Security **A**nd Interoperabi**L**ity in Next Generation PPDR Comm**U**nication Infrastructure**S**

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Deliverable 2.2

SALUS PPDR User Requirements– Intermediate

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***Abstract**: Deliverable 2.2 describes the SALUS user requirements as a result of multiple PPDR user inputs, and specifically flowing from the PPDR use cases that were produced as deliverable 2.1.*

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EXECUTIVE SUMMARY

The main objective of this document is to present the interim version of the PPDR user requirements developed from the three proposed SALUS Scenarios and Use Cases. These requirements will reflect the needs of the Public Protection and Disaster Relief (PPDR) user community as they migrate into the next generation PPDR network with their continuing exacting voice requirements augmented with ever increasing data needs and multimedia capabilities. This deliverable does not address the PPDR user requirements regarding the spectrum needs for next generation systems, as these will be the focus of SALUS deliverables D4.5 (Spectrum requirements) and D4.8 (Frequencies allocations proposals).

The interim user requirements have been captured based on the 3 interim use cases described in SALUS deliverable D2.1 [7]:

- Scenario 1 – Public order demonstration or riot [12][14]
- Scenario 2 – Olympic-style sporting event [13][15][16]
- Scenario 3 – Heavy flooding due to prolonged periods of rain [6][10][11]

The requirements capture at this stage are still at a high level; however they have been updated and refined following initial end user feedback. Additionally, the requirements developed by the European PPDR organisations under the auspices by the Law Enforcement Working Party (LEWP) have also been taken into account. The LEWP reports officially to JHA (Justice & Home Affairs) within the European Council.

Following this deliverable, the next stages are to produce a more detailed set of user requirements by further engagement with end-users.

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1 Introduction

This document is the second deliverable (D2.2) of work package 2 in accordance with the "Security And Interoperability in Next Generation PPDR Communication Infrastructures" (SALUS) description of work (DoW). It aims to provide intermediate user numbers and requirements for public safety communication systems including types of information needed by PPDR users at operational, tactical and strategic level and types of services PPDR users need [8].

These intermediate requirements have been captured based on the 3 interim use cases that have been developed as part of deliverable 2.1[7].

- Scenario 1 – Public order demonstration or riot
- Scenario 2 – Olympic-style sporting event
- Scenario 3 – Heavy flooding due to prolonged periods of rain

The requirements capture is phase 2 of 4 in the methodology and approach (as described in figure 1) taken to develop the solution based on the operational needs of the users in the given scenarios.

It is recognised that across the European member states, specific communications needs may vary depending on organisational and regulatory factors of an individual country. The approach therefore is to engage with end users across a variety of public safety organisations and EU countries to create a high level framework for PPDR that is capable of efficient cross-border PPDR operations [2].

2 Methodology for the SALUS User Requirements Capture

The approach to capturing requirements forms part of a 4-phase process encompassing both the use case development and the requirements capture. The 4 phases are as follows:

- **Phase 1** – Develop the use cases based on the 3 SALUS scenarios i.e. City Protection, Temporary Protection and Disaster Recovery. This includes the identification of PPDR end users that that are likely to be participating in each use case.
- **Phase 2** – Capture the high level requirements for each of the use cases taking into account the participating PPDR end users and their requirements as well as the technologies SALUS foresees to develop and exploit.
- **Phase 3** – Further refine the requirements to a sufficient level of detail
- **Phase 4** – Further develop the use cases that will be used to develop the technical solutions and test that they deliver against the requirements that were captured in the previous phases.

Throughout all phases, end user feedback will be sought in order to test the credibility and accuracy requirements. The collected end user feedback can be found in appendix 1.

The diagram that reflects the methodology for the requirements capture is depicted in Figure 1.

