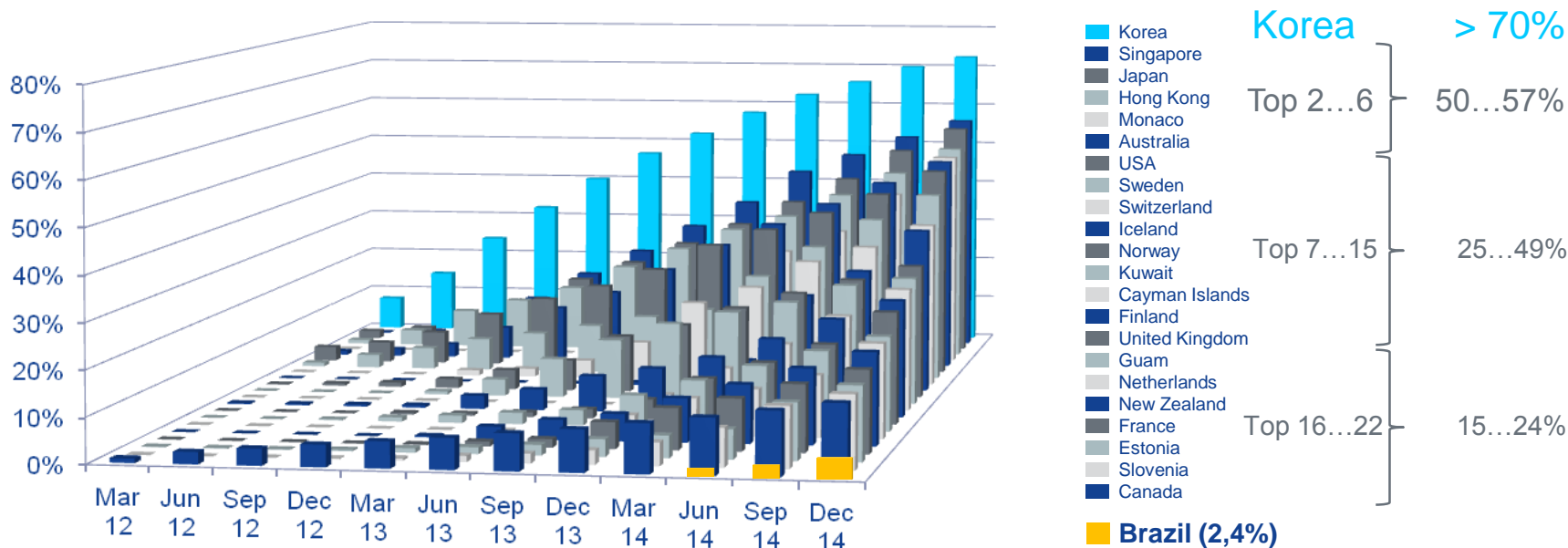


A Expansão do 4G no Brasil

- Wilson Cardoso
- 18-06-2015

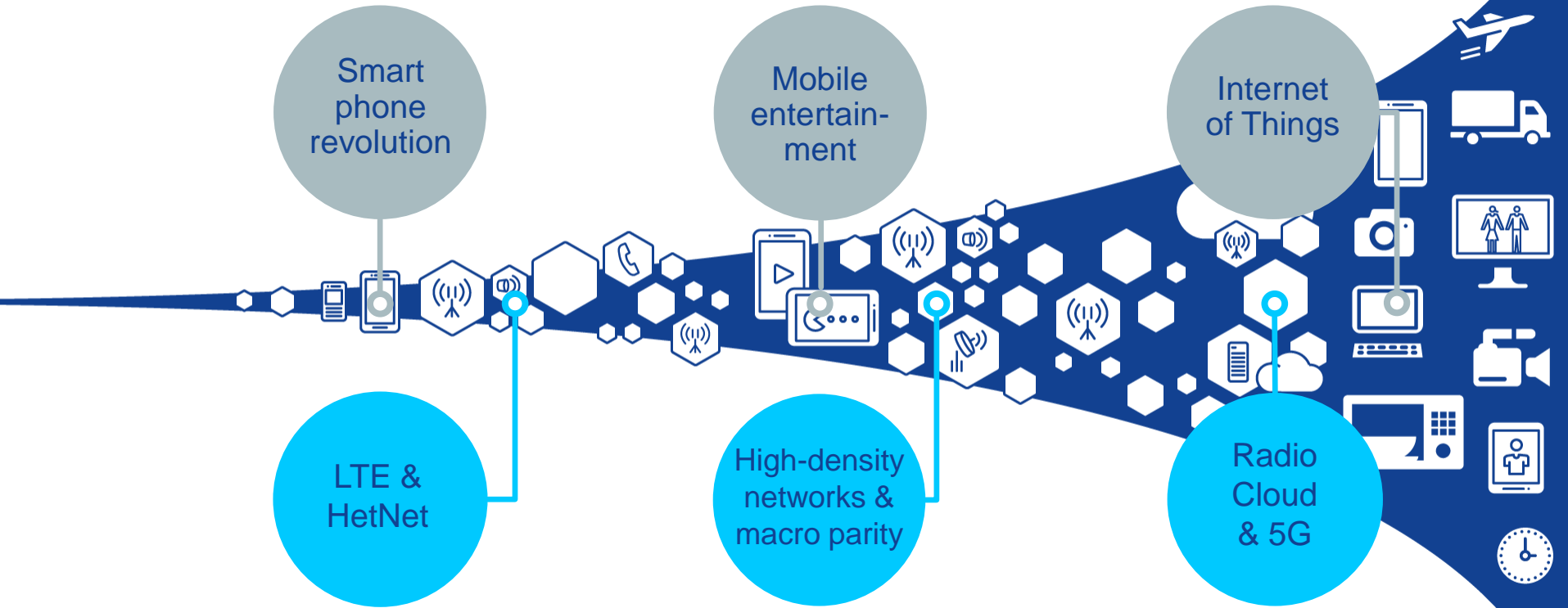
Adoption of LTE

Korea far ahead of the rest of the world in terms of LTE subscriber penetration



Subscriber penetration (LTE subscribers / capita) based on analyst estimations and reported operator data where available. Korea is the only market, in which all operators are reporting LTE subscriber figures on a regular basis. Graph shows top 22 countries, based on market estimations, as only some operators are reporting LTE subscriber figures.

Radio networks today and tomorrow



Top 11 FDD and top 5 TDD frequency bands by number of supporting networks

FDD												
Band	Region or typical name		20	40	60	80	100	120	140	160	180	200
1	UMTS core, “2.1GHz”	10										
2	US PCS, “1900MHz”	6										
3	“1800MHz”	158										
4	US AWS	36										
5	“850MHz”; US, Korea, APAC, MEA, Africa	7										
18	Japan 800											
19	Japan 800											
7	“2.6GHz”	91										
8	GSM 900	10										
12	US 700 MHz Lower (Band A,B,C)	55										
13	US 700 MHz Upper (Band C) – Verizon											
14	US 700 MHz Upper (Band D+)											
17	US 700 MHz Lower (Band B, C) – AT&T											
20	„800MHz“; European Digital Dividend band	68										
25	US ext. 1900	6										
28	APT700 Digital Dividend, mainstream	8										

TDD													
Band	Region or typical name		20	40	60	80	100	120	140	160	180	200	
38	2.6 GHz	12											
39	1.9 GHz	1											
40	2.3 GHz	21											
41	2.6 GHz	10											
42	3.5 GHz	9											

