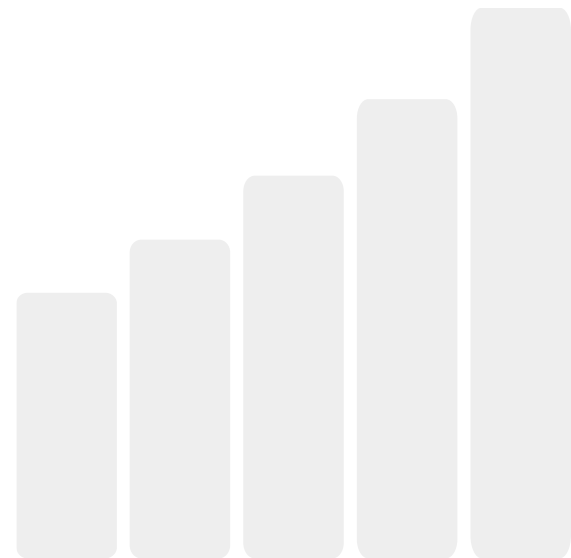




# 5G : Industry Perspective

July 23, 2018

**Vikram Tiwathia**  
Deputy Director General



# About COAI

## Core Members



## Associate Members



COAI was constituted in 1995 as a registered, non-governmental society. COAI's vision is to establish India as the global leader of innovative mobile communications infrastructure, products and services and achieving a national tele-density of 100%, including broadband. The association is also dedicated to the advancement of modern communication and towards delivering the benefits of innovative and affordable mobile communication services to the people of India.

