

The challenges, opportunities and setting the framework for 5G EMF and Health

5G, EMF & Health

5 December 2017, Warsaw, Poland

Mike Wood - General Manager

Telstra EME Strategy, Governance and Risk Management

Rapporteur ITU-T SG5 WP1

Chairman IEC TC106



Presentation Overview

What is 5G?

How does 5G work?

Benefits to society of 5G

Challenges for 5G & EMF

Opportunities for 5G & EMF

Responsible Framework for 5G & EMF

5G EMF & Health Research

Conclusions & Resources



What is 5G?

5G is the 5th generation of mobile networks



Extreme speeds - Gbps
High Capacity – 10x
Low Latency – 1ms

1G

1980s

2G

1990s

3G

2000s

4G

2010s

5G

2020

Analogue

Digital
SMS














Multimedia
Video Calling
Mobile internet

Mobile Broadband
Enhanced Video

Mobile Connected World
Enhanced Mobile Broadband
Low latency applications
Internet of Things
AR & VR



5G Technical Requirements

	Peak Data Rate	1 - 20 Gbps		Connection Density	10k – 1M devices / km ²		Reliability	99.999% (of packets)
	User Experienced Data Rate	10 - 100 Mbps		Network Energy Efficiency	×1 - ×100		Position accuracy	10m - <1m
	Spectral Efficiency	×1 - ×3		Area Traffic Capacity	0.1 - 10 Mbps / m ²		Security	Strong subscriber authentication, user privacy and network security
	Mobility	350 - 500 km/h		Availability	99.999% (of time)			
	Latency	1 - 10 ms		Battery life	10 years*			

*For low-power IoT devices

Source: ITU-R, NGMN, 3GPP



Why 5G?

1. Communities are using significantly more data and applications in everyday life
2. Enables digitalization of various industry sectors
3. Today's 4G LTE networks are reaching maximum capacity
4. A solution is needed to enable additional capacity and innovation for future societies

5G – Connecting the Community

THE CONNECTED COMMUNITY

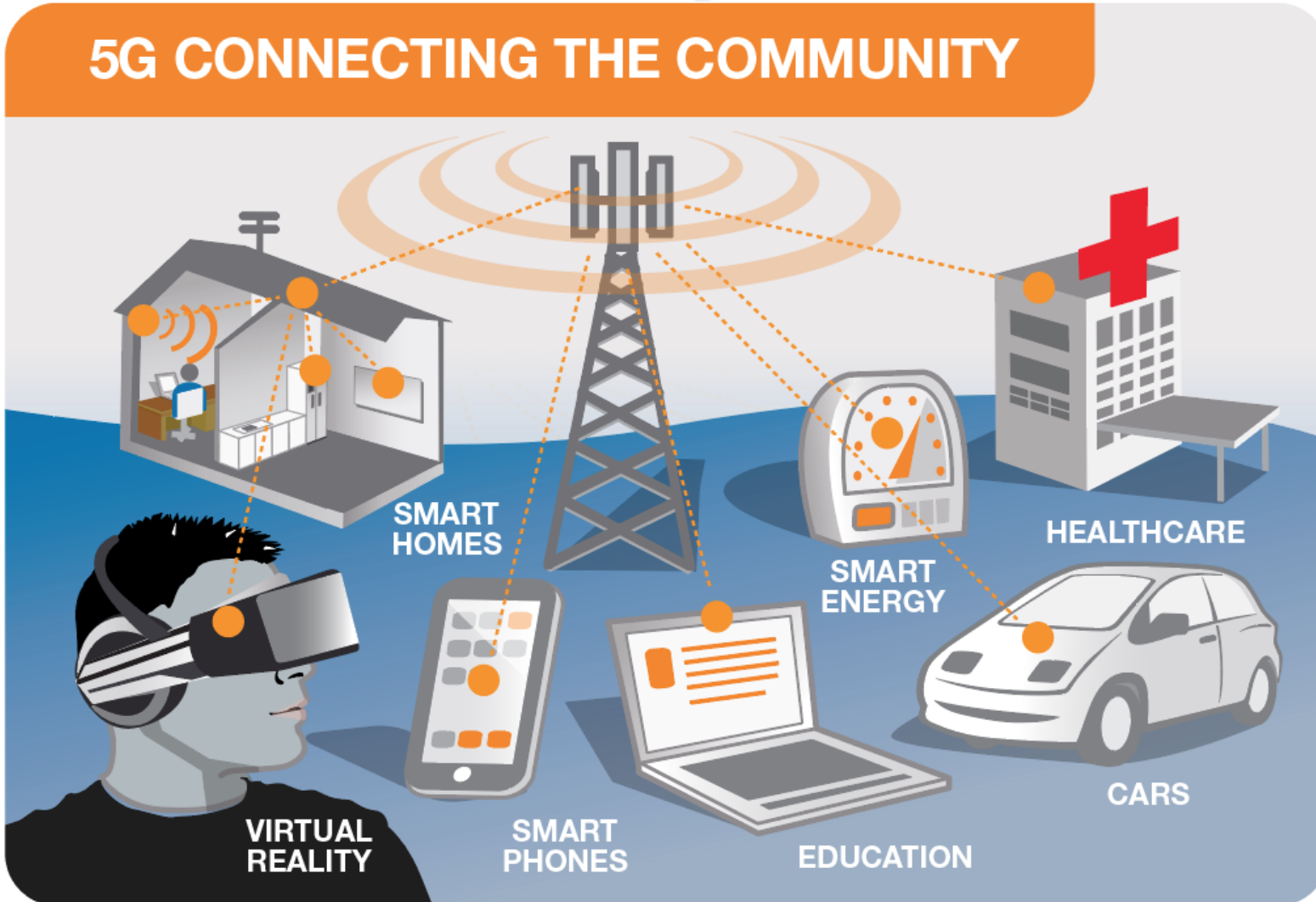


5G will enable the connectivity of today's modern society, the Internet of Things and tomorrow's innovations.

5G uses radio waves or radio frequency (RF) energy to transmit and receive voice and data connecting our community.

