LTE for Public Safety

6th Infocom Albania

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Agenda

- Public Safety Market Overview
- LTE Public Safety technology and network evolution
- Nokia LTE Public Safety Portfolio summary
- Nokia creating a superior e2e Public Safety Ecosystem
- Summary
Public Safety market overview

- Public Safety (PS) networks provide communication services to entities such as police, fire fighters, civil defense or paramedic services.
- TETRA or Project 25 (P25) PS Networks support mission-critical voice communications, but are limited in data connectivity:
  - TETRA provides 7.2 kbit/s data rate per time slot (4 slots can be combined), P25 offers even less.
  - New versions of TETRA support rates up to 691 kbit/s.
- TETRA or P25 Public Safety Networks are attracted by LTE data rates, and lower costs for devices and network equipment:
  - LTE peak rates today up to 300 Mbit/s DL and 75 Mbit/s UL. In the future LTE is planned to provide Gbit/s data rates.
  - Future proven global LTE ecosystem ensuring cost efficient solutions.
  - LTE Public Safety Network provides roaming possibilities.
LTE Public Safety band plans globally
Nokia supports any commercially viable standardized LTE band

**North America**
- Band 14 allocated for PS in the US and Canada
- *FirstNet* formed by the US government to establish and operate LTE PS network

**Europe**
- 2 x 10 MHz is considered as minimum in some countries, focus on flexibility
- 410-430 MHz, 450-470 MHz and 694-790 MHz under discussion in some CEPT (European Conference of Postal and Telecommunications Administrations) countries (e.g. Ukko Mobile/Finnland)
- **UK Emergency Services Network (ESN)** to be provided by existing MNO in commercial bands (e.g. EU800)
- Germany & Switzerland considering APT700
- Spain & France considering **450 MHz**

**Latin America**
- Mexico and Brazil have decided to utilize APT700 for public safety
- **Brazil 450 MHz**
- It is expected that majority of Latin America will use APT700

**Middle East**
- Qatar uses EU-800 band
- Israel has PS in the band 806-824/851-869MHz (~band 27)
- UAE considers to use **450 MHz** and APT700 for coverage and 2.3 and 2.6 GHz TDD for capacity
- Jordan considers APT700 for PS

**APAC**
- **Korea considering to use APT700 and existing bands**
- Japan considering 1500 MHz
- Australia planning 400 MHz, 800 MHz and 4,9 GHz for public safety, 2x5 MHz of band 27 for cellular LTE network
- New Zealand plans to use existing bands: APT700, 1800, 2100
LTE Public Safety technology and network evolution
LTE Public Safety in 3GPP Releases 12 and 13

Timeline

• 3GPP Release 12: Completion date 1Q/2015
• 3GPP Release 13: Completion date 1H/2016

Features

• Re-use of existing EPS functions specified from Release 8 onwards: Security, Charging, QoS, eMBMS, LCS, VoLTE, Emergency calls
• New functions in **Release 12**:
  • Proximity services (ProSe) and Device to Device (also known as Direct Mode)
  • Group Communication Service Enablers (GCSE) including use of eMBMS
  • QoS for mission critical services
• New functions in **Release 13**:
  • Proximity Services - Direct Discovery, UE Relay
  • GCSE - Application Layer to setup groups, Talker Identification, Floor Control, etc.
  • Mission Critical Push To Talk (MCPTT)
  • Isolated E-UTRAN Operations

EPS = Evolved Packet System (equals E-UTRAN + Evolved Packet Core)
eMBMS = evolved Multimedia Broadcast and Multicast Service
LCS = Location Services
Gradual transition from current PMR systems to mission critical public safety over LTE

- **LTE**
  - Best effort broadband data
  - Prioritized broadband data
  - Pre-standard PTT & apps
  - 3GPP Rel-13 MCPTT
  - Pre-standard interworking
  - 3GPP Rel-13 interworking

- **TETRA/P25**
  - Mission critical communication
  - TETRA/P25 devices
  - Data apps in PCs, tablets, smartphones
  - PTT/MCPTT in LTE smartphones

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LTE Public Safety Network deployment scenarios

**Public safety services**

- **Mobile operator**
  - OTT public safety
  - Hosted public safety
  - MVNO public safety
  - RAN sharing for public safety
  - Private LTE for public safety

**Core and background colors:**
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Nokia LTE Public Safety Portfolio summary
Nokia Public Safety overall organization

Nokia Solution Portfolio (MBB)
- System Architecture
- Radio (FDD, TD)
- Core
- CEM/OSS
- Security
- SYVE

Nokia Partnering Portfolio (PBU)
- Applications Products
- Device Products
- Partner Products
- Verification & Trial
- E2E System Architecture
## Nokia Solution Portfolio Summary for LTE public safety

### Radio Access
- Public safety bands (E.g. band 14 for NA)
- MOCN, RAN sharing
- QoS and prioritization
- Integrated IPSec and Routing
- Macro sites, Small cells

### Evolve Packet Core
- Scalable MME, SAE-GW, HSS & PCRF
- Cloud deployments
- Policy control & enforcement
- Geo-redundant solution