# Telecom Industry: Contribution to India



**Lowest voice & data rates in the world (ARPU Rs. 81)**

**Over 500,000 villages covered**

**Contributes 6.5% to India's GDP**

**Among Highest contributors in FDI in last two decades – INR 130,729 crores**

**Contributes directly to 22 Lakh employment and indirectly to 18 Lakh jobs**

**Among the highest contributors to Govt.: nearly INR 70,000 crores p.a.**

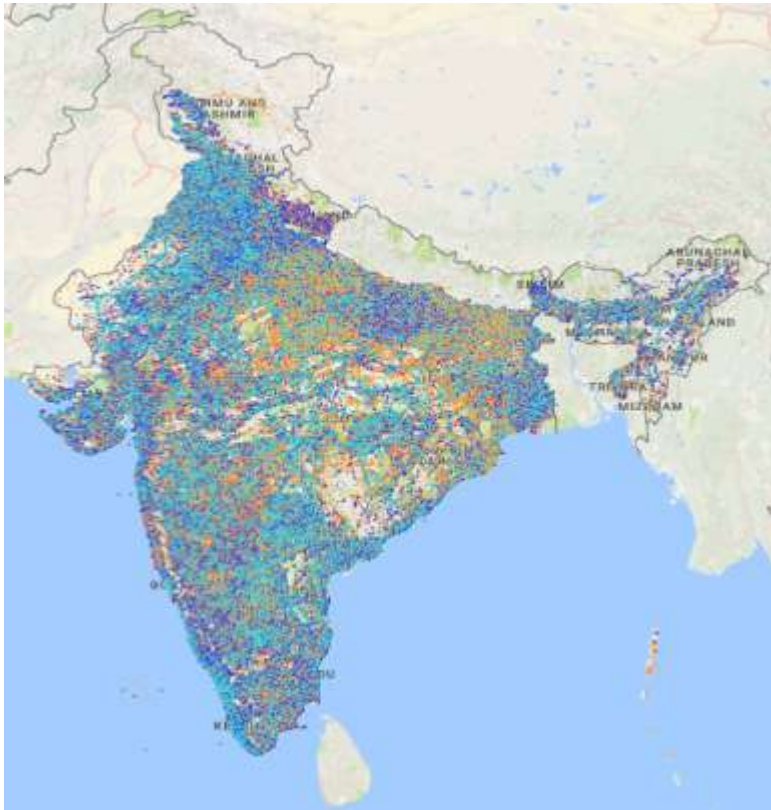