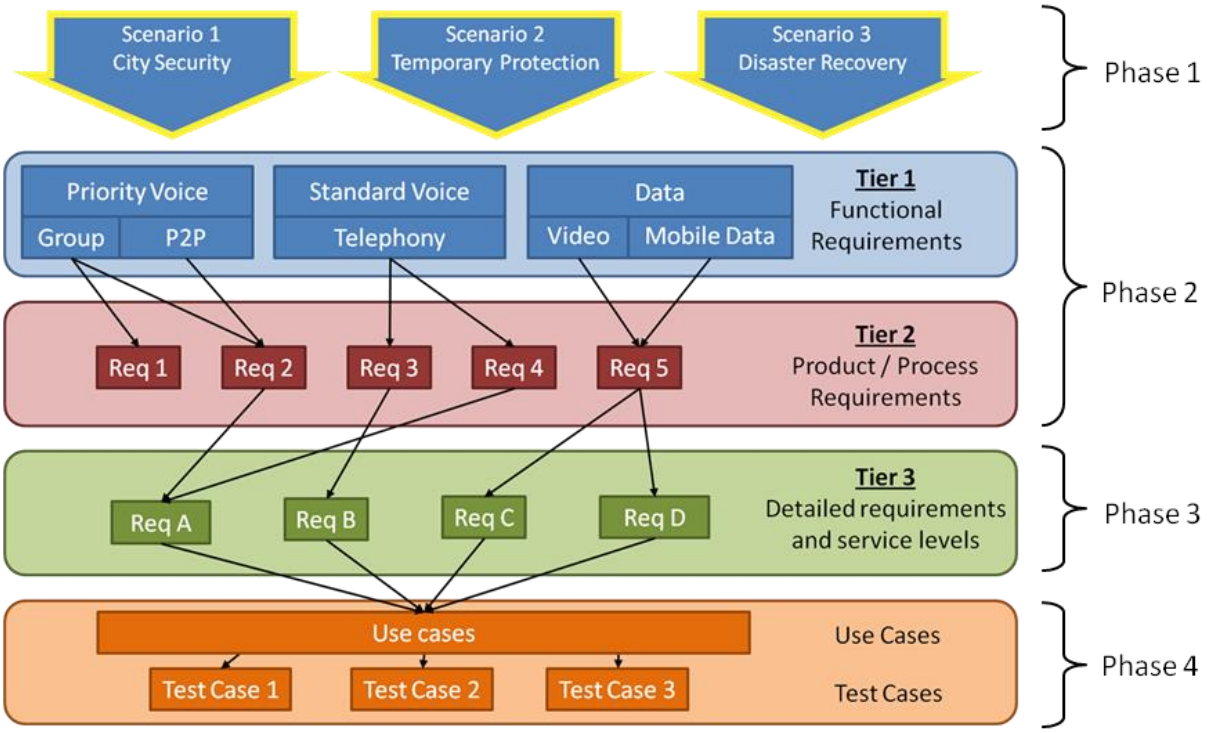

Figure 1–High level approach for use cases and requirements capture

2.1 High Level Delivery Plan

The following high level delivery plan was developed and agreed to manage these initial deliverables:

Table 1–High Level Delivery Plan

No.	Item	Owner	Due Date
1.	Work package start-up ▪ Develop delivery plan ▪ Identify participants ▪ Kick off meeting with participants	AW	19/09/13
2.	Collect examples of historic public order events from across the partner countries	All	18/10/13
3.	Initial draft of intermediate use case scenarios and requirements for discussion at kick off meeting	AW	18/10/13
4.	Collect end user feedback of initial draft of scenarios	AW / TI-WMC / PSCE / IT / ESC	14/11/13
5.	Update intermediate scenarios and requirements incorporating feedback	AW / TI-WMC / CAS	26/11/13
6.	Document updated scenarios and requirements and circulate for feedback	AW	27/11/13
7.	Feedback on final document	ALL	28/11/13
8.	Update final document and submit	AW	29/11/13
9.	Additional end user feedback on scenarios	AW	03/12/13
10.	Quality check by the Quality Assurance Group	UTWENTE, IT, ROH,	11/12/13
11.	Final version release (v1.0)	AW	23/12/2013

3 The SALUS Intermediate User Requirements

Following on from the development of the interim use cases in SALUS deliverable 2.1 [7], the initial requirements were captured based on those use cases and the participating end users.

3.1 Requirements for Command and Control

Although operational practices and procedures will vary across different EU member states and across the 3 use cases, the requirements have taken into account the universally accepted convention of users with strategic, tactical and operational responsibilities within a given scenario [5].