Source: Evolution to LTE report, GSA, Jan.7th, 2015

Trend 1: Mobile traffic expected to grow exponentially until 2020

Traffic has nearly doubled every year past five years

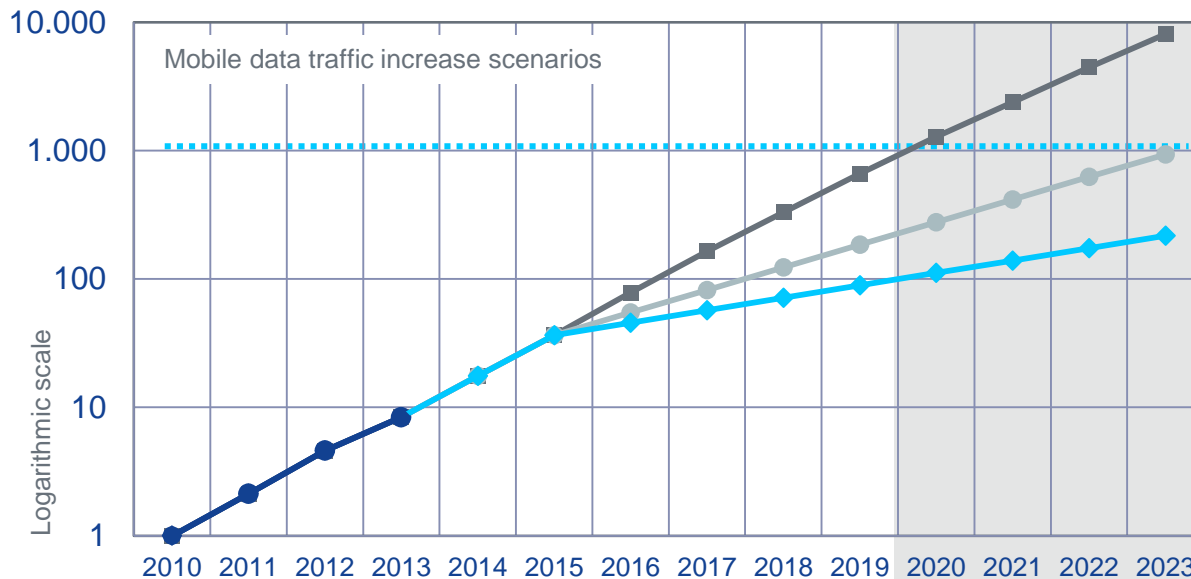
Drivers

- > LTE, WCDMA
- > Smartphones
- > Mobile video
- > Bandwidth hungry apps
- > New subscribers

Assumptions

Traffic volume per subscriber

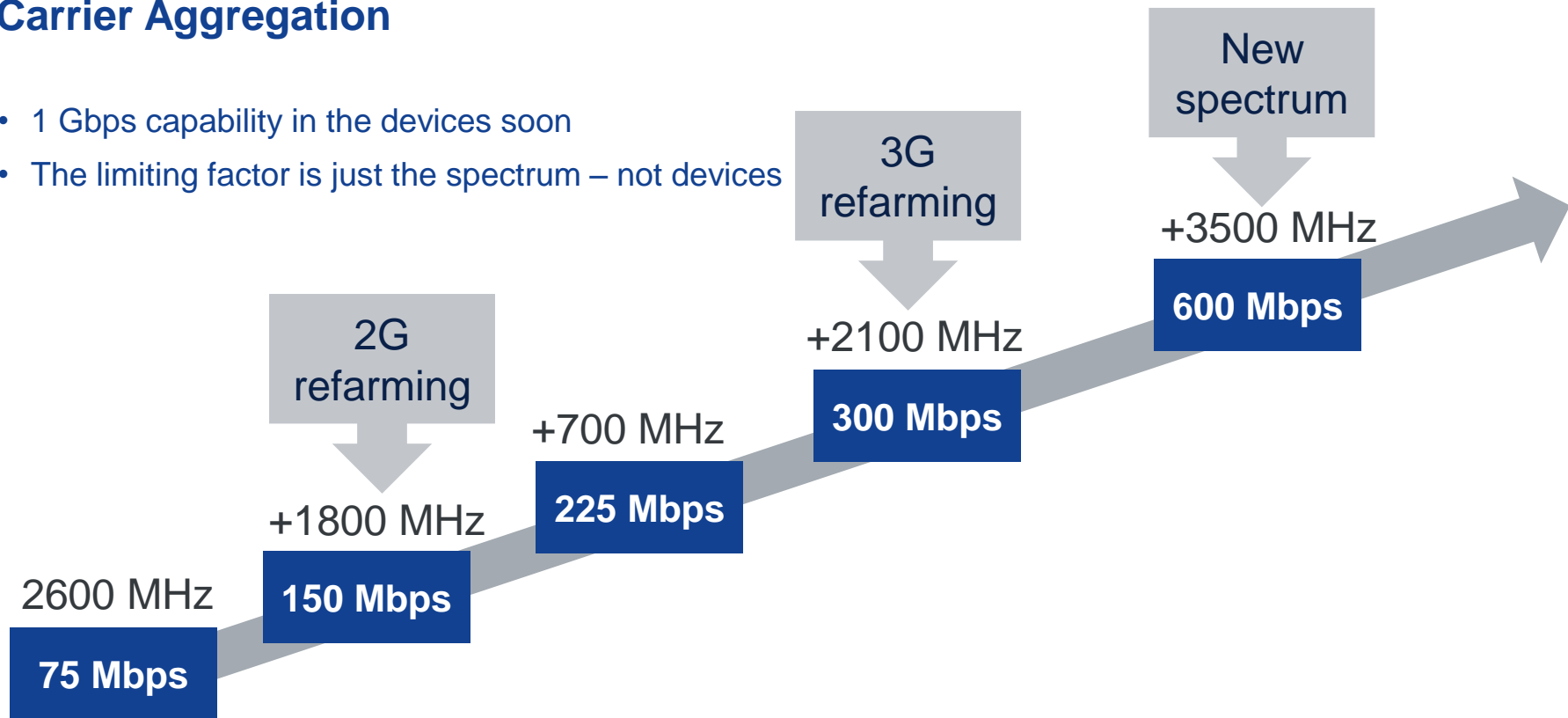
- +75% per year
- +50% per year
- ◆— +25% per year