Benefits to society

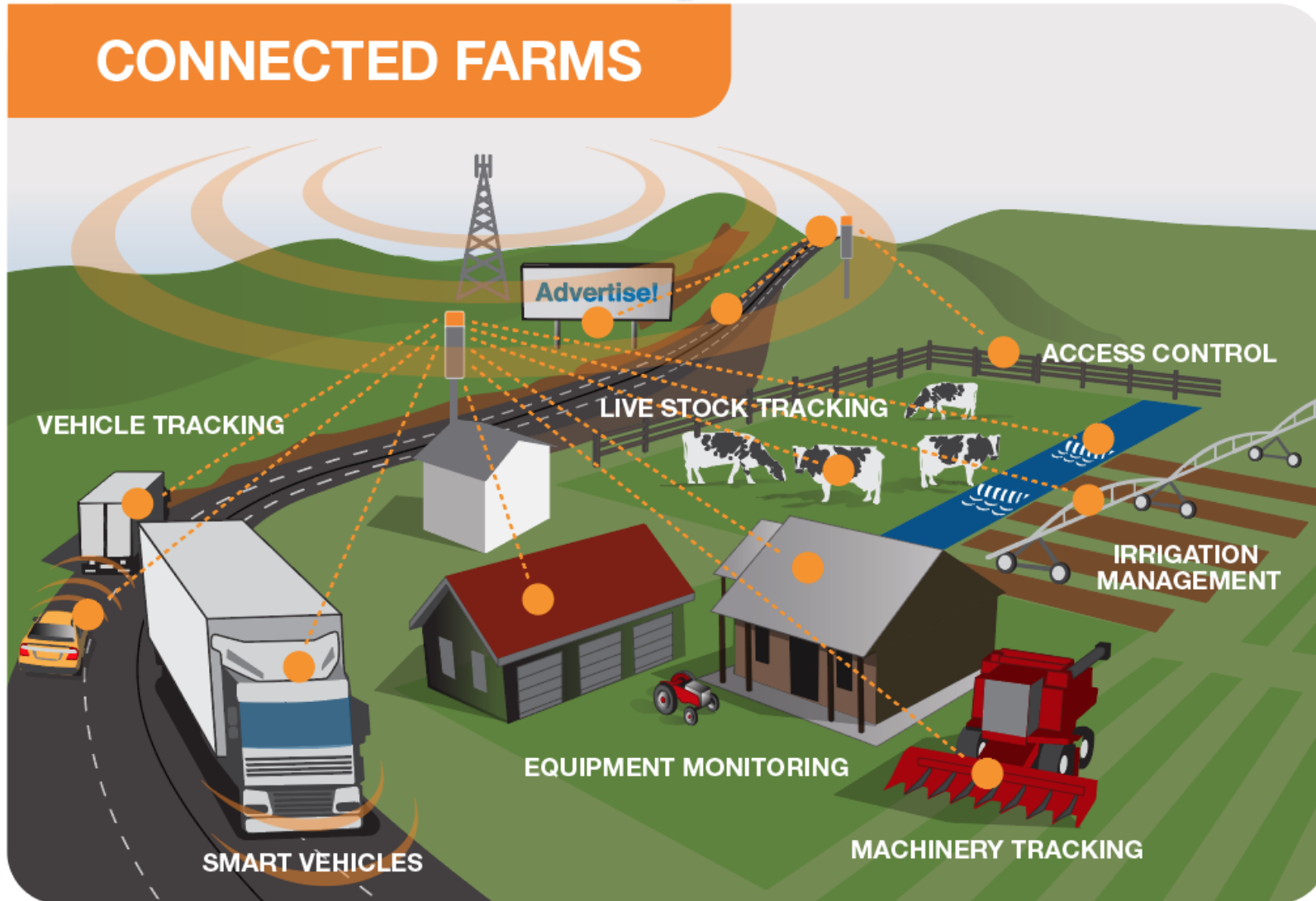
5G CONNECTING THE COMMUNITY



5G opens up a new world of connectivity and benefits.

- Smart cities, schools, homes
- Safer roads & transportation
- Remote health care
- Connected ambulance
- Smart manufacturing industries and farms