- **At the strategic level** the commander has the ultimate responsibility for determining the strategy and any tactical parameters that should be followed at the tactical and operational levels.
- **At the tactical level** the tactical commander commands and co-ordinates the overall tactical response in compliance with the strategy.
- **At the operational level** the operational commander is responsible for a group of resources, and carrying out the functional responsibilities related to the tactical plan. It is primarily at the operational level that the number of resources deployed.

At the three levels, the requirements and the type of information required in order to carry out their responsibilities are different.

The table below illustrates the kind of information required for the 3 levels of command based on the 3 use cases:

Table 2–Information Requirements for Command and Control [5]

	Strategic	Tactical	Operational
Scenario 1 - Public order demonstration or riot	▪ Threat levels ▪ Number of casualties ▪ Volumes of public and extent of public disorder ▪ Criminal intelligence ▪ Copy-cat activities in other locations ▪ Geographical location and spread ▪ Resources available including mutual aide ▪ Situational update from tactical command ▪ Video feeds	▪ Direction from strategic command ▪ Numbers and movement of rioters ▪ Criminal intelligence ▪ Network capability, availability and utilisation ▪ Resources available including mutual aide ▪ Situational update from operational command ▪ Video feeds	▪ Direction from tactical command ▪ Criminal intelligence ▪ Talk group information ▪ Local risk assessment ▪ Location of resources available ▪ Video feeds ▪ Database access
Scenario 2 - Olympic-style sporting event	▪ Threat levels ▪ Crowd movement ▪ Geographical location and spread	▪ Direction from strategic command ▪ Crowd numbers and movement	▪ Direction from tactical command ▪ Local risk assessment ▪ Layout of stadia and

	Strategic	Tactical	Operational
	▪ Situational update from tactical command, possibly via video feeds ▪ Resources available including mutual aide	▪ Resources available including mutual aide ▪ Situational update from operational command ▪ Specialist support ▪ Video feeds	access points ▪ Talk group information ▪ Location of resources available ▪ Database access
Scenario 3 - Heavy flooding due to prolonged periods of rain	▪ Levels of threat to public safety ▪ Weather information ▪ Extent of damage caused by flooding ▪ Numbers of casualties ▪ Geographical location and spread ▪ Situational update from tactical command, possibly via video feeds ▪ Resources available including mutual aide ▪ Video feeds	▪ Direction from strategic command ▪ Crowd numbers and movement ▪ Extent of damage caused by flooding ▪ Type of terrain and access restrictions ▪ Resources available including mutual aide ▪ Specialist support and equipment ▪ Situational update from operational command ▪ Video feeds	▪ Direction from tactical command ▪ Local risk assessment ▪ Talk group information ▪ Location of resources available ▪ Database access ▪ Video feeds

3.2 Typical User Numbers

The numbers of PPDR users to be deployed at a public event will depend specifically on the nature of the event in terms of severity, duration, number of attendees and other factors.

However studies undertaken by the UK home office suggest that the number of PPDR end users can increase by up to a factor of 10 when activities change from business as usual (BAU) to a high level public order event.

Table 3 below presents real Public Safety user equipment (UE) and group distribution data from an urban area in the UK. The data was captured on a day representing typical BAU activity. The data represents a snapshot of usage patterns at a particular instant in time; chosen to represent the peak total usage in the day. The selected 36 radio access networks (RAN) sectors represent the most concentrated contiguous area of activity within the urban area [9].

Table 3–Snapshot of User Numbers during BAU Activity [9]

Site	Sector	Footprint (km2)	# of groups	# of UEs
Site 1	A	0.84	16	43
	B	2.53	26	230
	C	1.07	8	18
Site 2	A	2.44	6	29
	B	1.86	9	40
	C	2.57	20	86
Site 3	A	1.07	19	63
	B	0.81	5	5
	C	0.52	5	7
Site 4	A	0.87	27	93
	B	1.19	23	154
	C	1.07	2	2
Site 5	A	1.5	26	109
	B	1.26	11	40
	C	0.62	11	29
Site 6	A	0.82	6	8
	B	3.16	14	29
	C	1.02	34	205
Site 7	A	2.6	13	32
	B	1.05	16	66
	C	1.7	18	63
Site 8	A	1.13	17	67
	B	3.43	8	30
	C	1.23	11	36
Site 9	A	0.52	8	18
	B	0.36	3	5
	C	0.42	5	7
Site 10	A	0.61	11	71
	B	0.52	21	63
	C	0.45	19	50
Site 11	A	1.16	2	2
	B	0.52	4	11
	C	0.73	15	77
Site 12	A	0.46	22	140
	B	1.06	11	155
	C	0.64	13	29

