Towards a Sustainable 5G

Michele Zarri, Technical Director GSMA

Who is The GSMA?

THE GSMA WAS FOUNDED IN 1987

15 OFFICES WORLDWIDE

SHANGHAI · SAN FRANCISCO · BEIJING · SAO PAULO · NAIROBI · NEW DELHI

LONDON · DUBAI · ATLANTA · BRUSSELS · BARCELONA · HONG KONG · BRASILIA · BUENOS AIRES

Connecting Everyone and Everything to a #BetterFuture

The mobile industry is the first to formally commit to the UN Sustainable Development Goals

The GSMA represents the interests of mobile operators worldwide

MORE THAN **750** MOBILE OPERATORS

WITH OVER **350** COMPANIES in the broader mobile ecosystem

The world's leading mobile industry events, Mobile World Congress and Mobile World Congress Shanghai, together attract nearly

190,000

The GSMA works to deliver a regulatory environment that creates value for consumers by engaging regularly with:

- MINISTRIES OF TELECOMS
- TELECOMS REGULATORY AUTHORITIES
- INTERNATIONAL & NON-GOVERNMENTAL ORGANISATIONS

CONNECTING **23,000+** Industry Experts

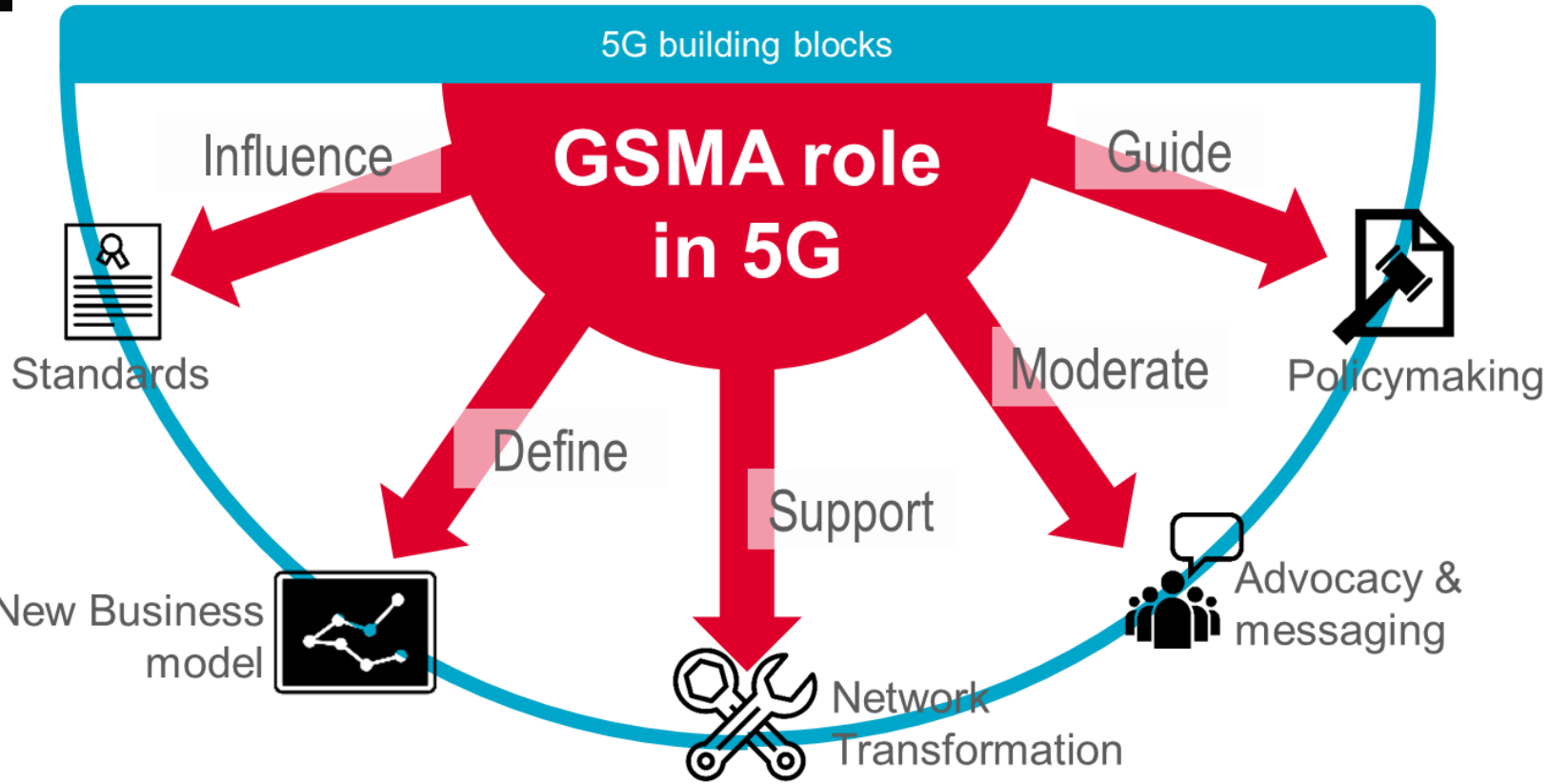
Exclusively for GSMA Members, InfoCentre[2] is your place to connect with a global community of industry experts

