



Wireless rObust Link for urban Force operations

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## WOLF project keynotes IST092 - September 2010



| Report Documentation Page                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    |                                     |                                          | Form Approved<br>OMB No. 0704-0188       |                                 |
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- Framework and motivations
- Aimed capabilities and roadmap
- Project organization
- Technical highlights
- Conclusion



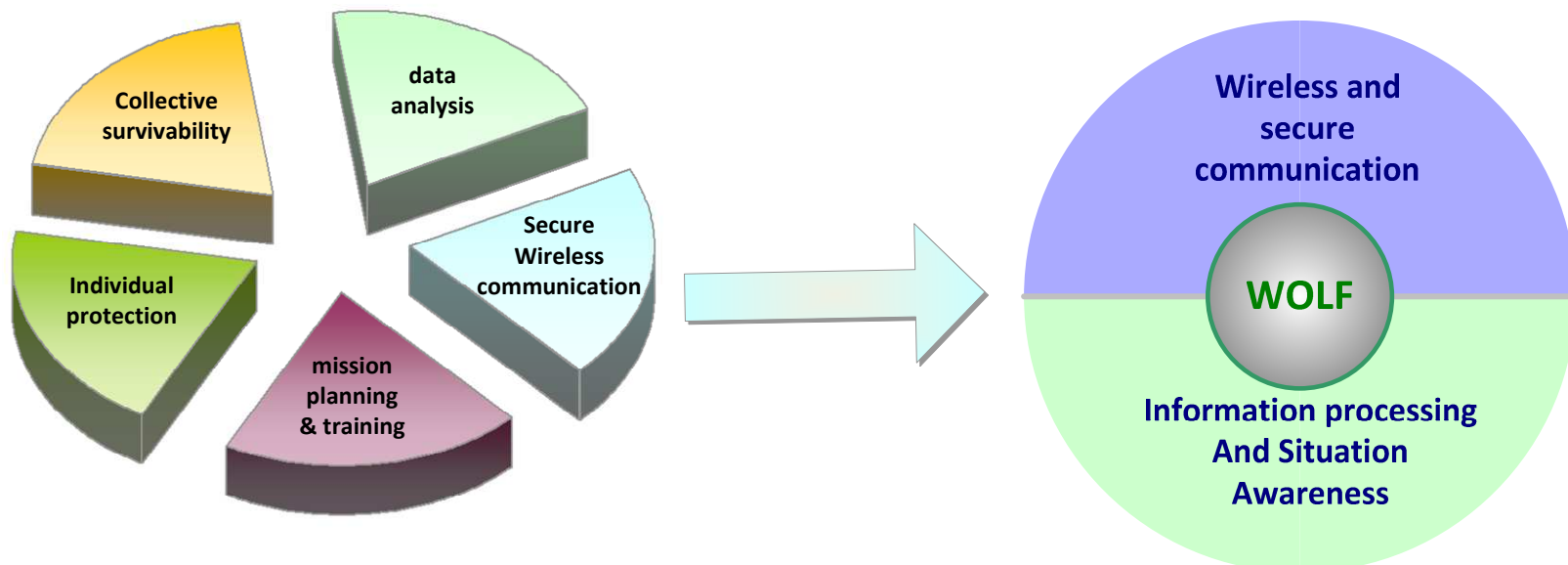
## Framework → Joint Investment Programme on Force Protection

### R&T Joint Investment Programme on Force Protection (JIP-FP)

- ❑ Launched by the European Defence Agency at the end of 2006
- ❑ 3-year programme
- ❑ Total € 54.9 million
- ❑ 20 European governments
- ❑ Promotion of partnership and networking among the European defence R&T stakeholders



### R&T priorities





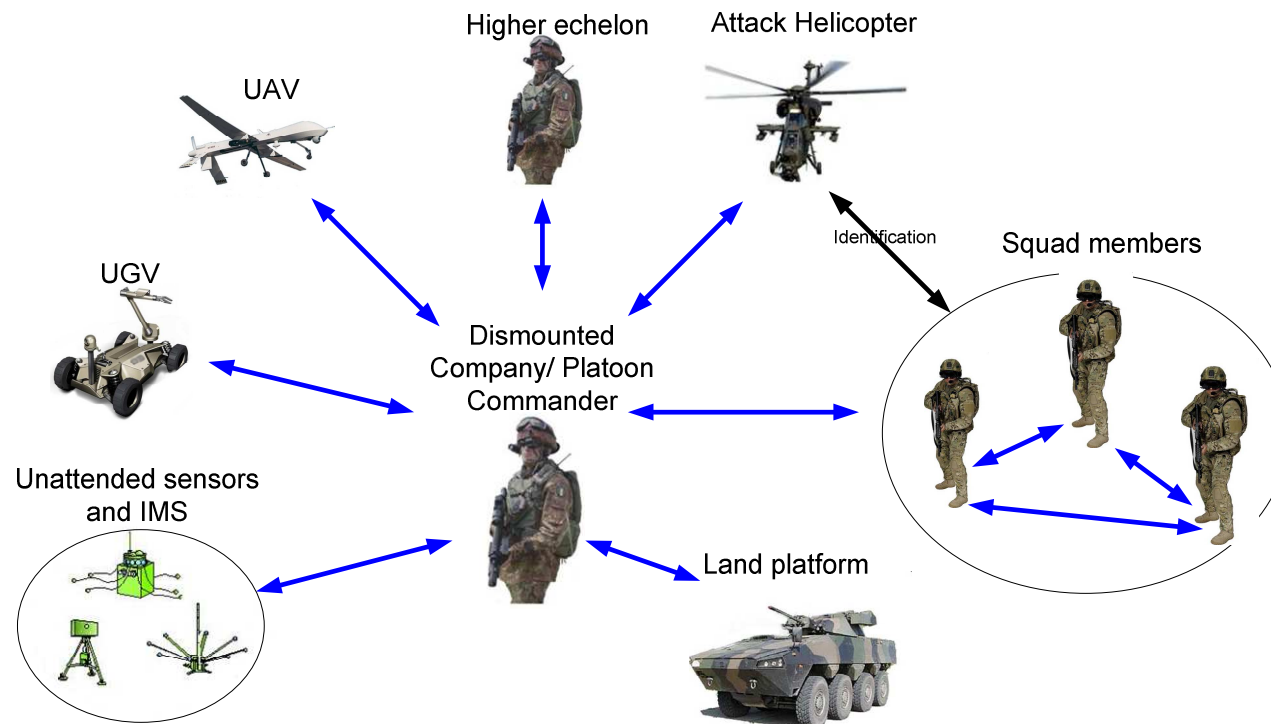
## Framework → MOUT : current situation

### Military Operations in Urban Terrain

- ❑ Complex situation due to urban environment : civilians, ambushes → need for awareness
- ❑ Command and Control are difficult
- ❑ Combats usually at squad level with low coordination with higher echelons
- ❑ Communication failures (indoors, urban canyons) with actual soldier radios

