PPDR–TRANSFORMATION CENTER: “BUILDING THE ROADMAP FOR FUTURE PPDR COMMUNICATION SYSTEMS EVOLUTION”

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PSC EUROPE FORUM CONFERENCE
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PARIS, FRANCE
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<tr>
<th><strong>Project full title:</strong></th>
<th>Public Protection and Disaster Relief - Transformation Center</th>
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<tr>
<td><strong>Call identifier:</strong></td>
<td>FP7-SEC-2012.5.2-1</td>
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<tr>
<td><strong>Programme Objective:</strong></td>
<td>SEC-2012.5.2-1: Preparation of the next generation of PPDR communication network</td>
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<tr>
<td><strong>Grant agreement no:</strong></td>
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<td><strong>Total budget:</strong></td>
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<td><strong>Funding:</strong></td>
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<td><strong>Start date:</strong></td>
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<td><strong>Duration:</strong></td>
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<td><strong>Coordinator:</strong></td>
<td>EXUS S.A.</td>
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CONSORTIUM
MAIN OBJECTIVES

- To gather European PPDR facts and figures data.
- To define PPDR reference usage scenarios and identify service requirements and future needs in the European context.
- To implement a detailed study of the reference scenarios with a view to establishing service classification and identifying key technical issues.
- To identify candidate PPDR technologies and architectures.
- To develop validation tools for future PPDR.
- To derive technical recommendations on candidate technologies and architectures.
- To provide economical recommendations on candidate technologies and architectures.
- To provide a roadmap towards full satisfaction of future PPDR requirements and to develop recommendations for PPDR standards for decisions-makers.
**EXPECTED IMPACT**

- PPDR-TC foresees to elaborate a holistic approach recommending future systems applied in critical events as well as normal work depending on end-users’ requirements.

- The proposed solution will have few dimensions so it can be tuned by decision-makers to the size of each critical incident taking technical, financial, organisational and business constraints into account.

- The future PPDR systems will be designed in order to handle sensitive information and increase the level of citizen’s security by strengthening cooperation among first responders in emergency situations.
METHODOLOGICAL APPROACH

• Identification of current PPDR status and requirements for future PPDR users
• Data synthesis and usage scenarios development
• Assessment of current and emerging Telecommunication Technologies
• Economical and political implications of future PPDR development.

Recommendations for PPDR Roadmap
CURRENT STATUS

@M20 of the project we have:

- **Gathered** European PPDR facts and figures and established relevant DB
- **Defined** PPDR reference usage scenarios
- **Established** PPDR service classification
- **Analysed** the radio spectrum currently utilized by PPDR agencies around the world and the projected future needs for radio spectrum
- **Identified** several business models (with sub-models) presenting different approaches to set a PPDR system up and developed a tool for Technical, financial, economical and organizational analysis
MAIN OUTCOMES-STUDY BASIS

- Analysis of collected questionnaires from 24 PPDR organizations around Europe
- 2011 studies for German government by BMWI, WIK and Aegis
- ECC Report 199, prepared by CEPT Project Team 49
- Hypothetical major incident scenario submitted to the US Federal Communications Commission by the New York City PPDR Authorities
- 2011 Canadian Centre for Security Science study to identify 700 MHz spectrum requirements for PPDR Mobile Broadband Communications
- Other EU Framework Studies:
  - HIT GATE (FP7-284940) - Heterogeneous Interoperable Transportable Gateway For First Responders
  - E-SPONDER (FP7-242411) - A Holistic Approach Towards The Development Of The First Responder Of The Future”
  - eVACUATE (FP7-313161) - A Holistic, Scenario-independent, Situation-awareness And Guidance System For Sustaining The Active Evacuation Route For Large Crowds
• 5 distinct communication requirements identified:
  • Voice
  • Narrow Band Data (e.g. for messaging)
  • Broad Band Data (e.g. images or large files)
  • Video
  • Use of repeater stations to extend coverage or provide air-to-ground communication
• Video and Image transmission identified as important in various scenarios
  • Surveillance
  • Maintaining public order / safety at large events
  • Assisting treatment of casualties
  • Identification of suspects or vehicles
  • Situational awareness (e.g. during rioting or high speed pursuits)
MAIN OUTCOMES - HIGH LEVEL COMMUNICATION SCENARIOS