GSMA Working Groups provide frameworks and standards in commercial, operational and technical matters that help maintain and advance mobile industry ecosystems

8.7 bn+

MOBILE CONNECTIONS WORLDWIDE

GSMA activity in the 5G Era



The five GSMA goals for the 5G era

1. Boundless Connectivity for All
2. Innovation and Network Economics
3. Transformation of Vertical Industries
4. Revolutionise the Mobile Broadband Experience
5. Help to Grow New Use Cases

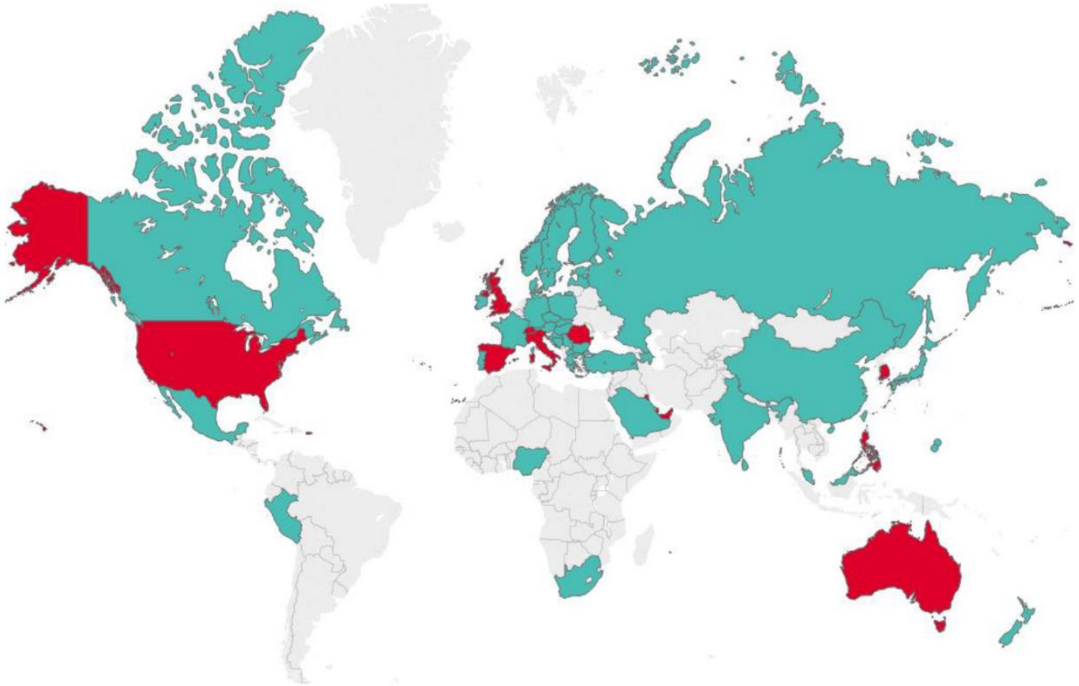
The 5G design goals: IMT-2020 requirements

Requirement		Value
Data rate	Peak	Downlink: 20Gb/s Uplink: 10Gb/s
	User experience	**Downlink: 100Mb/s** **Uplink: 50Mb/s**
Spectral efficiency	Peak	Downlink: 30 bit/s/Hz Uplink: 15 bit/s/Hz
	5th percentile user	Downlink: 0.12~0.3 bit/s/Hz Uplink: 0.045~0.21 bit/s/Hz
	Average	Downlink: 3.3~9 bit/s/Hz Uplink: 1.6~6.75 bit/s/Hz
Area traffic capacity		10 Mbit/s/m^2
Latency	**User plane**	**1ms~4ms**
	Control plane	20ms

Requirement	Value
Connection density	1,000,000 devices per km^2
Energy efficiency	Loaded: see average spectral efficiency No data: Sleep ratio[1]
Reliability	**1-10^{-5} success probability of transmitting a layer 2 PDU (protocol data unit) of 32 bytes within 1ms**
Mobility	0km/hr~500km/hr
Mobility interruption time	0ms
Bandwidth	**100MHz**

[1] **The fraction of unoccupied time resources (for the network) or sleeping time (for the device) in a period of time corresponding to the cycle of the control signalling (for the network) or the cycle of discontinuous reception (for the device) when no user data transfer takes place.**

