# 4G Americas

*The Voice of 5G for the Americas*

**Perspective from Industrial Associations**

# 5G Spectrum Requirements

**Dr. Håkan Andersson, Ericsson presenting**
**on behalf of Chris Pearson, President, 4G Americas**

5G Workshop between Regional Initiatives

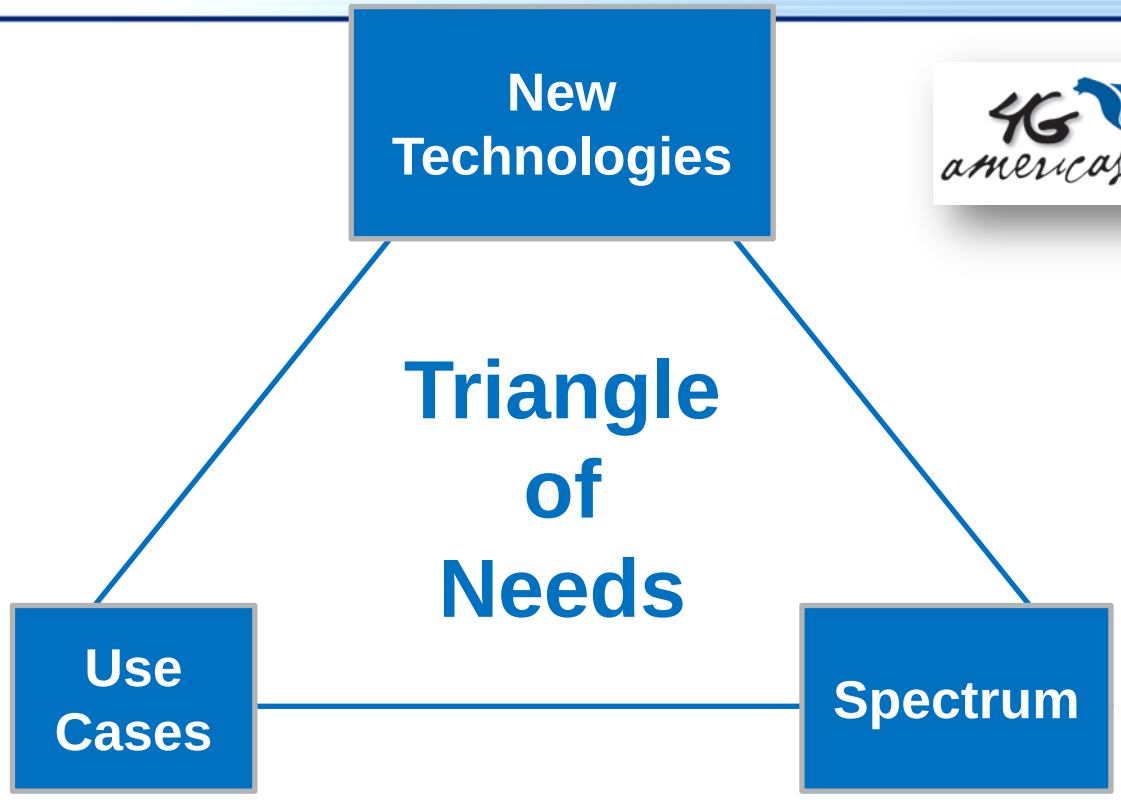
20 October 2015, Lisbon

# Why is 5G spectrum important in 2015?

**Increasing mobile broadband demand**

Information Technology
Smartphones
Vertical Industries

**Spectrum Shortage**




- **Identification of spectrum relies on regulators' cooperation and guidance in the WRCs in the years 2015 (WRC-15) and 2019 (WRC-19)**
- **WRC-15 should decide which 5G spectrum will be studied and considered for identification at WRC-19**

# 5G Considerations – An Overview

## 5G is coming!

- 5G applications and usage scenarios are envisioned
- ITU-R administrations have agreed on a timeline for IMT-2020
- Industry is preparing for specifications, prototypes and trials

## Spectrum needs of 5G must also be addressed as the vehicle to deliver various 5G applications and use cases

- Technological advancements enabling access to cm/mm-bands bands in support of applications requiring large contiguous channels
- Access to more low frequency spectrum in support of 5G applications requiring wide coverage areas

***Identification of sufficient and adequate spectrum relies on regulators' cooperation***

# Regional/Global Harmonization

- **As 5G will move to inclusion of a larger set of bands, global harmonization becomes essential in the success of 5G as it reduces:**
  - Device/deployment complexity
  - Cost to consumers through economies of scale

