

Is Commercial Cellular Suitable for Mission Critical Broadband?



Study on use of commercial mobile networks and equipment for mission-critical high-speed broadband communications in specific sectors, SMART 2013-0016, on behalf of DG CONNECT, UNIT B4

Agenda

- Remit of the study
- Context

Key conclusions:-

- Feasibility of using commercial mobile networks for mission-critical communications
- Cost comparisons of various options
- Could a common critical infrastructure be built?
- Spectrum demands and ways forward
- Next Steps: actions for NRAs and administrations

Our remit

- **Understand the potential for using commercial LTE networks instead of dedicated networks**
- **Look at the requirements and demand for mission critical broadband across 3 sectors (not just PPDR but also Utilities & ITS)**
- **Explore 5 scenarios based on various combinations of networks, equipment and ownership/operation permutations – GO-GO, CO-CO, etc, including a complete ‘clean sheet’ for supporting all 3 sectors optimally**
- **Comparative analysis of scenarios via estimated costs**
- **Report on technical options – specifically 3GPP/ETSI’s progress toward extending LTE standards for mission critical applications**

The current state of play in the EU

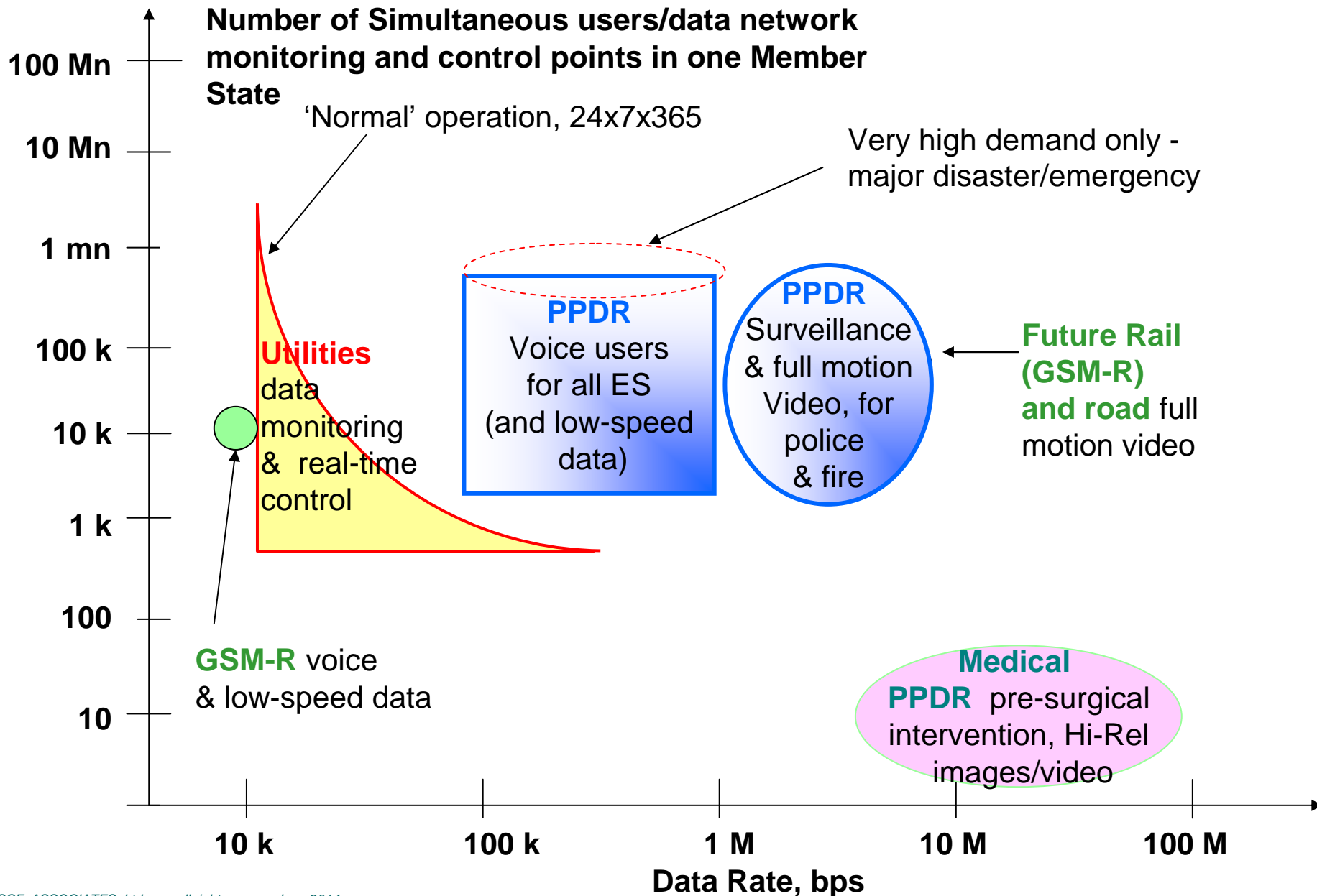
- For PPDR : Most EU MS have dedicated TETRA and TETRAPOL networks, mainly using 380 - 400 MHz – at least €19 Bn spent so far
- For EU rail: €25 Bn may be invested to deploy GSM-R at 900 MHz
- The above technologies are voice-centric, with weak competition among equipment suppliers and questionable long-term industrial support. For some PPDR, future access to current spectrum is under NATO control
- Utilities rely on dedicated (often analogue) voice networks and narrowband telemetry. But they need to adopt new forms of 2-way digital communication as smart grids with dispersed/renewable energy inputs and smart city services gain acceptance [1]
- Some EU governments are already going towards commercial MNO networks – e.g. Belgium (ASTRID's Blue Light MVNO) and UK (ESCMP to replace Airwave TETRA).

