



5G IMPLICATIONS TO PS AND CRITICAL COMMUNICATIONS

BRUCE OBERLIES

CHIEF TECHNOLOGY OFFICE

MOTOROLA SOLUTIONS



SAFER CITIES. THRIVING COMMUNITIES

PRODUCTS

\$3.8B 2014 Revenue



- Radio devices, systems, accessories and software for ASTRO, TETRA & PCR technologies
- Public Safety LTE

SERVICES

\$2.1B 2014 Revenue



- Integration services
- PS-LTE services
- Life-cycle support
- Smart Public Safety
- Managed services
- iDEN Services

USER
EXPERIENCE
& DESIGN

SOLUTION
ARCHITECTURE

DIFFERENTIATING
TECHNOLOGY

MISSION CRITICAL GROUP INTELLIGENCE

**TO CREATE GREAT EXPERIENCES WE MUST
COORDINATE AND OPTIMIZE ALL ASPECTS OF
THE SYSTEM.**

A world map with a dark background, showing glowing orange and yellow points of connection across the continents, particularly concentrated in North America and Europe.

EVERYTHING IS
CONNECTED

A graphic showing three laptops with glowing spheres on their screens, connected by curved lines. The background is a blue grid with binary code (0s and 1s) and a faint world map.

SOFTWARE DEFINED
EVERYTHING

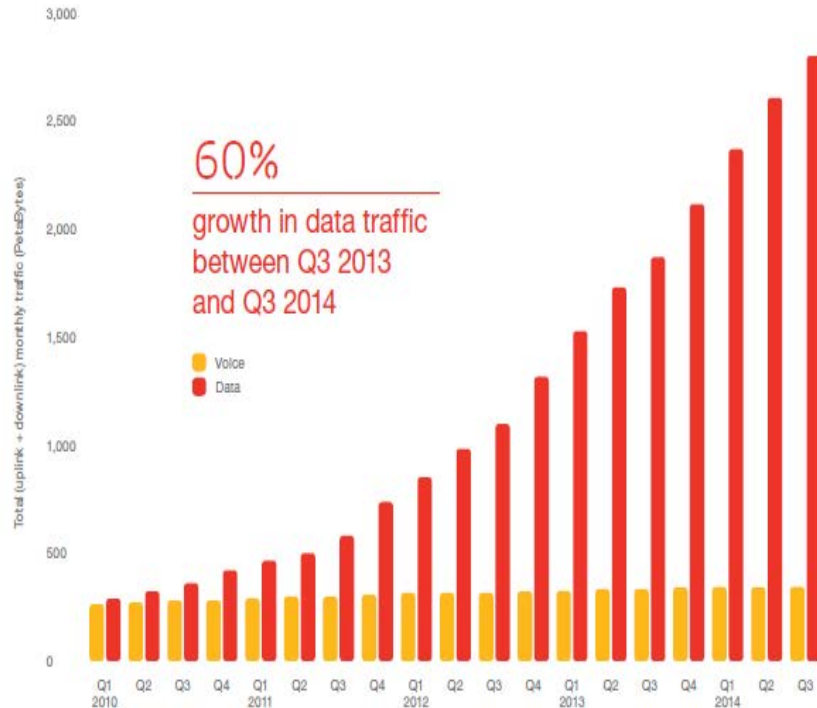
An aerial view of a city with a blue tint, showing buildings and streets.

