rose vision

Resources database

Repository of models

DFMS

User Interface

Web services

JBoss

Drools Expert
Rule Engine

Drools Guvnor
Knowledge Management

Drools Flow
Modeling business processes

Input data

Output data

Core supervisor

Knowledge Rules

Drools Fusion
Pattern analysis and events. Time restrictions in rules

Drools Planner
Automated planning

Meteorological data

GIS data (satellite based)

SEVENTH FRAMEWORK PROGRAMME

OPTIMIZER data flow

DFMS

Sensor data
Processed data
Context Layer Data

SOA

OPTIMIZER

**Main Server,
Databases,
Knowledge
Base**

**Administrators
& users**

Web Services

**Planned Actions
Decisions
Crisis Snapshot**

eSPONDER

External Data

Static Model

Data Gathering

Static & Temporal Model

PORTAL

Static & Temporal Model

Crisis Snapshot

• FRU
• MEOC

Crisis Information Context

Processing (DFMS/OPTIMIZER)

Field Data

Crisis Field

1....
2....

Static & Temporal Model

Crisis Action Plan

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EOC Crisis Snapshot

MEOC_1 Crisis Snapshot

MEOC_1

MEOC_2 Crisis Snapshot is augmented with part of MEOC_1 data (explicitly requested)

FRs

FRs

EOC

MEOC_2

MEOC_2 Crisis Snapshot

Legend

	Generic information element (Sensor Measurement, User Input etc.)
	FRU (under MEOC_1) Sensor Measurements
	FRU (under MEOC_2) Sensor Measurements
	MEOC_1-related EOC operator input
	MEOC_2-related EOC operator input
	MEOC_1, MEOC_2 input from ICs or in-vehicle operators

Real-time Communication

- **Types**
  - Voice
  - Video
  - Group communication

- **Main characteristics**
  - Robustness & flexibility
  - Security
  - Convergence at the network layers
  - Hierarchical SIP-based infrastructures for Voice & Video over IP services
  - SIP-based mobility support for the FRs mobiles