**Dismounted soldier should not be isolated**

**Provide dismounted soldier with efficient communication system**



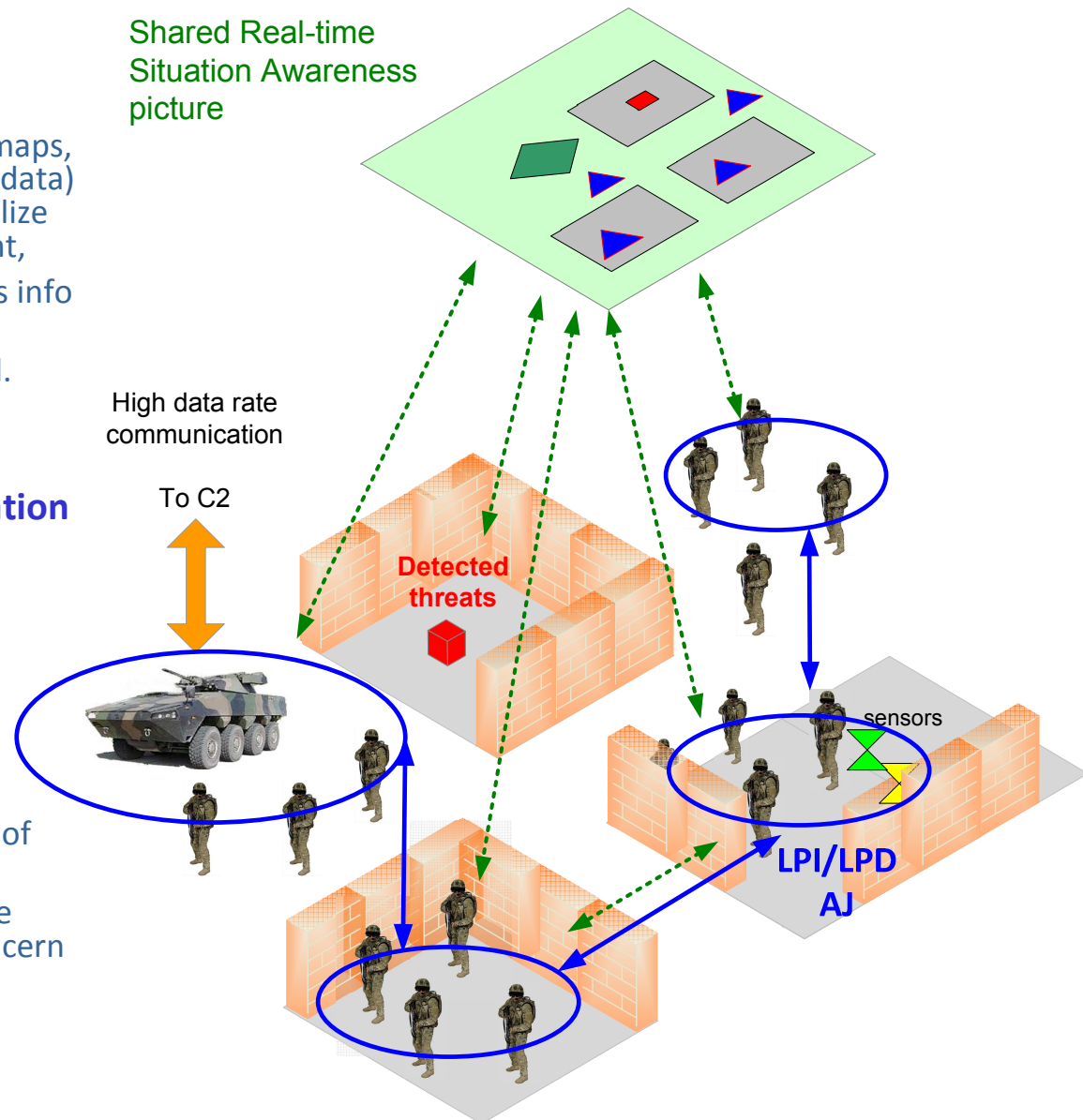


## Information processing & situation awareness

- ❑ Transmission of digitized information (maps, photo, videos, tracking and positioning data) that will permit to soldier squads to realize progression in an unknown environment,
- ❑ Exchange of shared situation awareness info between vehicular and soldier nodes.
- ❑ Connection with Command and Control.

## Wireless secured & robust communication

- ❑ Based on MANET for connectivity
- ❑ Specific urban constraints :
  - physical characteristics of the building constructions,
  - Specific propagation environment
- ❑ Possible jamming or limited availability of frequencies,
- ❑ Various countries, and situations, where frequency regulation may not be of concern

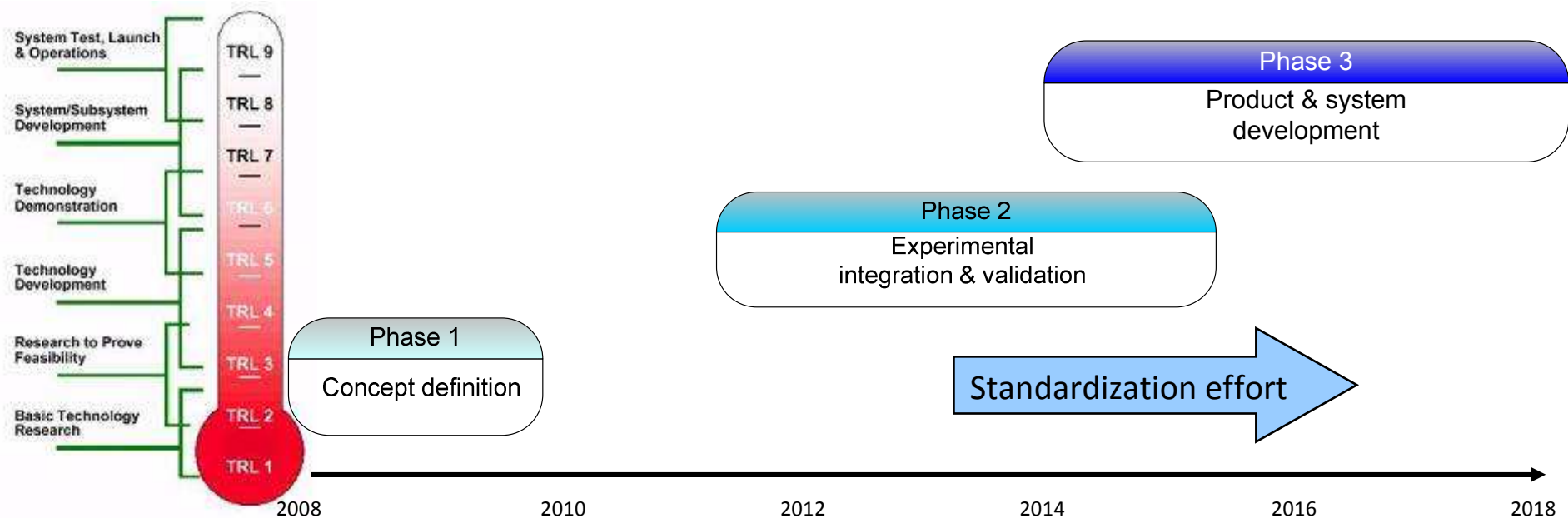




## WOLF roadmap in 3 phases

### Phase 1 (current contract) : concept definition

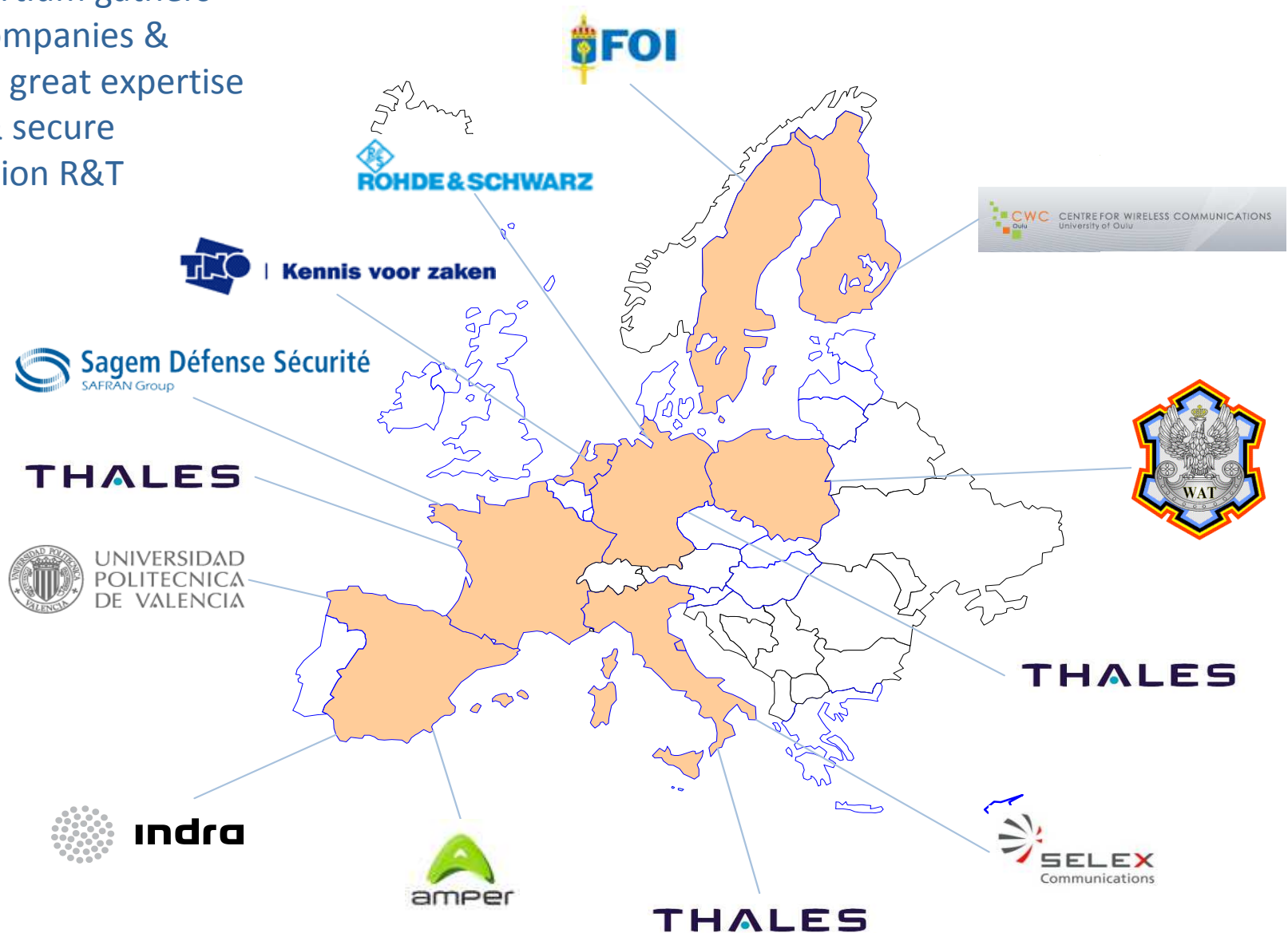
- ☐ Define the requirements
- ☐ Define the system architecture
- ☐ Study and evaluate different possible technical solutions
- ☐ Identify the best suited techniques with unitary simulations based on relevant scenarios
- ☐ Propose and promote an harmonized scheme for the future system