**Investment in Spectrum Auctions since 2010: INR 3,48,000 crores**

**2nd largest private sector investment in infrastructure – INR 10,44,000 crores**

# We have State of the Art Network...

Pan India 2G/3G/4G Coverage

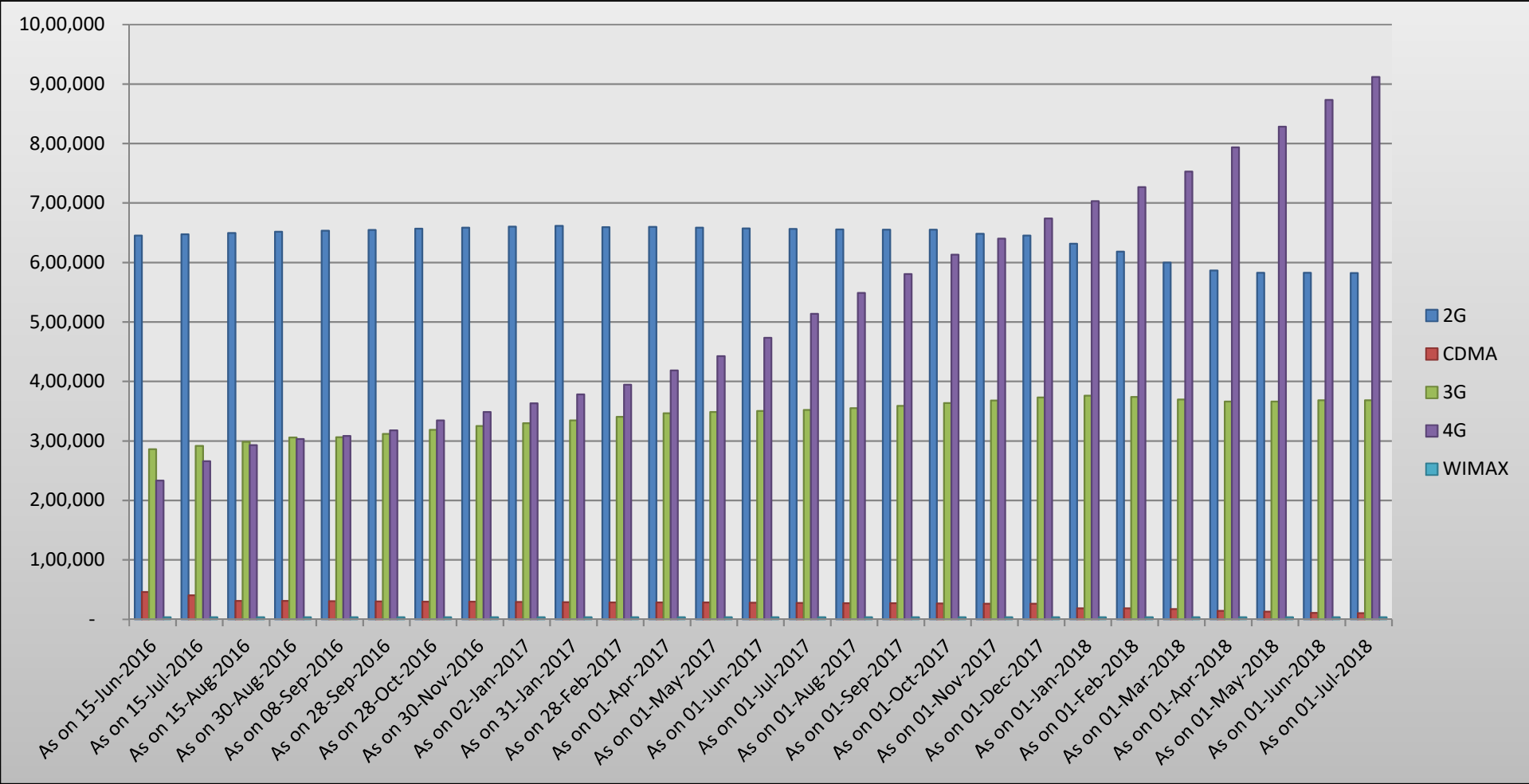


Total number of BTSs

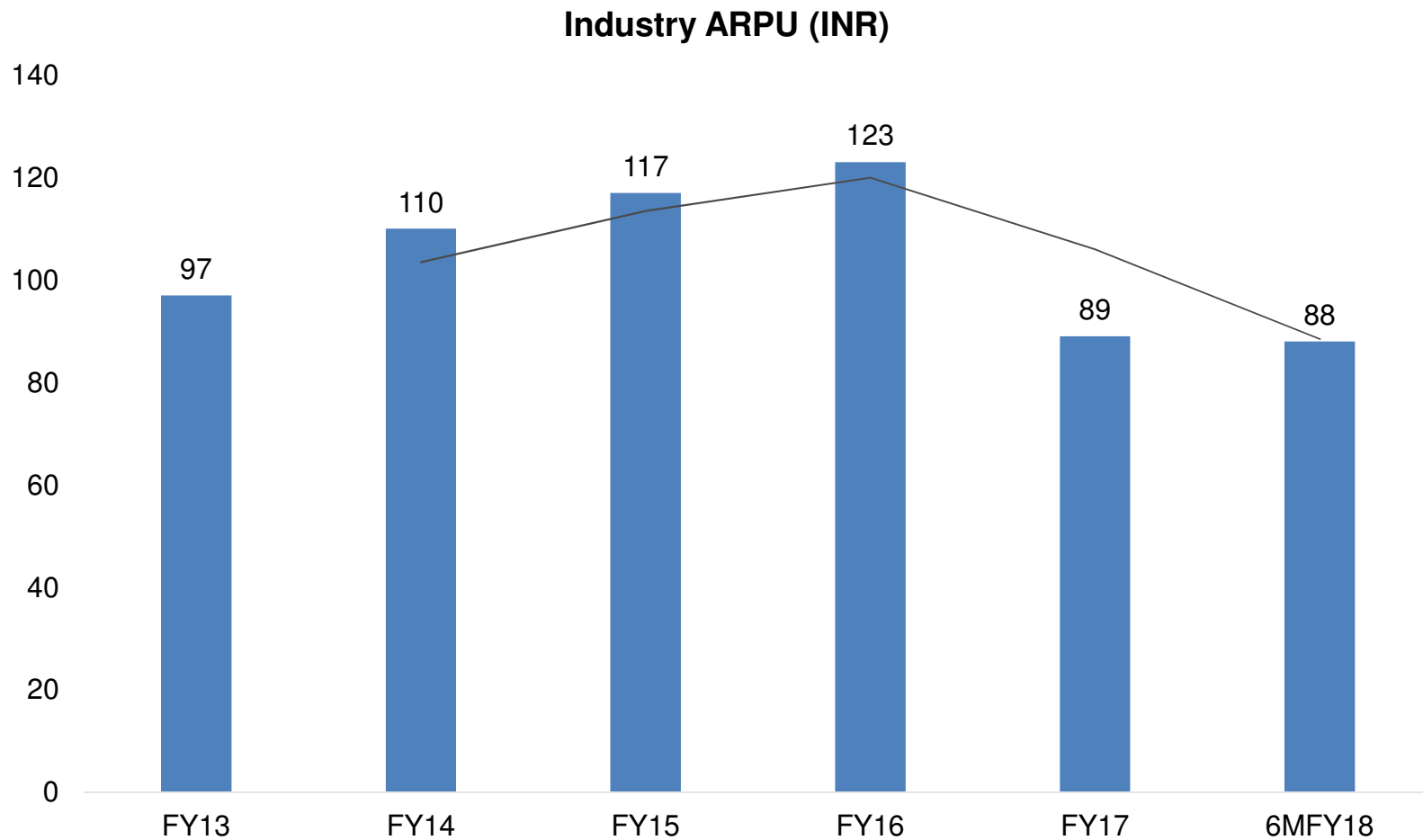
BTS Type	Count	Percentage
GSM	5,82,135	31.02%
CDMA	10,430	0.56%
3G	3,68,595	19.64%
4G	9,11,688	48.59%
WiMAX	3,535	0.19%
<b>Total</b>	<b>18,76,383</b>	<b>100%</b>