- **Performance evaluation**
  - Network & Services
  - Simulations

The user interface

- **Map view**
    - Operational view (FR/MEOC) → Local scale (e.g. building, sector)
    - Tactical view (MEOC) → Incident scale
    - Strategic view (EOC) → Regional scale
- **Layers**
    - Resources & actions (human, material)
    - POIs (e.g. hospitals, emergency entities)
    - Integrated applications of E-SPONDER (e.g. voice call by clicking on a FR)
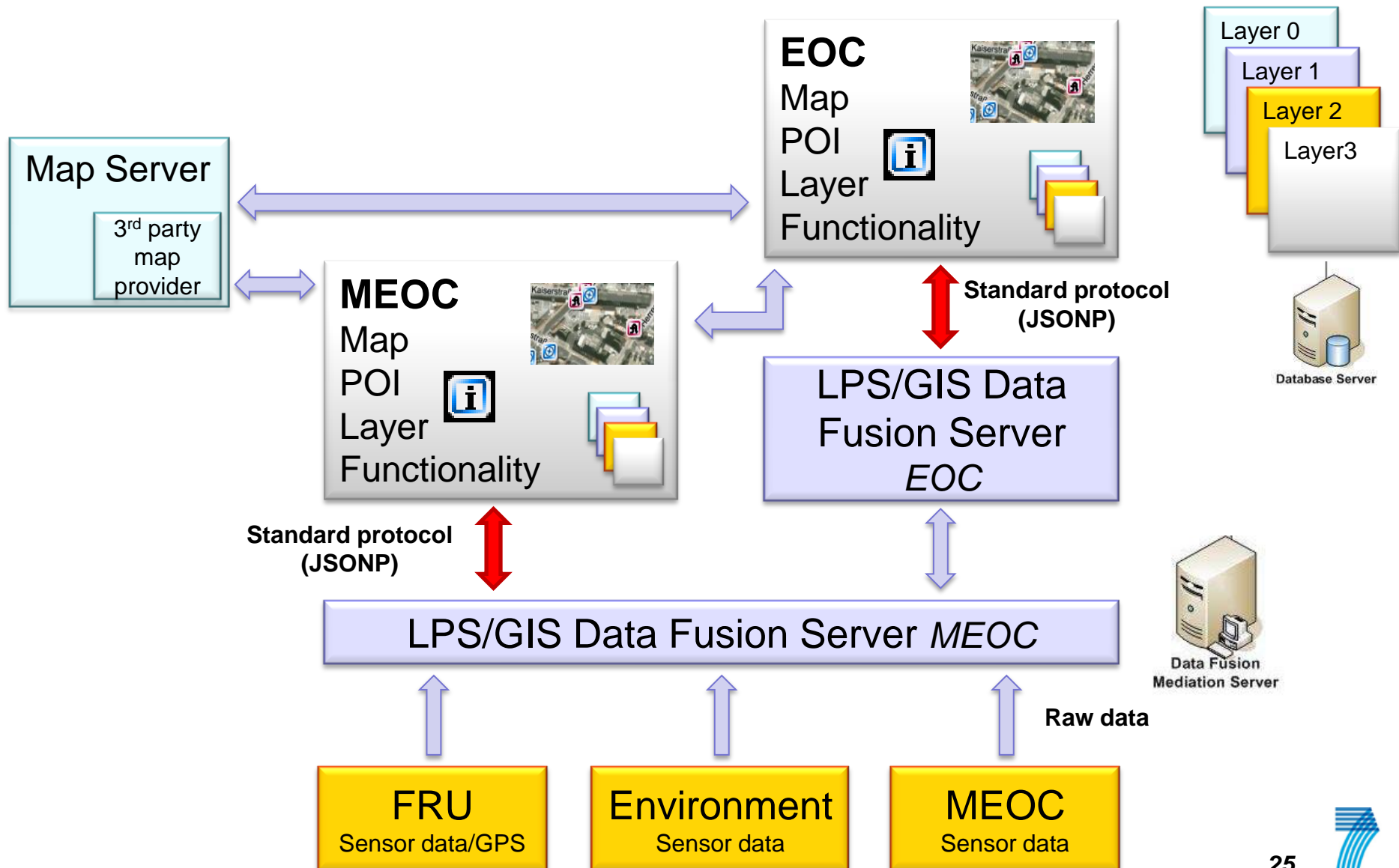   - Hand-written notes, hand-drawn sketches
- **Web-based E-SPONDER portal (2D)**
- **Text view**
    - Journal view, listing all events in a chronological order
    - Report view, web publishing interface to enable quick development of reports during crisis
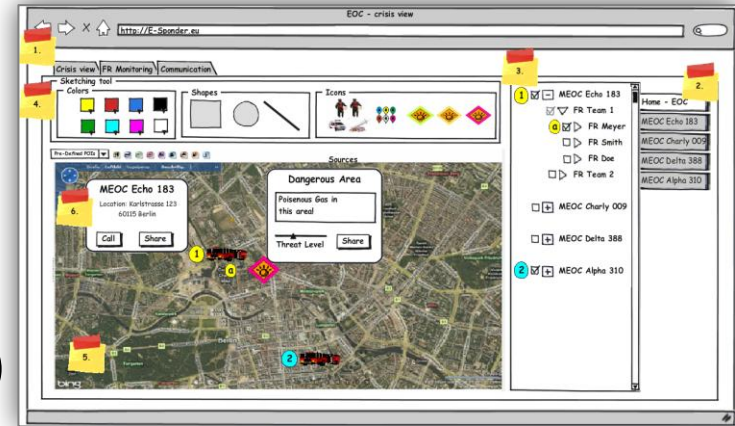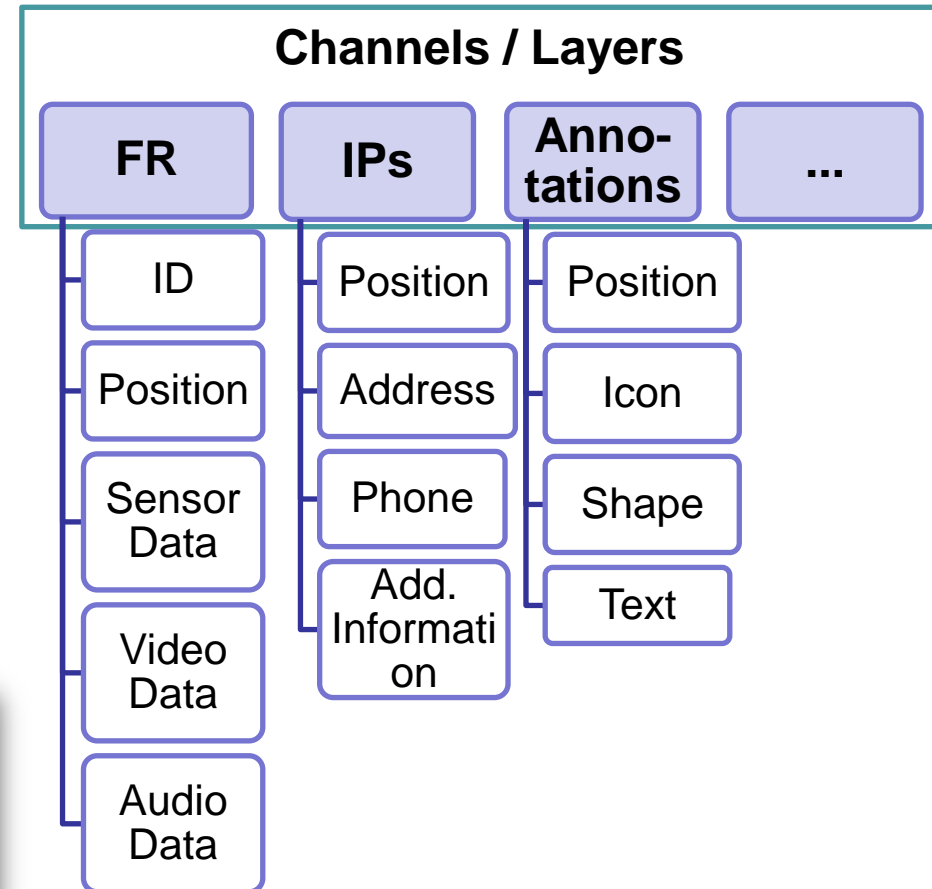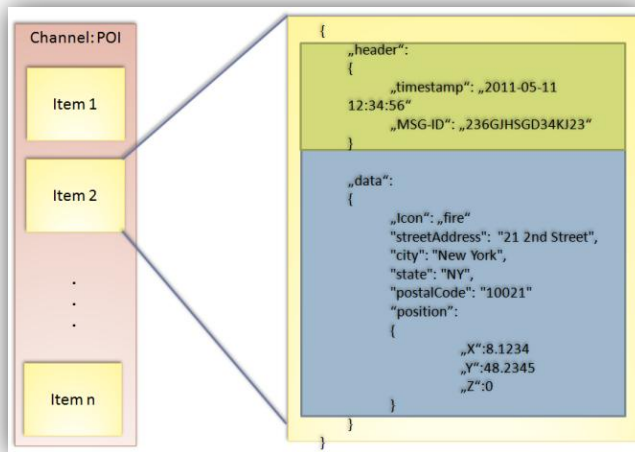
The user interface: design