- **A:** Between a Central Control Station and Field Personnel at an Incident
- **B:** Between PPDR Vehicles and an Incident Location or Control Station
- **C:** Between Individuals at an Incident
- **D:** Between Different PPDR Entities (e.g. Police, Fire, Ambulance, Volunteers)
- **E:** Accessing External Data Sources (e.g. Internet)
- **F:** Communication in Enclosed Spaces (e.g. Tunnels Or Basements)
- **G:** Communication With Remote Locations (e.g. Mountains or at Sea)
- **H:** Communication with or between Machines (e.g. Remotely Controlled Vehicles)
• **Coverage**
  • Incomplete with significant black spots, especially indoors, underground or in remote areas.
  • Worse for data services

• **Lack of Interoperability**
  • At the technology and working protocol level

• **Resilience:**
  • At the network level (uninterruptable power supplies etc.) and terminals (e.g. need to be rugged and waterproof)

• **Reliance on public networks:**
  • Often unusable after major incidents due to congestion. Especially a problem for data transmission as not supported by most existing PPDR networks.
• **Video**
  - Applications include automatic number plate recognition, body worn cameras, portable CCTV deployments, surveillance, suspect identification, telemedicine and thermal imaging

• **Other data applications**
  - Breathing apparatus telemetry, vital signs monitoring, access to online forms and databases

• **Location services:**
  - Tracking of personnel, vehicles and other assets. Also electronic mapping services are increasingly used

• **Resilience and Backup:**
  - Multiple networks preferred (e.g. voice and data) to provide fall back if one fails.

• **Flexibility:**
  - Rapid provision of extra coverage or capacity when needed

• **Better interoperability** between different agencies and ICT systems
## MAIN OUTCOMES - PPDR

### REQUIREMENTS MATRIX

<table>
<thead>
<tr>
<th>Communication scenario</th>
<th>Application / Service</th>
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<tbody>
<tr>
<td>A: Between the CCC and PPDR personnel at the incident</td>
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<td>B: Between PPDR vehicles and the incident or the CCC</td>
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<td>C: Between PPDR individuals at the incident</td>
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<td>D: Between different PPDR entities</td>
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<td>E: Accessing external data sources</td>
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<td>F: Communications in enclosed spaces</td>
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<td>G: Communications with remote locations</td>
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<td>H: Communications with or between machines</td>
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• 18 PPDR network solutions were analysed according to:
  • Relevant players in the development and adoption
  • Standards development
  • Technical details
  • Requirements
  • Strengths and weaknesses for PPDR applications

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<th>Category</th>
<th>Network solution</th>
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<td>Candidate technologies for future PPDR applications</td>
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<td>Software-Defined Radio</td>
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<td>Cognitive Radio</td>
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## PPDR-TC Network Requirements

### Users
- TETRA Release 1: Fully Compliant
- TETRA Release 2: Fully Compliant
- TETRAPOL: Fully Compliant
- Analog PMR: Fully Compliant
- Digital PMR: Fully Compliant
- DMR: Fully Compliant
- SATCOM: Fully Compliant
- GPS/EDGE: Fully Compliant
- CDMA 2000: Fully Compliant
- UMTS: Fully Compliant
- HSPA+ HSPA+: Fully Compliant
- LTE: Fully Compliant
- Wi-Fi: Fully Compliant
- WiMAX: Fully Compliant
- MANETs: Fully Compliant

### Coverage Area
- TETRA: Fully Compliant
- TETRAPOL: Fully Compliant
- Analog PMR: Fully Compliant
- Digital PMR: Fully Compliant
- DMR: Fully Compliant
- SATCOM: Partially Compliant
- GPS/EDGE: Partially Compliant
- CDMA 2000: Fully Compliant
- UMTS: Fully Compliant
- HSPA+ HSPA+: Fully Compliant
- LTE: Fully Compliant
- Wi-Fi: Fully Compliant
- WiMAX: Fully Compliant
- MANETs: Fully Compliant

### Required Network Topology
- TETRA: Fully Compliant
- TETRAPOL: Fully Compliant
- Analog PMR: Fully Compliant
- Digital PMR: Fully Compliant
- DMR: Fully Compliant
- SATCOM: Fully Compliant
- GPS/EDGE: Fully Compliant
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- HSPA+ HSPA+: Fully Compliant
- LTE: Fully Compliant
- Wi-Fi: Fully Compliant
- WiMAX: Fully Compliant
- MANETs: Fully Compliant

### Node Connectivity Models
- TETRA: Fully Compliant
- TETRAPOL: Fully Compliant
- Analog PMR: Fully Compliant
- Digital PMR: Fully Compliant
- DMR: Fully Compliant
- SATCOM: Partially Compliant
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- UMTS: Fully Compliant
- HSPA+ HSPA+: Fully Compliant
- LTE: Fully Compliant
- Wi-Fi: Fully Compliant
- WiMAX: Fully Compliant
- MANETs: Fully Compliant