Wireless is the key provider of connectivity in the country

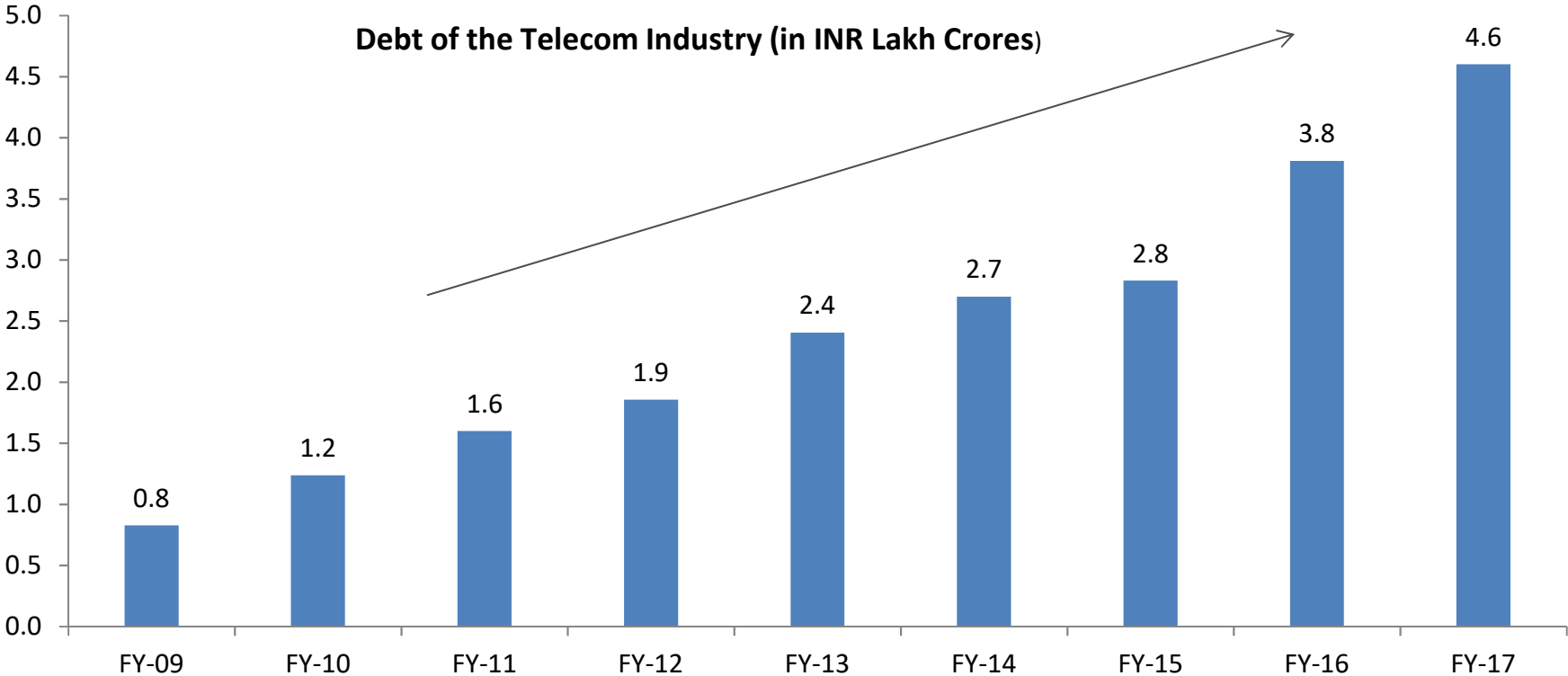
# BTS Status in the Indian Telecom NW: As on June 2018