5G commercialisation status



Planned commercial 5G network

Commercial mobile 5G network

86 Operators have announced plans to launch 5G services

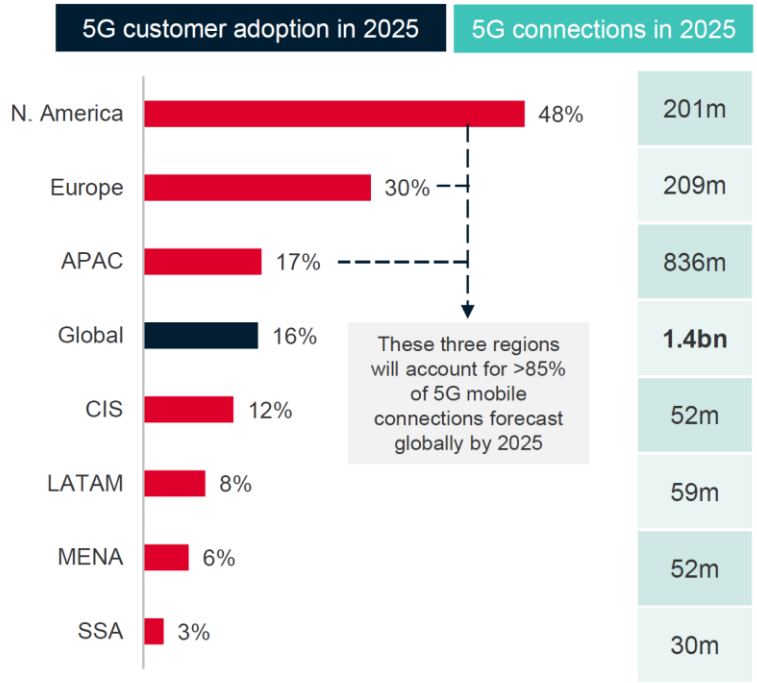
across **56** countries

17 Operators are already commercially live

across **11** countries

Note: This data is up-to-date as of June 2019

Customer adoption and connections in 2025



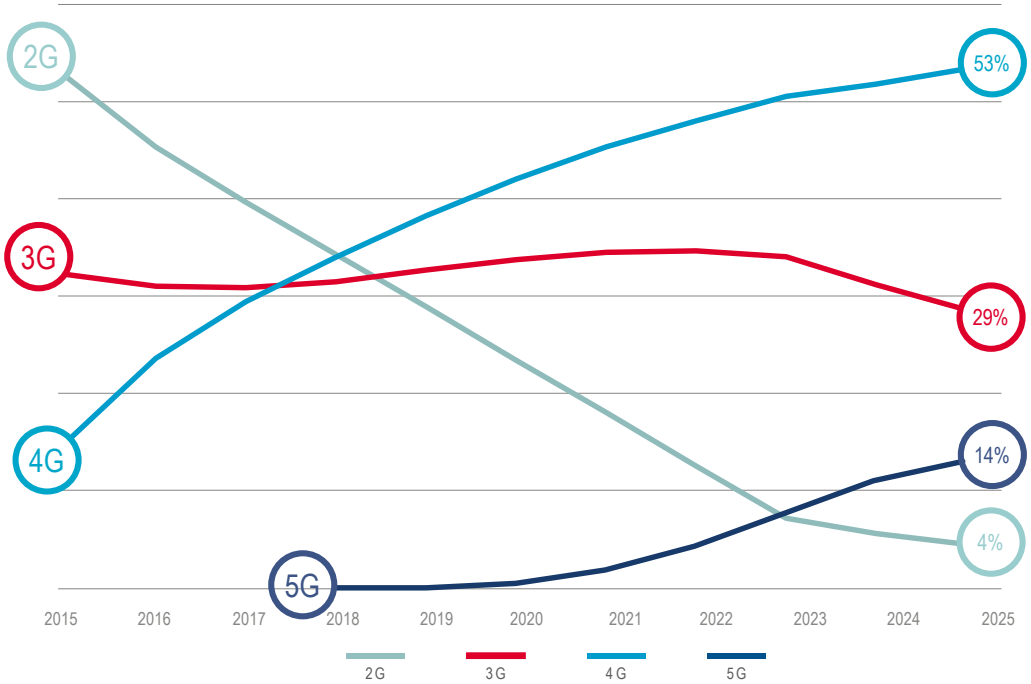
Data correct to 30 June 2019. For updates, see gsmaintelligence.com

Source: GSMA Intelligence

Notes

- APAC
  - Most of the connections expected to be in China
  - Expected launch in China in 2020
- Europe
  - just over 30% of total connections, 75% of the population
  - The leaders will be Germany, the UK and France
- Mena
  - Operators in 12 other countries across MENA are expected to deploy 5G services, covering around 30% of the region's population
- North America
  - Fastet adoption rate with 50% of connections expected to be 5G by 2025