### Capacity in Terms of Data and Required Bandwidth
- TETRA: Fully Compliant
- TETRAPOL: Fully Compliant
- Analog PMR: Fully Compliant
- Digital PMR: Fully Compliant
- DMR: Fully Compliant
- SATCOM: Partially Compliant
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- HSPA+ HSPA+: Fully Compliant
- LTE: Fully Compliant
- Wi-Fi: Fully Compliant
- WiMAX: Fully Compliant
- MANETs: Fully Compliant

### Mobility Requirements
- TETRA: Fully Compliant
- TETRAPOL: Fully Compliant
- Analog PMR: Fully Compliant
- Digital PMR: Fully Compliant
- DMR: Fully Compliant
- SATCOM: Partially Compliant
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- UMTS: Fully Compliant
- HSPA+ HSPA+: Fully Compliant
- LTE: Fully Compliant
- Wi-Fi: Fully Compliant
- WiMAX: Fully Compliant
- MANETs: Fully Compliant

### Interoperability Requirements
- TETRA: Partially Compliant
- TETRAPOL: Partially Compliant
- Analog PMR: Partially Compliant
- Digital PMR: Partially Compliant
- DMR: Partially Compliant
- SATCOM: Partially Compliant
- GPS/EDGE: Partially Compliant
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- UMTS: Fully Compliant
- HSPA+ HSPA+: Fully Compliant
- LTE: Fully Compliant
- Wi-Fi: Fully Compliant
- WiMAX: Fully Compliant
- MANETs: Partially Compliant

### Service Availability, Reliability and Resilience
- TETRA: Fully Compliant
- TETRAPOL: Fully Compliant
- Analog PMR: Fully Compliant
- Digital PMR: Fully Compliant
- DMR: Fully Compliant
- SATCOM: Partially Compliant
- GPS/EDGE: Partially Compliant
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- UMTS: Fully Compliant
- HSPA+ HSPA+: Fully Compliant
- LTE: Fully Compliant
- Wi-Fi: Fully Compliant
- WiMAX: Fully Compliant
- MANETs: Partially Compliant

### Performance Requirements
- TETRA: Fully Compliant
- TETRAPOL: Fully Compliant
- Analog PMR: Fully Compliant
- Digital PMR: Fully Compliant
- DMR: Fully Compliant
- SATCOM: Partially Compliant
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- HSPA+ HSPA+: Fully Compliant
- LTE: Fully Compliant
- Wi-Fi: Fully Compliant
- WiMAX: Fully Compliant
- MANETs: Partially Compliant

### Security
- TETRA: Fully Compliant
- TETRAPOL: Fully Compliant
- Analog PMR: Fully Compliant
- Digital PMR: Fully Compliant
- DMR: Fully Compliant
- SATCOM: Partially Compliant
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- HSPA+ HSPA+: Fully Compliant
- LTE: Fully Compliant
- Wi-Fi: Fully Compliant
- WiMAX: Fully Compliant
- MANETs: Partially Compliant

### Specific Voice Communication Requirements
- TETRA: Fully Compliant
- TETRAPOL: Fully Compliant
- Analog PMR: Fully Compliant
- Digital PMR: Fully Compliant
- DMR: Fully Compliant
- SATCOM: Partially Compliant
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- UMTS: Fully Compliant
- HSPA+ HSPA+: Fully Compliant
- LTE: Fully Compliant
- Wi-Fi: Fully Compliant
- WiMAX: Fully Compliant
- MANETs: Partially Compliant

### Specific Data Communication Requirements
- TETRA: Partially Compliant
- TETRAPOL: Partially Compliant
- Analog PMR: Partially Compliant
- Digital PMR: Partially Compliant
- DMR: Partially Compliant
- SATCOM: Partially Compliant
- GPS/EDGE: Partially Compliant
- CDMA 2000: Fully Compliant
- UMTS: Fully Compliant
- HSPA+ HSPA+: Fully Compliant
- LTE: Fully Compliant
- Wi-Fi: Fully Compliant
- WiMAX: Fully Compliant
- MANETs: Partially Compliant
### MAIN OUTCOMES - INTEROPERABILITY

#### Interoperability in terms of roaming

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<th>TETRA 1</th>
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#### Interoperability in terms of data exchange

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### MAIN OUTCOMES – PPDR REFERENCE

#### SERVICE CLASSIFICATION

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<td>Access to internal databases (narrowband)</td>
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<td>Access to external sources (narrowband)</td>
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<td>Augmented reality</td>
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<tr>
<td>Remote operations</td>
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</table>
WHAT SPECTRUM IS REQUIRED FOR PPDR?