- **International/regional regulatory groups (ITU-R, CITEL, etc.) could play a significant role now by agreeing on:**
  - An agenda item for WRC-19 on 5G spectrum
  - Studies of a range of frequencies from which a set of globally harmonized bands could be identified for 5G
  - Consideration of bands that could accommodate various 5G use cases/applications

- **The FCC (USA) role:**
  - Remain engaged with industry (e.g. workshops)
  - Work on service rules and licensing options for potential 5G bands (NPRM)
  - Active support in WRC-15/19 discussions

# Access to Variety of Spectrum

## Lower Frequency Bands (< 6 GHz)

- Lower bands provide better coverage through and around obstacles and flexible transition from 4G to 5G.
- Continued growth of data and video demands more spectrum.
- Additional spectrum 389-1009 MHz needed by 2020, according to ITU-R

## Higher Frequency Bands (>6 GHz)

- New technologies enable use of higher bands
- Below 30 GHz important for propagation/RF and above 30 GHz easier access to wider channels
- Several hundred MHz per operator (multi-operator)

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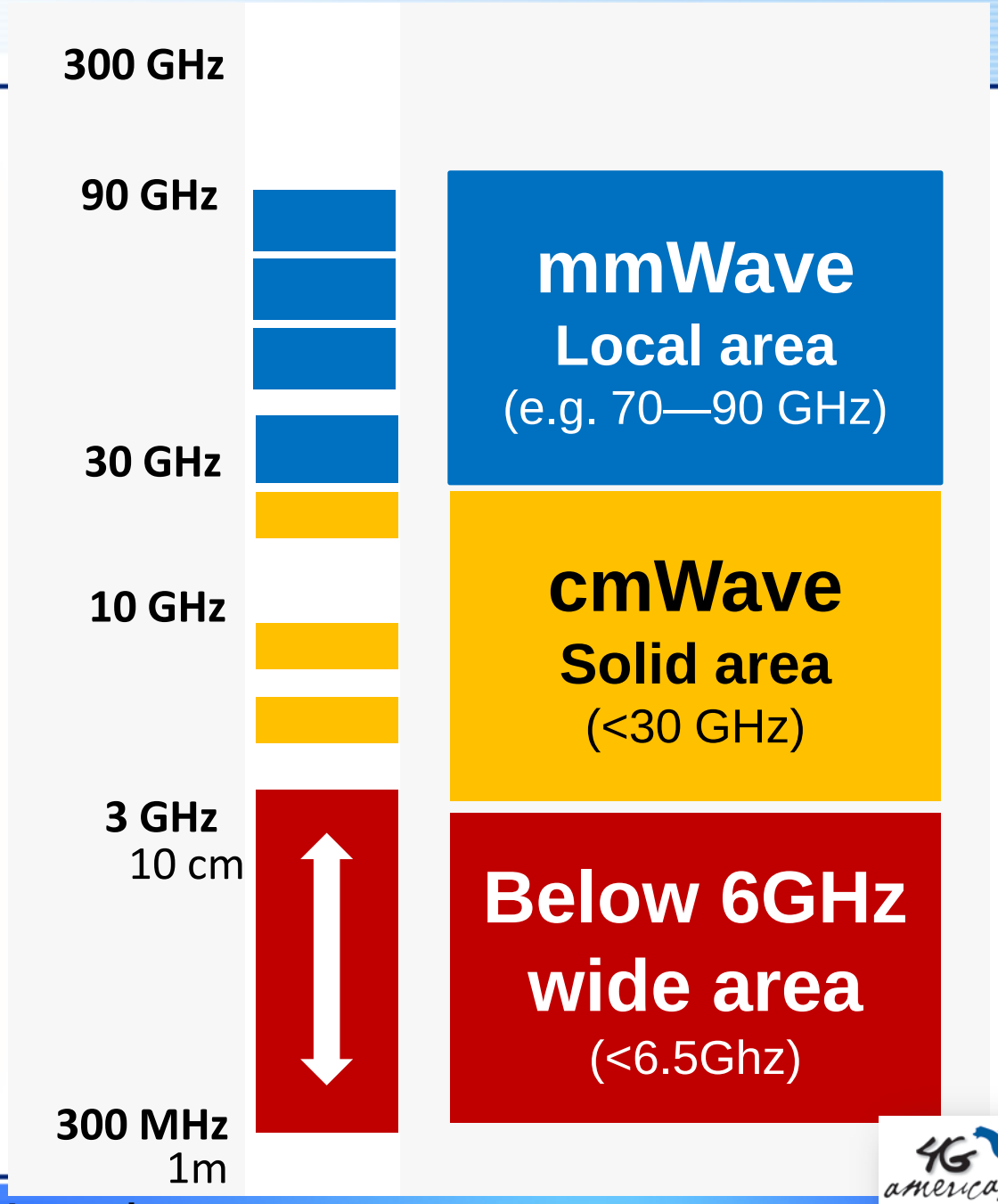
**Having access to a variety of spectrum bands in support of all applications is key to success of 5G**