Connections growth by generation



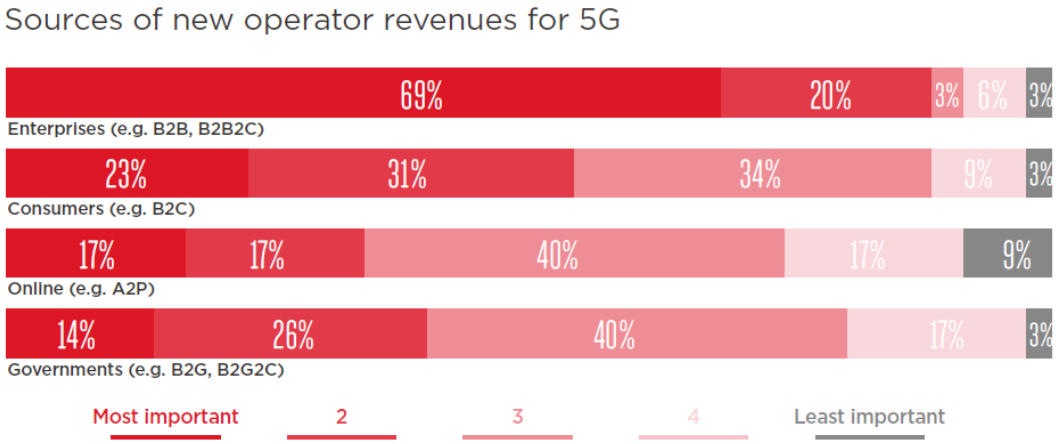
Source: GSMA Intelligence

Remarks

- Globally it was only in 2018 that 4G connections overtook 2G connections
- 5G connections growth set to be faster than 4G connection growth
- By 2025 3G connections will still be significant

Sustainability of business model

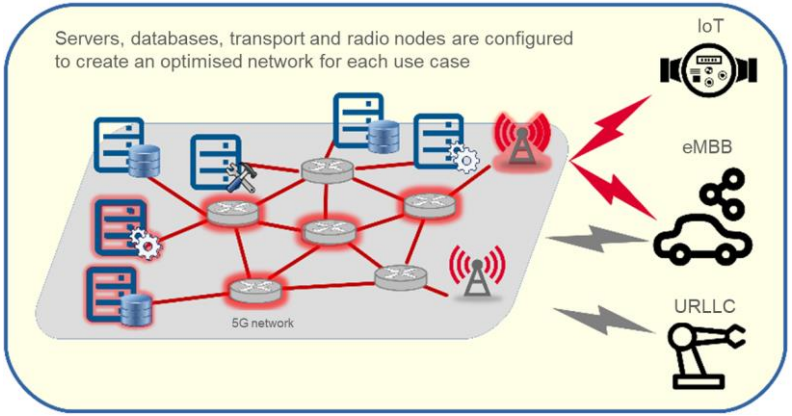
Source: CEO 5G survey, October 2016



The B2B opportunity

- In the GSMA CEO 5G Survey, operators clearly indicated they felt the enterprise segment represented the biggest opportunity to expand their business
- Network slicing is earmarked as the enabler for unlocking this opportunity