Benefits to society – connected farms

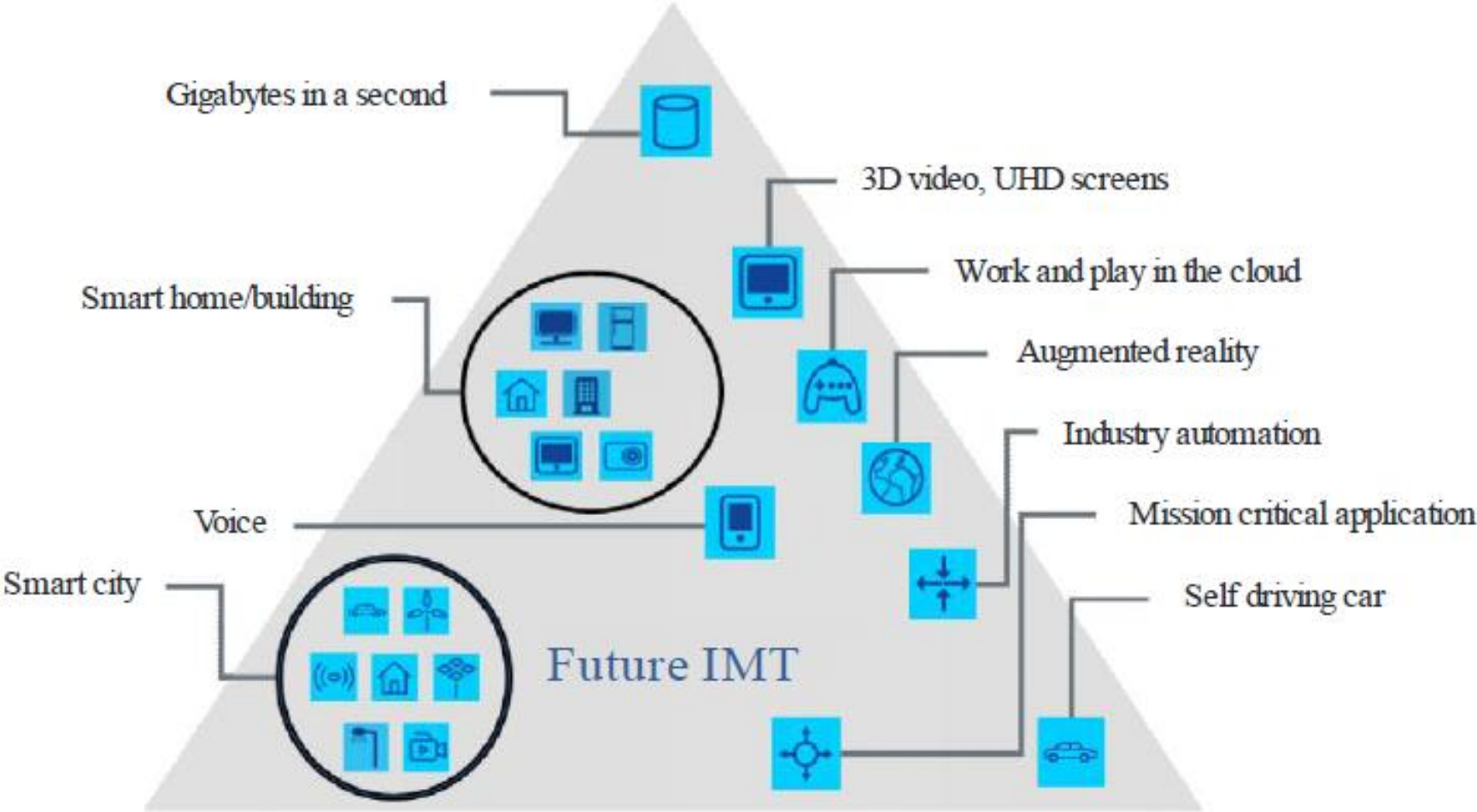


5G enabling smart agriculture and connected farms through

- new IoT applications
- connecting everything
- low power long range sensors
- smart data management