[1] EG see Ofcom: Consultation on 870-876 MHz and 915-921 MHz, Update and Way Forward, SCF Associates Ltd, 2013

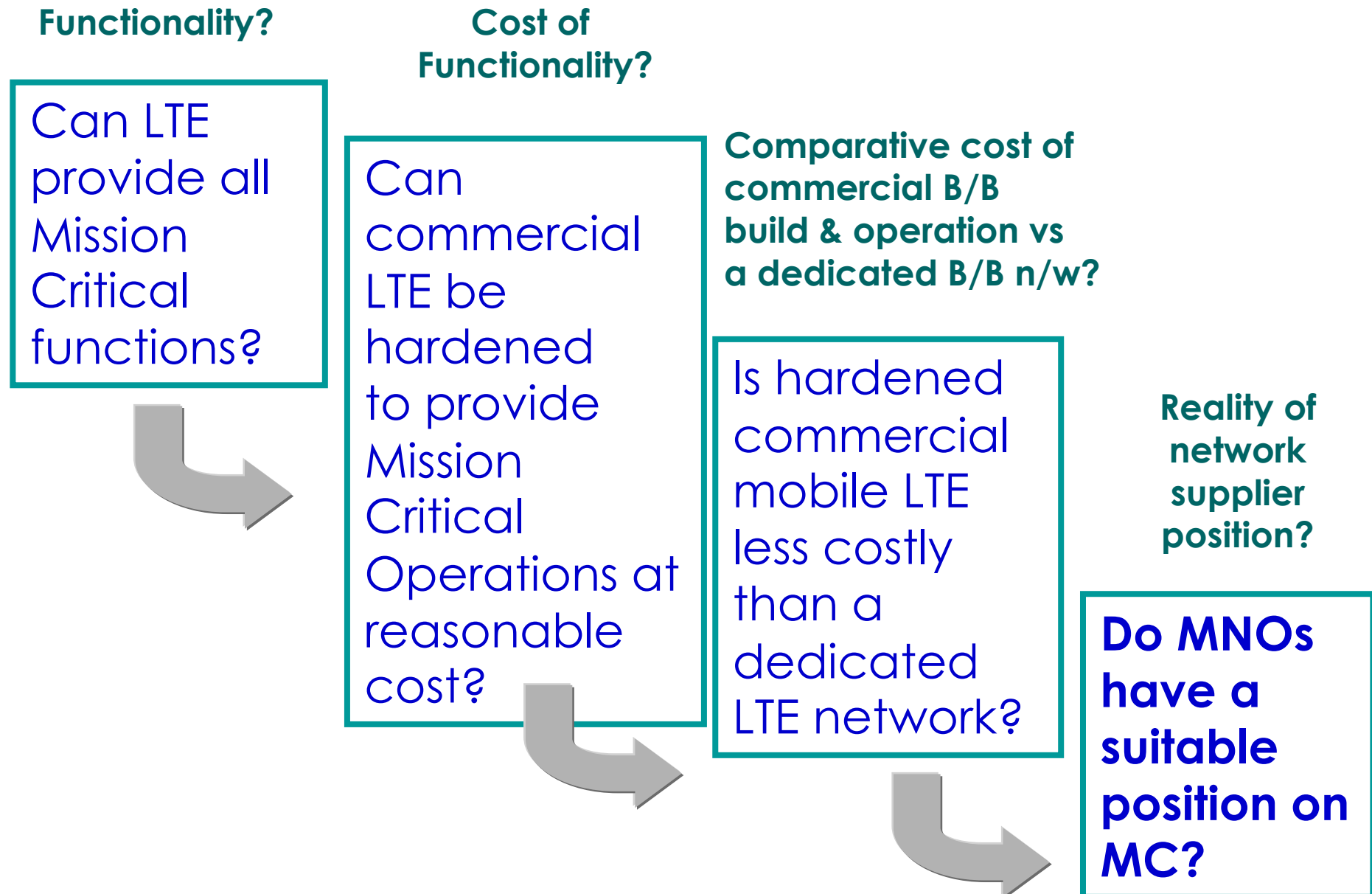
The context: quite different models today of Public Safety networking versus the Commercial Carriers

