Status and Trends of Public Protection and Disaster Relief (PPDR) Communications

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Chair, APT-AWG Task Group on PPDR
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Head of International Spectrum, Motorola Solutions Inc.
AGENDA

• What is PPDR
• What are the PPDR Technologies and how they are evolving
• What is ITU doing on PPDR
• What are PPDR implementation Strategies
• Summary and recommendations
WHAT IS PPDR?

PUBLIC PROTECTION

MAINTAINING LAW AND ORDER, PROTECTING LIFE AND PROPERTY, RESPONDING TO EMERGENCIES

DISASTER RELIEF

RESPONDING TO SERIOUS DISRUPTIONS OF THE FUNCTIONING OF SOCIETY THAT POSE A SIGNIFICANT WIDESPREAD THREAT TO HUMAN LIFE, HEALTH, PROPERTY, OR THE ENVIRONMENT
PPDR AGENCIES RELY ON WIRELESS COMMUNICATIONS. TWO-WAY MISSION CRITICAL NARROWBAND RADIO IS THEIR LIFELINE.

TODAY, THEY ALSO NEED BROADBAND WIRELESS TO SUPPLEMENT THEIR MISSION CRITICAL RADIO.
“There was a 228 percent increase in push-to-talk communications between county and local police from the day before Irma hit to the day of the hurricane. In that time, there were no sites down, no outages and all [radio] communications worked flawlessly.”

Greg Holcomb
Director of Public Safety Communications
Lake County, Florida
September 2017
LIMITING THE IMPACT OF SYSTEM FAILURES

RESILIENCE TO FAILURE AT MULTIPLE LEVELS

- Fault Tolerant Components
- Redundant Components
- Geographic Redundancy
- Redundant Links (Alternate Paths)
- Edge Availability
  - Fallback Local Control (Site Trunking)
  - Fallback Local Basic Control (Failsoft)
  - Talkaround (Direct-Mode)

CONTINUED OPERATION, EVEN IN A CATASTROPHE

BUILT FOR MISSION CRITICAL VOICE
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PPDR COMMUNICATIONS ARE INCREASINGLY BEING COMPLEMENTED BY INTELLIGENCE

MISSION-CRITICAL COMMUNICATIONS

CONNECTING PEOPLE
Voice-Centric

SITUATIONAL AWARENESS
Command and Control

PHYSICAL RESOURCES
Dedicated Network / Computing / Storage

PRODUCTS/DEVICES
Hardware-Centric

CRITICAL COMMUNICATIONS
React and Respond

MISSION-CRITICAL INTELLIGENCE

CONNECTED EVERYTHING
Data-Centric

CONTEXTUAL AWARENESS
Intelligent Edge

VIRTUAL RESOURCES
Shared Networks / Cloud / Data

INTELLIGENT ECOSYSTEMS
Multi-Modal / Cognitive

CRITICAL INTELLIGENCE
Predict and Prevent
THE ERA OF MISSION CRITICAL INTELLIGENCE
## MISSION CRITICAL PPDR TECHNOLOGIES

### MISSION CRITICAL VOICE

<table>
<thead>
<tr>
<th>Terrestrial Trunked Radio (TETRA)</th>
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<tbody>
<tr>
<td>• Formerly known as Trans-European Trunked Radio</td>
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<tr>
<td>• European standard for a trunked radio system</td>
<td></td>
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<tr>
<td>• Specifically designed for PPDR</td>
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<tr>
<td>• Provides Mission critical voice, SMS and low speed data</td>
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<thead>
<tr>
<th>APCO P25</th>
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<tr>
<td>• Developed by Association of Public safety officials in USA (APCO)</td>
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<td>• Provides Mission critical voice, sms and low speed data</td>
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<thead>
<tr>
<th>DMR</th>
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<tr>
<td>• Digital mobile radio (DMR) is an open digital mobile radio standard defined in the European Telecommunications Standards Institute (ETSI)</td>
<td></td>
</tr>
<tr>
<td>• Being used by many PPDR agencies due to lower cost</td>
<td></td>
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### MISSION CRITICAL INTELLIGENCE