Table 4 below presents UE and group numbers during a significant large planned event, requiring a much greater PPDR users' presence.

The event occurs in a smaller concentrated area of fewer sectors. With the existing TETRA mission-critical voice network it is necessary to introduce additional cell sectors to the event area to handle the high user numbers [3][17].

Table 4–PPDR user numbers during a large planned event [9]

Site	Sector	Footprint (km2)	# of groups	# of UEs
Site 7	C	1.7	32	155
Site 8	A	1.13	69	452
	B	3.43	30	133
	C	1.23	42	147
Site 10	C	0.45	20	54
Temporary Additional Site	A	1.6	83	2025
	B	1.4	58	1153

An example of this occurred when during the rioting in the UK in 2011, sixteen thousand additional police officers were drafted in from surrounding forces into London to assist the Metropolitan police contain the situation [1].

3.3 PPDR Intermediate Requirements

Taking the 3 use cases from D2.1, the intermediate requirements of the PPDR users are summarised in the list below:

- **Voice -** Users can make a variety of voice calls including group, announcement, emergency, individual and telephony interconnect calls. The infrastructure should ensure that emergency calls have priority over other calls, releasing capacity for an emergency call to be connected if required.
- **Video –** Users can send and receive video imaging to groups or individuals, either from a dispatcher to the group or vice versa.
- **Data Applications –** Users can have mobile access to various data applications such as messaging services and email, organisation-specific databases and other data-rich applications such as location services, augmented reality and DNA/Fingerprint scanning.
- **Air to Ground –** Communications are possible between users in aircraft and users on the ground.
- **Interoperability –** Communications are possible between users connected via different technologies or networks.
- **Ad Hoc Mobile Networks –** Additional network coverage or capacity can be deployed quickly and easily where such a requirement exists, for example in remote locations[3][17].
- **Crowd Control –** The communication system can be utilised to manage large crowds of people using a combination of loud speakers, video, social networking applications etc.

Table 5 shows the intermediate high level requirements that have been identified and how they relate to the 3 use cases:

Table 5–User Requirements Matrix (intermediate)

Category	Item	Use Case 1				Use Case 2				Use Case 3			
		P	F	A	O	P	F	A	O	P	F	A	O
Group Voice	*Group call	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Late entry	✓	✓	✓		✓	✓	✓			✓	✓	
	Dynamic reassignment	✓	✓	✓		✓	✓	✓			✓	✓	
	Prioritisation within group	✓	✓	✓		✓	✓	✓			✓	✓	
	Only 1 person to speak	✓	✓	✓		✓	✓				✓		
	Fast call set-up	✓	✓	✓		✓	✓	✓		✓	✓	✓	
1-2-1 Voice	Point to point	✓	✓	✓		✓	✓	✓		✓	✓	✓	
	Telephony	✓	✓	✓		✓	✓	✓		✓	✓	✓	
Group video	*Group video streaming	✓	✓			✓	✓			✓	✓	✓	✓
	Late entry	✓	✓			✓				✓	✓	✓	
	Dynamic reassignment	✓	✓			✓				✓	✓	✓	
	Prioritisation within group	✓	✓			✓				✓	✓	✓	
	*Video from ad-hoc fixed locations to CC					✓	✓				✓		
	*Video on location for local use (unit-commander)										✓		
1-2-1 Video	Video streaming	✓	✓	✓		✓	✓	✓		✓	✓	✓	
Emergency voice	Pre-emptive priority	✓	✓	✓		✓	✓	✓			✓	✓	
	Open microphone	✓	✓	✓		✓	✓				✓	✓	
Data Applications	Instant messaging	✓	✓	✓						✓	✓	✓	
	Email	✓	✓	✓		✓	✓	✓		✓	✓	✓	
	Automatic number plate/license plate recognition	✓				✓							
	Picture messaging	✓	✓	✓		✓	✓	✓		✓	✓	✓	
	Remote controlled CCTV	✓	✓			✓	✓	✓		✓	✓		
	*Sending location data (vehicle/person) to CC	✓	✓	✓						✓	✓		
	*Broadcasting location from CC to units	✓	✓	✓						✓	✓		
	Augmented reality	✓	✓										
	Augmented reality - text to voice	✓	✓										
	*Fingerprint scanning	✓				✓						✓	
	DNA testing	✓				✓		✓				✓	
	*Patient monitoring (e.g. ECC)							✓				✓	
	*Monitor personnels' vital signs (drop detection, stress, toxicity levels...)					✓	✓			✓	✓	✓	