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

Differences in Sector Requirements: user numbers & data rates



A cascade of key questions



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

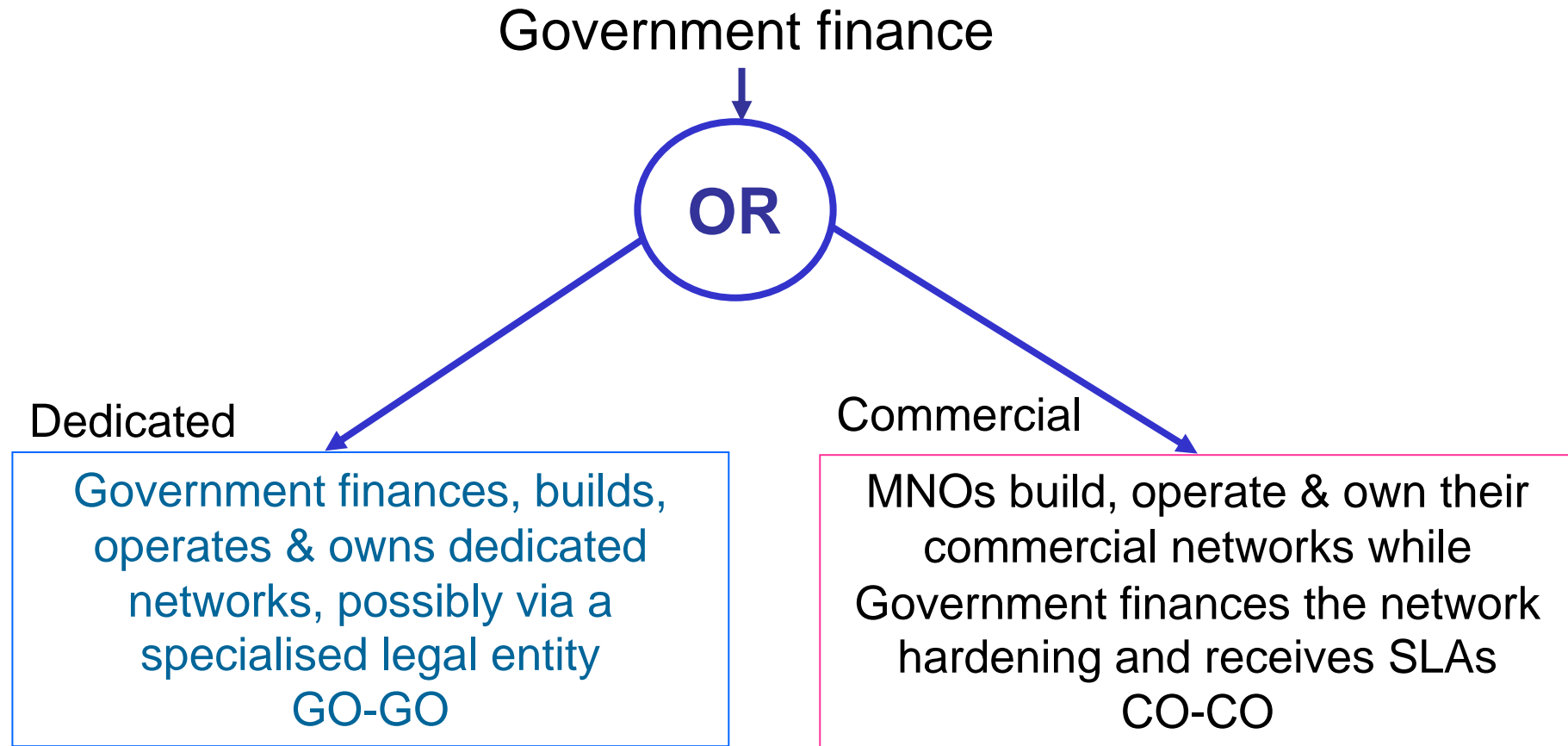
- Without this structure, the risk may be too high:-

all 3 sectors are highly reluctant to become completely dependent on the MNOs for mission critical communication

But 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 major (costly) upgrades for mobile broadband :-**
 1. **Hardening for resilience to improve availability from 95% to over 99%(99.999%?)**
 2. **New functionality specifically for teamwork in emergency situations and faster set-up, call prioritisation - the 3GPP LTE Releases 12 -15 are expected to add them by 2020 - that means use of 'pre-standard' LTE solutions before then**
 3. **Coverage extended - eg up to 99% of land mass**
 4. **Appropriate tariff structures – flat rate pricing as well as usage based**

Is government financing of Mission Critical network upgrades the key to unlocking MNO co-operation?



GO-GO = Government owned, government operated
CO-CO = Commercially owned, commercially operated
SLA= Service level agreement
MNO = Mobile network operator

It is unlikely to be enough – major revisions are 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 commercial drive**
- **This explicitly recognises that they operate modern society's main communications platform. We are increasingly dependent on constant and ubiquitous access to mobile broadband**
- **But changing the MNOs' position and attitude will require regulatory amendments**

For many Mission Critical users to accept the MNOs, specific changes must be made to their commercial behaviour – and thus the core business model

1. Being prepared to upgrade their operations to higher standards of reliability and faster responses to failure
2. Acceptance of long-term (15 - 30 year) contract commitments to mission critical services
3. Willingness to work with other MNOs and MVNOs – e.g. agreeing to handover sessions to the MNO with the strongest local signal
4. Keeping to the spirit and letter of long-term contracts for mission critical services without arbitrary changes in technical features, tariffs or conditions of service
5. Readiness to submit cost-based pricing analyses of tariffs with full open book accounting for NRAs and government clients
6. Willingness to offer new charging regimes (e.g. flat rate, unmetered)
7. Remove international/national roaming charges across the EU and also any 'surprise charges' for agreed services.