<table>
<thead>
<tr>
<th>LTE (ADVANCED) and 5G</th>
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<tbody>
<tr>
<td>• LTE-Advanced systems (Release 13 onwards) have attractive capabilities of meeting the needs of broadband PPDR</td>
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<tr>
<td>• LTE-advanced can meet the needs of mission critical intelligence by supporting Mission critical voice, data and video services as an IMT radio interface.</td>
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</table>
3GPP Releases for PPDR

**Release 12 (4G standards)**
- ProSe
- GCSE_LTE

**Release 13 (4G standards)**
- MCPTT
- eProSe-Ext
- MCPTT codec
- ProSe Enhancements (REAR: UE-Network Relay)
- MCPTT-MCPTT Interconnect Enh.*

**Release 14 (4G standards)**
- MCPTT Enhancements, MC Video, MC Data, MC Arch Enhancements
- MC Video codec
- ProSe Enhancements
- MCPTT-MCPTT Interconnect Enh.*
- MBMS for MC services*
- 5G: SMARTER*, 5G Arch*, 5G RAN*
- C/NB-IoT, MTC, V2X, EnTV

**Release 15 (4G standards)**
- MCPTT, MCVideo, MCDATA, MC Arch Enhancements
- MONASTERY Railway PTT, Video, Data
- R13 MCPTT Conformance Test
- MCPTT – MCPTT Interconnect Enh.
- MCPTT – LMR Interworking
- High Power UE (B3, B20, B28)
- ProSe Enh. (REAR2, WLAN Discovery)
- Maritime PTT, Video, Data*
- License Assisted Access (LAA) for CBRS 3.5GHz band in US
- Common API Framework*
- NAPS – Northbound APIs for SCEF

**Release 16 (estimated) (4G standards)**
- MCPTT, MCVideo, MCDATA, MC Arch Enhancements
- Railway (Phase 2) & Maritime PTT, Video, Data
- MCPTT – MCPTT Interconnect Enh.
- MCPTT – LMR Interworking Enh.
- Common API Framework
- Common API MC Middleware APIs?
- IMS RTC Enhancements
- Virtual Reality media services
- Efficient Delivery of Streaming Service*

**Release 16 (estimated) (5G standards)**
- Phase 2.5G
- MPS/MC Service Priority & QoS

*Study items: produce only proposals; then standards may be defined based upon the proposals.
MISSION CRITICAL PPDR COMMUNICATIONS

MISSION CRITICAL BROADBAND

- Mission Critical Geographic Coverage
- Dedicated N/W – Resilience
- Dedicated Spectrum - Determinism
- Mission Critical QoS Managed including Preemption

CARRIER LTE/5G NETWORK
- Commercially Driven Population Coverage
- Shared N/W – Commercial Engineering Grade
- Shared Spectrum
- Commercial QoS Policy

LMR NETWORK
- Mission Critical Geographic Coverage
- Dedicated N/W – Resilience
- Dedicated Spectrum (Determinism)
- Mission Critical QoS
PPDR NEEDS A COMPLETE SOLUTION

MODERN Nationwide TETRA Radio

Select Private LTE, Deployable, Hotspots, Carrier 4G Interop

Nationwide PS LTE, Commercial MVNO, Spectrum sharing, 5G

Enterprise Application Platform

Intelligence-Led Command and Control

Mission Critical Radio & Broadband Networks
Work Group Interoperability

Sensors, Cameras, IoT
Connected Vehicles
Mobile Commanders
Connected Responders

Next generation devices, personal and vehicle area networks
AGENDA

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Resolution 646 adopted by WRC-2003 recognized regionally harmonized frequency bands for narrowband PPDR.

Region 1 (EMEA)

380-470 MHz – Harmonized Band for PPDR (P25 and TETRA)
380-385/390-395 preferred core harmonized band for permanent PPDR

Resolution 646 adopted by WRC-03
Rec. M.2015 (PPDR FREQUENCY ARRANGEMENTS)
Rec. M.2009 (PPDR TECHNOLOGIES)
Report M.2033 (PPDR REQUIREMENTS)
Report ITU-R M.2291 (LTE FOR PPDR)
Since 2010, Studies have been carried out around the world on the need and value of Broadband to Public Safety Wireless Communications

- **Phoenix Study in USA** to find the value of 10+10 MHz spectrum in 700 MHz band

- **EU study** on the amount of spectrum needed for broadband Public Safety LTE

- **Study by Hong Kong university** on the Value of 10+10 MHz spectrum in key asian countries