YellowMap

EOC
Map
POI
Layer
Functionality

Layer 0
Layer 1
Layer 2
Layer3

Database Server

Map Server

3rd party map provider

Standard protocol (JSONP)

MEOC
Map
POI
Layer
Functionality

LPS/GIS Data Fusion Server *EOC*

Standard protocol (JSONP)

LPS/GIS Data Fusion Server *MEOC*

Data Fusion Mediation Server

Raw data

FRU
Sensor data/GPS

Environment
Sensor data

MEOC
Sensor data

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eSPONDER

YellowMap

- # Communication protocol
  - Categorization of POI data
  - Representation of data for general data interfaces

- # Protocol examples
  - JSON-based communication protocol recommendation
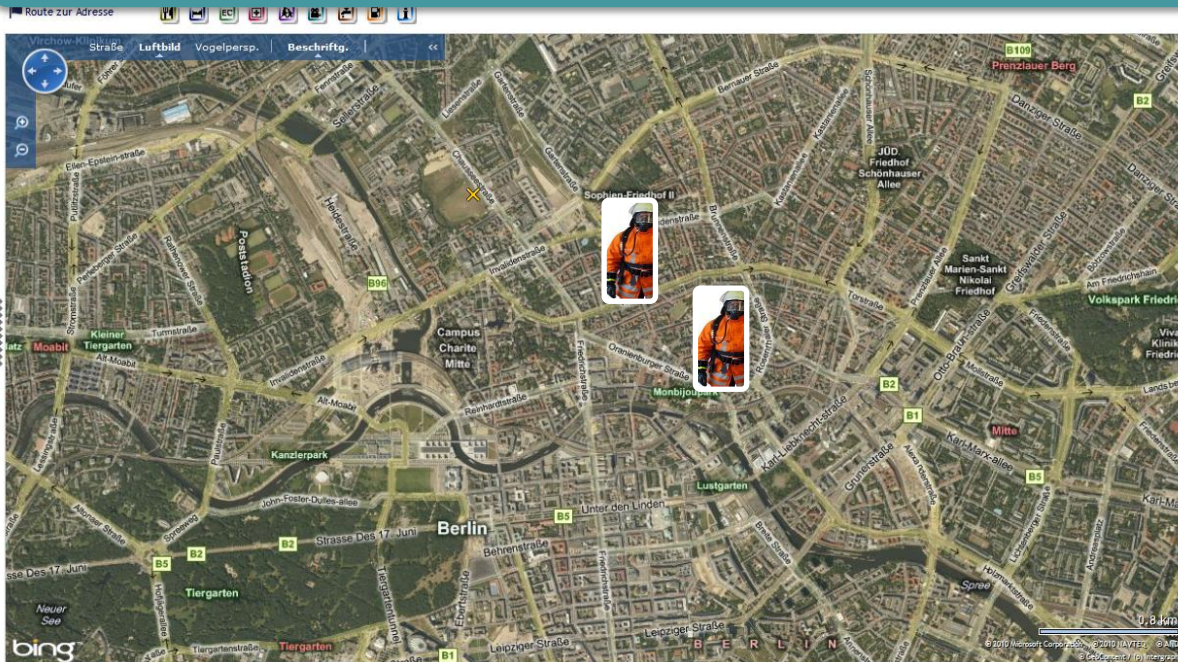 - Highly adaptative structure
  - Integration of multiple data sources

Channels / Layers

FR	IPs	Anno-tations	...
ID	Position	Position	
Position	Address	Icon	
Sensor Data	Phone	Shape	
Video Data	Add. Information	Text	
Audio Data			