Regulatory measures at the MS level are needed to amend MNO behaviour for mission critical service

5 conditions are necessary:

1. NRAs should be authorised to introduce and enforce relevant regulations nationally to assure appropriate MNO support for mission critical services in the long term and their QoS
2. NRAs must have the authority to mandate priority access for mission critical communicators over commercial networks. They should also be able to require the handover of mission critical communications to the MNO with the strongest signal, as determined by the MC terminal
3. NRAs should be authorised to support governments and public services to set tariffs for mission critical services contracts, based on research into the true costs of MNO operation and comparative cost studies with other NRAs. This will require appropriate accounting efforts by NRAs and the preparation of cost base declarations by MNOs in suitable forms.

Regulatory measures at the MS level are needed to ensure adequacy & fair pricing of mission critical service

4. Mission critical services would be defined to include electricity, water and gas suppliers and distributors, as well as eCall and other critical road management and railway operations.
5. There are several possible regulatory mechanisms to ensure that MNOs participate with enhanced responsibility in EU society, 2 are:-
 - Either – operator licence conditions would oblige MNOs and MVNOs to provide capacity and functions for mission critical services as an essential condition of their licence to operate a public mobile service
 - Or – any current exercise of, purchase, assignment or transfer of a mobile spectrum licence includes the obligation to support mission critical services for as long as the spectrum licence is **valid**. *So the spectrum is not 'lost' if the operator does not comply – it can be withdrawn and re-assigned.*

The decision is up to individual EU Member States

- Some MS governments believe PPDR services should operate only on GO-GO (or at least GO-CO) networks. So flexibility is mandatory as some MS will decide to opt out of using commercial networks
- In consequence, NO recommendation for a common EU policy can be made
- But financial pressures may impose later MS migration to commercial
- Thus, there is a need for *EU guidelines* on how NRAs can ensure satisfactory MNO performance for Mission Critical services, if the MNO path is chosen. This may also include a common model of a European MNO/MVNO licence, to guide MS and NRAs on the conditions for introducing and long term regulatory management of Mission Critical services
- Note that market forces are now an incentive for MNOs to offer Mission Critical – saturation and LTE investment funding.

What exactly is the cost advantage of commercial?