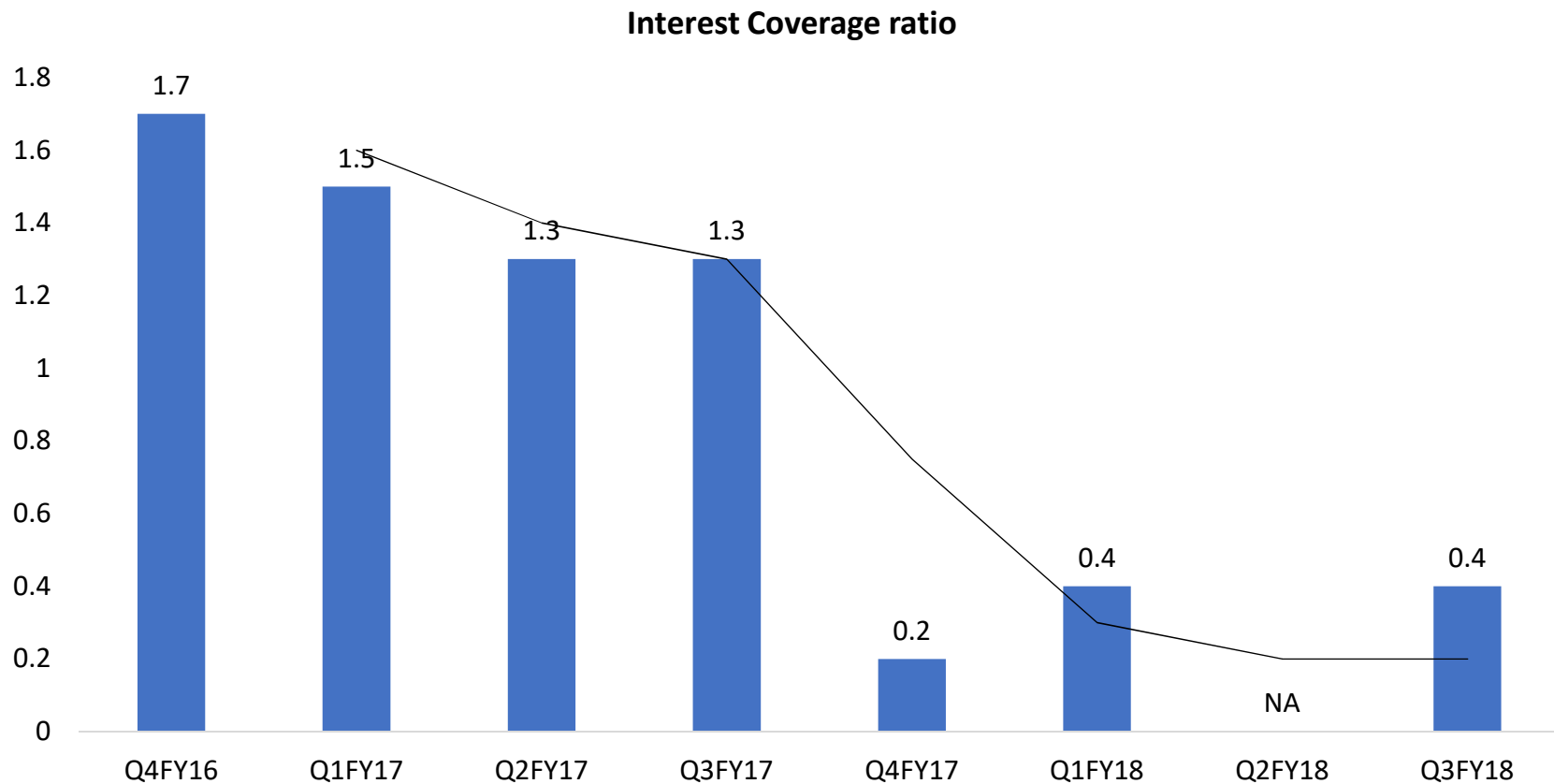
# ARPU continues to be depressed....



# Sector continues to be highly indebted...



# Profits not enough to cover interest cost...





# Sector is inching towards a world class Mobile Broadband Infrastructure

Mobile Operators are working at breakneck speeds to create a world class Digital Highway



**Coverage Expansion**  
200 Million new connections by 2023



**Network Rollout**  
More than 18 lakh BTSs out of which >11lakh BTSs are of 3G/4G



**Internet Traffic** will grow 5.6 Exabytes per month by 2020 with a CAGR of 34% against the corresponding global CAGR of 22%.