# U.S. Current and Future Spectrum Allocations

| Frequency Band | Amount of Spectrum | Comments |
|---|---|---|
| **700 MHz** | 70 MHz | Ultra-High Frequency (UHF) |
| **850 MHz** | 64 MHz | Cellular and Specialized Mobile Radio |
| **1.7/2.1 GHz** | 90 MHz | Advanced Wireless Services (AWS)-1 |
| **1695-1710 MHz<br>1755 to 1780 MHz<br>2155 to 2180 MHz** | 65 MHz | AWS-3. Uses spectrum sharing |
| **1.9 GHz** | 140 MHz | Personal Communications Service (PCS) |
| **2000 to 2020<br>2180 to 2200 MHz** | 40 MHz | AWS-4 (Previously Mobile Satellite Service) |
| **2.3 GHz** | 20 MHz | Wireless Communications Service (WCS) |
| **2.5 GHz** | 194 MHz | Broadband Radio Service / Closer to 160 MHz deployable |
| | **FUTURE** | |
| **600 MHz** | Up to 120 MHz | Incentive auctions |
| **3.55 to 3.70 GHz** | 150 MHz | Small-cell band with spectrum sharing |
| **5 GHz** | 195 MHz | Unlicensed band |
| **Above 6 GHz** | Multi GHz | See FCC Chairman's blog of August 3, 2015 |

# Possibilities for 5G Spectrum

**Allocating new spectrum is key for commercial 5G rollout**






Source: 4G Americas Member Company 2015

# U.S. Spectrum Recommendations

**The United States proposed the following ranges to be studied for consideration at WRC-19 (overlaps with Regional CITEL proposal):**


- 27.5-29.5 GHz
- 37-40.5 GHz
- 47.2-50.2 GHz
- 50.4-52.6 GHz
- 59.3-71 GHz

# Outcome of the CITEL Meeting – 17-23 August 2015

**CITEL PCC.II met the week of 17 August and finalized the Americas regional positions on WRC-15 agenda items including on 5G spectrum**

CITEL agreed on a regional proposal to WRC-15, supported by 10 countries, to consider studying the following bands for 5G (WRC-19):

| | | |
|---|---|---|
| **10-10.45 GHz*** | **27.5-29.5 GHz** | **47.2-50.2 GHz** |
| **23.15-23.6 GHz** | **31.8-33 GHz** | **50.4-52.6 GHz** |
| **24.25-27.5 GHz** | **37-40.5 GHz** | **59.3-76 GHz** |

*Only for countries included in footnote 5.480 in ITU-R Radio Regulations

**Inclusion of several bands below 30 GHz by the Americas region strengthens worldwide support, especially for the 28 GHz as one likely common band between the Americas and certain Region 3 administrations such as Korea, Japan, and China**

# Licensing Aspects of 5G Spectrum

## Licensed

- Regulator granting exclusive right to an operator
- Provides reliable, secured spectrum for predictable quality/capacity
- Critical part of 5G deployments

## Shared

- Shared with incumbents
- Coordinated access when/where not used by incumbents.
- Facilitates timely access to spectrum in shared bands

## Unlicensed

- No registration or individual permission
- Rules established to avoid interference
- Complement for 5G, e.g. in small cell deployment



**All licensing schemes have a role to play in 5G!**

# Solutions to Enable Access to New Spectrum

## Protection of Incumbents

- Studies using realistic models and parameters
- Consideration of mitigation techniques such as sensing, database, beacons, etc.
- Examples of prior experience (e.g. US AWS-3, 3.5 GHz band, etc.)