## Project organization → partnership

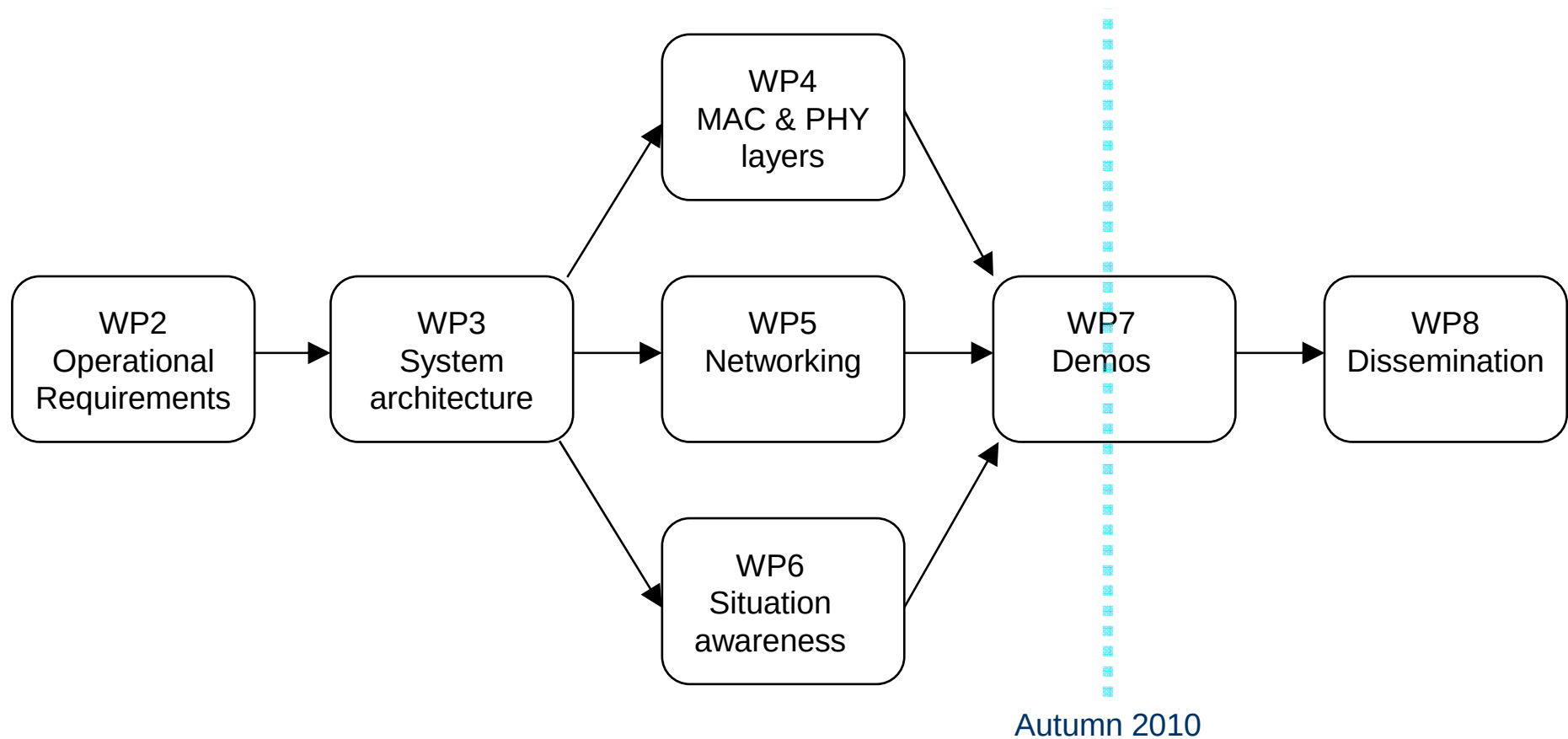
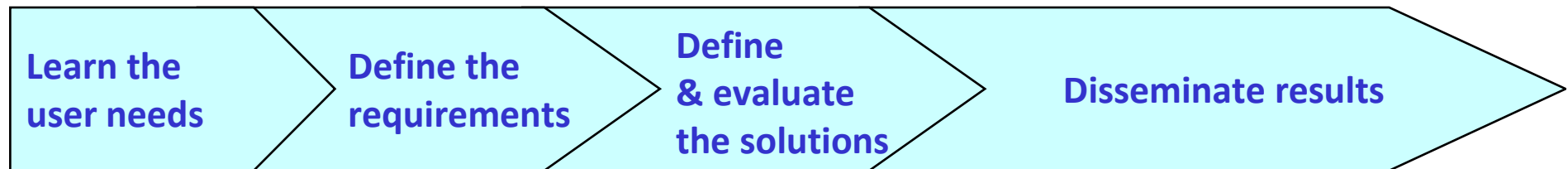
WOLF consortium gathers  
European companies &  
entities with great expertise  
in defense & secure  
communication R&T