**Wireless Broadband users**  
500 Million new internet users by 2023



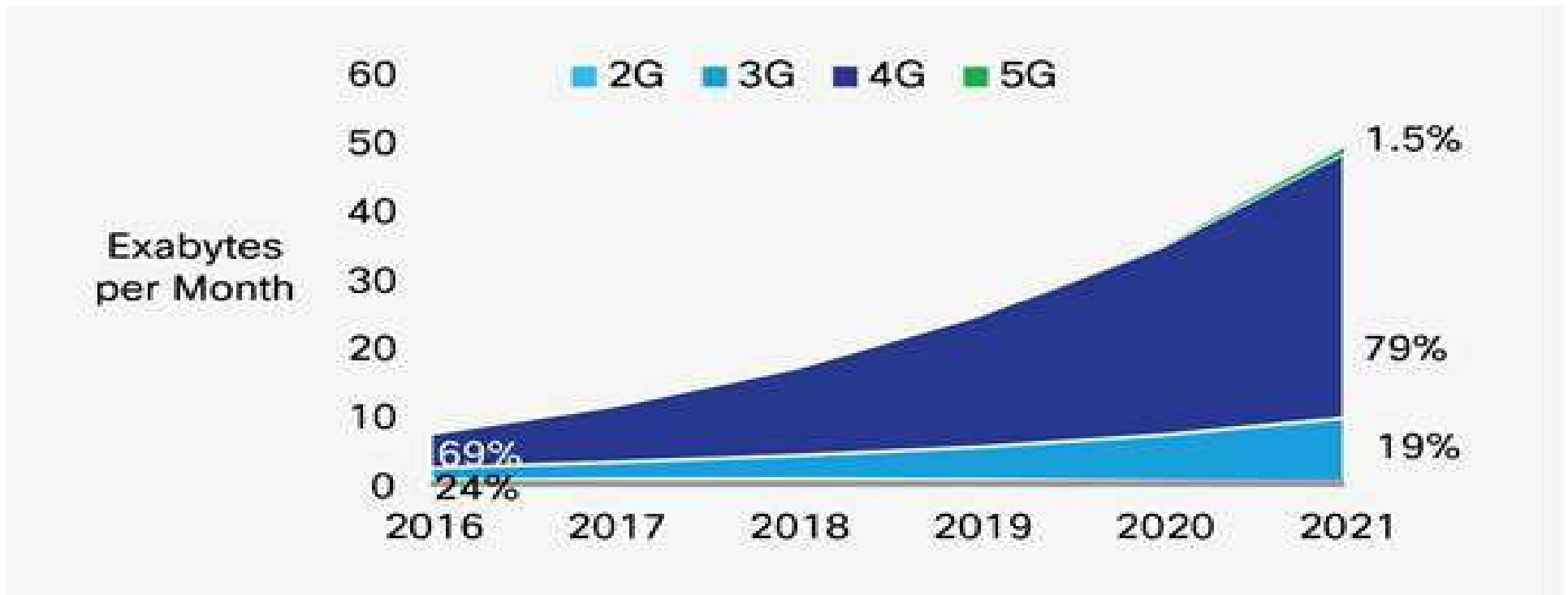
**Massive increase in Data Usage**  
Monthly smart phone data consumption to be increased to 18GB by 2023



India will be second largest **smartphone market** (after China) with 1 Bn smartphones by 2025