- **Wide area voice and messaging**, e.g. TETRA
- **Wide area broadband**, e.g. video
- **Local area communication**, including:
  - Extending coverage of wide area networks
  - Direct communication between terminals (DMO)
  - Ad-hoc local area networks
- **Air to ground communications (A2G)**, e.g. helicopters
- **Satellite communications**, e.g. for remote areas and disaster recovery
- **Fixed links**, e.g. network backhaul or temporary links
CURRENT PPDR SPECTRUM IN EUROPE

- Only fully harmonised band is **380-400 MHz** – only half of this is available (2x5 MHz) and is used mainly by TETRA/TETRAPOL
- Some specific frequencies in this band set aside for DMO and A2G
- Many countries still have **analogue** systems operating in a variety of VHF and UHF bands (68 – 470 MHz)
- Some countries already have specific bands identified for **broadband PPDR** (e.g. video links) – main bands are **2.3 GHz** and **3.5 GHz** but precise frequencies vary
- CEPT has attempted to harmonise spectrum around 5 GHz (**4940-4990 MHz** and **5150-5250 MHz**) for **local area broadband PPDR**, but few countries have taken this up
- Existing international bands used for **satellite** and **fixed links** (generally shared with other users)
CONCLUSIONS IN SPECTRUM REQUIREMENTS

- Growing global consensus that additional spectrum is required for BB PPDR (already implemented in some countries outside EU)
- Should comprise low frequency (<1 GHz) for WAN and higher (e.g. 4940-4990 MHz) for WLANs
- 700 MHz strongly favoured for BB WAN – ECC PT49 has proposed 2x5 MHz dedicated band plus additional from adjacent mobile band where needed
- Also need spectrum for specialist apps like DMO and A2G
  - 700 MHz centre gap / 2.3 GHz / 3.5 GHz?
- BB LANs should use existing allocations around 5 GHz
- Other potential bands of interest include
  - 3G unpaired bands (1900-1920/2010-2025 MHz)
  - 3G satellite bands (1980-2010/2170-2200 MHz)
- Will still need 400 MHz for narrow band for some time
BUSINESS MODELS

a) User Owned – User Operated (UO-UO): Building, ownership & operation of the network(s) by the end-user agency (or agencies) themselves.

b) User Owned – Commercial Operated (UO-CO): Build & ownership of the network(s) by the end-user agency (or agencies). Operation of the network(s) by a commercial provider of outsourced managed network services.

c) Commercial Owner – Commercial Operated (CO-CO): User agencies subscribe for services provided by a commercial network owner / operator.
# MODEL BENCHMARKING – ASSUMPTIONS (1)

<table>
<thead>
<tr>
<th>Scenario 1.1 Mobile broadband network planned, built, run and owned by the authority</th>
<th>Scenario 1.2 Mobile broadband service provided through service offering</th>
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<th>Scenario 3.4 Extended MVNO</th>
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# Model Benchmarking – Assumptions (2)

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<th>Scenario 1.1 Mobile broadband network planned, built, run and owned by the authority</th>
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**Changes assumption:**

- no changes

**Leased cost:**

- TETRA: 50/75
- LTE: 50/75
- WiMAX: 75

**Outsourcing cost:**

- TETRA: 45/45
- LTE: 55/55
- WiMAX: 75

**Discount for 1st, 2nd, 3rd technologies:**

- TETRA: 0%
- LTE: 0%
- WiMAX: 0%
MODEL BENCHMARKING – CAPEX/OPEX

- SYSTEM 1: CAPEX 329,542,283, OPEX 668,411,164
- SYSTEM 2: CAPEX 2,130,200,000, OPEX 2,410,127,650
- SYSTEM 3: CAPEX 2,130,200,000, OPEX 1,857,730,179
- SYSTEM 4: CAPEX 2,130,200,000, OPEX 2,041,849,330
- SYSTEM 5: CAPEX 2,130,200,000, OPEX 3,631,738,450,440,585
- SYSTEM 6: CAPEX 2,130,200,000, OPEX 4,923,488,468
- SYSTEM 7: CAPEX 2,130,200,000, OPEX 5,685,805,348
- SYSTEM 8: CAPEX 2,130,200,000, OPEX 9,022,083,160
MODEL BENCHMARKING – ENPV
Simulate, validate and optimize the reference PPDR system architectures in terms of performance, resilience, interoperability and spectrum flexibility

Provide technical recommendations

Provide economical recommendations

Propose a migration path towards full compliance to PPDR requirements
THANK YOU FOR YOUR ATTENTION

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