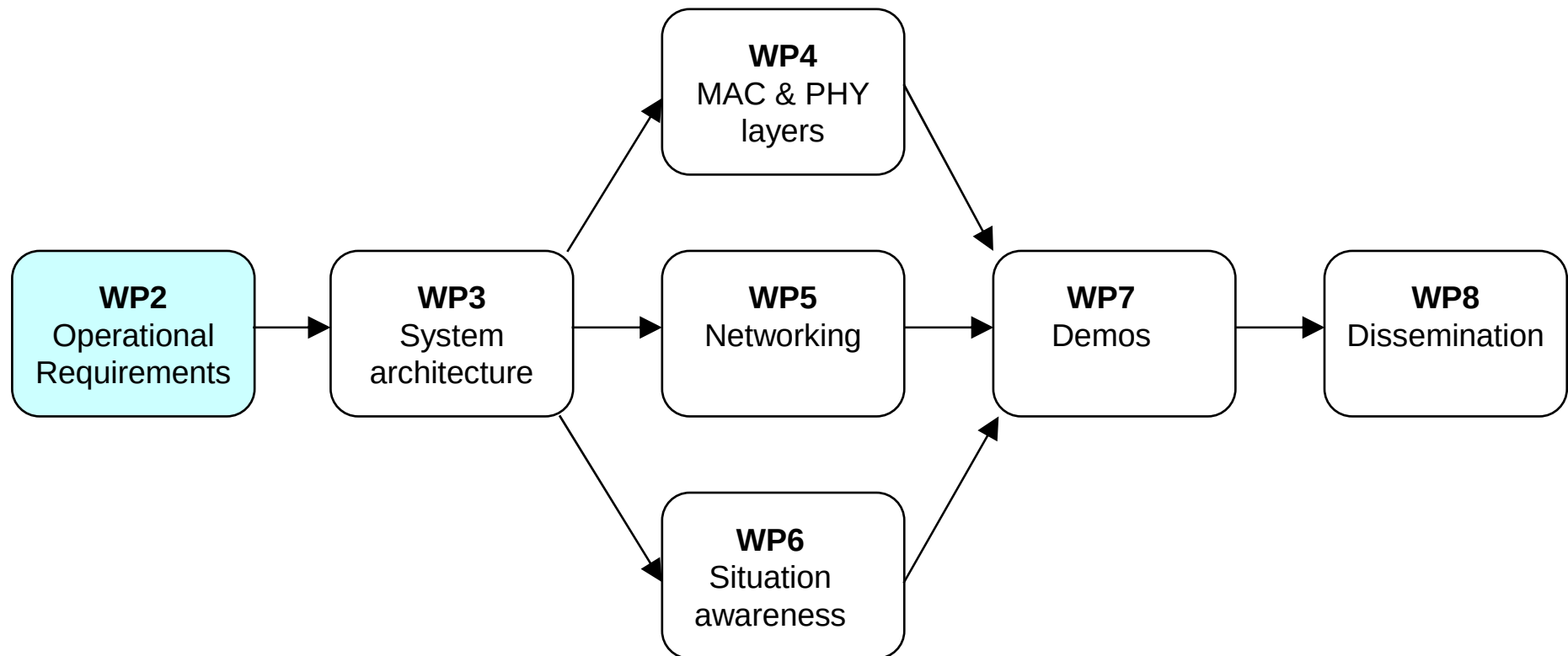






## Project organization → tasks



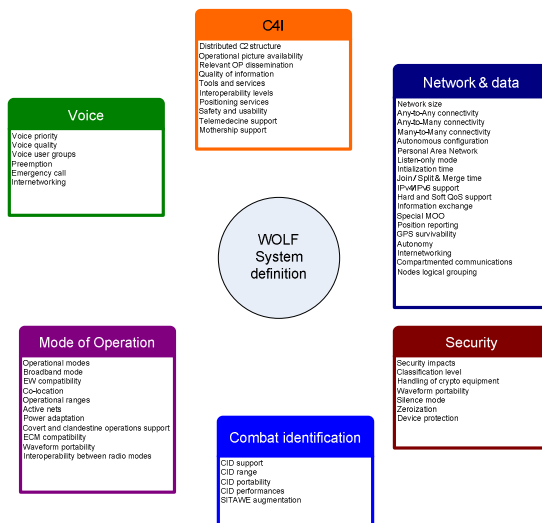




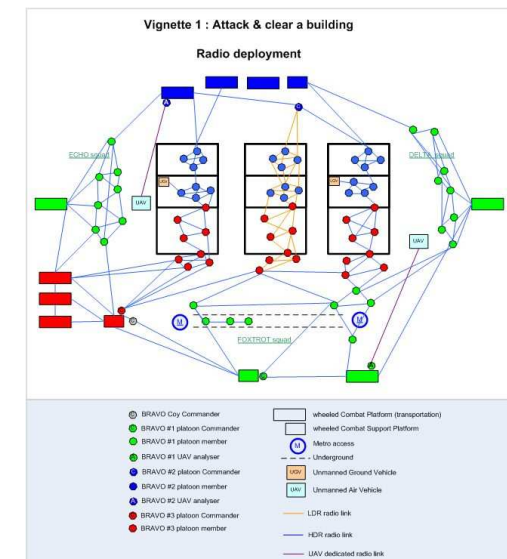
## Technical insights → Operational Requirements

### Analysis of end-user requirements in terms of secured tactical wireless communication in urban environment

- ❑ Perform end user interviews to refine operational needs
- ❑ Develop scenarios to identify the framework of the project
- ❑ Derive requirements from the soldier's point of view (NATO Architecture Framework)
- ❑ Tune the project to focus on technical aspects derived from user requirements



- ✓ High density
- ✓ Indoor, indoor/outdoor and underground comm.
- ✓ Need of non-hierarchic communication
- ✓ Need for accurate positioning information
- ✓ Need for image transfer
- ✓ Risk for jamming





## Technical insights → Operational capabilities : specific MOUT

### □ GNSS survivability

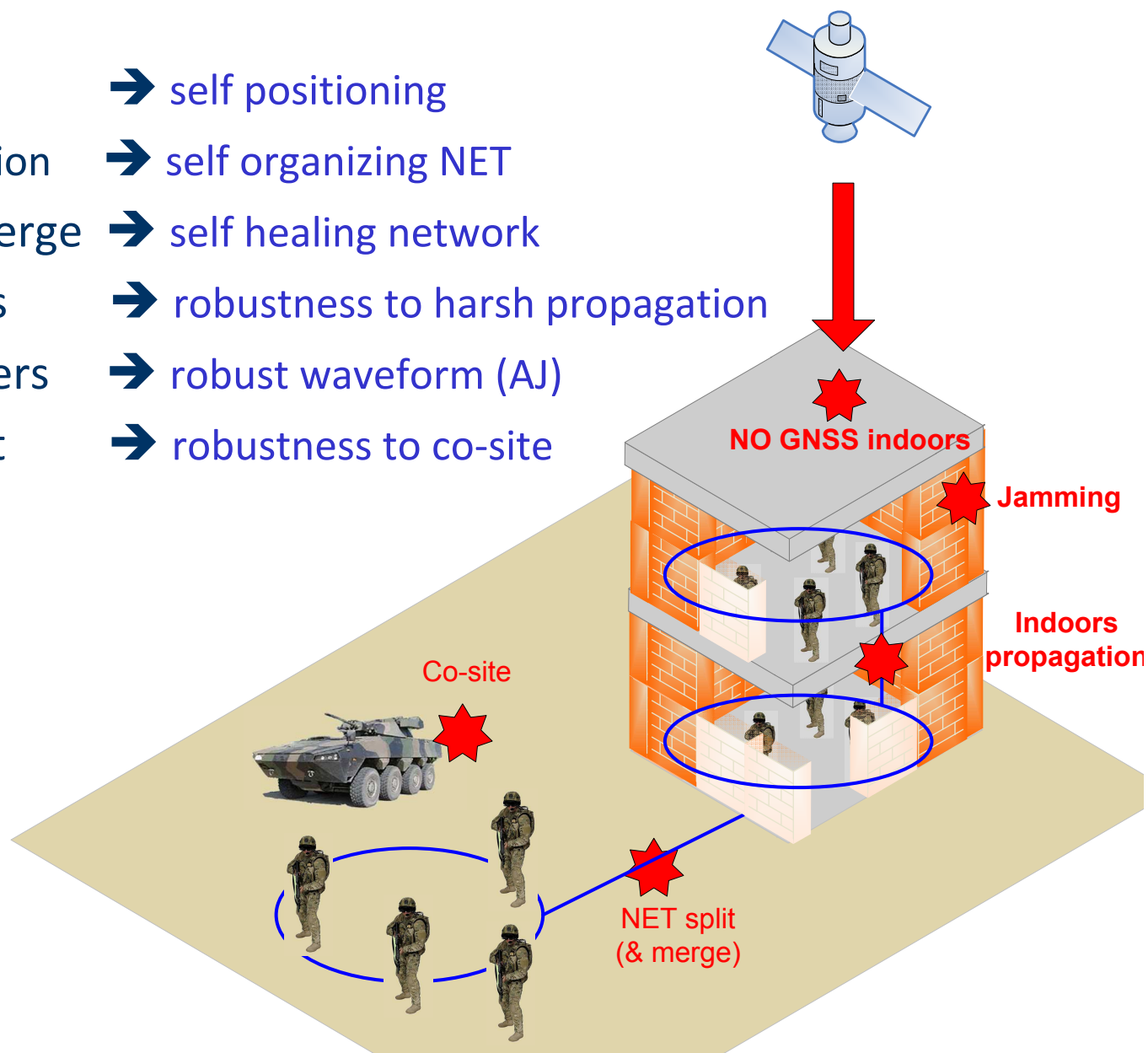
- Positioning → self positioning
- NET synchronization → self organizing NET