The user interface: map interfaces

YellowMap

Bidirectional → Interaction →

Collaborative Tools

Layer Control

POI Control

Firefighter Team 1
- Team Members
- Equipment
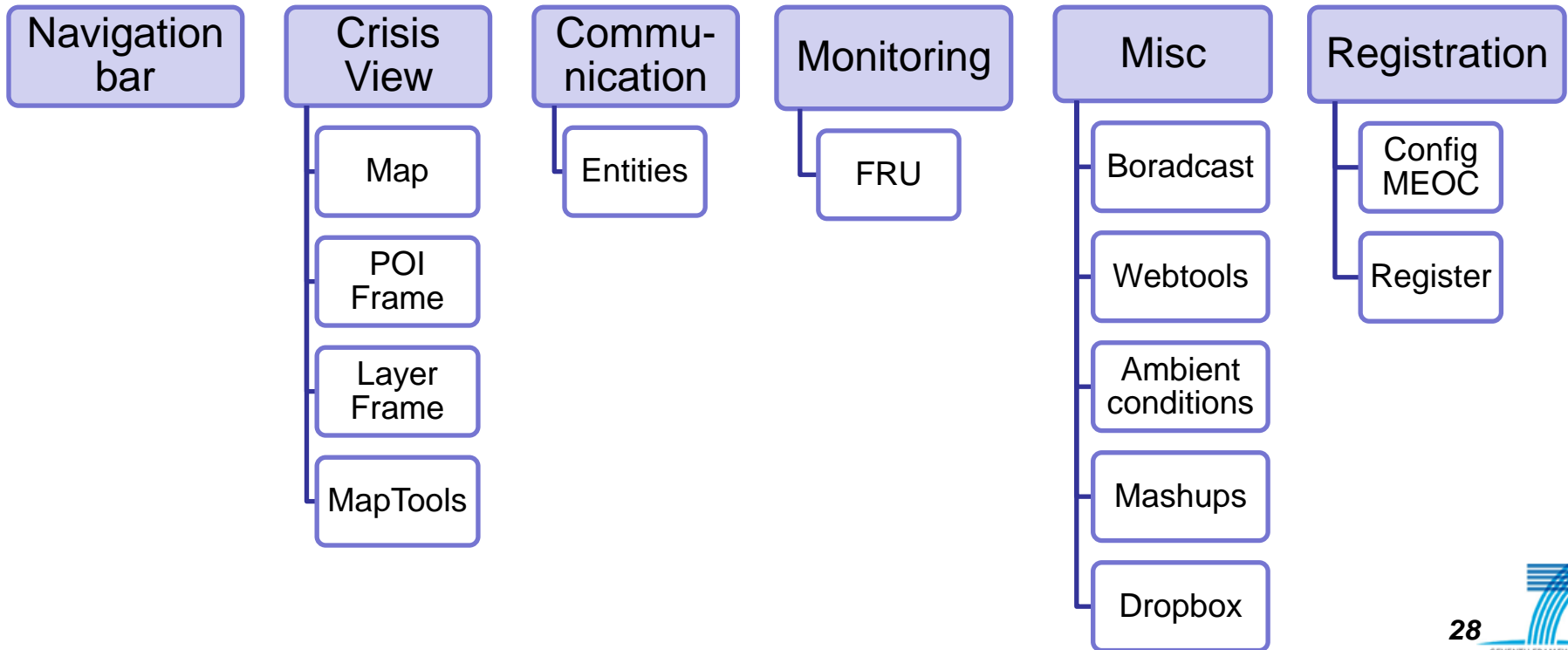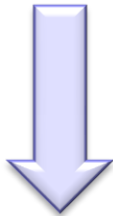
Thomas Jones
- Ffirefighter Team 1
- Personal Specs

Alex Mulder
- Firefighter Team 1
- Personal Specs

SEVENTH FRAMEWORK PROGRAMME

Login

Navigation bar

Crisis View
- Map
- POI Frame
- Layer Frame
- MapTools

Commu-nication
- Entities

Monitoring
- FRU

Misc
- Boradcast
- Webtools
- Ambient conditions
- Mashups
- Dropbox

Registration
- Config MEOC
- Register

eSPONDER

The user interface: 3D

- Strong alternative to spatially organize and sort info out

- Ease of the user interaction with digital content
→ more efficient use

- Synthesis, visualization & share of the COP & related data

- Direct input & collaborative capacities → Multitouch tactile inputs

MEOC: saving of space
→ Foldaway table
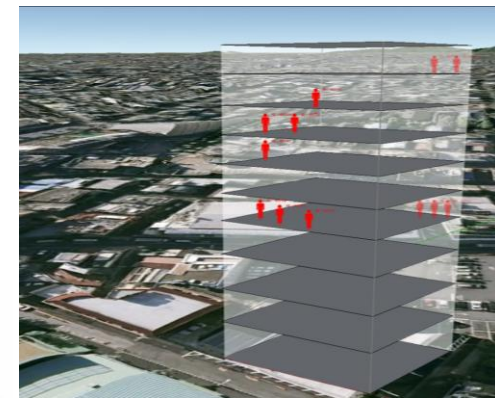
Representation of
a 3D-building