### Communication Core
- IMS core for VoLTE, ViLTE and RCS
- Fast application deployments
- Support for group communication evolution

### OSS & Automation
- E2E network management
- Automation (SON)
- Customer experience management (CEM)
- Subscriber & device management

## LTE E2E solutions
Full 3GPP Interoperability, QoS including support for mission critical services, Security, Deployable cells (CoW), Network in a Box, eMBMS for group communication and content delivery, Applications at the Edge

## Professional services
Consulting, design, implementation, optimization, care, SAC Wireless Acquisition customization, system integration and managed services
LTE public safety network - High availability & Resilience

Core elements:
- High available nodes, unit redundancy, session continuity in failure switchover
- Pooling, load balancing, congestion control

Backhaul, transport, routing, synchronization:
- Fast IP rerouting
- Backup IPsec tunnels
- Diameter geo-redundant routing
- Synchronization network resilience

eNB
- Automatic congestion control (signaling load)
- User plane load balancing
- Automatic self-healing (e.g. cell outage)
- Transport interface/link protection
- Extended battery backup
- Fallback to eNB local trunking in case of backhaul failure (3GPP isolated operation)

Cell site

OSS & Core sites:
- Geo-distributed sites
- 3-site database replication

Agency 1
- Control room / Dispatcher

Agency 2
- Control room / Dispatcher

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LTE public safety network - Security

UE
• Device security (user access & storage, remote management)

eNB
• 3GPP radio ciphering
• Secure computing HW

Cell site

HSS:
• Authentication keys/parameters

Core site

Applications
• E2E communication security
• Secure databases

Core for PS services (optionally dedicated)

MCPTT, Group Comm
Live video

Agency 1
Control room / Dispatcher

Agency 2
Control room / Dispatcher

Backhaul & transport
• VPNS for traffic separation (e.g. different authorities & user group)
• IPsec encryption

EPC
• 3GPP authentication
• APNs per authority / user group

IMS
• 3GPP security (authentication & access)

IP backbone

IP backhaul

UE

Core site

OSS, BSS

Internet

Cell site

eNodeB

Tetra/P25 BTS

Tetra/P25 BTS

BM-SC

MBMS-GW

HSS, SPR

PCRF

IMS

AS (e.g. VoLTE)

Interworking
Tetra/P25 core

IP backbone

IP backhaul

EPC

MME

S/P-GW

PCRF

UE

Applications
• E2E communication security
• Secure databases

Backhaul & transport
• VPNS for traffic separation (e.g. different authorities & user group)
• IPsec encryption

HSS:
• Authentication keys/parameters
LTE public safety network – User services

**Core and background colors:**

- **Core site OSS, BSS:**
- **EPC:**
  - APNs for different services (Internet, IMS, public safety)
- **UE:**
  - VoLTE, ViLTE, PTT clients
  - Downlodable apps
  - Proximity services:
    - Direct UE-UE communication
    - Relay function
- **Cell site eNodeB:**
  - Broadcast & multicast
    - eMBMS
- **Cell site eNodeB:**
  - Alert services
    - ETWS, CMAS
  - IP backhaul
- **Core site:**
  - IMS
    - VoLTE, ViLTE
    - Emergency call, MPS
  - Public safety services
    - PTT 1-to-1, 1-to-group
    - Group messaging, data multicast
    - Location info
    - Streaming services, other PS data services
- **Core for PS services (optionally dedicated):**
  - Live video
  - MCPTT, Group Comm
  - Interworking
- **Agency 1 Control room / Dispatcher:**
- **Agency 2 Control room / Dispatcher:**
- **Tetra/P25 core:**
- **ETWS Earthquake and Tsunami Warning System**
- **CMAS Commercial Mobile Telephone Alerts**

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LTE public safety network - Automation and management

OSS, Public safety CEM
- SON
- Rapidly deployable cells
- Network management
- KPIs for public safety users, services, QoS classes.

PS authority
- User and group management
- Public alerts
- Access class control per cell/location

Core for PS services (optionally dedicated)
- MCPTT, Group Comm
- Live video
- Interworking
- Tetra/P25 core

Agency 1
Control room / Dispatcher

Agency 2
Control room / Dispatcher

UE
- Management for PS devices and apps
- UE based ANR

Cell site
eNB
- Auto-connectivity, ANR
- Self-healing

Cell site

OSS, BSS
Management

Charging
Network in a box for public safety
A complete LTE network within 2 compact modules

Solution
- MME, S/PGW, HSS, PCRF functions enable data connectivity services
- Integrated management
- Future options include local services such as VoLTE and group communication
- Robust and fully outdoor-capable, can be carried or mounted virtually anywhere

Benefits
- Pre-standard (Rel-13) isolated E-UTRAN operation for basic local connectivity between UEs
- Rapidly deployable solution for coverage extension and coverage recovery

Internet EPC

System module
RF module

Server unit extension within system module
eNodeB

Network in a box

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Network in a box (NIB) scenarios in public safety networks
No transport connection to centralized core

Deployable NIB
• EPC enables access for selected users (HSS data)
• UEs can communicate within eNB coverage area

NIB serving isolated area after transport failure
• NIB EPC enables access for selected users (HSS data)
• UEs can communicate within area served by NIB and multiple eNBs
Deployable Network

3 variants of deployable networks:

• **COW (Cellular on Wheel)**
  • Rapidly deployable, semi movable, complete LTE/SAE Network in rack.
  • Macro capacity, range 10’s of miles (up to 60 miles with extended cell feature).
  • Satellite, Microwave, Fiber, PtP, PMP Near-LOS backhaul.
  • 600 simultaneous attach users with 150Mbps DL and 75Mbps UL capacity.