TODAY'S
TECHNOLOGY
TRANSFORMING
TOMORROW

PRODIGIOUS
DATA



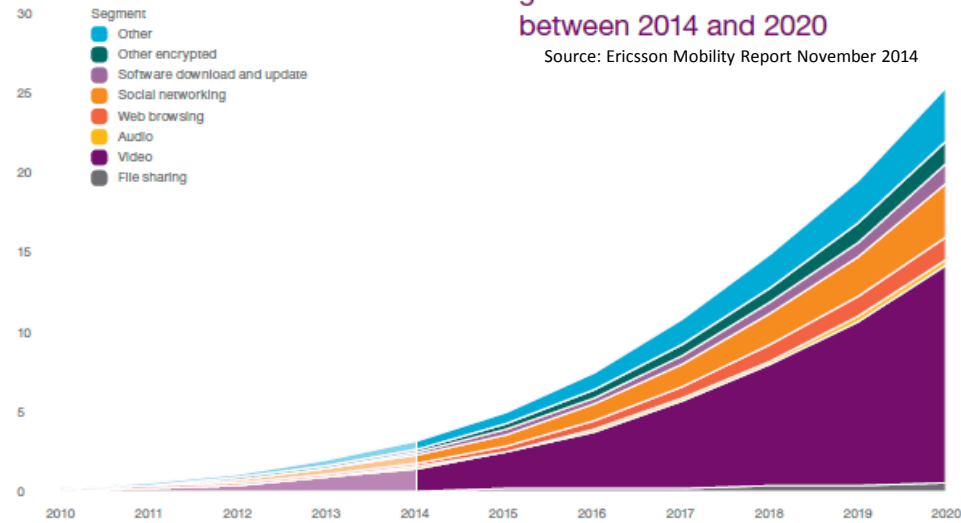
THE UBIQUITOUS PLATFORM



Source: Ericsson Mobility Report November 2014

* Traffic does not include DVB-H or Wi-Fi. Voice does not include VoIP. M2M traffic is not included.

Mobile data traffic by application type (monthly ExaBytes)