Category	Item	Use Case 1				Use Case 2				Use Case 3			
		P	F	A	O	P	F	A	O	P	F	A	O
	Location services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Air to ground	Integration with aircraft communications	✓	✓	✓		✓		✓		✓	✓		
Mobile ad hoc networks	Local broadband data communication facilities					✓	✓	✓	✓	✓	✓	✓	✓
	Capacity extensions					✓	✓	✓	✓	✓	✓	✓	✓
Database searching	*(Operational database search)	✓	✓	✓		✓	✓	✓		✓	✓	✓	
	*Query cargo information (from crashed vehicles)		✓	✓		✓	✓			✓	✓		
	*Remote medical database services			✓				✓				✓	
	*Car crash recovery system (cutting open crashed cars)	✓	✓			✓	✓				✓		
Broadcast Voice	*Site related	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Talk Group related	✓				✓				✓			
	Geography related	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Function related	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Broadcast Image	Site related	✓	✓			✓	✓			✓	✓		
	Talk Group related	✓	✓			✓	✓			✓	✓		
	Geography related	✓	✓			✓	✓			✓	✓		
	Function related	✓	✓			✓	✓			✓	✓		
Interoperability	Interoperability	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Local range extender	Incident comms	✓	✓	✓						✓	✓	✓	✓
Crowd Control	Loudspeakers					✓			✓				
	Geo-cast (via LTE) of alarms					✓			✓				
	Evacuation procedures, etc via mobile phones,					✓			✓				
	Use of the screens at the stadium and outside					✓			✓				

P = Police, F = Fire, A = Ambulance, O = Other

* Fields referenced in the Law Enforcement Working Party (LEWP) requirements Matrix [4]

4 Next Steps

Building on the intermediate user requirements the next step is to further develop them to a greater level of detail, incorporating the technological capabilities that are associated with each scenario. The feed will be taken from the further developed use cases and as well as further engagement with PPDR end users.

Therefore the next steps are: (i) further refinement of requirements; (ii) further consultations with end users for validation. Additionally the monitoring activities undertaken by CEPT/LWEP will be factored into the requirements capture exercise.

It is envisaged that at least 1 workshop, involving PPDR end-users, will be required to address these next steps. The workshop is foreseen to take place early in 2014. In preparation for this workshop, the proposed methodology for the SALUS requirements capture will be updated.

This deliverable does not address the PPDR user requirements regarding the spectrum needs for next generation systems or considerations of future frequency harmonisation of the PPDR sector, as these will be the focus of SALUS deliverables D4.5 (Spectrum requirements) and D4.8 (Frequencies allocations proposals).