Network Slicing will enable addressing a plethora of use cases

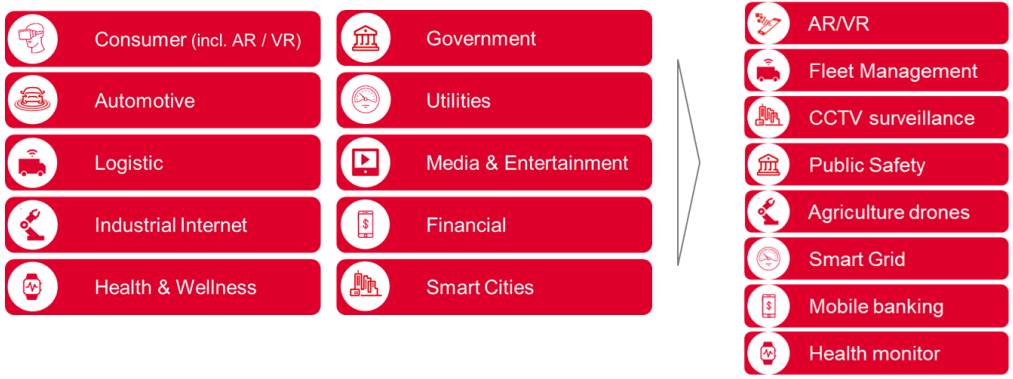


Network slicing

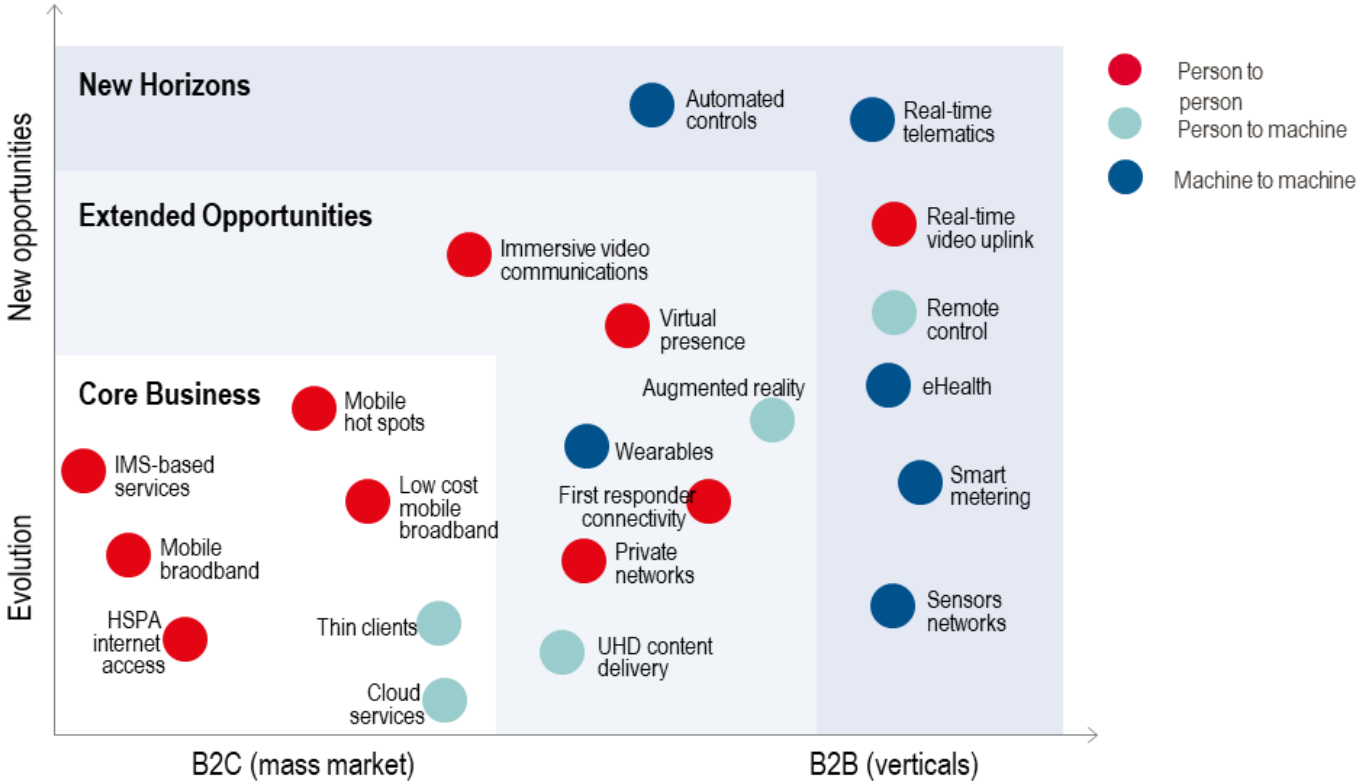
- The capability of creating logical networks with different features and behaviour using the same hardware
- GSMA defined 30+ attributes that characterise fully a network slice
- Unlocks new business models through enforcement of SLAs and different levels of customer control (e.g. private networks)

Diverse use cases

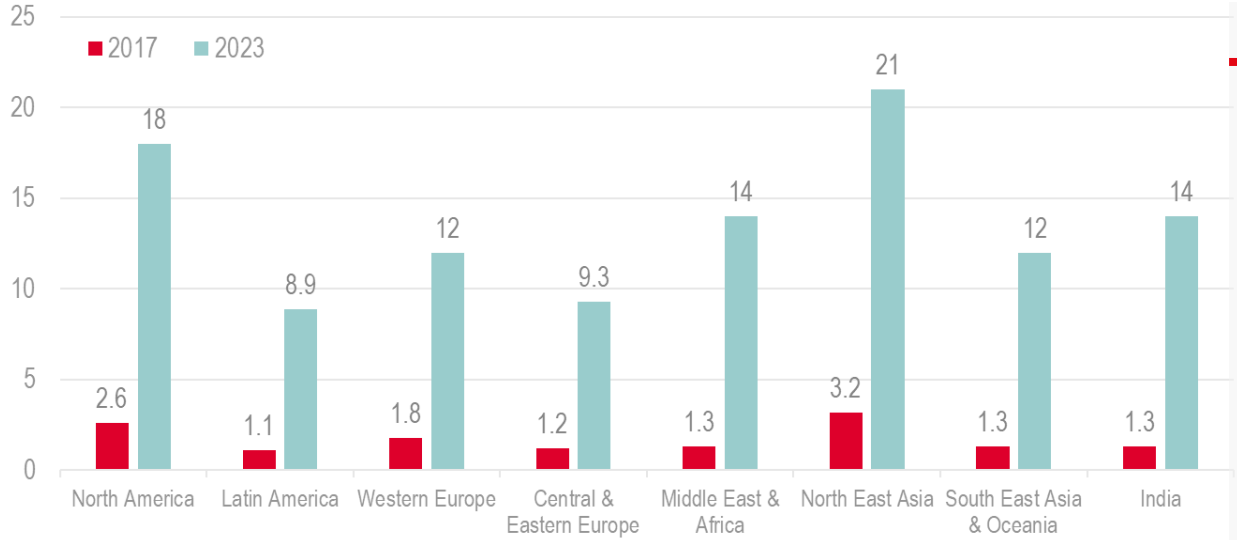
- GSMA identified 10 industry segments that can benefit from adopting mobile technology in their processes
- Each segment will need to support different use cases. Shift from service to use case.