Networks should be ready even if traffic grows aggressively @ 75%/yr

Trend #2: Data Rates Increasing Rapidly with Carrier Aggregation

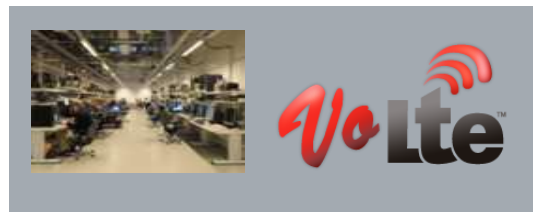
- 1 Gbps capability in the devices soon
- The limiting factor is just the spectrum – not devices



Trend #3: Voice over LTE Gaining Speed



VoLTE service launched with Nokia radio in August 2012. First VoLTE in USA by Nokia 2014.



Over 10 billion VoLTE calls have been carried on Nokia radio networks. 40M VoLTE calls every day.



Excellent end user KPIs with fast setup, high quality, low latency and low drop rate



Trend #4: Indoor Coverage Becoming More Important

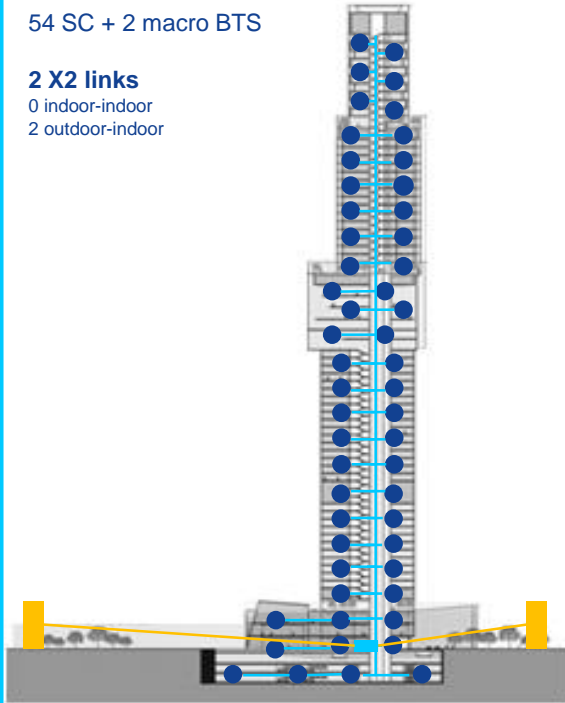
With aggregation (FZ controller)