### □ Network split & merge → self healing network

### □ Indoors operations → robustness to harsh propagation

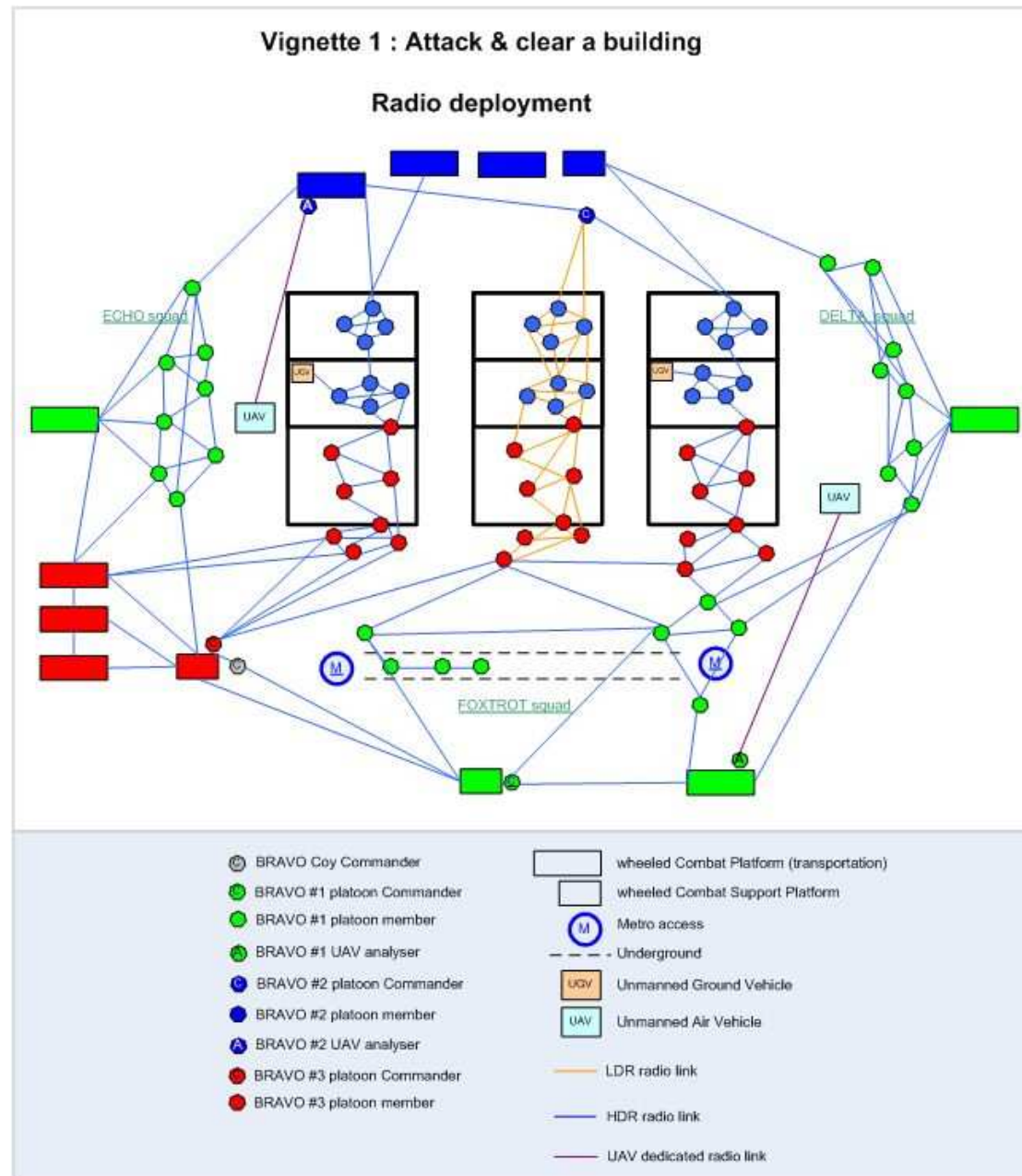
### □ Presence of jammers → robust waveform (AJ)

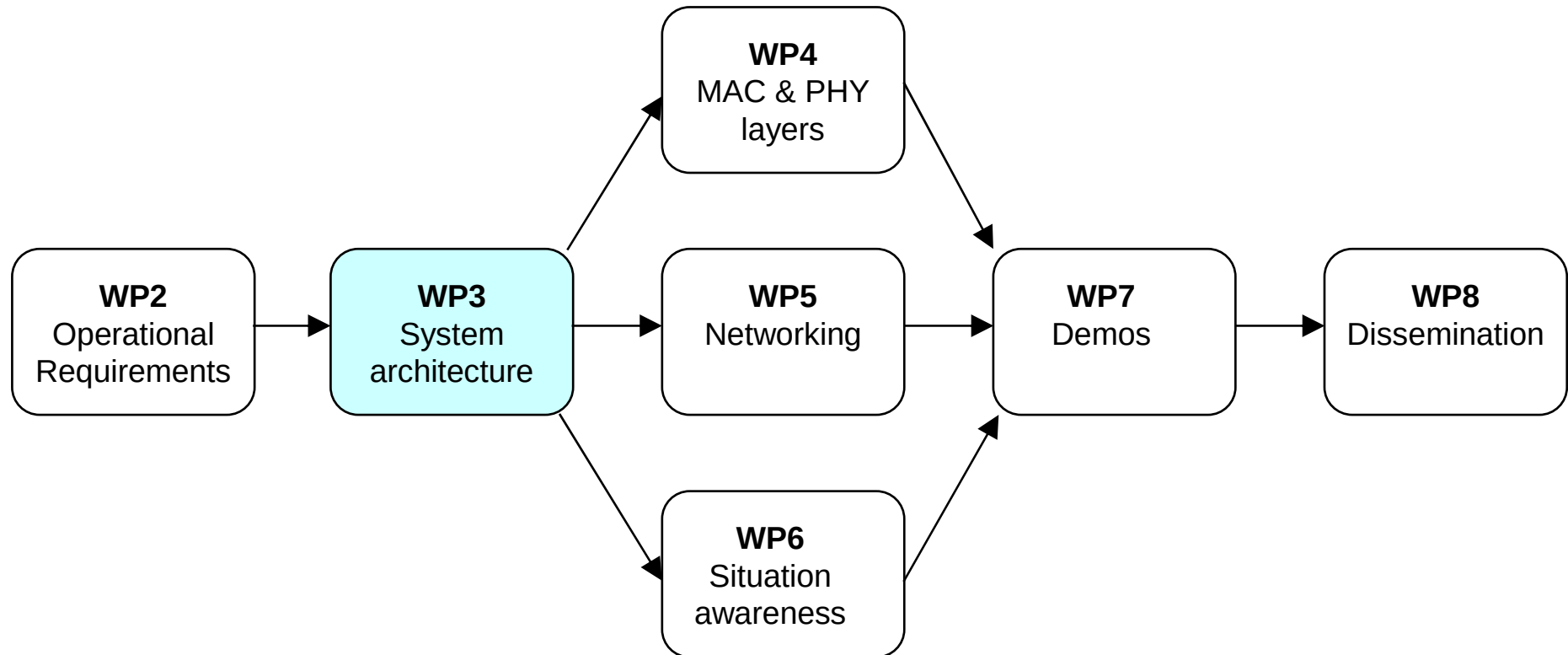
### □ Dense deployment → robustness to co-site