- **Prototype validation tests**
    - Lab scale
    - Field scale (at least 50 FRs)

- **Pilot demonstrations**
    - Airplane crash, NL → *base scenario*
    - Building collapse, F → *advanced features*
    - Forest fire, F → *large scale*

- **Evaluation of results**
    - Usability of devices and applications by end-users
    - Added value to regular disaster management

e-training

- Development of tutorials, etc. concerning E-SPONDER issues

- Integration of actors and potential users of E-SPONDER to enhance the acceptability of the project

- Web-training platform
   - Online training
    - Simulation

- **Integrated approach**
  - Efficiency & sustainability
  - Adoption of available standards during system design
  - National & European levels

- **Common reference**
  - Terminology
  - Qualifications
  - Specifications
  - Declaration of conformity

The Integrated Approach

- **Main objective**
  - Launch of a new standard
  - → *Common Information and Communications Technology Framework for First Responders Assistance*
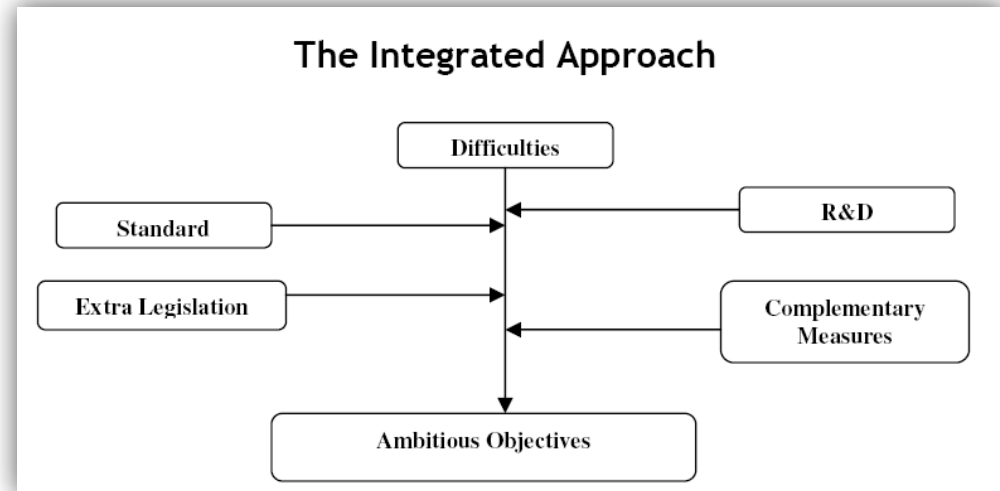
e-SPONDER

THANK YOU!

www.e-sponder.eu

Contact address

Presenter's Name – Role

Company

CURRENT RESULTS

Presenter's Name – Role

Company

# The positioning system

- **First results**
  - First hardware prototype of LPS under development
  - Goal is the verification of positioning principles using microwaves
  - Two printed circuit boards, one for analogue and one for digital processing
  - Basis of positioning is distance measurements between units