X2 view only

54 SC + 2 macro BTS

2 X2 links

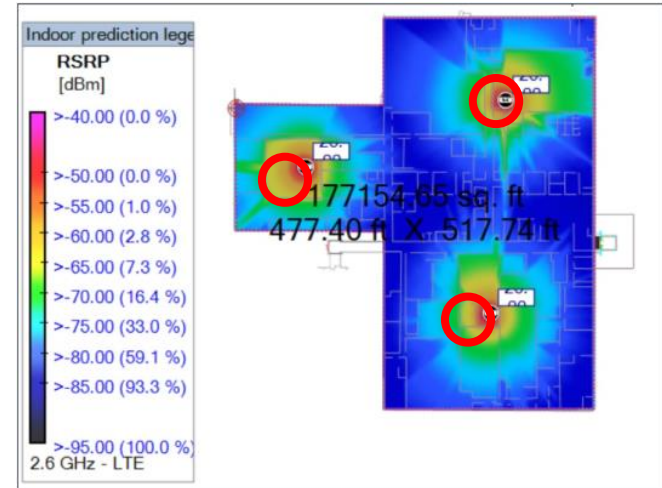
0 indoor-indoor
2 outdoor-indoor



- Pico BTS one solution for indoor coverage
- LTE, 3G and Wi-Fi radios



3G & Wi-Fi
LTE & Wi-Fi

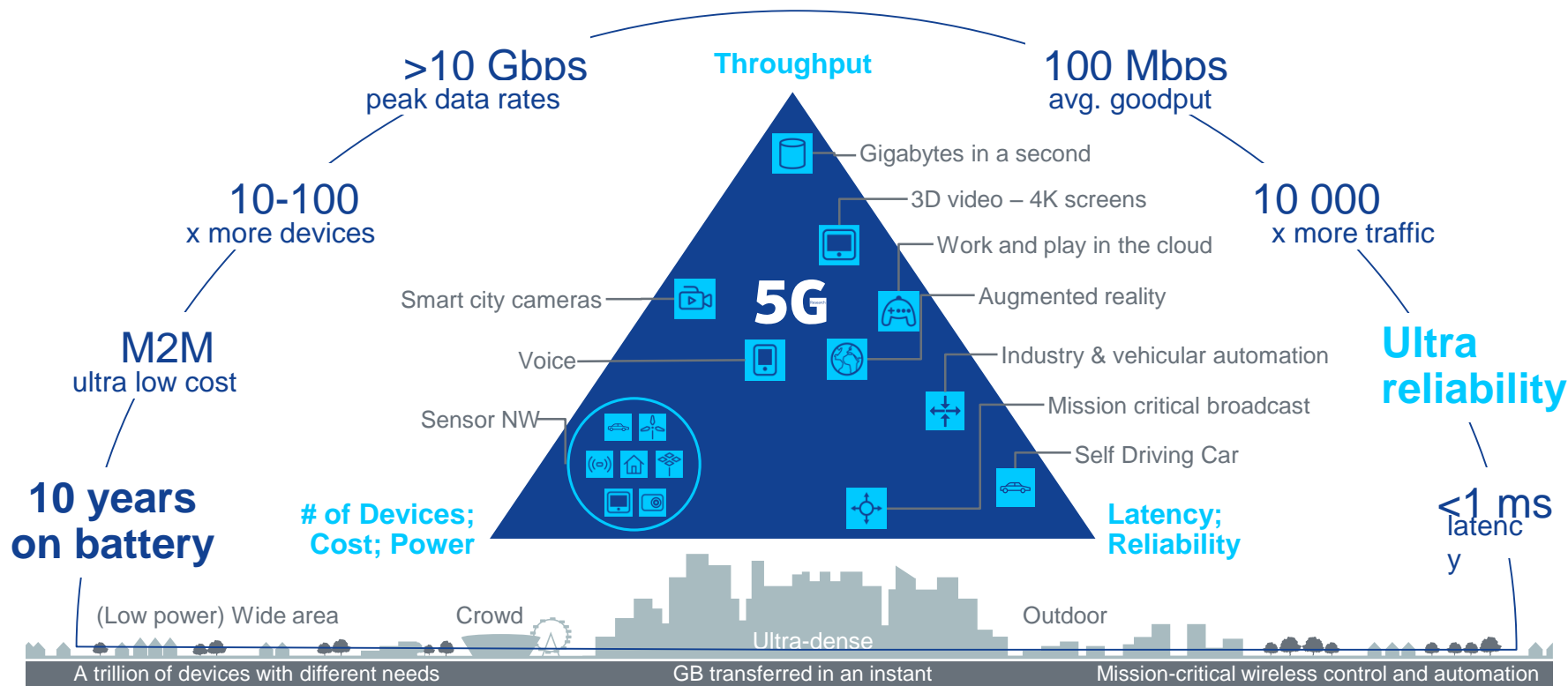


Trend #5: 5G Applications on Top of LTE-Advanced evolution

Internet of things	LTE-M = Machine-to-Machine
Public safety	LTE for Public Safety