The B2B opportunity



Global Mobile Data Growth

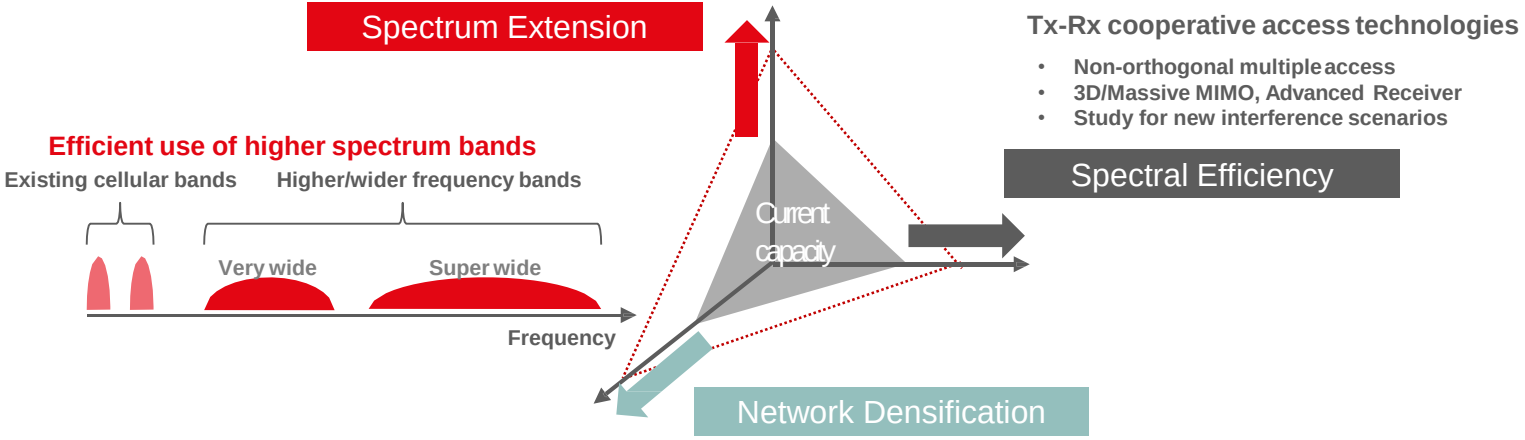


Source: Ericsson Mobility Report 2018

Data usage in the 5G Era

- Consumers appetite for data, especially video still on the rise
- Millions of 'things' also expected to add to mobile data traffic
- Some estimates suggest the capacity of mobile networks will need to grow by a factor of 1,000,000

The three dimensions of the network



Reconstructed from Takehiro Nakamura "5G Concepts and Technologies" (Globecom 2014)

Available tools for extending capacity

SPECTRAL EFFICIENCY

- How many bits of information can be sent every second for each hertz of bandwidth
- No major improvements expected compared to already efficient LTE
- Target is **x3** efficiency over LTE

NETWORK DENSIFICATION

- More smaller cells can dramatically improve capacity
- Physical limitation due to interference between adjacent cells
- With mmWave very high capacity multiplier possible (x1000)

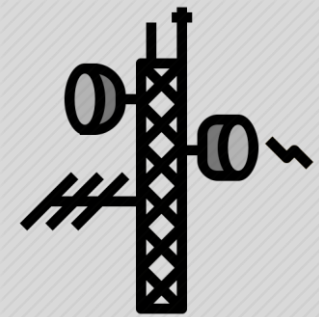
NEW SPECTRUM

- Capacity is directly proportional to the bandwidth (see spectral efficiency)
- Licensed spectrum preferred due to possibility of controlling quality and maximising potential