5G Usage Scenarios

Enhanced mobile broadband

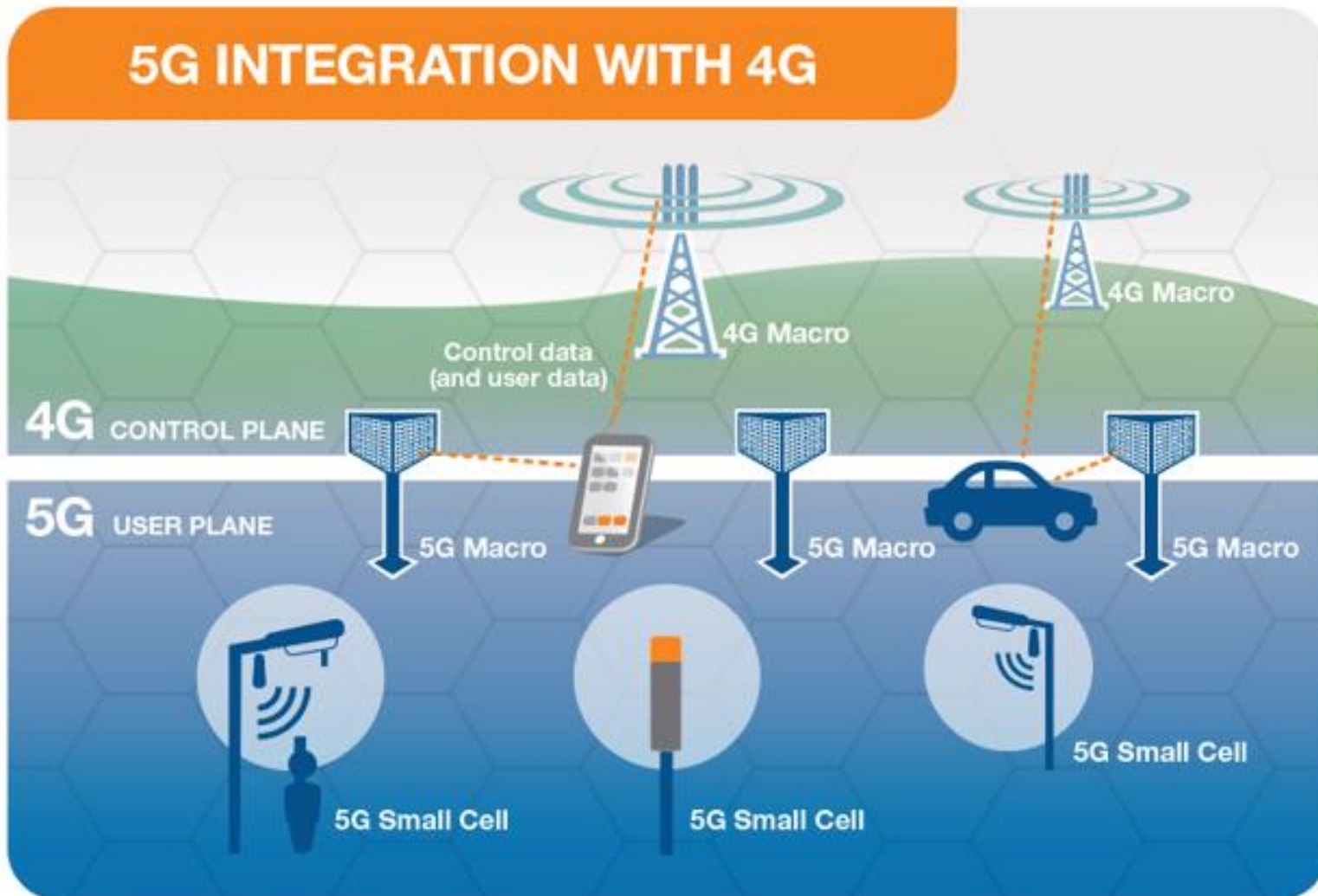


Massive machine type communications

Ultra-reliable and low latency communications



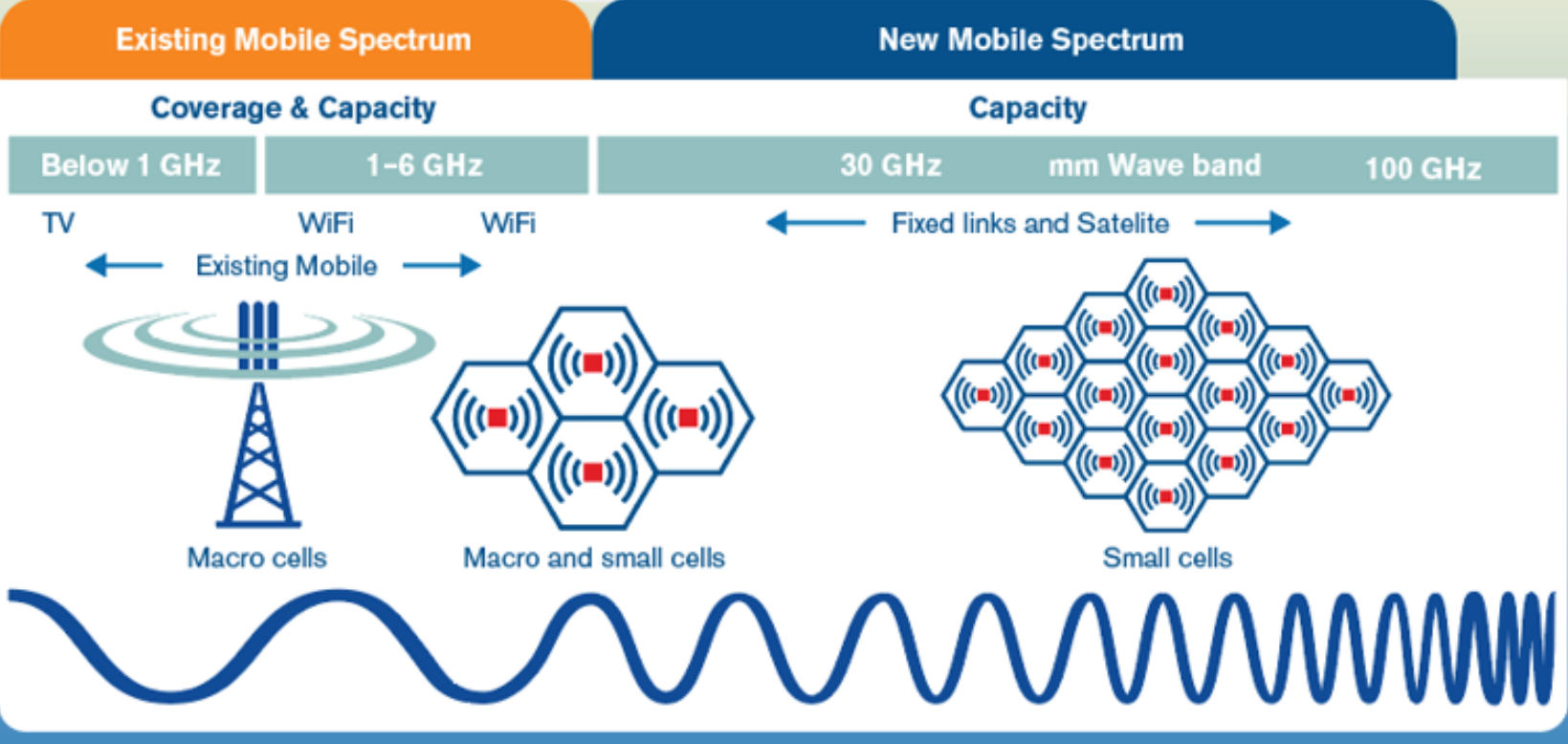
How does 5G work?



- 5G works together with 4G (initially non standalone NSA)
- 4G acts as control plane
- 5G acts as data/user plane
- 5G will operate stand alone in later releases

How does 5G work - spectrum

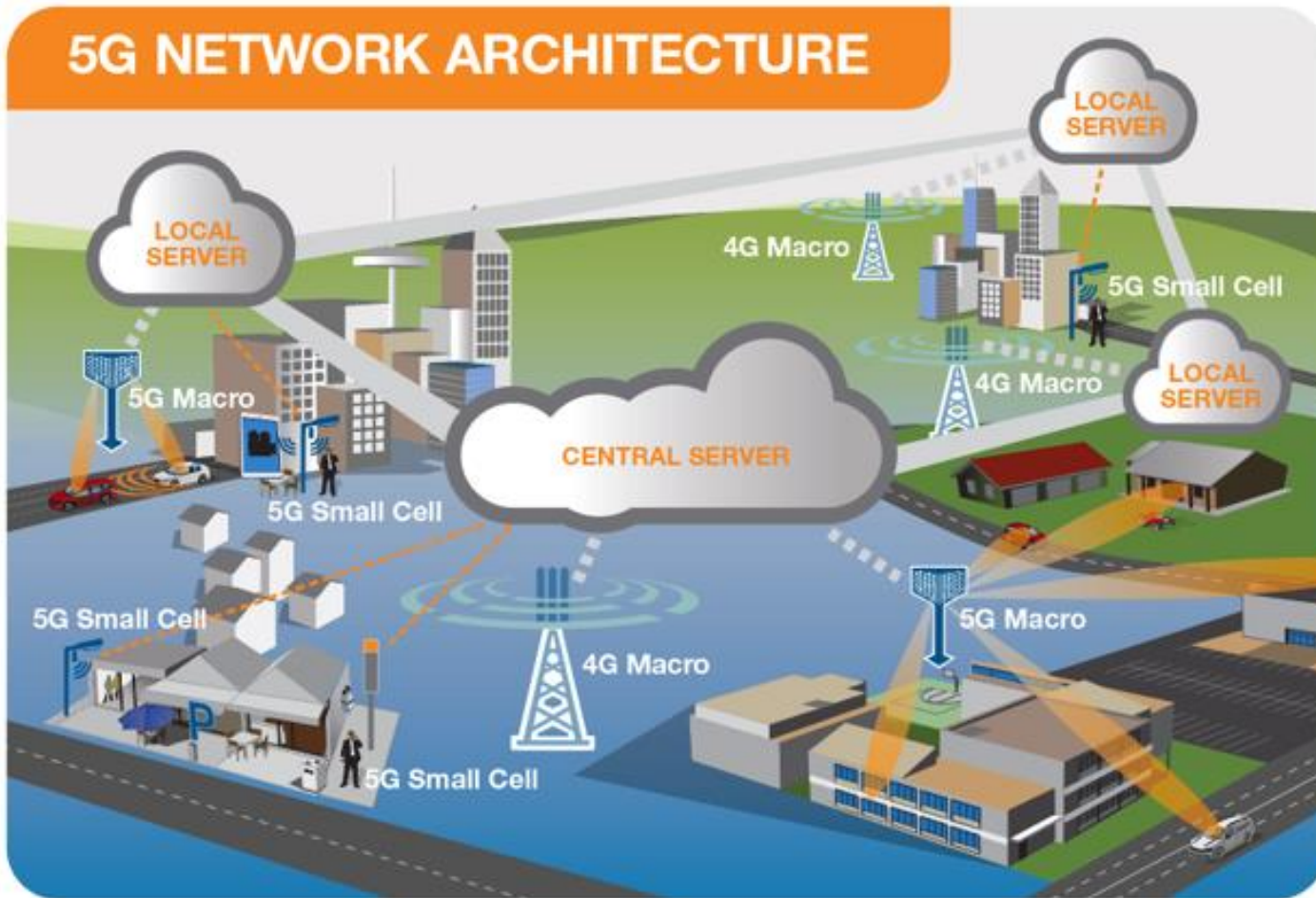
5G SPECTRUM



Frequency & Service
<1 GHz Coverage, IoT,
1-6 GHz Coverage, IoT, Capacity
> 6 GHz Capacity, extreme data rates