• **SUV/Truck deployable**
  • Rapidly deployable, full mobility, complete LTE Network in a rack.
  • Macro capacity, range < 3 miles.
  • Satellite, PtP, PMP Near-LOS backhaul.
  • 600 simultaneous attach users with 150Mbps DL and 75Mbps UL capacity.

• **Backpack deployable network**
  • Complete LTE/SAE network in a box.
  • Micro/pico capacity, range <1 mile, Battery/Solar powered.
  • Satellite, PtP, PMP Near-LOS backhaul.
  • 200mW- 5W output power with 150Mbps DL and 75Mbps UL capacity.
Nokia creating a superior e2e Public Safety Ecosystem with Partners
Nokia bringing partners together for complete LTE public safety solutions

Devices and SW clients

Nokia LTE network

Transport & Synchronization

Public Safety Applications & Interworking products

- Applications such as PTT and video share
- Interworking GW (e.g. TETRA)
- Dispatcher center tools

E2E LTE public safety services with Nokia and partner solutions
Push to Talk, Group calling, Direct communication, Positioning, Sensor analytics, Alerts, Maps & location, Video sharing, Database access, Reporting, Surveillance
Public Safety Devices
Rugged LTE and LTE+LMR devices

Handheld

Tablets

Vehicle

Notebooks

USB-modems/Modules
## Ruggedized (MIL-STD-810G & IP6x) LTE devices

30+ vendors with products available Jan 2015, more will come

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Video and sensor feed analytics at edge
Automated Video security solution

Distributed video and other sensor feeds analytics at the mobile edge and low latency action triggering

Raw video data → Small meta data → eNodeB with RACS & Video Analytics → Intelligent Operations Center (IOC)

Use case
- Big data analytics based on real-time and non-real-time feeds from multiple sensor / information domains. e.g. Analyze real-time video streams to detect criminal patterns
- Predict, monitor, react and avoid / resolve crisis
- Video analytics use cases e.g. Abandoned Object, Object Removal, Person or vehicle detected in unauthorized area or crossing perimeter or crowd forming etc
- Further upside with sophisticated use cases e.g.
  - Combine video and Audio analytics with low latency actions triggered at the base station
  - Sensor analytics with sensors in critical bridges or hazardous chemical factories triggering the threat awareness

Benefits
- Support for rapid response to unplanned events and disruptions
- Reduction of backhaul capacity up to 100 times
- Low installation costs and flexible placement of video cameras or sensors connected via LTE

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Local application content for quicker access
Provides faster access time with latency in sub seconds

- RACS provides the storage and mechanism to access & bring the content to the edge acting like a cache for public safety applications
- Frequently access contents are cached
- Predefined content contents are cached

Use case
- Real-time whether its Police, Fire Department or Big public event management. e.g.
  - Circulate the suspects details
  - Access of the medical records for Paramedics
  - Situational awareness
  - Localized ID scan and verification
  - License plate scanner and verification

Benefits
- Ultra fast response time
- Improved reliability, localized data accessible even without the connectivity to core (which are needed during disaster).
Using the current First Responder’s position and constructing all possible street paths that can be traversed is Electronic Horizon. In general, the structure is a pseudo-tree with the root on the road where the first responder is positioned, together with street geometry, attributes, etc.

Electronic Horizon accounts for all feasible paths

**Use case**

> Provide personalized and contextualize mapping with real-time electronic Horizon; Map shall also contain the location of other First responders, other crews and point of interest like fire station or police station.

> Static and Dynamic Content, Independent of a Navigation System
Dynamic QoS - Fire

- Firefighter crew communication priority is raised when alarm arrives
- Used priority profiles can include group calls
Dynamic QoS - EMS

- Ambulance capacity priority is raised when patient is in the car.
- Car is connected to receiving hospital IT systems
Police in a shootout need to initiate dynamic priority for voice and video communications without taking their eyes off of the perpetrator.
New Revolutionary M2M Wearable
Summary

- Nokia has 60-year track record of working with government customers
  - Public Safety vendor with 400Mhz TETRA solution, network and devices
  - Sold Tetra business in 2005 to focus on 3GPP solutions

- Nokia can provide e2e Public Safety solutions, with Nokia Networks product portfolio and best fitted partnering organizations.
  - Networks (Radio, Core, OSS, CEM, Security)
  - Transport
  - Applications
  - Devices
  - Security