Proximity services	LTE-D = Device-to-Device
Terrestrial TV	LTE-B = Broadcast = eMBMS
Car communication	LTE for V2X (Vehicle-to-X) communication
Public transport	Train, airplane connectivity

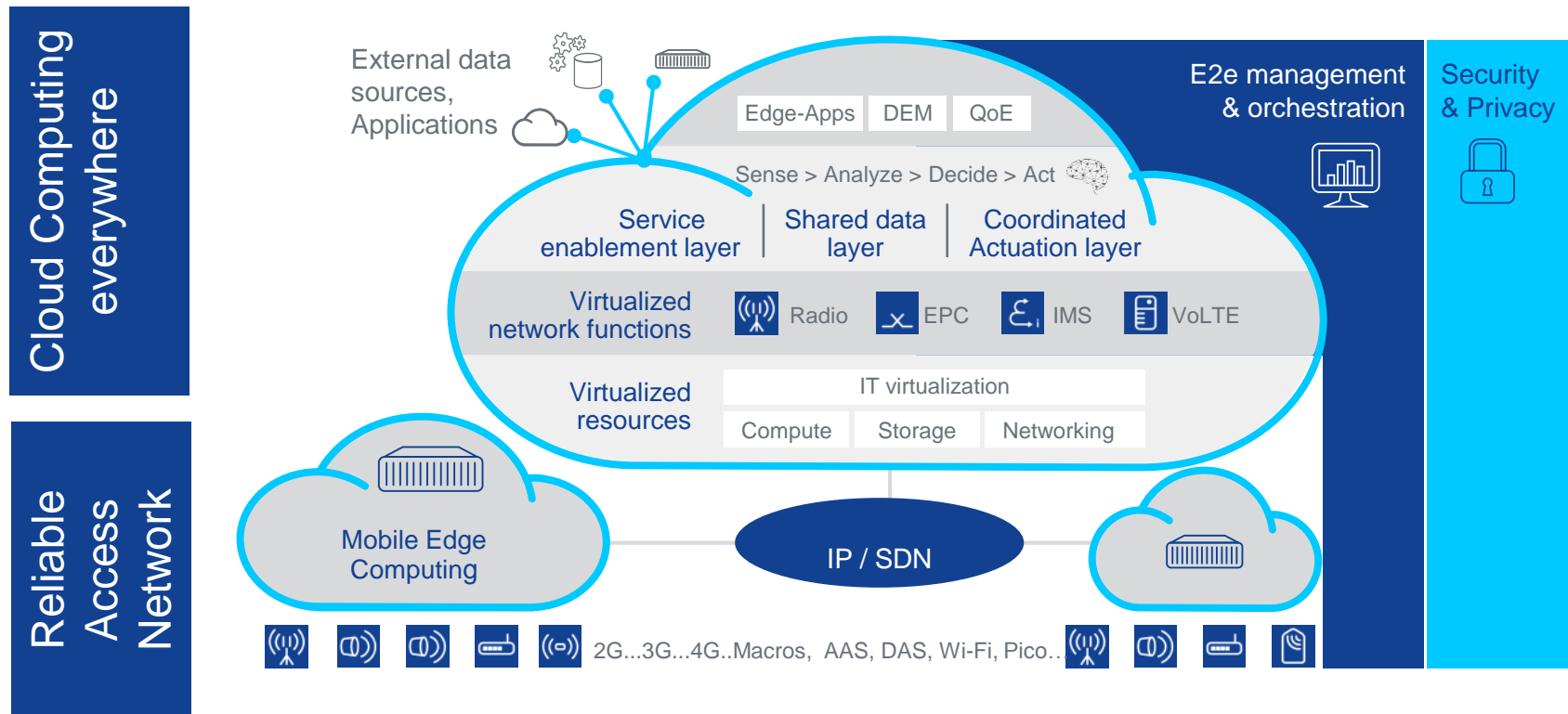
- A number of new use cases and application areas on top of LTE network driven by
 - Massive ecosystem in LTE networks
 - Good coverage
 - Attractive performance