How does 5G work – network architecture



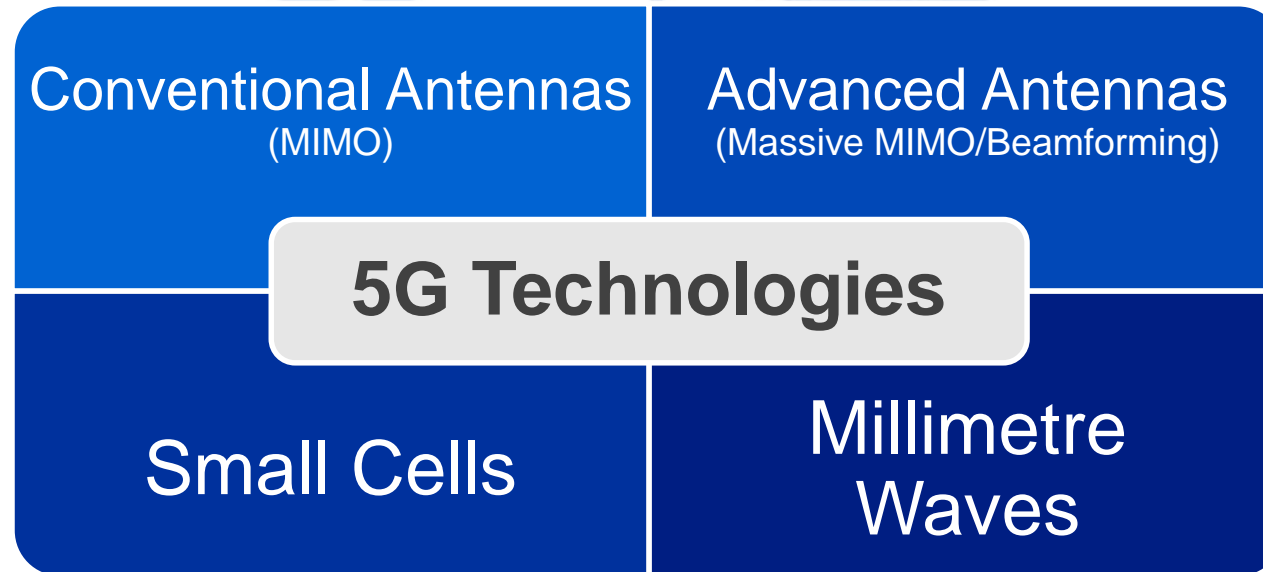
Radio Access Network - small cells, towers, masts & dedicated in-building and home systems that connect mobile users and wireless devices to the core network

Core Network - mobile exchange and data network, manages mobile voice, data and internet connections.

The 5G 'core network' is redesigned to better integrate with the internet and cloud based services, includes distributed servers across the network.

5G network architecture - illustrating 5G and 4G working together, with central and local servers providing faster content to users and low latency applications