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ACRONYMS

3G	Third Generation
3GPP	Third Generation Partnership Project
AIE	Air Interface Encryption
AODV	Ad hoc On demand Distance Vector Protocol
AP	Access Point
ASFPG	Association Security and Fraud Prevention Group
ATHO	ATHENS Olympic Games
ATIS	Alliance for Telecommunications Industry Solutions
AUTOCON	Ad-Hoc Network Autoconfiguration
AW	Airwave Solutions
BAN	Body Area Networks
BAU	Business As usual
BS	Base Station
CA	Certification Authority
CAS	Cassidian (company)
CCSR	Centre for Communication Systems Research
CEPT	The European Conference of Postal and Telecommunications Administrations
CISM	Computing, Information Systems and Mathematics
COSI	Standing Committee on Internal Security
DMO	Direct Mode Operation
DoW	Description of Work
e2e	End-to-End
EAP	Extensible Authentication Protocol
EC	European Commission
ECC	Electronic Communications Committee
EC/EU	European Commission / European Union
ECRIT	Emergency Context Resolution with Internet Technologies
ECS	Emergency College Services (Finland)
EOS	European Organization for Security
ERIC	Emergency Response Interoperability Center
ESA	European Space Agency
ESRIF	European Security Research and Innovation Forum
ETSI	European Telecommunications Standards Institute
FP5/6/7	Framework Programme 5th/6th/7th
FRONTEX	European External Borders Agency
GPRS	General Packet Radio Service
GSM	Global System for Mobile communications

IAP	Integrated Applications Promotion
ICT	Information and Communication Technologies
IDABC	Interoperable Delivery of European eGovernment Services to public Admin., Businesses, Citizens
IDS	Intrusion Detection System
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISI	Inter System Interface
ISO	International Organisation for Standardisation
iSOF	interoperable Secure Operation Framework
IST	Information Society Technologies
IT	Instituto de Telecomunicações
ITU	International Telecommunication Union
KU	Kingston University
LEWP	Law Enforcement Working Party
LTE	Long Term Evolution
MAC	Medium Access Layer
MANET	Mobile Ad-hoc Network
MCR	Multi Channel Routing
MIMO	Multiple Input Multiple Output
MSK	Master Session Key
NATO	North Atlantic Treaty Organisation
OLSR	Optimized Link State Routing
OTAK	Over The Air Keying
P2P	Peer-to-Peer
PAS	Tetrapol Publicly Available Specification
PC	Project Coordinator
PCC	Project Coordination Committee
PHY	Physical layer
PKI	Public Key Infrastructure
PM	Project Manager
PMs	Person Months
PMC	Project Management Committee
PMR	Professional Mobile Radio
PSTN	Public Switched Telephone Network
QMR	Quarterly Management Report
QoS	Quality of Service
R&D	Research and Development

RAN	Radio Access Network
RFC	Request For Comment
ROH	Rohill Technologies B.V.
SAE	1: Simultaneous Authentication of Equals
SAE	2: System Architecture Evolution (3GPP)
SDS	Short Data Services
SIP	Session Initiation Protocol
SME	Small Medium Enterprise
SON	Self-Organizing Networks
STREP	Specific Targeted Research Project
SwMI	Switching and Management Infrastructure
TC	Technical Committee
TEA	TETRA Encryption Algorithms
TETRA	TErrestrial Trunked RAdio
TFEU	Treaty on the Functioning of the European Union
TL	Task Leaders
TM	Terminal Manager
TMO	Trunked Mode Operation
UCIF	Unified Communications Interoperability Forum
UMTS	Universal Mobile Telecommunications System
UE	User Equipment
UPAT	University of Patras
VoIP	Voice over IP
WBAN	Wireless Body Area Networks
WG	Working Group
Wi-Fi	IEEE 802.11
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless LAN
WMN	Wireless Multimedia and Networking
WP	Work Package
WWRF	Wireless World Research Forum

APPENDIX 1: END USER FEEDBACK – QUESTION 3

Question: Within the context of the scenarios, are there any specific mobile communication requirements that you would consider to be particularly challenging to meet.