- **Short term goal**
  - perform reliable, accurate distance measurements

Local Positioning System – LPS –

The 2 circuit boards
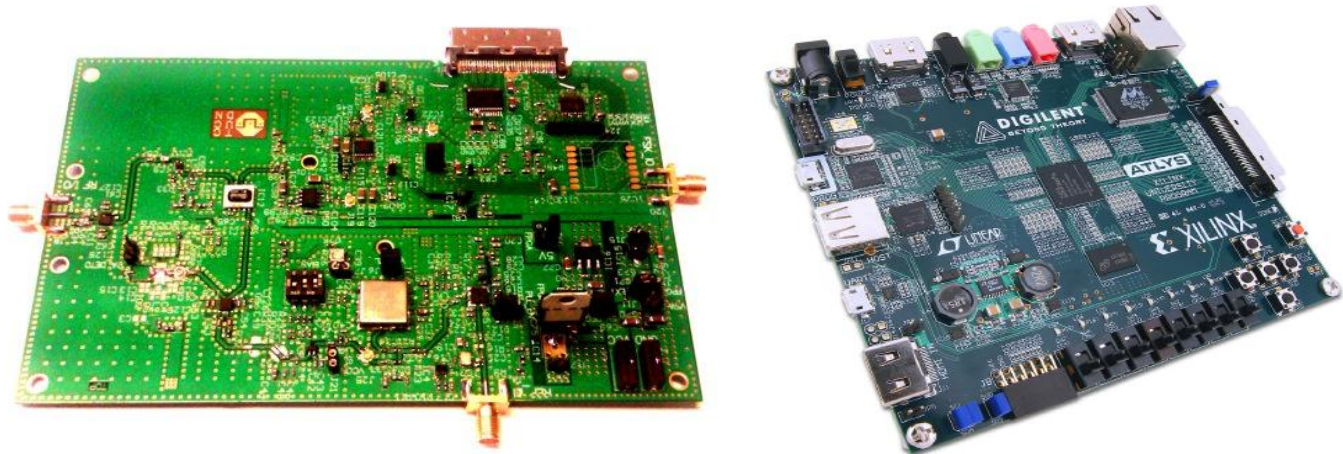
- ## D5.1 → end of June 2011
  - Analysis & specification of the E-SPONDER ERS&LS simulation and decision support tool
  - Operational concept
    - Definition of the emergency phases
    - Definition of the actors and layers in place
    - Definition of the flow of information, level of interaction

- ## D7.x → Use cases, system requirements specific to the OPTIMIZER tool

- ## D7.x → Architecture & design of the OPTIMIZER tool

- **Results**

  - Development of the Real Time communication server & the configuration manager (EOC / MEOC)

  - Integration (conceptual) & evaluation (simulations) of FRU cooperative transmission / networking into the system concept

  - Novel identity-based cryptography authentication method to secure communication in the Ad-Hoc part of the network

- **Short-term goal**

  - Voice communication services at FRU level

Performance evaluation

- **Evaluation of network performance**
  - FR network radio range → indoor & outdoor scenarios
  - Incident area network (IAN) radio range

- **Analysis of ICT security**
  - Evaluation of ICT security issues in emergency networks
  - Planning of QoS-oriented security solutions