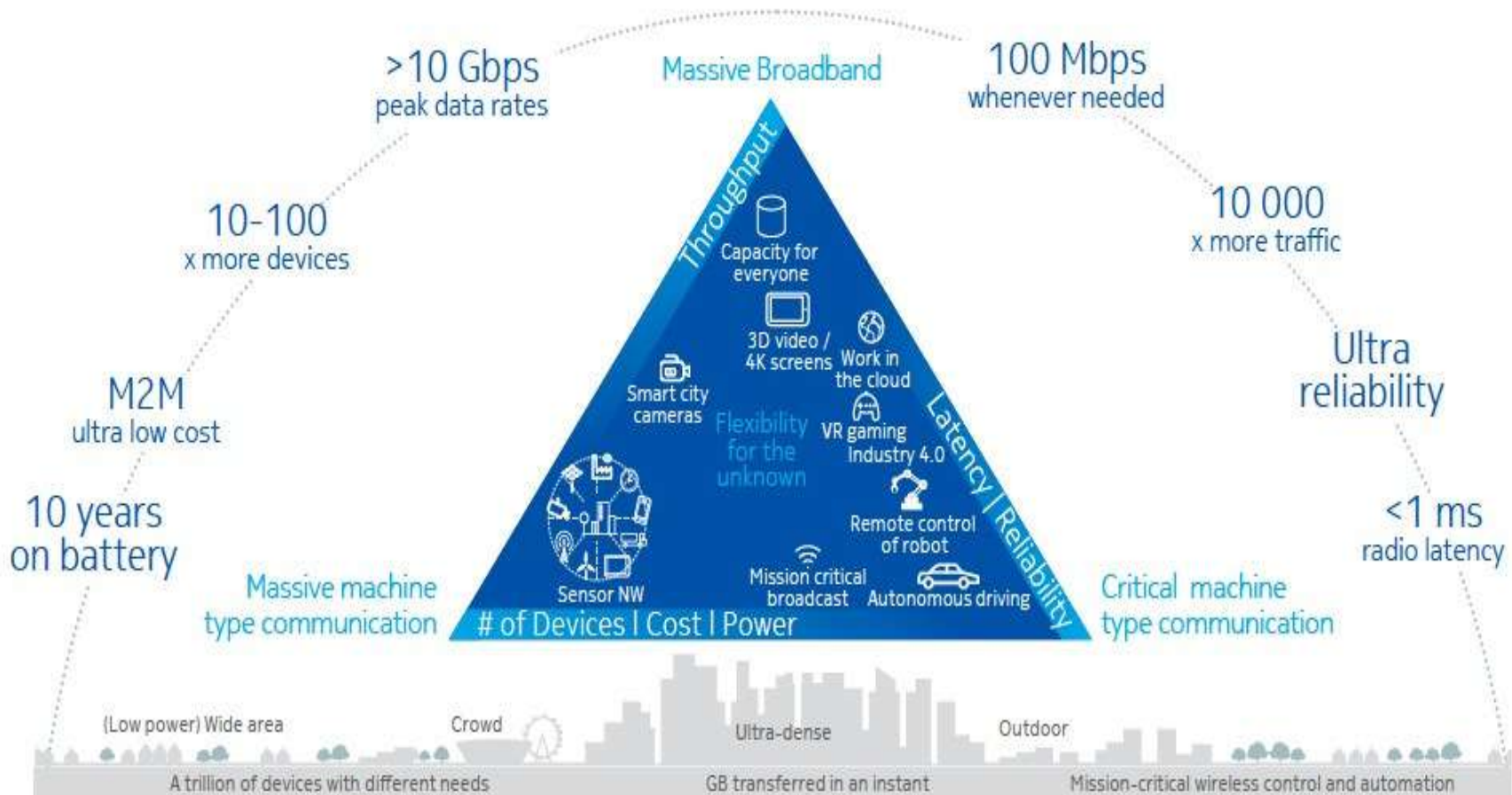
## 5G would be the key to meet this future demand

# By 2021, 5G will account for 1.5% of global mobile traffic



5G connectivity with its very high bandwidth (100 Mbps) and ultra low latency (1 millisecond) is expected to drive very high traffic volumes.