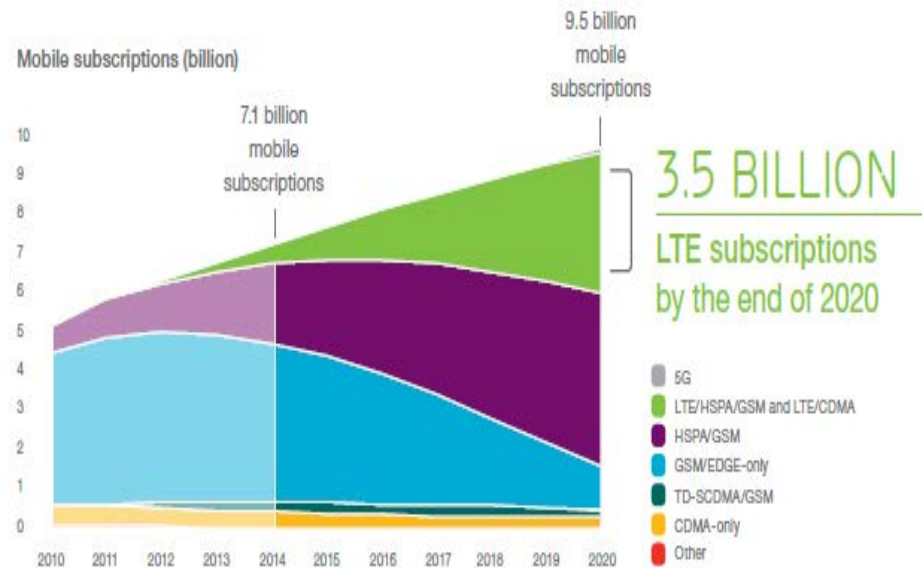


10X

growth in mobile video traffic
between 2014 and 2020

Source: Ericsson Mobility Report November 2014

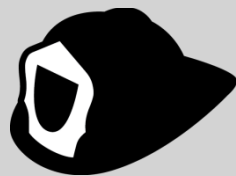
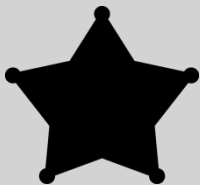
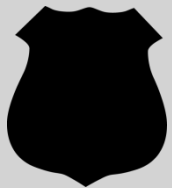
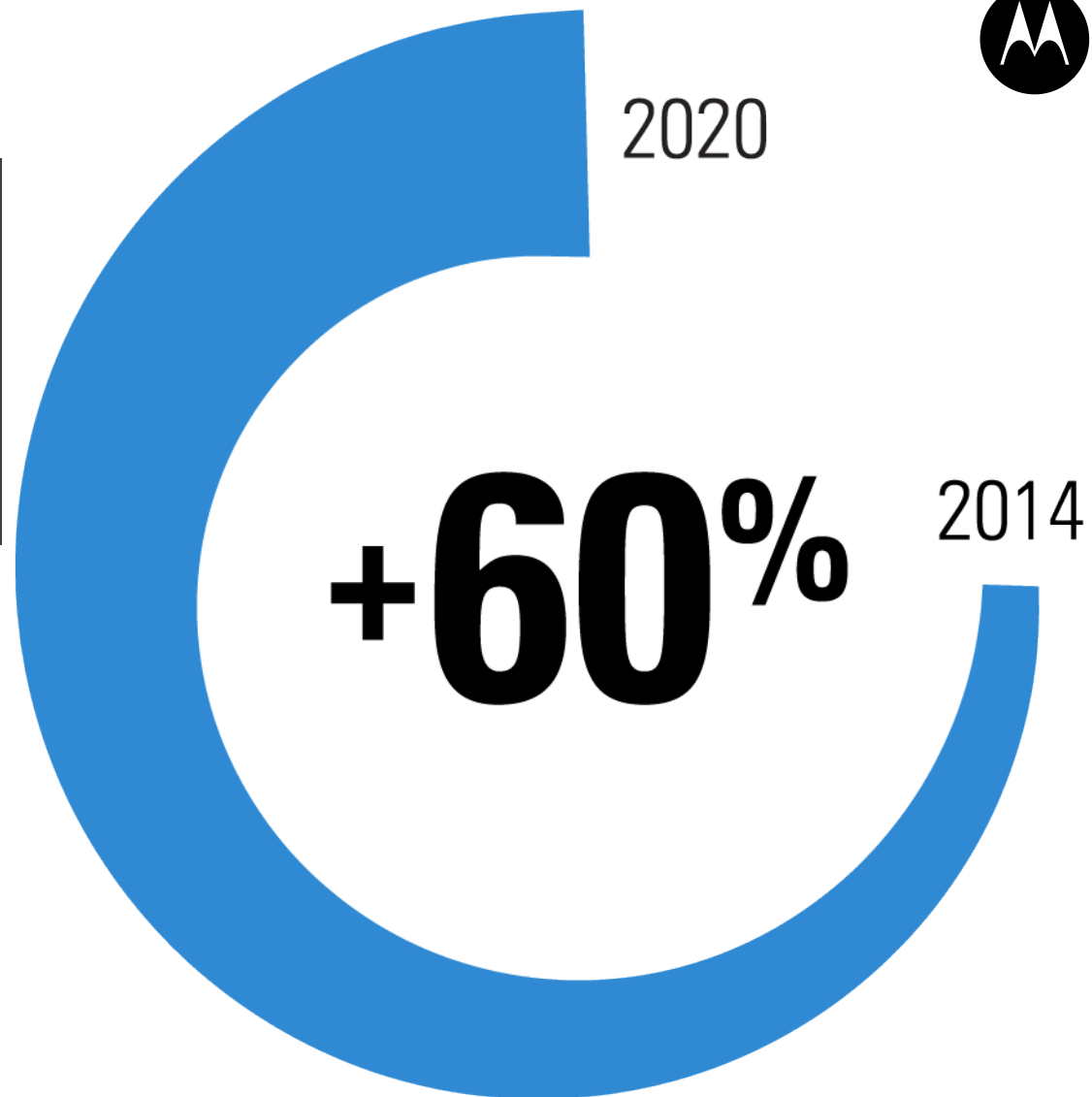
Mobile subscriptions (billion)






LTE IS GAINING TRACTION IN PUBLIC SAFETY

4 MILLION PRIVATE LTE
PUBLIC SAFETY
SUBSCRIBERS
PREDICTED WORLDWIDE
BY 2020



 PURSUING
NATIONWIDE
LTE

PS DEPLOYMENT OPTIONS



PRIVATE NETWORK

DEDICATED SPECTRUM

PUBLIC-PRIVATE PARTNERSHIP

SHARED SPECTRUM

CARRIER NETWORK

PUBLIC SPECTRUM

PRECISE COVERAGE
COMMITTED CAPACITY
EXTENSIVE CONTROL
OFF-NETWORK CAPABILITIES
DEFINED COST

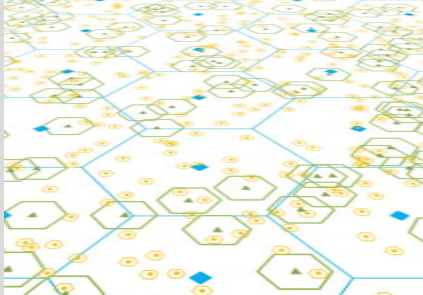
SHARED COVERAGE
SHARED CAPACITY
LIMITED CONTROL
RESTRICTED CAPABILITIES
RECURRENT COST

WHAT IS 5G



COMMON THEMES UNDER THE 5G UMBRELLA

DENSIFICATION

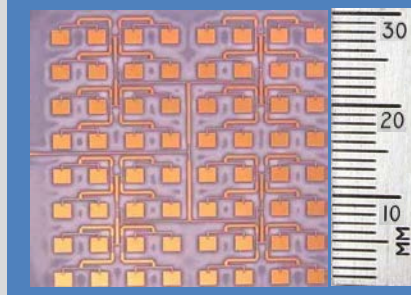


Heterogeneous networks – a type of densification – are enabled in LTE starting with Release 10

Densification in 5G goes beyond LTE. Number of sites approaches one site-per-active device