- **Communication services**
  - Study of communication services to be provided

VoIP & Data

VIP & Sensors

VoIP

MEOC/EOC
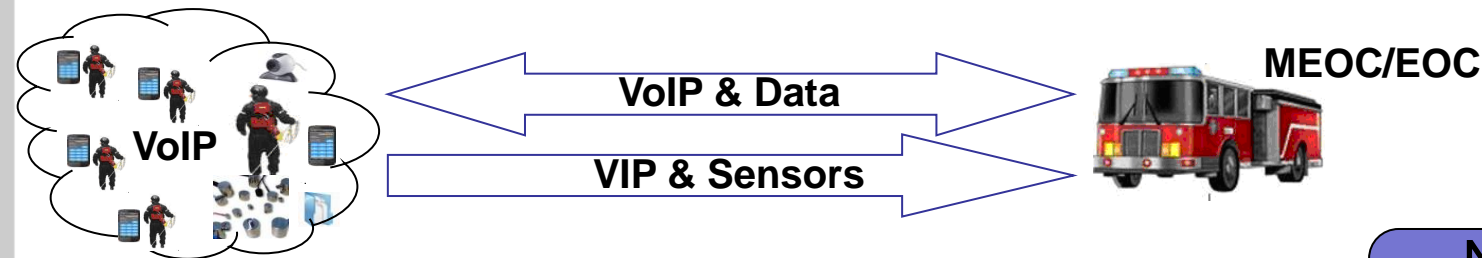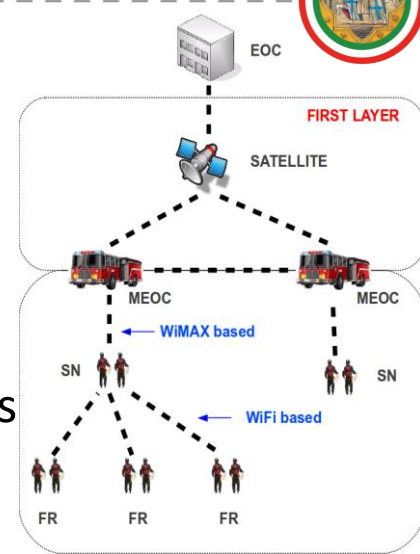
  - Quality of Experience (QoE) of received video (reproduction of Evalvid modules in NS-3 simulator)

source → **NS-3** Video quality evaluation → destination

PSNR/SSIM

eSPONDER
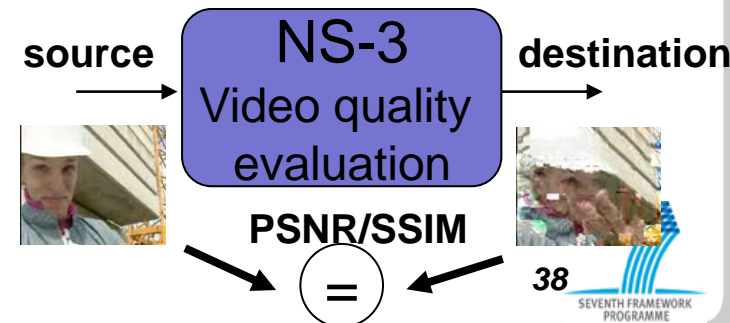
- **Goals**

  Does the proposal match the needs?
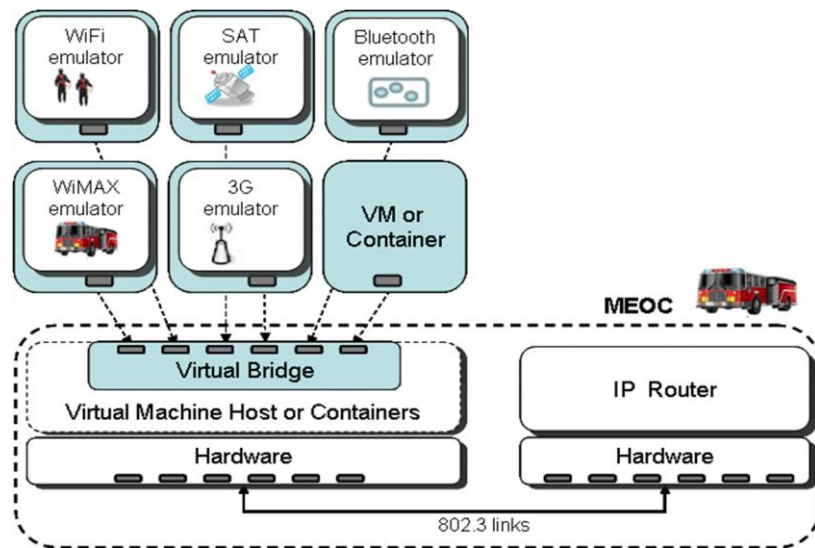 *Flexibility / scalability / reliability*

  Performance limits?

  With respect to the traffic patterns of the supported applications

  End-to-end QoS/security scheme?

- **Testbed: modular framework, based on**
  - network emulators
  - software routers

- **Interconnection of emulators inside the testbed to reconstruct & analyze the network performance**

SEVENTH FRAMEWORK PROGRAMME