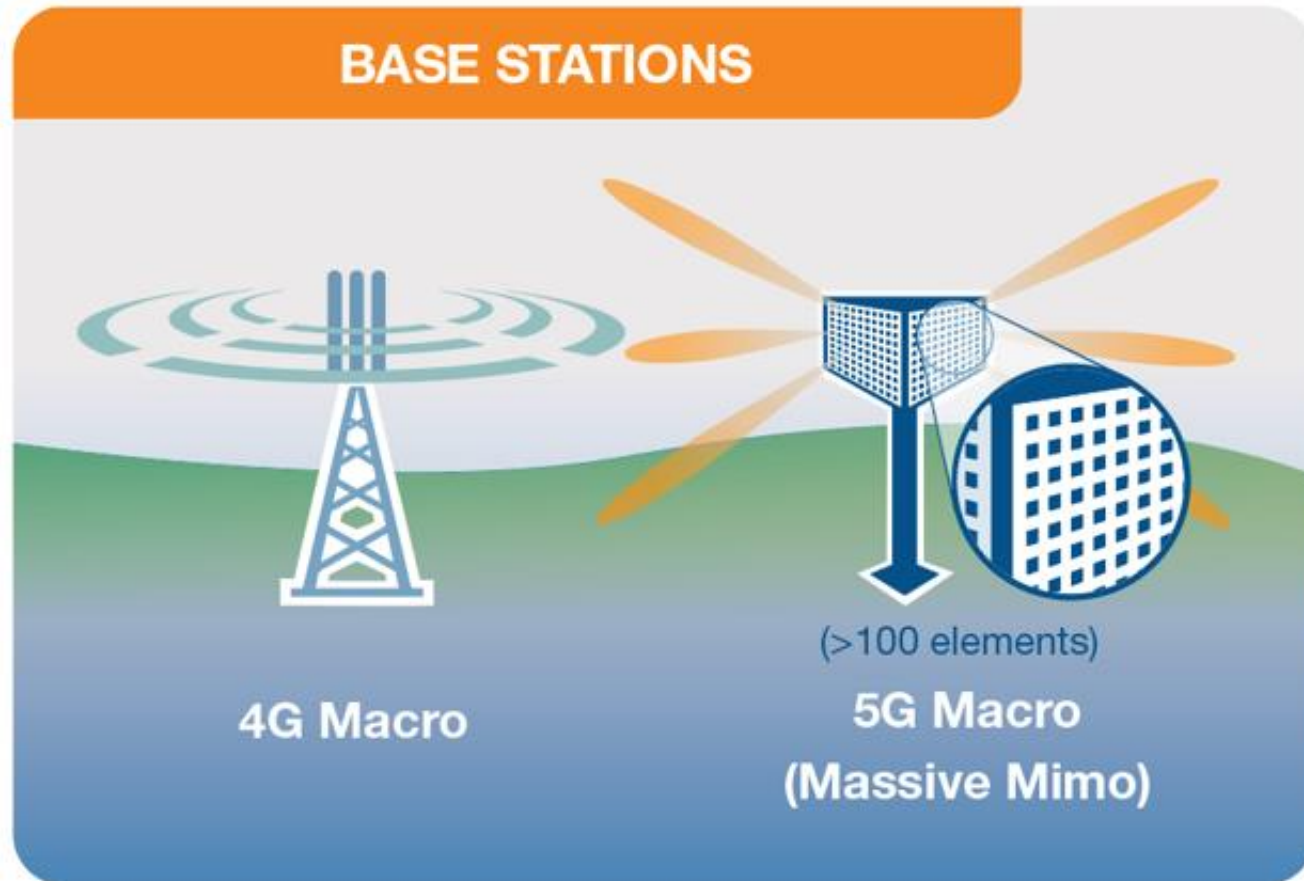
How does 5G work – technologies



MIMO = Multiple Input Multiple Output element Antenna



5G Technology - Massive MIMO



- Multiple Input, Multiple Output antenna elements
- “Massive” number of send/receive elements
- Provide multiple simultaneous connections
- More signal paths, more capacity
- Allows more users to connect at the same time
- Efficient use of radio spectrum

4G

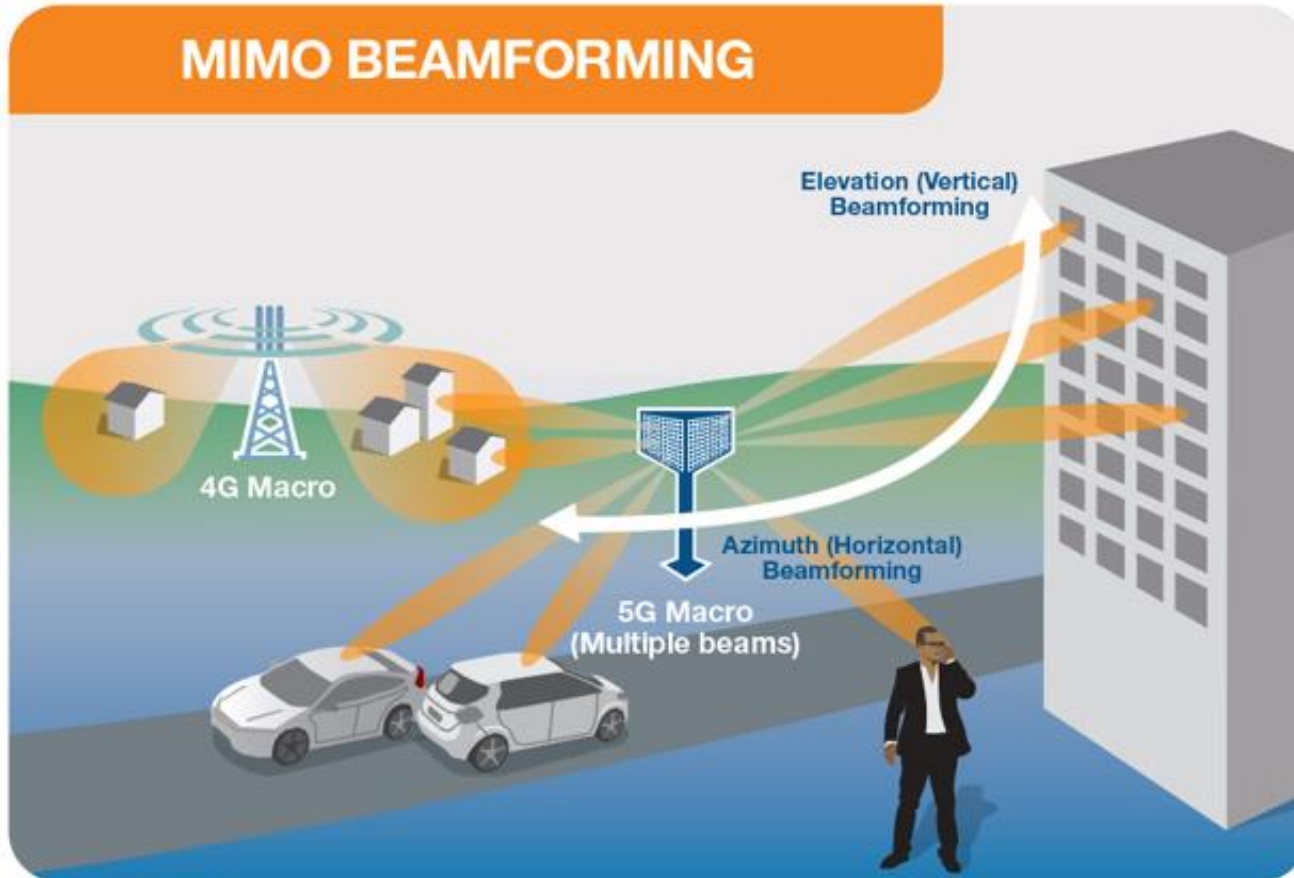
Typically 2-8
antenna ports

5G

Large number
of antenna
elements
(>100)