Health warning – all costings are best effort estimates

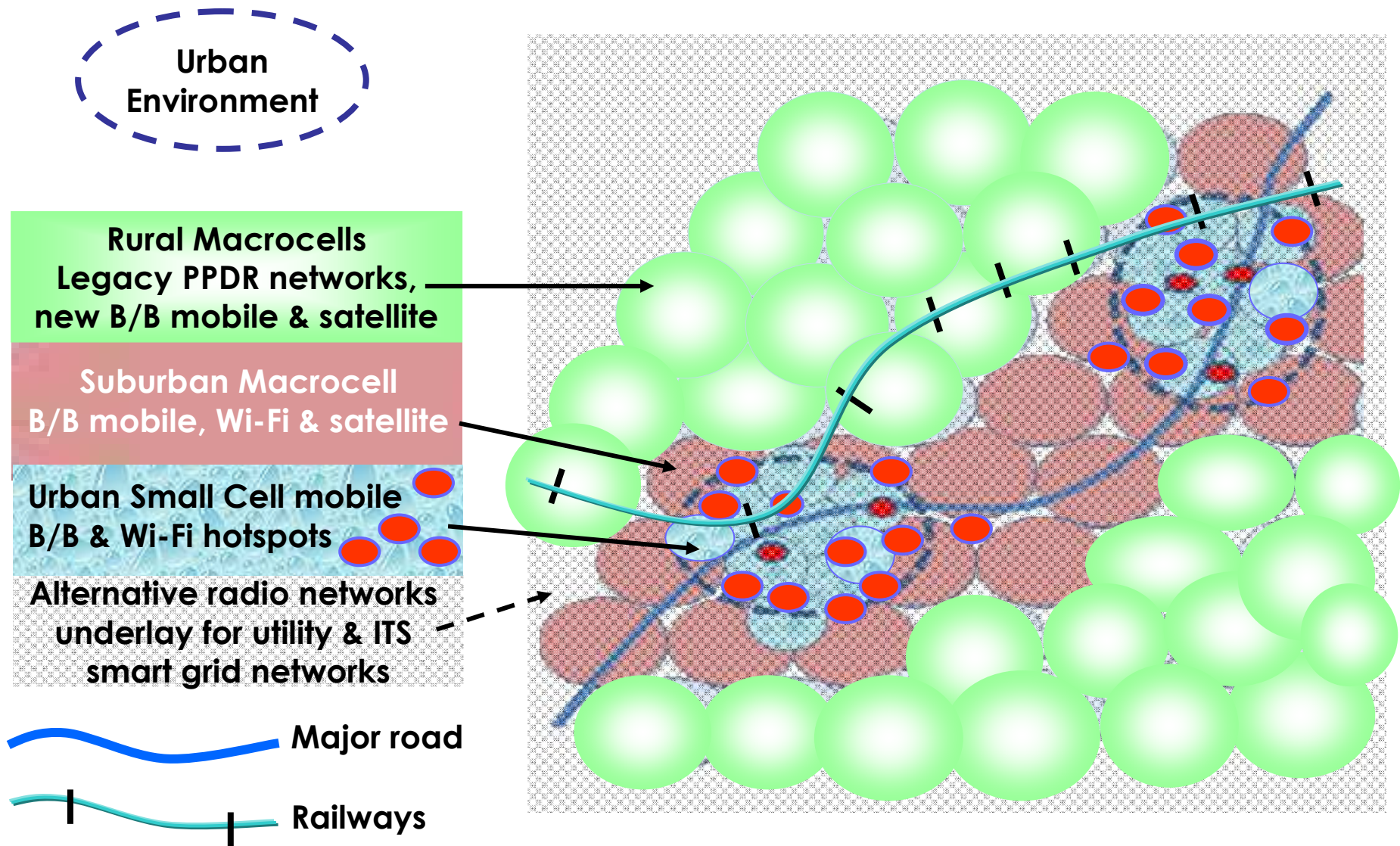
- Our information sources included the NRAs, public reports, parliamentary hearings and court audits, network owners and equipment suppliers.
- **WHAT IS INCLUDED in CAPEX & OPEX VARIES BY MS - INCLUDING VAT**
- **ALSO most information on network costs is confidential and commercially sensitive, so our knowledge has gaps and uncertainties**
- Previous generations of cellular technology showed that equipment prices are subject to sudden and large price falls when mass production begins

Thus all conclusions about costs are open to challenge and debate.

Conclusions on cost comparisons of 5 scenarios

- **Overall, Scenario 2 (commercial networks) is the most attractive in terms of value for money and 3-sector support. But it is only viable if strong regulatory safeguards overcome the reservations of mission critical users**
- **Scenario 1** (continuing with TETRA for as long as possible) is a short-term solution that appeals mainly to PPDR. But all stakeholders realise that value for money is limited by the lack of bandwidth for video & other visual data
- **Scenario 3** (dedicated networks based on hardened LTE) also appeals mainly to PPDR. Opex would be much higher than sharing public networks & needs dedicated spectrum
- **Scenario 4** (a hybrid combining existing PPDR networks with a phased transition to a mix of dedicated & commercial networks) can support requirements of all 3 sectors. Would be technically challenging, but offers great flexibility. Flexible for time dependent factors, - eg late introduction of LTE mission critical features or availability of new spectrum bands
- **Scenario 5** (a common dedicated network specially designed for all 3 sectors), starts with a fresh concept: a resilient safety & emergency network on a European scale – a social value decision.

