Use of commercial mobile networks and equipment for mission-critical high-speed broadband communications in specific sectors (PPDR, Utilities and Intelligent Transport Systems) from EC Study SMART 2013-0016

Presented by Simon Forge
The context: quite different models today of Public Safety networking versus the Commercial Carriers

<table>
<thead>
<tr>
<th></th>
<th>Carrier Model</th>
<th>Public Safety Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goals</strong></td>
<td>Maximise revenue &amp; profit</td>
<td>Protect life, property &amp; the State</td>
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<tr>
<td><strong>Capacity</strong></td>
<td>Defined by “busy hour” on a typical day- peak traffic</td>
<td>Defined by “worst-case scenario”</td>
</tr>
<tr>
<td><strong>Coverage</strong></td>
<td>Population-density</td>
<td>Territorial, focused on whatever may need protection across MS</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td>Outages undesirable (revenue loss/customer loss)</td>
<td>Outages unacceptable (lives lost or threatened)</td>
</tr>
<tr>
<td><strong>Communications</strong></td>
<td>One-to-one</td>
<td>Dynamic groups, one-to-many, field crews/control centre</td>
</tr>
<tr>
<td><strong>Broadband data traffic</strong></td>
<td>Internet access (mainly downloads)</td>
<td>Traffic mainly within agency (more uploads than downloads)</td>
</tr>
<tr>
<td><strong>Subscriber information</strong></td>
<td>Owned by carrier</td>
<td>Owned by agency</td>
</tr>
<tr>
<td><strong>Prioritisation</strong></td>
<td>Minimal differentiation - by subscription level or application</td>
<td>Significant differentiation - by role &amp; incident level (dynamic)</td>
</tr>
<tr>
<td><strong>Authentication</strong></td>
<td>Carrier controlled, device authentication only</td>
<td>Agency controlled, user authentication</td>
</tr>
<tr>
<td><strong>Preferred charging method</strong></td>
<td>Per minute for voice; per GB for data; per message for SMS</td>
<td>Quarterly or annual subscription with unmetered use</td>
</tr>
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</table>
A cascade of key questions for the study

**Functionality?**
- Can LTE provide all Mission Critical functions?
- Can commercial LTE be hardened to provide Mission Critical Operations at reasonable cost?

**Cost of Functionality?**
- Comparative cost of commercial B/B build & operation vs a dedicated B/B n/w?
- Is hardened commercial mobile LTE less costly than a dedicated LTE network?

**AND - can we do all this across 3 sectors?**

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Key conclusions

- Feasibility of using commercial mobile networks for mission-critical communications
- Cost comparisons of the various options
- Spectrum demands and ways forward
- Could a common critical infrastructure be built? (for the 3 sectors)
- Towards a definition of “mission critical”
- Could LTE fill the TETRA gap?
Key conclusion: feasibility of using commercial mobile networks for mission-critical communications

- Commercial MNO networks are a feasible option, technically and financially, but only IF:-
  - a specific regulatory structure is developed to assure their service level commitment
- Without this structure, the risk may be too high:-
  - and all 3 sectors are highly reluctant to become completely dependent on the MNOs
Also, commercial mobile networks and operations must be upgraded for mission-critical communications

- Current MNO commercial network technology with LTE (and 3G UMTS) does not yet support the key demands of mission critical users with the specific features necessary
- MNOs’ networks could become realistic contenders with (costly) major upgrades for mobile broadband:
  1. Hardening for resilience - availability from 95% to > 99%(99.999%?)
  2. New functionality specifically for mission critical - **3GPP LTE Releases 12 - 15** must add them by 2020 (-use of ‘pre-standard’ LTE solutions before ?)
  3. Coverage to all land mass needed
  4. Roaming across MNOs according to signal strength
  5. Appropriate tariff structures - flat rate pricing as well as usage based
Key conclusion

BUT that is unlikely to be enough – major revisions needed

- The attitude of MNOs determines the feasibility of commercial use
- The position of MNOs would have to evolve from purely commercial motives to having social responsibility as well as a commercial drive
- This explicitly recognises their role as operating the prime communications platform in modern society as we all become ubiquitously connected by (broadband) mobile

But changing this position requires some regulatory amendments:
New measures to give NRAs specific powers to act on behalf of mission critical services are essential

• MNOs should be mandated to assure support of mission critical services by MNOs – 2 possible ways are:

  1. Operator licence mandatory to be MNO or an MVNO – and a condition is providing mission critical services, with all extensions mentioned. May entail a SEPARATE programme manager for mission critical to implement

  2. Alternative - a mobile *spectrum licence* that brings the obligation to support mission critical services. Offers spectrum re-assignment, so spectrum is not ‘lost’ if MNO fails to comply

• NRAs have powers to enforce the provisions of long-term MNO contracts with mission critical users.