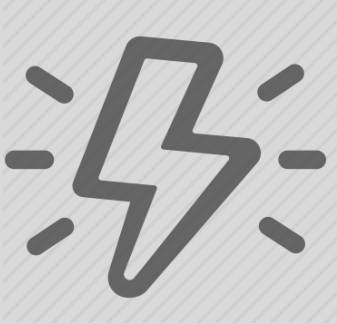
Four areas of research to improve sustainability

Backhaul

Infrastructure



Energy



AI & Automation

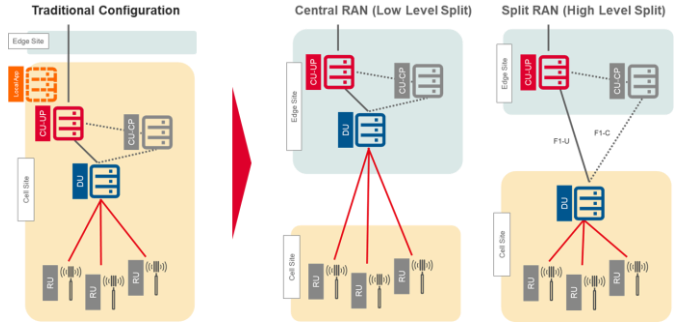
The Backhaul conundrum

Demand

- Consumer demand e.g. 4K video, Fixed Wireless Access, AR/VR
- IoT data demand
- Cloud RAN may will need fibre also for front haul
- Support of multiple mobile generations

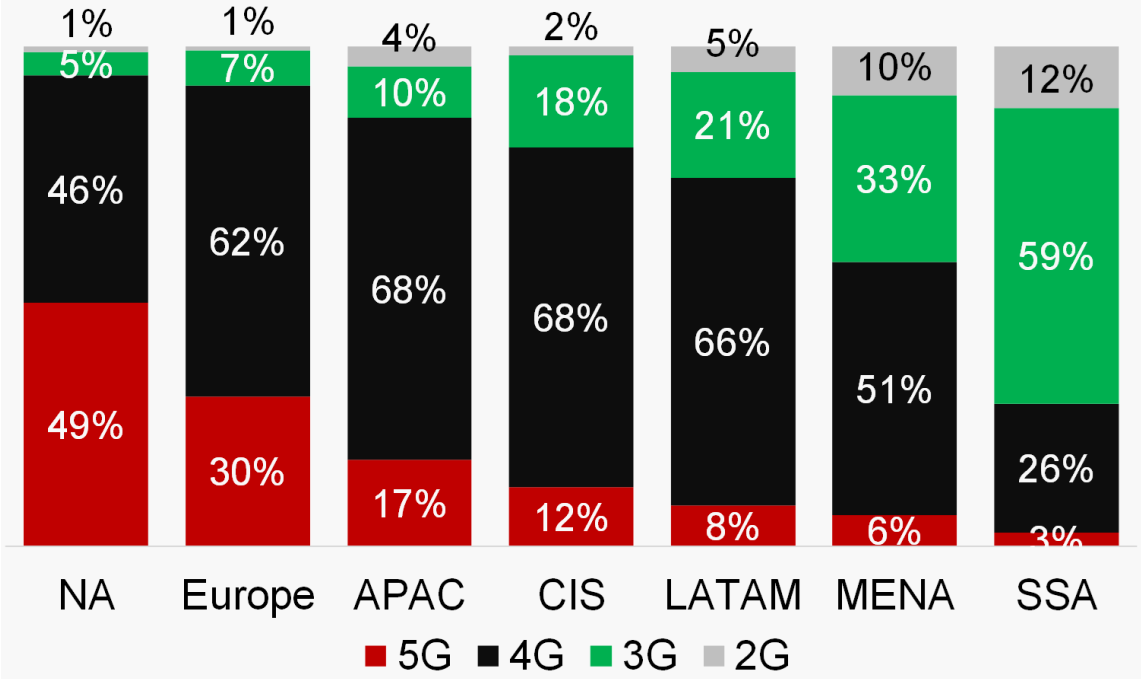
Supply

- New microwave links in E band
- Use of mmWave + space diversity for integrated self backhauling
- Move more service logic at the edge of the network