## Technical insights → Operational Requirements



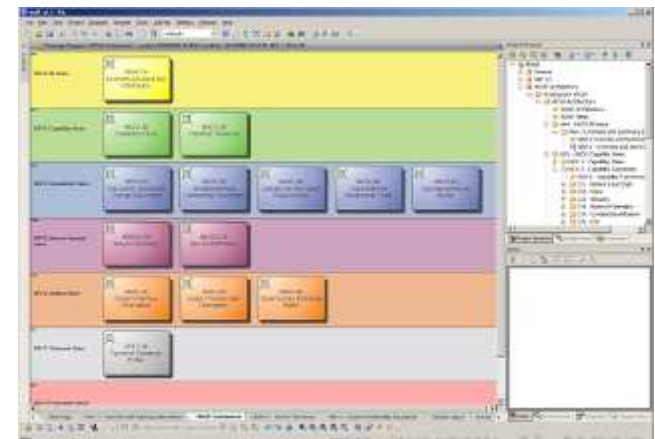


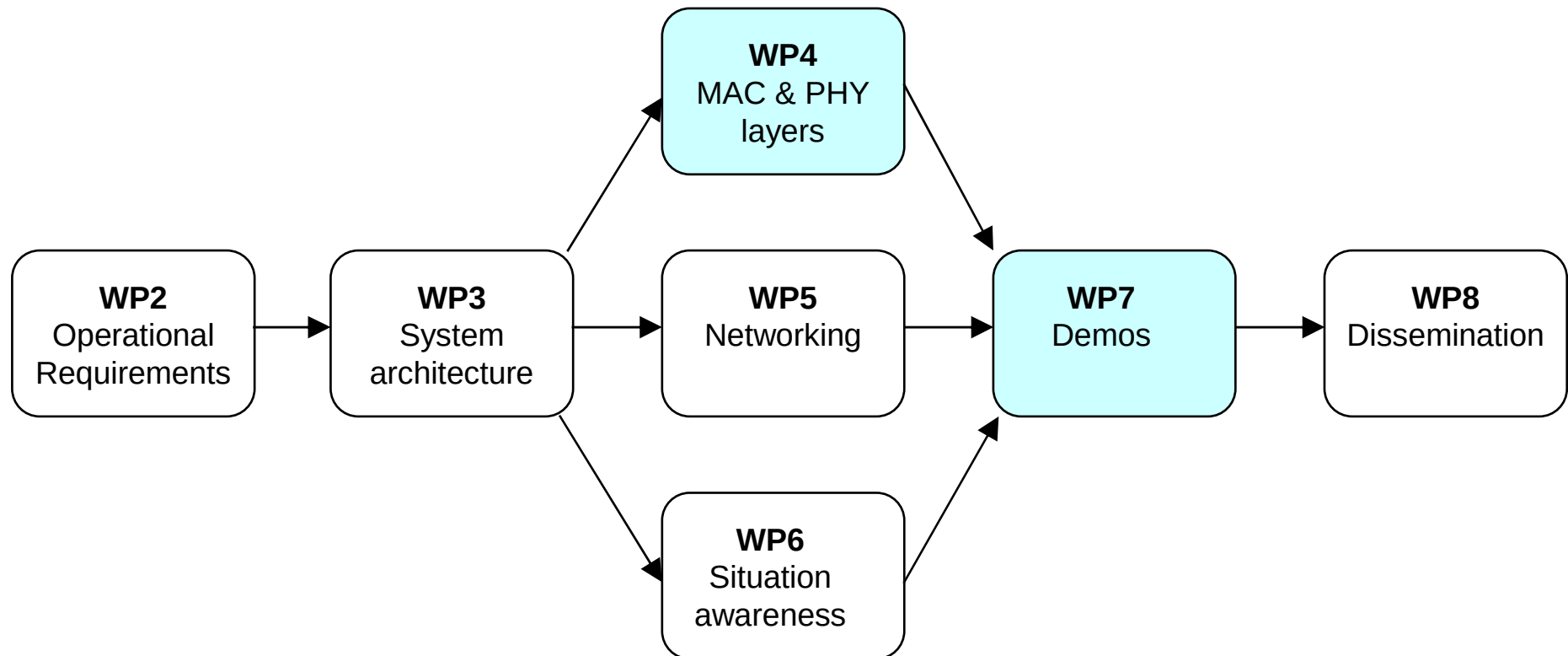
**Objective : Define the general system architecture for the WOLF system, from operational requirements**



## Technical insights → System Architecture

- ❑ System requirements defined
- ❑ Architecture utilizes concept of civil standards
  - ❑ Cross-layer management from Communications Access for Land Mobiles (CALM)
  - ❑ QoS aspects from IP and IEEE 802.11
- ❑ Use of NAF V3 for Architecture description
- ❑ Application oriented architecture concept
  - ❑ Different modes of operation share the same basic set of interoperable services





**Objective: specify and evaluate candidate schemes for MAC and physical layers, suitable for MOUT context**





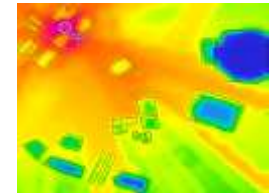
## Technical insights → MAC & PHY layers

### ❑ Identified frequency bands

- V/UHF [200-400] MHz : **propagation** / **crowded spectrum** → Low data rate
- L band [1.3-1.7] GHz : **short range** / **bandwidth** → High data rate

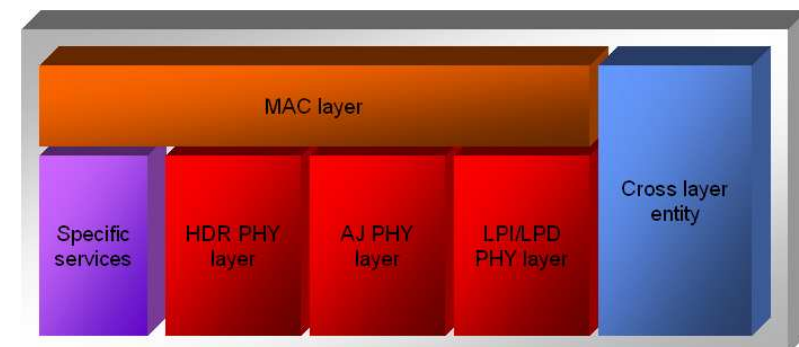
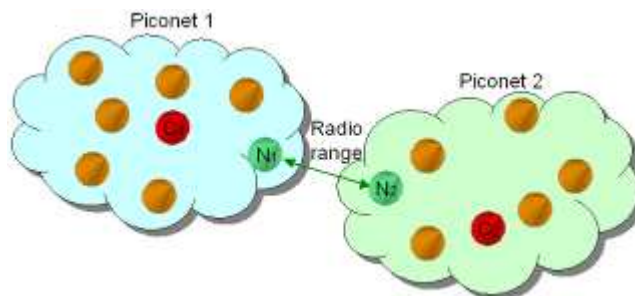
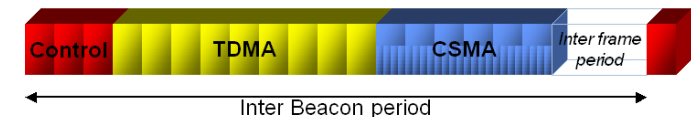
### ❑ Propagation analysis provides models for

- Simulations of urban propagation
- Future tool for propagation prediction (range estimation)



### ❑ Proposal for a MAC layer

- Management for interoperability of the PHY modes
- Ensuring QoS continuity → TDMA, queuing mechanisms
- Adaptation to operational needs (Split & Merge)
- Clusterized network
- Cross-layer mechanisms (relaying, link status, QoS,...)