Hybrid MC radio network with 4 technology layers assigned by population density to geographic locations (Scenario 4):



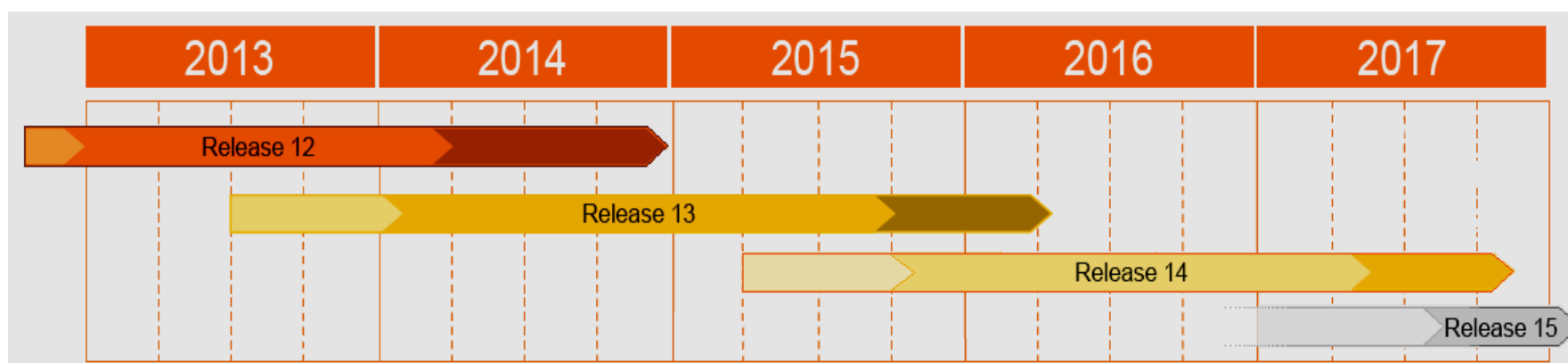
Source: SCF Associates Ltd and following Ittner, AI (2006), 'Implementing 700 MHz Advanced Systems', APCO Annual Conference 6-10.Aug 2006 Orlando USA, <http://www.youtube.com/watch?v=40JgdQbjrzU>

Could a common critical infrastructure be built?

- **The answer is yes - as a social value decision - but the real barrier to such a project is the novelty of the concept itself:**
 - **Such a critical communications infrastructure could well be quite different to today's networks technically, politically and in business model (ie closer to military concepts of resilience) or it could be closer to the hybrid model (scenario 4)**
 - **A common European platform could have economic benefits for all three sectors while providing a more secure safety net for digital society in the future**
 - **The cost – and social value – would be high. Could also be difficult to fund collectively and manage, thus politically risky**
 - **Its successes and failures could act as a demonstrator for other regions and for global systems**

Could LTE fill the “TETRA gap”?

Public safety profiles are being developed for LTE networks & equipment to operate at 450 MHz, 700 MHz and 800 MHz with support for DMO - group communications, mission critical push-to-talk etc



3GPP timeline for future LTE standards releases

- **Release 11 (March 2013)** – a few public safety work items included
- **Release 12 (December 2014)** – additional PS work items (many still incomplete)
- **Release 13 (March 2016)** – most important PS work items completed
- **Products based on Release 13 could be introduced 2017- 2018.**

Spectrum demands and possible ways forward

Conclusions on dedicated spectrum

- Policy diversity among the MS makes the *dedicated spectrum reservation* and allocation choice an **unavoidable option**
- Migration to commercial networks may occur progressively over the next decade even in MS which reject that option now, as economic pressures on government budgets grow in the medium term
- A move to commercial networks **might be helped rather than hindered by an exclusive reservation**, because it may be released later for commercial service provision for mission critical purposes by each MS, if the financial situation so dictates.
- As ever, frequency bands and thus signal range (/ total number of base stations) set network costs.