Results in users getting the maximum throughput the site can offer

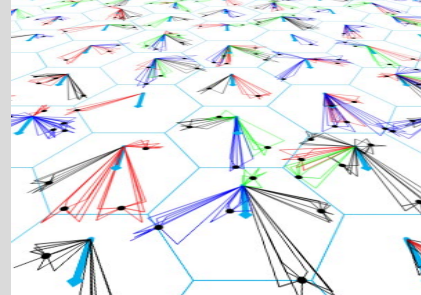
mm-WAVE SPECTRUM



WiGIG/802.11ad utilizes 60 GHz spectrum, 2.16 GHz channels and beam forming
5G adds mobility and extends range

High beam-forming gains offset path loss due to high frequency

MASSIVE MIMO



LTE enables up to 8x8 MIMO
MIMO in 5G goes beyond LTE in that the number of site antennas is much larger than the number of active devices

Results in much higher spectrum efficiency

MORE CONNECTED WORLD



Mission critical (e.g. autonomous vehicle control, public safety) to M2M (e.g. high link margin, ultra-long battery life)

LTE can deliver over 100 Mbps; 5G can deliver similar bit rates to everyone in a crowd

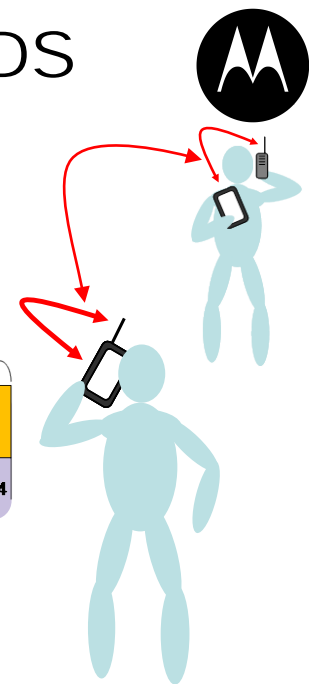
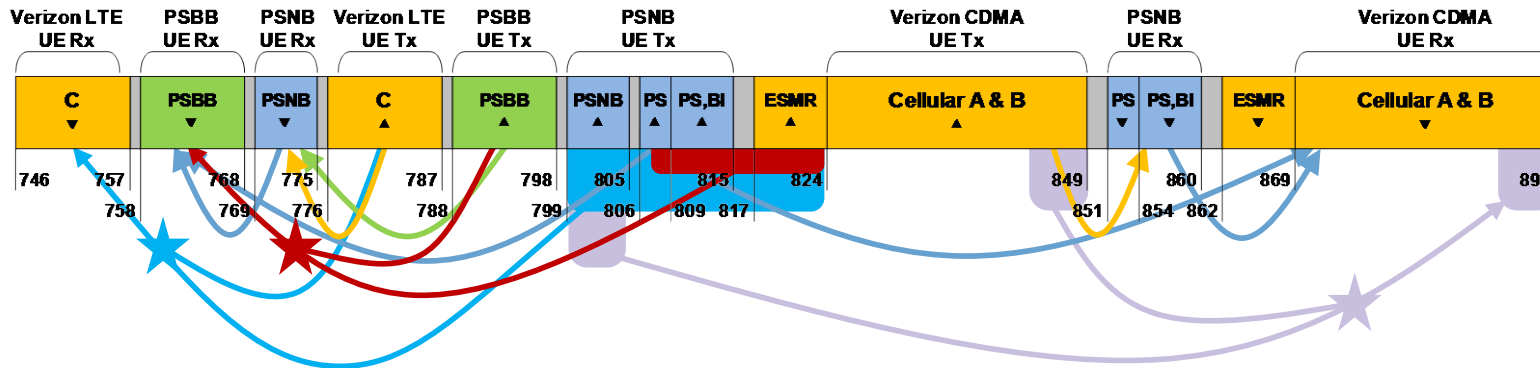
Improved coverage, reliability, availability

Low latency (e.g. 1 ms)

PUBLIC SAFETY COMMUNICATION DEMANDS

Collocated interference scenarios, including integrated device:

700/800 MHz Band



- Public Safety requires reliable coverage in cars, on street, deep in-buildings
- 4G & LMR share the same spectrum – results in many interference scenarios
- 5G turns today's “beachfront spectrum” into tomorrow's narrowband spectrum - which is still valuable

5G Opportunity:

- 5G requires new spectrum; providing additional shared spectrum options for PS

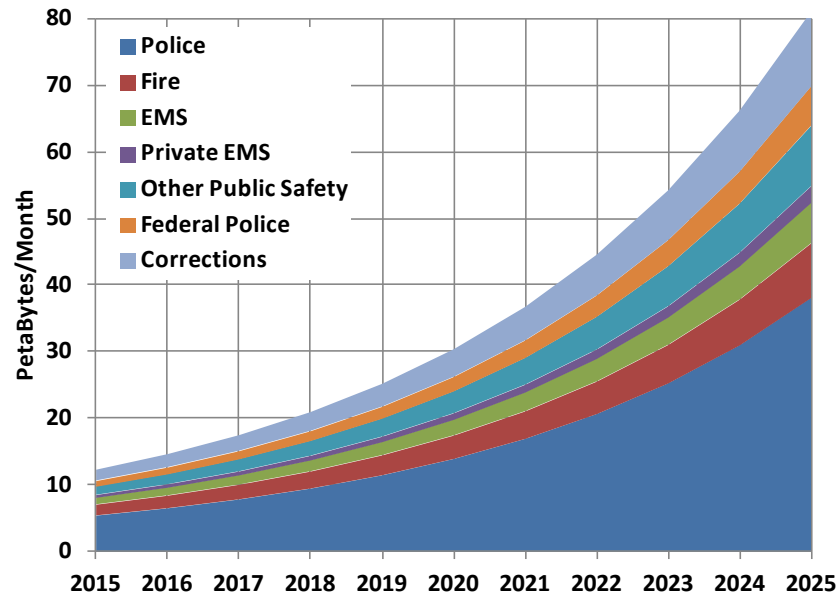
Focus for 5G innovators:

- Devices that can operate in multiple and on multiple services simultaneously

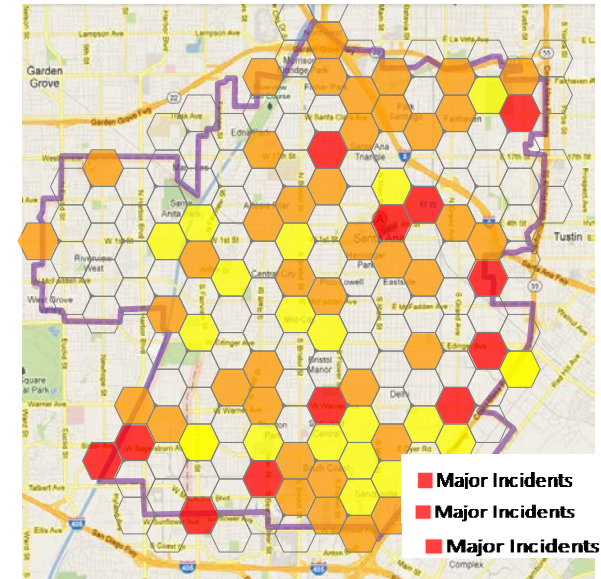
PUBLIC SAFETY CAPACITY DEMANDS



MSI Projected U.S. Public Safety Traffic Demand



Projected Public Safety Incident Blocking Frequency



5G Opportunity:

- 5G provides much higher capacity overall and in dense areas
- Provides PS Capacity via Offloading to 5G (Public and Private)
- Incident Area Network Options

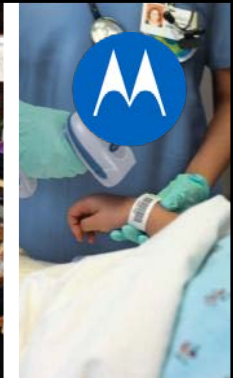
Focus for 5G innovators:

- "Capacity in a Crowd"
- Effective mobility & meshing

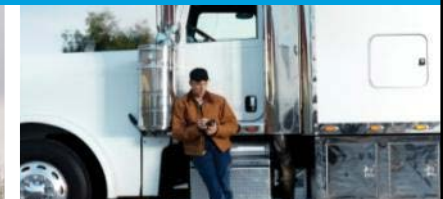
REMAINING GAPS FOR BB CRITICAL COMMUNICATION SYSTEMS



- **System Reliability**
 - Coverage reliability > 95% desired (incl. NLOS)
 - Hardened sites needed (power loss tolerance in disasters)
 - Graceful fall back and recovery modes
- **Infrastructure-less Communications (Direct Mode)**
 - 3GPP currently only addressing infrastructure DM (ProSe)
 - Long range communications remain a challenge
 - One to many
- **Spectrum**
 - PS / Critical Communication users will need to use Shared Spectrum – ideally with priority
- **Rural Coverage**
 - Public Safety systems need very wide-area coverage
 - More difficult to achieve at higher operating frequencies
 - Must be cost effective



WE INNOVATE TO MOBILIZE AND CONNECT PEOPLE
IN THE MOMENTS THAT MATTER



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