- **Report ITU-R M.2291** – The use of International Mobile Telecommunications (IMT) for broadband public protection and disaster relief (PPDR) applications.
- **Recommendation ITU-R M.2009** – Radio interface standards for use by public protection and disaster relief operations in some parts of the UHF band in accordance with Resolution 646 (WRC-03).
- **APT, Report 38 on technical requirements for mission critical broadband PPDR communications.**
- **CEPT, ECC Report 199** – User requirements and spectrum needs for future European broadband PPDR systems (Wide Area Networks).
- **ETSI TR 102 022-1 V1.1.1 (2012-08)** - User Requirement Specification; Mission Critical Broadband Communication Requirements
  - [http://www.etsi.org/deliver/etsi_tr/102000_102099/10202201/01.01.01_60/tr_10202201v010101p.pdf](http://www.etsi.org/deliver/etsi_tr/102000_102099/10202201/01.01.01_60/tr_10202201v010101p.pdf)
- **CEPT ECC WG FM PT 49 Radio Spectrum for Public Protection and Disaster Relief (PPDR), Report from FM Project Team 49 (2nd and 3rd meetings)**
  - [http://www.cept.org/ecc/groups/ecc/wg-fm/fm-49](http://www.cept.org/ecc/groups/ecc/wg-fm/fm-49)
- **Public Safety Broadband High-Level Statement of Requirements for FirstNet Consideration, 700 MHz Spectrum Requirements for Canadian Public Safety Interoperable Mobile Broadband Data Communications**

PUBLIC PROTECTION AND DISASTER RELIEF SPECTRUM REQUIREMENTS , Helsinki, January 2007, ECC REPORT 102
Revised Resolution 646 adopted by ITU WRC-2015 recognized 694-894 MHz (700-800) as the globally harmonized frequency range for broadband PPDR.
BROADBAND SPECTRUM HARMONIZATION: WHAT WE KNOW TODAY

38+ countries, >2.6 Billion population: dedicated B_PPDR spectrum in 700/800MHz

<table>
<thead>
<tr>
<th>Region</th>
<th>Band Plan/Plan</th>
<th>Frequency Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 700 Band Plan /Canada</td>
<td>3GPP Band 14 (special band)</td>
<td>788-798/758-768 MHz</td>
</tr>
<tr>
<td>APT 700 Band plan (LATM, ASIA, ME)</td>
<td>3GPP Band 28</td>
<td>703-748/758-803 MHz</td>
</tr>
<tr>
<td>Arab/Europe. Africa</td>
<td>3GPP Band 68 (New band) Or Band 28 2x(30+3)MHz</td>
<td>698-728/753-788 MHz/ 703-736/758-791MHz</td>
</tr>
<tr>
<td>R1* 700 Band plan (MEA)</td>
<td>3GPP Band 26</td>
<td>814-834/859-879 MHz</td>
</tr>
<tr>
<td>Asia 800 Band Plan (ASIA)</td>
<td>3GPP Band 20</td>
<td>791-821/832-862 MHz</td>
</tr>
<tr>
<td>EU 800 Band Plan (R1*)</td>
<td>3GPP Band 20</td>
<td>791-821/832-862 MHz</td>
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CRITICAL SUCCESS FACTORS FOR MISSION-CRITICAL PPDR NETWORKS

**PPDR Spectrum**
- PPDR Spectrum allocation for Public Safety Provider, that is available for the PSP to use when and where it is needed
- Regulation that allows PSP to share spectrum and network builds with MNOs for commercial viability

**Governance model**
- Appropriate governance model and vehicles for administration of the model to ensure end to end service levels are met
- Governance authority must include user reps.

**Technology model**
- Network sharing models are more efficient and good long term models
- Governance models can be extended from LTE technology now to 5G in the future
# Multiple LTE Deployment Models

**Value Propositions for All Models**

<table>
<thead>
<tr>
<th>PRIVATE/STANDALONE PS LTE NETWORK</th>
<th>HYBRID PUBLIC-PRIVATE</th>
<th>CARRIER LEVERAGED (ps &amp; non ps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dedicated Spectrum</td>
<td>Dedicated Spectrum</td>
<td>Shared Spectrum</td>
</tr>
<tr>
<td>Dedicated Network</td>
<td>Shared Network</td>
<td>Shared Network</td>
</tr>
</tbody>
</table>