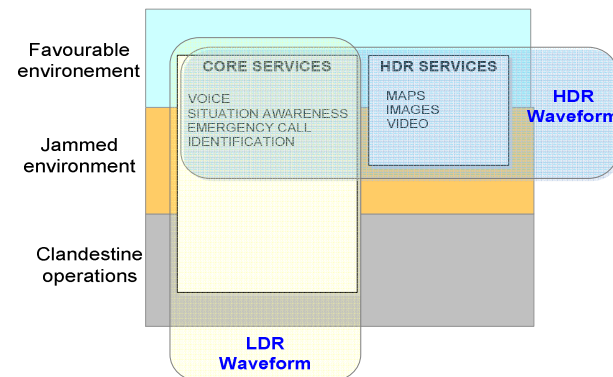




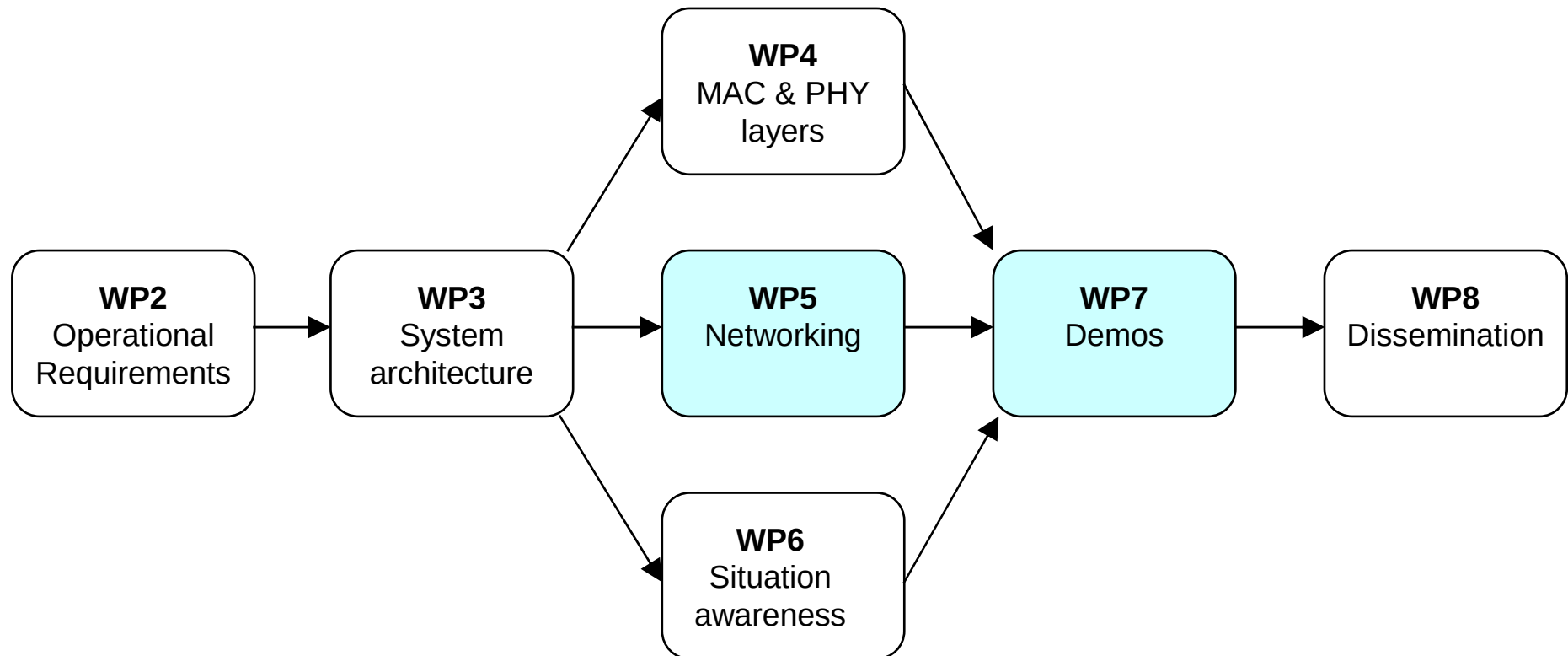
## Technical insights → MAC & PHY layers

### □ Candidates for PHY layer

- LDR waveform → max. range + LPI/LPD or AJ properties
  - Low data rate mode (in a 25kHz bandwidth for FH, 5MHz for DS),
  - Medium data rate mode (in a 100kHz and 250kHz bandwidth for FH, 5MHz for DS)
  - Emergency call mode (maximum robustness and elongation), but no MANET support.
- HDR waveform → high throughput
  - FH into 1.25MHz or 5 MHz
  - Multi carriers (OFDM/A, FFH-OFDM, MC-SS), single carriers (CPM) or SC-FDMA



- Candidates are being **evaluated** and **selected** through **simulations** (2010):
  - Robustness of LPI/LPD and AJ waveforms ?
  - Performance and robustness to multipath of HDR waveforms (synchronization) ?
- Demo in Thales Communication, France, October 2010

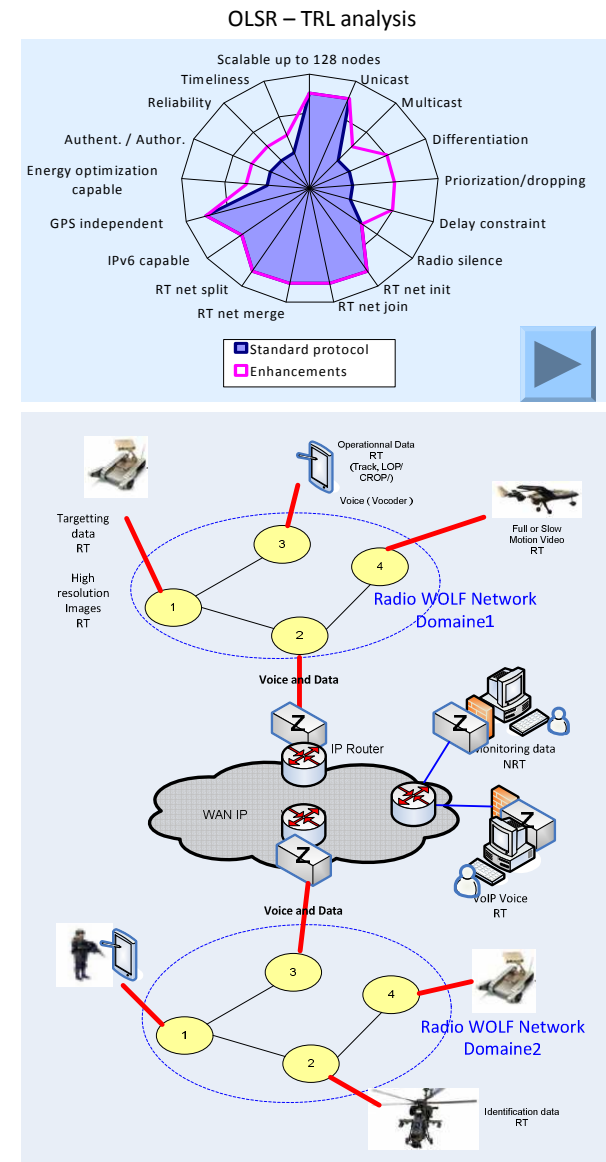


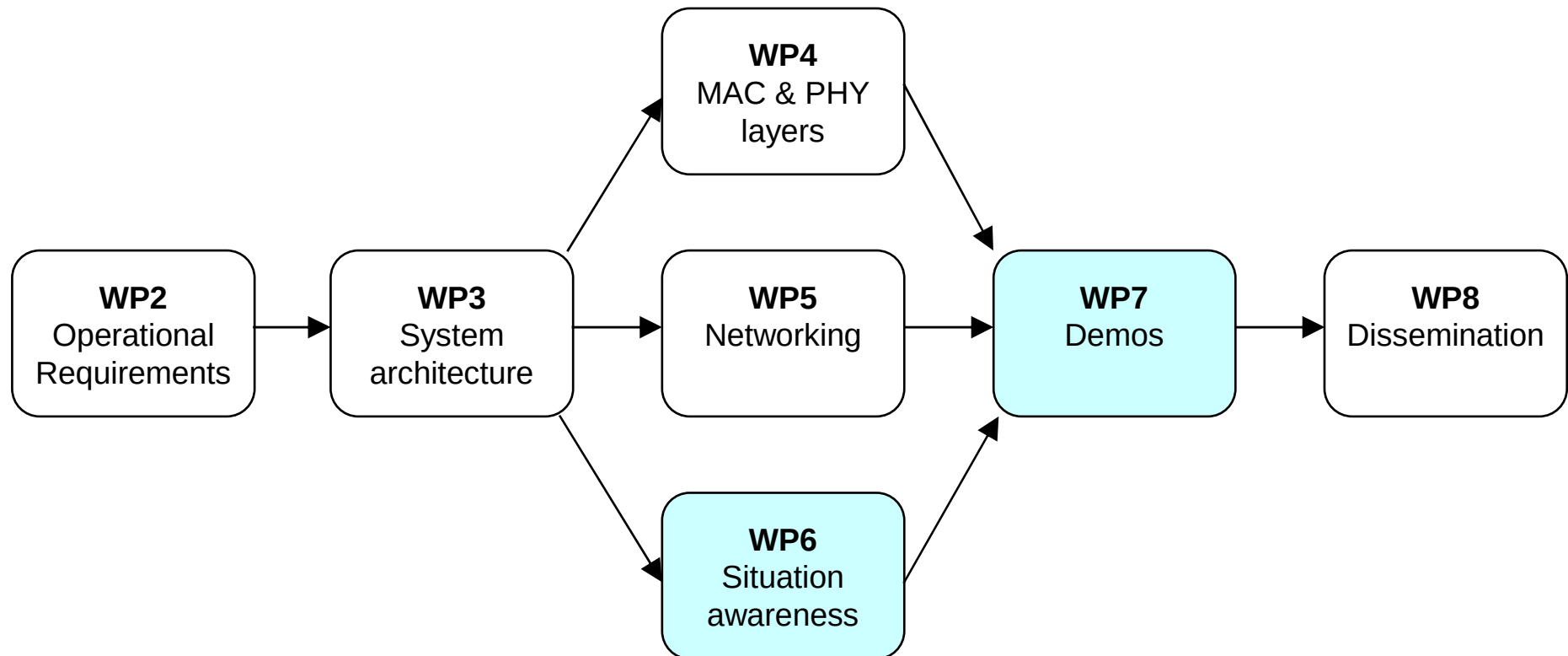
**Objective: define network topology, strategies & mechanisms (addressing, routing) suitable for MOUT and in collaboration with MAC**