Network rationalisation: phasing out 2G/3G

Mobile connections by generation: a 2025 view



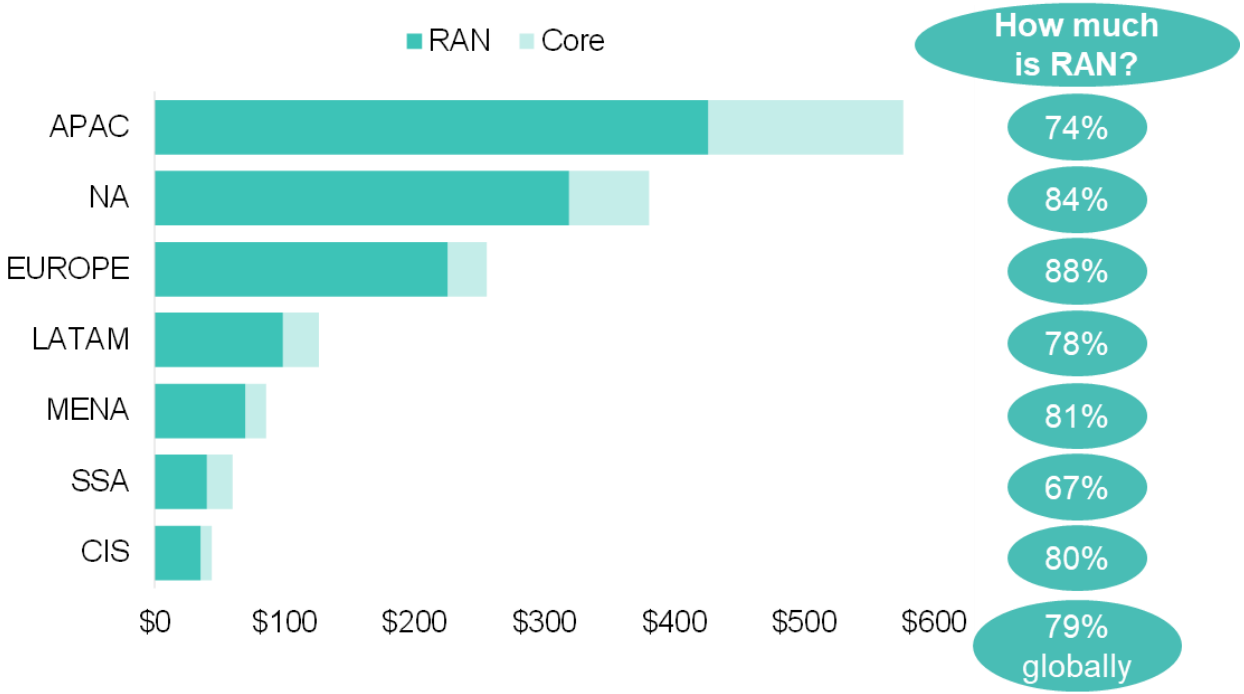
Source: GSMA Intelligence. Mobile connections excluding cellular IoT

What matters

- 5G will add pressure to phase out previous generation networks (2G and 3G)
- The timeline for such phasing out and the network most likely to be phased out will vary by country
- Many factors play a role: spectrum, # of devices connected, speed of migration to VoLTE and, eventually, 5G new radio (VoNR)

RAN vs Core

Capex by region, $ bn, cumulative 2018-2025



What matters

The distribution of core and RAN investment will vary by country depending on:

- NSA vs SA deployment
- Densification
- Developments needed in core network
- Fixed infrastructure

Source: GSMA Intelligence

11 Case Studies Resulting in Cumulative Saving of $500M

NTT DOCOMO: 'GREEN BASE STATION'

VODAFONE: BATTERY REPLENISHMENT

TURKCELL - ENERGY SAVING STRATEGIES

SKT: INNOVATIVE FRONTHAUL NETWORK ECONOMICS

CCS: STREET-LEVEL CONNECTIVITY AT A SUITABLE COST

TELEFÓNICA: MANAGING INCREASING ELECTRICITY DEMAND

CHINA TELEKOM: SMALL CELL DEPLOYMENT

WILLOWMORE: MULTI-ROLE ACCESS CONTROL MANAGEMENT

RURALSTAR, HUAWEI, MTN GHANA: COST-EFFECTIVE DEPLOYMENT OF RURAL COVERAGE

POWERSTAR, HUAWEI, MTN SOUTH AFRICA: ENERGY SAVING CASE STUDY

GENCELL: FUEL CELL ENERGY

Beta Labs

AI-based network automation in early days

Four main areas of AI deployments for operators

Operations optimisation

1 **Network operations**
Greater automation and prediction across different areas: planning, deployment, daily operations, maintenance, spectrum, security

2 **Customer experience**
Chatbots, precision and customised marketing, targeted advertising, automatic contract management

New products and services

3 **New services and smart products**
Digital assistants, smart speakers, IoT services

4 **AI-as-a-service (AIaaS)**
Microservices, data analytics, platform-based solutions, managed services

What matters

- 5G networks need greater and more sophisticated automation to deal with unprecedented quantity, diversity and complexity of devices
- Early evidence of benefits for operators across various network dimensions…but long-term impact still uncertain
- Don't forget the potential for new AI-powered services/revenue

Any question?

If you want to get in touch after this presentation…

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