Trend #6: Research Activities for 5G Radio Ramping Up Rapidly



Architecture vision for mobile networks

Cognitive and Cloud Optimized Network Evolution



Wearables and IoT

The rise and rise of sensors



iPhone 3 – Three sensors

- Accelerometer
- Proximity
- Ambient light

2007

Samsung Galaxy S – Three sensors

- Accelerometer
- Proximity
- Compass

2010



iPhone 6 – Seven sensors

- Accelerometer
- Proximity
- Ambient light
- Gyro
- Compass
- Fingerprint
- Barometer

2014

Samsung Galaxy S5 – Ten sensors

- Accelerometer
- Proximity
- Compass
- Gyro
- Fingerprint
- Barometer
- Cover open/closed
- Ambient light
- Gesture
- Heart rate

2014



LTE-M

Enables massive machine type communication

Utilities

Sensors

Wearables

Automotive

Traffic

Smart cities

Smart grids



Use Cases

Battery life

>10 years with two AA batteries

Support

large number of M2M devices

Performance

Additional 15dB coverage

Cost

Very low device cost

Requirements

3GPP Ran Rel. 13:

LTE evolution for Cellular IoT

- Reduced UE Bandwidth of 1.4MHz in downlink and uplink
- Reduced maximum transmit power of [20dBm]
- Reduced support for downlink transmission modes
- UE processing relaxations

Technology

LTE-M – Low Device Cost for M2M applications

Release 12 introduced low complexity UE category (“Cat-0”) with lower data rate, half duplex and single antenna

Release 13 will further reduce complexity with narrowband RF and lower transmit power

	Release 8	Release 8	Release 12	Release 13
	Category 4	Category 1	Category 0	
Downlink peak rate	150 Mbps	10 Mbps	1 Mbps	1 Mbps
Uplink peak rate	50 Mbps	5 Mbps	1 Mbps	1 Mbps
Number of antennas	2	2	1	1
Duplex mode	Full duplex	Full duplex	Half duplex	Half duplex
UE receive bandwidth	20 MHz	20 MHz	20 MHz	1.4 MHz
UE transmit power	23 dBm	23 dBm	23 dBm	~20 dBm
Modem complexity	100%	80%	40%	20%

IoT market outlook reveals substantial potential in applications, analytics, Services

Platforms are attractive as consolidation is expected

	Car, Transport	Energy	Smart Homes	Manu- facturing	Health Care	Retail	
Applications, Analytics							
Application Enablement Platform							
Connectivity Management Platform							
Connectivity							
IoT modules							

Services

- Consulting
- System Integration
- Managed services

Summary

- 4G impactará positivamente a produtividade.
- 700 MHz suportará a cobertura de 4G e é crítico para o futuro desenvolvimento de IoT e outras aplicações.
- Facilidades para instalações de antenas e small-cells será crítica para a expansão da Banda Larga Móvel
- Altíssima carga tributária continua impedindo crescimento e penetração da Banda Larga Móvel
- Espectro disponível é fundamental para o crescimento da Banda Larga Móvel
- Melhora da Qualidade e Cobertura são imprescindíveis

Muito Obrigado!

NOKIA