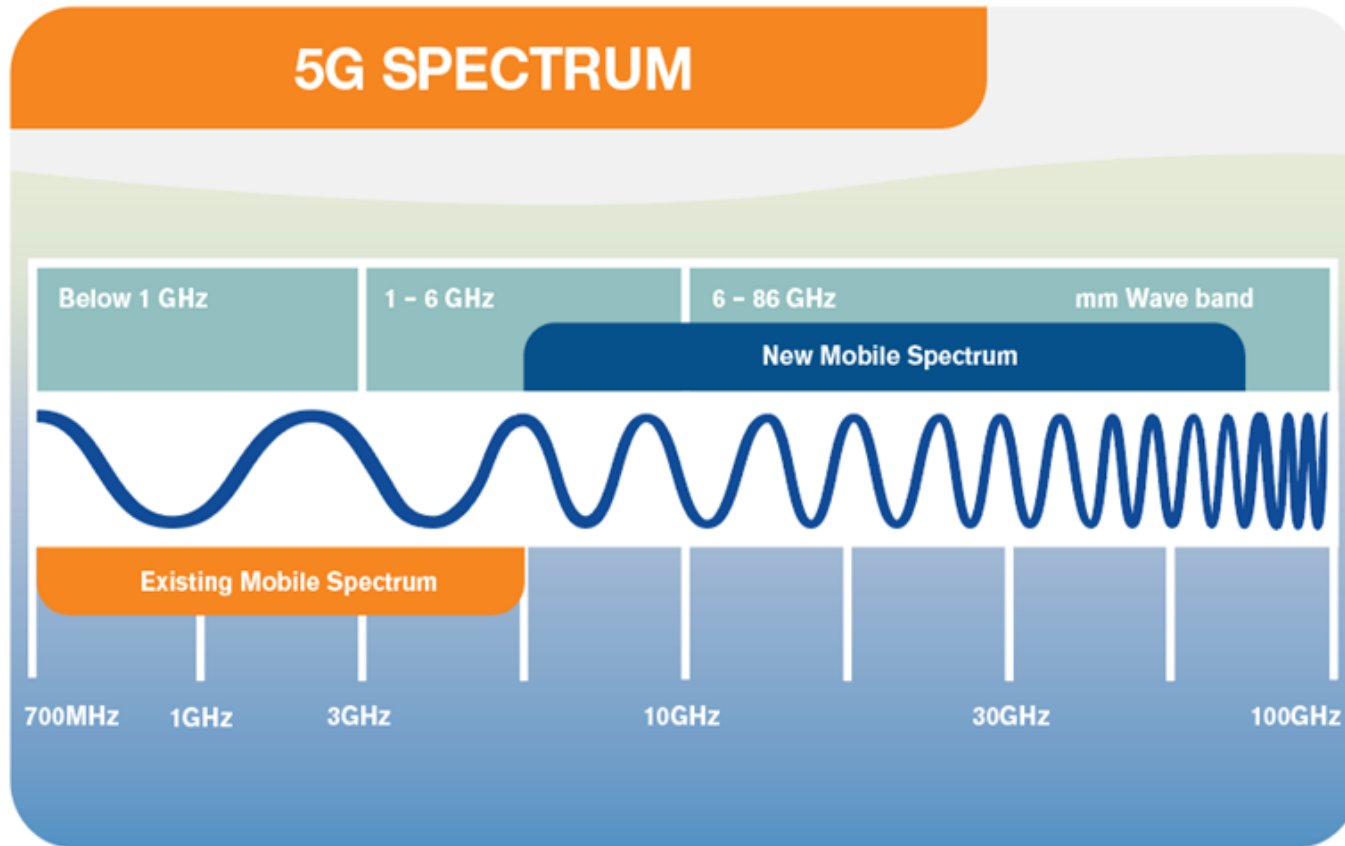


5G Technology - Beamforming



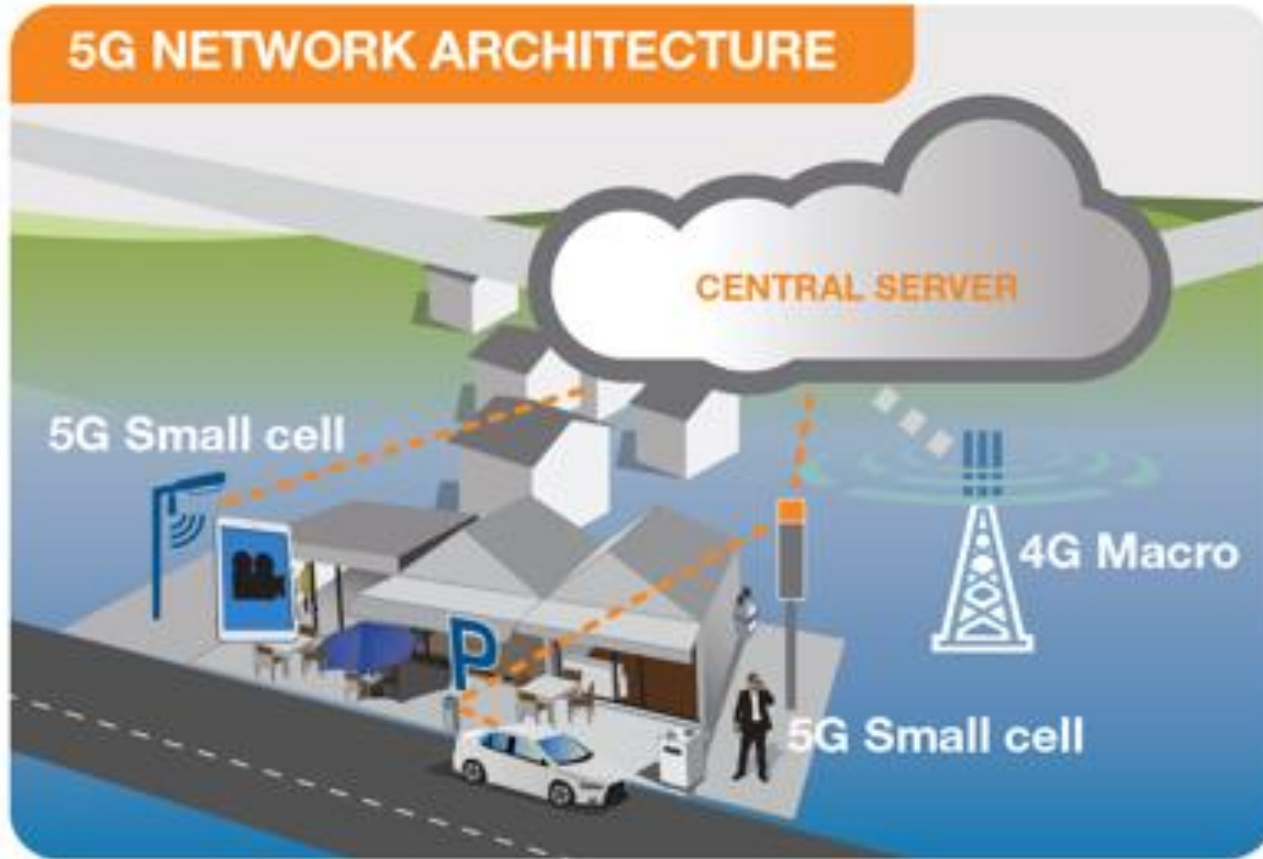
- Dedicated radio signal towards the user
- A 4G signal is typically spread across a wide area
- Enabled by Massive MIMO technology
- Identifies most efficient signal path
- Improves connection reliability
- Reduces interference (unwanted signals)
- Efficient use of spectrum and power
- Allows more simultaneous data streams