- **Private/Standalone PS LTE Network**
  - Utilized only by Government agencies
  - Owned and Operated by Govt agency, usually as a CAPEX model

- **Hybrid Public-Private**
  - PS-LTE network shared with other entities (e.g., utilities, carriers, military)
  - Requires unique governance and operating model to accommodate PS demands and reduce costs

- **Carrier Leveraged (ps & non ps)**
  - Network shared with consumers, businesses, and PS agencies
  - Select enhancements and hardening to meet PS agency needs

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**Examples**

**US Firstnet, Korea GRN, Singapore, Middle east**

**Examples**

**Mexico MVNO**

**Examples**

**UK ESN,**

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**Lower Levels of PS Control, Functionality, Reliability**

**Lower Cost Per User**

**More Likely an 'aaS' Deployment**

**Higher Levels of PS Control, Functionality, Reliability**

**Higher Cost Per User**

**More Likely A CAPEX-Based Deployment**

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## Public Safety LTE Network vs Carrier LTE Network

<table>
<thead>
<tr>
<th>Public Safety LTE Network</th>
<th>Carrier LTE Network</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Geographical coverage</strong></td>
<td></td>
</tr>
<tr>
<td>Maximum capacity for incident handling, supported by deployables</td>
<td>Population coverage</td>
</tr>
<tr>
<td>Serving small customer base with the service needed for emergency handling</td>
<td>Busy-hour capacity, catering to hot-spots for additional capacity (but not a single hour anymore)</td>
</tr>
<tr>
<td>User / Role based device provisioning</td>
<td>Serving large customer base with best possible service</td>
</tr>
<tr>
<td>Dynamic prioritisation based on situation of user</td>
<td>IMSI based device provisioning</td>
</tr>
<tr>
<td>Security across users, devices, network and applications, including encryption of voice calls</td>
<td>Prioritisation only for specific service like VoLTE</td>
</tr>
<tr>
<td>Redundancy 2x normal load, business continuity process critical. Maintenance personnel are critical to operation</td>
<td>Security not a critical issue, therefore end to end encryption and security is left to applications</td>
</tr>
<tr>
<td>Services are based on Public Safety User requirements</td>
<td>Redundancy not 2x normal load. Heavily focused on User experience and can recognise conditions leading to failures</td>
</tr>
<tr>
<td></td>
<td>New features are implemented for new revenue-generating services</td>
</tr>
</tbody>
</table>
EARLY PPDR LTE DEPLOYMENTS

LA-RICS
Los Angeles County, USA
Population: 10 million
Dedicated Network
Dedicated Spectrum

HALTON, ONT.
Regional Municipal Police Network
Dedicated Network
Dedicated Spectrum

ESN
UK nationwide network
Shared Network
Shared Spectrum

MIDDLE EAST 1
National defense agency network
Dedicated Network
Dedicated Spectrum

FIRSTNET
USA Nationwide Network
Shared Network
Dedicated Spectrum

HARRIS COUNTY
Houston metro area, USA
Population: 4.4 million
Dedicated Network
Dedicated Spectrum

MIDDLE EAST 2
National public safety network
Dedicated Network
Dedicated Spectrum

MIDDLE EAST 3 (UAE)
National defense agency network
Dedicated Network
Dedicated Spectrum

Korea LTE
National public safety network
Dedicated Network
Dedicated Spectrum

SINGAPORE LTE
National public safety network
Dedicated Network
Dedicated Spectrum
Currently Trial only
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In Summary

- PPDR agencies depend on their mission critical TETRA/P25 radios to save lives and will continue to do so.

- Mission critical intelligence and data is becoming just as important as voice. LTE-advanced and 5G networks will provide ultra reliable, low latency and high mobility designed to meet high demands of mission critical video and data by the PPDR agencies.

- 700 MHz (3GPP Band 14, 28, 68) and 800 MHz (3GPP Band 20, 26) has already harmonized for PPDR by WRC-15.

- PPDR LMR networks are typically dedicated systems owned and operated by PPDR agencies. LTE and 5G systems could be dedicated, shared or commercial depending on the economic considerations. Report ITU-R M.2291 provides details of the options and choices.

- Many countries are already implementing 4G LTE advanced networks to support PPDR, complementing their LMR networks.
Spectrum saves lives
Harmonisation saves Public money.

THANK YOU

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