• NRAs should be authorised to grant priority access to commercial mobile network services for mission critical communications, including handover of calls ‘tween MNOs

• NRAs should support governments in setting tariffs for mission critical services by research into true costs of MNO operation - cost based declarations by MNOs.
For many Mission Critical users to employ the MNOs, the commercial behaviour would have to be modified via specific changes to the core MNO business model

1. Upgrade networking to much higher standards of reliability (4x 9’s?) with failover, without any degradation in that commitment over several decades

2. Acceptance of long-term (15 to 30 year) contract commitments to mission critical customers, with stable conditions and agreed rates

3. Providing priority access to mission critical services, especially when emergencies create a risk of network overload

4. Providing geographic coverage to meet the needs of mission critical users - indoors also

5. Willingness to cooperate with other MNOs and MVNOs – for instance, in handing over a mission critical call to another operator with a better local signal

6. Keeping to the spirit and letter of long-term contracts for mission critical services without arbitrary changes in technical features, tariffs or service conditions

7. Readiness to submit cost-based pricing analyses of tariffs with full open book accounting for NRAs and government clients

8. Willingness to offer new charging regimes and metering procedures

9. Removal of excessive charges for international roaming across the EU and avoidance of “surprise charges” for previously agreed services.
Thank you

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In the study we examine 5 Scenario options

Network operation & ownership

Equipment (networking & terminals)

Scenario 1

Scenario 4
Hybrid (e.g. TETRA voice + Commercial LTE data)

Scenario 5 is orthogonal – EU-wide next generation multi-sector

Scenario 2

Dedicated

Commercial
The final scenario – Option 5 - A compound network for mission critical - Integration of multiple radio networks as a single mission critical communications resource

**Primary Emergency Services**
- Network: (police/fire/ ambulance/ civil defence) – engineered for:
  - Robust architecture
  - Rapid rollout and ease of expansion
  - Cost effectiveness
  - Spectrum availability and broadband speed
  - Coverage

**Alternative Backup Network**
- Secondary resource network with robust architecture for emergency services and conventional communications used for:
  - Backup
  - Failover

**Infrastructure Operation Networks**
- Transport
- Utilities
- Industrial processes
- Built environment

**Multiple Sensor Networks**
- M2M /IOT
- Capture/ monitor local parameters
- Secured industrial areas
- RFID/ Smart Motes
- Personal area vital signs

**Disaster site networks**
- Ad hoc establishment - portable RF nodes/beacons, sensors and handsets
- Instant infrastructure
- Capture/ monitor/report
- Track and co-ordinate resources, emergency workers and victims

**Citizens’ alerts Network - activated in time of crisis**
- Public warnings
- Guidance and precautions
- Public updates
- Community services

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The 5 Options for Mission Critical networking as a Migration Path

1. Dedicated specialised networks using specialised equipment only

Search for upgrade to broadband with high resilience

2. Commercial MNO networks using commercial (hardened) equipment only

Search for broadband at lower cost with sufficient resilience

3. Dedicated specialised networks using commercial equipment hardened

Longer term view

4. Hybrid solutions

Pragmatic use of existing investments

5. Common multi-purpose Mission critical network for use by all 3 sectors

Longer term view

- The 5 options are not mutually exclusive. They may be viewed as alternatives that suit the economic condition of each Member State
- Consequentially they have the potential to form the 3 phases of a migration path to an eventual common broadband mobile platform for European mission critical safety

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Scenario 4 - Hybrid radio network for mission critical communications with 4 technology layers assigned by population density to geographic locations

Urban Environment

Rural Macrocells
Legacy PPDR networks, new B/B mobile & satellite

Suburban Macrocell
B/B mobile, Wi-Fi & satellite

Urban Small Cell mobile
B/B & Wi-Fi hotspots

Alternative radio networks underlay for utility & ITS smart grid networks

Major road

Railways

Scenario 4 - Forming the Hybrid system - a federated architecture via gateways into a common core network

Control rooms

Dedicated | Shared | Core Network

TETRA core network

Dedicated LTE Macro cell RAN

Dedicated Small cell urban RAN

Alternative Radio Networks - Wi-Fi, Satellite, 2G, 3G, VHF PMRs

Commercial core networks

Commercial Mobile LTE RANs

Gateway - functions:
- AAAA security
- Data interfacing
- Naming & addressing
- Session control, etc, etc

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Is government financing of Mission Critical service the key to unlock MNO co-operation? - AND is it enough?

Government finance

OR

Dedicated
Government finances, builds, operates & owns dedicated networks, possibly via a specialised legal entity GO-GO-GF

Commercial
MNOs build, operate & own their commercial networks while Government finances the network hardening and receives SLAs CO-CO