## Technical insights → NET layer specification

- ❑ Ad Hoc Networking guarantees survivability of WOLF communication
- ❑ Best capabilities coverage with AODV, DYMO and OLSR
- ❑ Focus on OLSR
- ❑ Main functionalities
  - Unicast routing considering several metrics (multi route computation)
  - Multicast routing (predefined and dynamic multicast groups)
  - Soft QoS routing (differentiation)
  - Hard QoS routing (reservation)
  - External connectivity based on Mobile IPv6
- ❑ definition of the Wolf Adaptation Layer (WAL) for efficient cross-layering with the MAC
- ❑ Demo in SAGEM, France, October 2010





**Objective: Identify suitable techniques for SA, and define the SA mechanisms (data model, aggregation, dissemination)**



## Technical insights → Situation Awareness

### □ Robust sensor fusion

- Use cases evaluation: sniper detection, close combat, CSAR, evacuation of hostages
- Intelligent sensor management is needed
- Goal : virtual distributed cognitive sensor system

### □ Proposal for TDCSA

### □ Positioning techniques

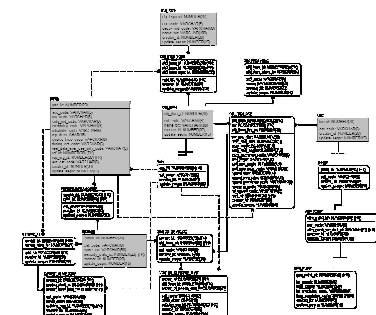
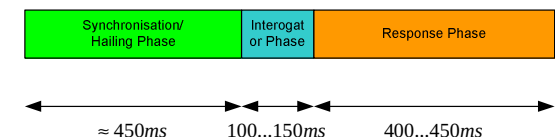
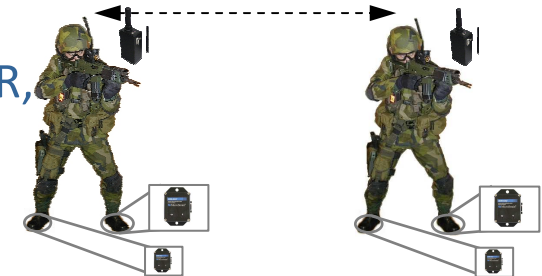
- combination of GNSS, inertial, RF-positioning techniques

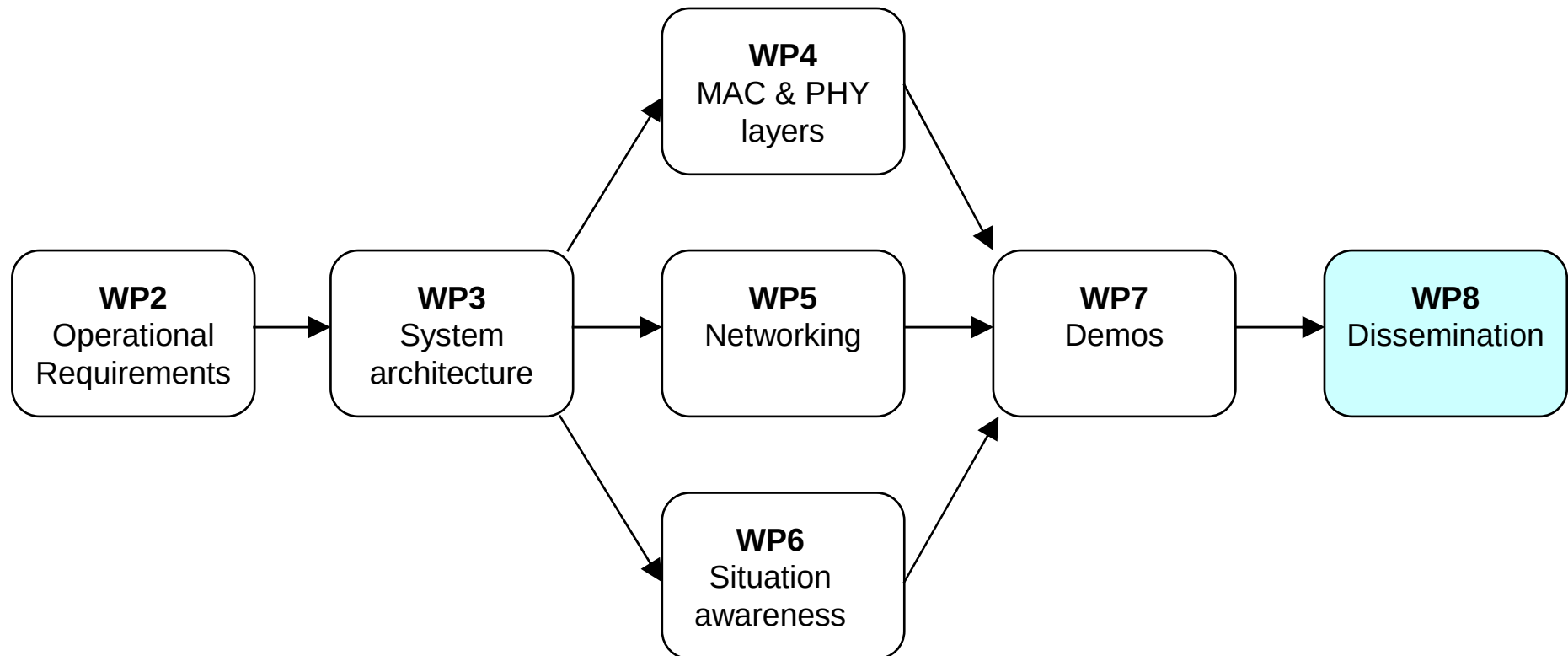
### □ Integration of RBCI in the access scheme → Identification Methods

### □ Situation Awareness

- Distribution, Interoperability, flexibility → Information data model proposal

### □ Demo in AmperLab, Madrid, in September 2010







November 17, 2010

European Defense Agency, Brussels

### Objective

- ☐ Disseminate WOLF **outcomes** to **operational & technical end-user**
- ☐ **Gather feedback** on the proposed vision and technical solutions

### Content

- ☐ General presentation focusing on **operational** rationales, expectations and **impact** of the proposed solutions
- ☐ Dedicated technical workshops on specific matters (flexible, according to the audience)
- ☐ Video replay and analysis of September/October demos (SITAWE, Net, Waveform)

### Audience

- ☐ National representatives
- ☐ End users interested in tactical communication : project countries (each entity) + contributing members





### **WOLF : 1st step in the definition of a future European soldier waveform**

- ☐ User needs and scenarios
- ☐ System architecture has been defined
- ☐ Best-suited techniques have been evaluated and compared

### **Next step :**

- ☐ Investigate additional topics : frequency management, interference avoidance
- ☐ Integrate all the technical concepts (layers) in one testbench
- ☐ Evaluate and tune the mechanisms

**➔ base waveform**



Thank you !



Additional slides



### OLSR - TRL ANALYSIS