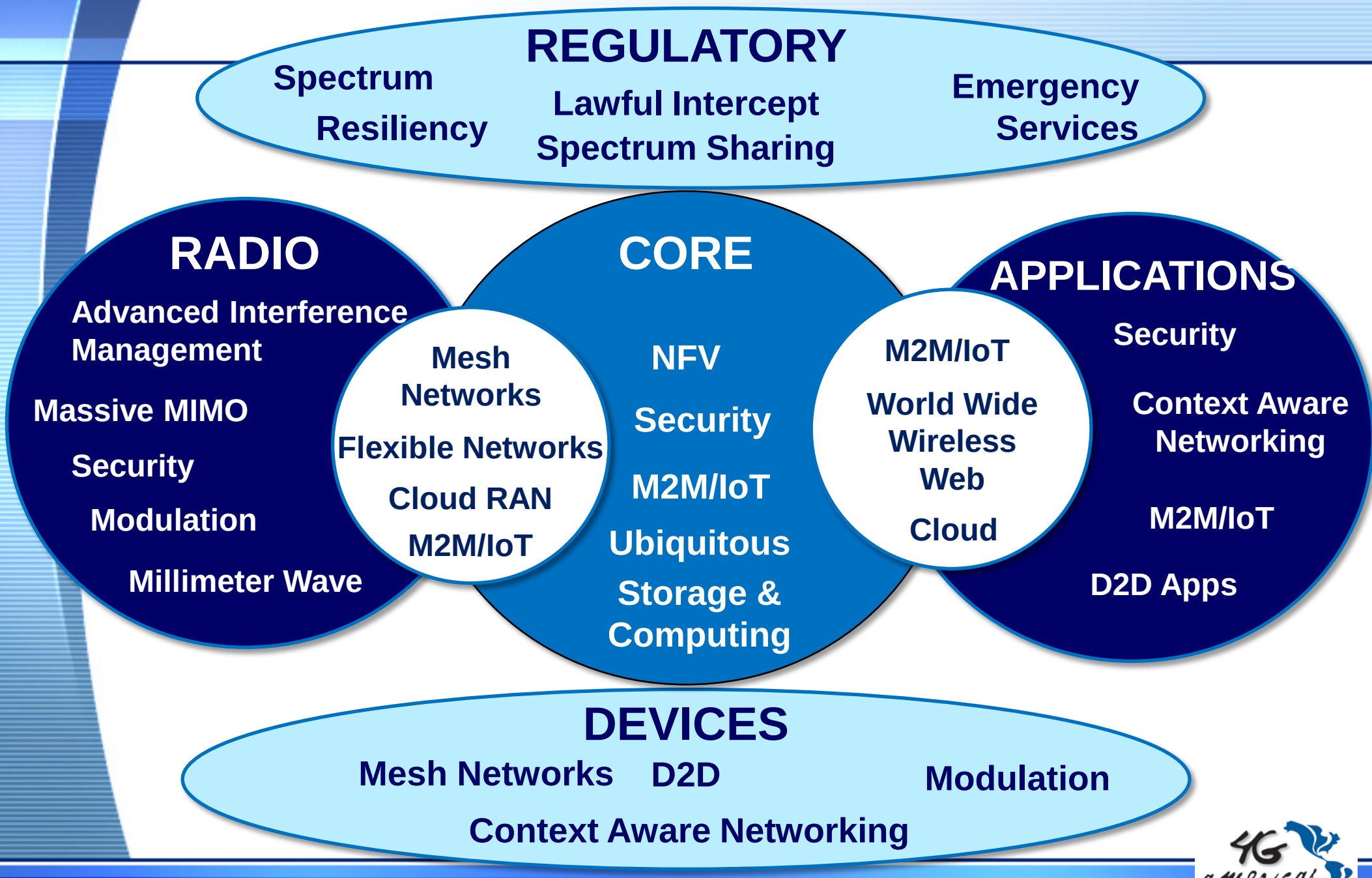
## Propagation-related Challenges

- Various impairments and ways to cope with them are described
- Need for proper channel models stressed

## Semiconductor and Antenna technology

- Beamforming and spatial multiplexing techniques
- RFIC and hardware implementation advancements

# End-to-End 5G Ecosystem



# Conclusions

A variety of bands is needed to address both coverage and capacity needs of evolved 4G and 5G systems.

Frequencies beyond those traditionally used for cellular systems, especially those above 6 GHz are important to consider.

While the lower frequencies have better propagation characteristics for better coverage and thus can support both macro and small cell deployments, higher frequencies can support wider bandwidth carriers (due to large spectrum availability at mm-wave bands) for providing very high peak data rates in specific areas where traffic demands are very high.