Scenario 1

Feedback	By	Organisation
There will be several governmental and first responders organisations in action. Each of them will use some central control room structure (maybe a joint one), some of them an additional mobile command post. Wireless communications between those command structures is key for success, cross-agency communication an important aspect in dealing with the incident(s).	Manfred Blaha	Ministry of the Interior, Austria
Mutual aid – talkgroups, call signs, different terminals if issued by the requesting Force. You have a large PSU – Police Support Unit – requirement. Lots of officers, some might rely on direction from supervisors and so may not be issued with radios, radios/mics in public order equipment. Lots of officers in an area testing capacity Noise and chaos, dealing with a moving feast, getting full sight of incident to Silver/Gold command. Getting PSU relief. The main issues with large scale public order is getting the most up to date information and then communicating that out to the PSU commanders.	Darren Chamberlain	Airwave Solutions (previously Humberside Police)
Bandwidth and spectrum. Standardization based on open standards with good end-to-end encryption.	Geir Myhre	National Police Computing and Material services
Typically, each such event triggers a government response. This is done by a central command and control centre and several mobile centres, which requires strong and reliable communication means.		Special Telecommunications Service - Romania
The situation itself will be challenging. Governmental Involvement and a Coordinated Multi Agency approach to planning and execution of the plans. The ability to have War Room Communications Hubs to supply sufficient accurate dynamic information to enable multi agency coordination as well as logistical support to a variety of centres of disorder. The spread of disorder and copycat disorder will be an issue as will the fatigue of all involved.	Tom Blair	Airwave Solutions (Previously Strathclyde Police)
Loss of MNO availability owing to congestion of network during significant disorder	Mark Swift	Airwave (previously Metropolitan Police)

Scenario 2

Feedback	By	Organisation
High volume communication in a dense area. Limited usability of commercial 2G/3G networks due to congestion/overload	Manfred Blaha	Ministry of the Interior, Austria
Volunteers with radios, untrained, limited functionality and with poor radio discipline so as well as the Emergency Services users you may need to consider management of the volunteer base and getting them to direct people. Lots of people on the streets heading for local transport when not expected – much trickier if panicked. Ability/inability to transmit with the danger of triggering an explosive device not only around the venue but also potential RV/muster points. Radio discipline i.e. users not mentioning bombs!	Darren Chamberlain	Airwave Solutions (previously Humberside Police)
Live video streaming. Distribution of public location based information will be challenging	Geir Myhre	National Police Computing and Material services
Concentration of forces in a relatively small area may require increasing communication resources at the level of networks which may be difficult to attain in a very short time.		Special Telecommunications Service - Romania
A desirable functionality is to allow a first responder to broadcast his own voice on a louder level (as in loudspeaker), this way it could make is message reach a larger area of citizens (make them understand). Alternatively, the first responder device at the location could be used as a relay to actually transmit the voice (louder) of a commander at the command and control centre.	Comandante Rui Esteves	Associação Nacional de Protecção Civil (ANPC)
Mobile Data would be challenging – people need to gather, collate, type and send – time taken to receive, digest and understand – can take to long. Much better to have dynamic systems operating with real time information to support voice communications and verbal commands. The Comms plan needs to fit the roles, responsibilities and accountabilities of the various players.	Tom Blair	Airwave Solutions (Previously Strathclyde Police)

Scenario 3

Feedback	By	Organisation
Biggest problem will be the maintaining of PPDR communications on 24/7 basis, despite all upcoming problems.	Manfred Blaha	Ministry of the Interior, Austria
I think you mention them, main one being loss of infrastructure – batteries then genies failing due to their being no power – how long is the scenario due to last. Coverage and temp coverage solutions being required, getting these to and from the area given the area and people exiting the area.	Darren Chamberlain	Airwave Solutions (previously Humberside Police)
Coverage on public communication and PPDR to be a challenge in rural areas. Distribution of public location based information will be challenging	Geir Myhre	National Police Computing and Material services
Communicating data, that is, a common actual picture: Satellite images of the “day after the flood” as Google Crisis Response did after Hurricane Sandy in NYC.	J.W. van Aalst	Imergis
No.		Special Telecommunications Service - Romania
Currently, in Portugal, at disaster coordination level, the coordinator needs to use multiple radio devices (each with different frequency bands, and different technologies) to reach the different First responder teams (police, ambulance, etc…). The vests sometimes need to transport 4 or 5 different radio device types.	Comandante Rui Esteves	Associação Nacional de Protecção Civil (ANPC)
Within reason any communications relying on permanent ground based infrastructure routed to the low lying geographies will be at risk. In large part TETRA masts tend to be located in higher positions than other technologies and are thus less susceptible (in general terms) – utilise Cumbria Flooding as an example.	Tom Blair	Airwave Solutions (Previously Strathclyde Police)