If new spectrum allocations are necessary, they must accommodate potentially differing choices by MS

The 400 MHz band* (alone or aggregated)

- 2x10 MHz preferred but no refarming agreement across the EU (FM-49 Survey of MS NRAs)
- At least 2 x 5 MHz might be possible across the EU at 450 MHz, making either an exclusive governmental band or one allocated for commercial networks to serve mission critical clients (?perhaps complemented by 2 x 5 MHz in another band?)

The 700 MHz band

- Favoured by PPDR and actively considered by regulatory agencies, France and Germany recently announced future mobile license auctions
- The band is close to existing commercial mobile frequencies but networks are more costly to build than at 400 - 450 MHz
- **Key Question: Will WRC-15 support a mission critical band at 700MHz?**
Subsequent refarming could help commercial networks.

***380-400 MHz, 410-430 MHz and/or 450-470 MHz**

Next Steps: actions for regulators and administrations following the key conclusions

- **Develop a common platform for discussing, defining, planning and monitoring the implementation of powers needed for NRAs to prepare, qualify and oversee commercial networks' mission critical services, eg:-**
 - *EC guidelines to harmonise regulatory frameworks, best practices & key technical issues (e.g. standards and interoperability)*
 - *Regionally harmonised network performance/resilience/QOS requirements*
- **Perform a public consultation on the costs of hardening cellular mobile networks to an agreed level of resilience (useful for decision taking in Member States)**
- **Prepare standard cost-based models for budgetary assessment of national mission critical networks, using principles of cost-benefit analysis (including social benefits & risks):-**
 - **Evaluate existing networks' value for money and project the costs and benefits of envisaged future mission critical networks to 2030**

Progress of UK Government's ESCMP initiative

- ESCMP = Emergency Services Mobile Communications Programme
- Existing Airwave TETRA private network to be replaced by the Emergency Services Network (ESN) **from 2017**, based on contracts with commercial MNOs
- Contract bids were submitted in October 2014. Specifications with broadband applications were developed with the emergency services
- ESN to be constructed and managed via 4 contract Lots, now in adjudication, for awards in 2015:-
 1. Programme management
 2. Systems integration and terminals
 3. Resilient network services from MNOs
 4. Coverage extension
- In January 2015 the Home Office cancelled coverage extension contract (Lot 4) because MNOs' promised improvements in signal coverage made plans for a national contract redundant. ESN's geographic coverage to match Airwave, while emergency comms will have priority access.
- **Importantly for the UK, the need for separate (& expensive) spectrum for mission critical services is avoided.**

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Final report: *Is Commercial Cellular Suitable for Mission Critical Broadband?*

SCF Associates Ltd, Dec 2014, Published by EC/DG CONNECT, is available from:-

http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=8211

EXECUTIVE Summary, English version from:-

http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=8208

Value and cost comparison – not comparing like with like

Scenario option	Value	Capex & Opex Ratio
1: Dedicated specialised networks using specialised equipment only as for today (TETRA/ TERAPOL)	Limited – voice really Aimed at PPDR	Taken as 100% (Capex €7,150 per user) (Opex €1.35 BN/year)
2 Commercial mobile networks using hardened commercial LTE equipment (800MHz)	High - broadband at lower cost than Option 1. Opex reduced by shared assets & the possible participation of all 3 sectors	Capex 70% Opex 44%
3 Dedicated specialised network using hardened commercial equipment At 700MHz: At 450MHz:	Limited - broadband, but mostly for the sector to which it is dedicated.	Capex 98% at 700MHz Opex 296% Capex 49% at 450MHz Opex 133%
4: Hybrid solutions (10 year spend)	Broadband for all 3 sectors and their specialised needs although more expensive as phase out TETRA slowly	Capex 290% without M2M Data; 180% if 40% capacity for M2M; Opex 400%
5: Feasibility assessment for a common multi-purpose network for all 3 sectors	Feasible project based on concepts of very high resilience for a separate European infrastructure	High