# Conclusions

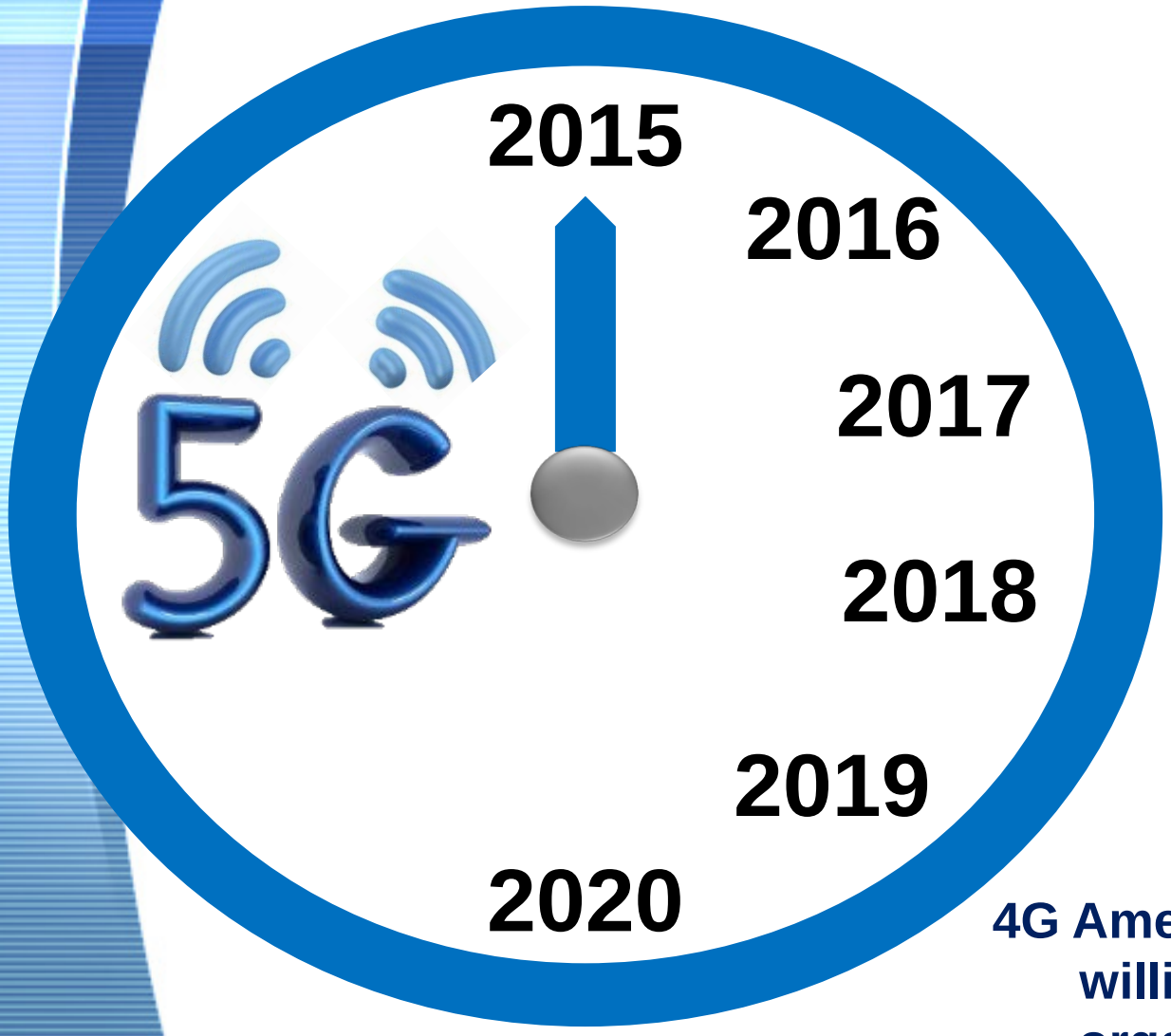
As 4G systems evolve and 5G systems develop over time, mobile spectrum bands below 6 GHz will be valuable to allow the smooth migration from 4G LTE usage to 5G.

Despite challenges, the mobile industry is capable of extending mobile services into spectrum bands in the range above 6 GHz.

Action is needed by regulators to ensure that new spectrum needs are addressed for the evolution of 4G and, to address societal needs and for the timely introduction of 5G, to identify new spectrum ranges to be studied in ITU-R.

# Toward……2020

## *5G and the 5C's*




**Connect**

**Communicate**

**Collaborate**

**Cooperate**

**Contribute**

**4G Americas publicizes 5G work and is willing to embrace the 5C's with organizations around the world.**

# THANK YOU





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