5G Technology – New Spectrum & Millimetre Waves



- New additional spectrum
- 5G uses frequencies from 600 MHz -100 GHz
- mmWaves start from 30 GHz
- Add significant bandwidth and capacity
- Maximise data throughput

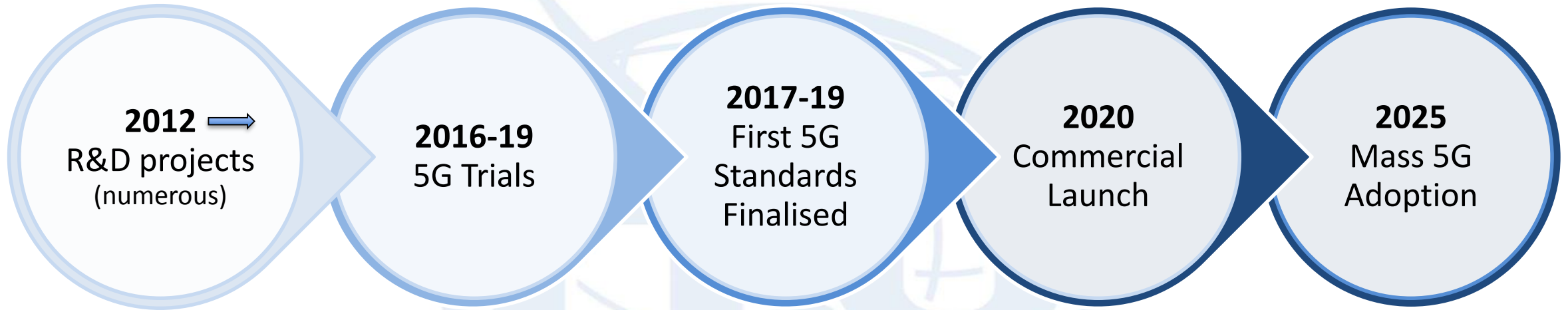
5G Technology - Small Cells



- Small, low power mobile base stations
- Designed for very localised coverage
- Range 10 – 100's metres
- Complement macro base stations
- Fill in capacity & coverage gaps
- Reduce blackspots



5G Timeline



Fixed wireless access for homes and **enhanced mobile broadband** services are likely to be the first applications using new 5G wireless access modems and hot spots.

Mobile handsets with 3G, 4G and 5G connectivity expected in the 2020 – 2021 timeframe
Low latency and widespread machine to machine applications using 5G in similar timeframe

5G – what it means for EMF

5G Technology

- 5G uses radio frequency transmissions like existing mobile technologies and many other radio services e.g. TV, FM, emergency and commercial radio services, microwave links & satellite
- Significant evolution of 4G technology – greater efficiency
- Typical EMF levels from networks and devices in everyday use will remain low

5G Devices

- very efficient & output power optimised – this means low levels of EMF
- must comply with the EMF safety standards

5G Networks

- Very efficient and EMF levels in public areas will be far below safety standards - even with many more people using wireless connections
- Environmental EMF levels may increase slightly (near to sites) with the addition of 5G networks
- EMF Compliance zone evaluation – actual EMF levels are under investigation with results to date showing levels well below theoretical maximum



5G EMF & Health Research

- **Over 50 years of scientific research** has been conducted into the possible health effects from radio frequency, mobile phones, base stations and other wireless services including mmWave.
- **The data from this research** has been analysed by many expert review groups. Weighing the whole body of evidence, there is no evidence that exposure below the guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) carries any health risks, for adults or children.
- **The EMF Portal** managed by the RWTH Aachen University in Germany linked from the WHO website, lists more than 25,000 published scientific articles on EMF and health including 2500 articles on mobile communications.
- **In terms of research the database lists approximately 350 articles on mmWave** EMF health related research. Extensive research on mmWave and health has been conducted on radar, microwave and military applications.



Challenges for 5G & EMF

- **Explaining 5G** to stakeholders and citizens, addressing issues
- **Globally harmonised** EMF exposure limits
- Implementing **new** network and device **testing procedures**
- **Additional infrastructure** on existing base stations
- Deployment of **small cells** in communities

Opportunities for 5G & EMF

- **Harmonised EMF Limits** - Adoption of international EMF exposure limits means that new efficient 5G networks can be rolled-out and EMF levels kept low while improving capacity
- **Proactive Stakeholder Information** - updated EMF and 5G information from the WHO and ITU (updated ITU EMF Guide for 5G)
- **Delivering enhanced mobile technologies** - whilst maintaining low levels of EMF exposure through new 5G radios, efficient network design, deployment of small cells

Responsible Framework for 5G & EMF

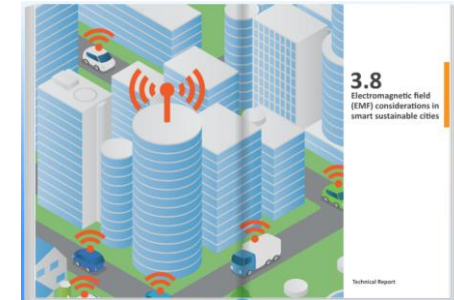
1. Harmonised EMF Standards

- adoption of International EMF Exposure Limits
- adoption of International EMF Exposure Assessment Methods
- implementation of realistic exposure assessments



2. Responsible Network Deployment

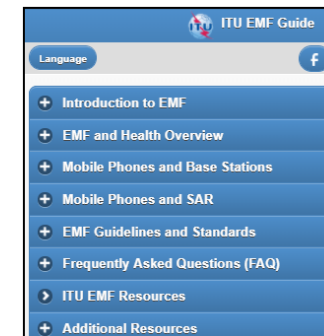
- spectrum allocation for 5G
- government policy supporting efficient network rollout
- responsible and efficient network design & deployment



[ITU Smart City Guide](#)

3. Stakeholder Engagement

- provision of EMF information to governments and stakeholders
- compliance information
- open information to communities and citizens



[ITU EMF Guide](#)



[GSMA 5G EMF](#)

Conclusions

- **5G will unlock significant benefits** for citizens, communities, industries, and countries
- **5G will keep EMF levels below safety standards**
- **Harmonised** EMF exposure standards are recommended
- **Non harmonised** EMF standards may create inefficient network design that can increase the power required to operate base stations and devices
- **Responsible framework & effective community information** on 5G is recommended

Thank you - Questions ?