# Future Network-5G: Different Apps/Verticals demand different flexibility



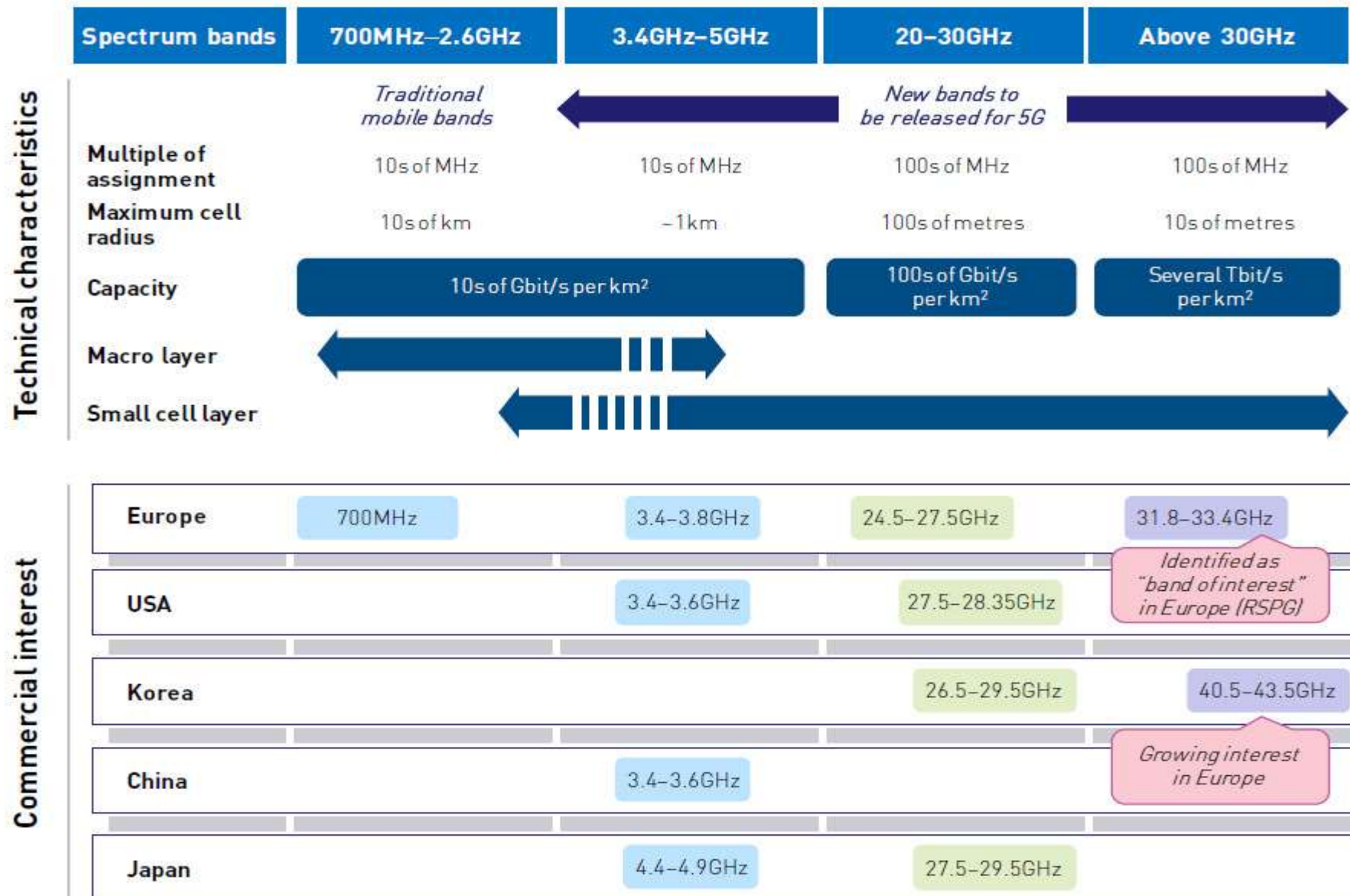
**5G Network is envisaged to accommodate Apps & Services with different Latency, Reliability & Bandwidth**

# 5G: Not just telecom Sector



Across the sectors the 5G technology will improve issues that centre around data security, connectivity issues, and automating processes.

# Technical characteristics and industry interest in



# Global Experience: 5G

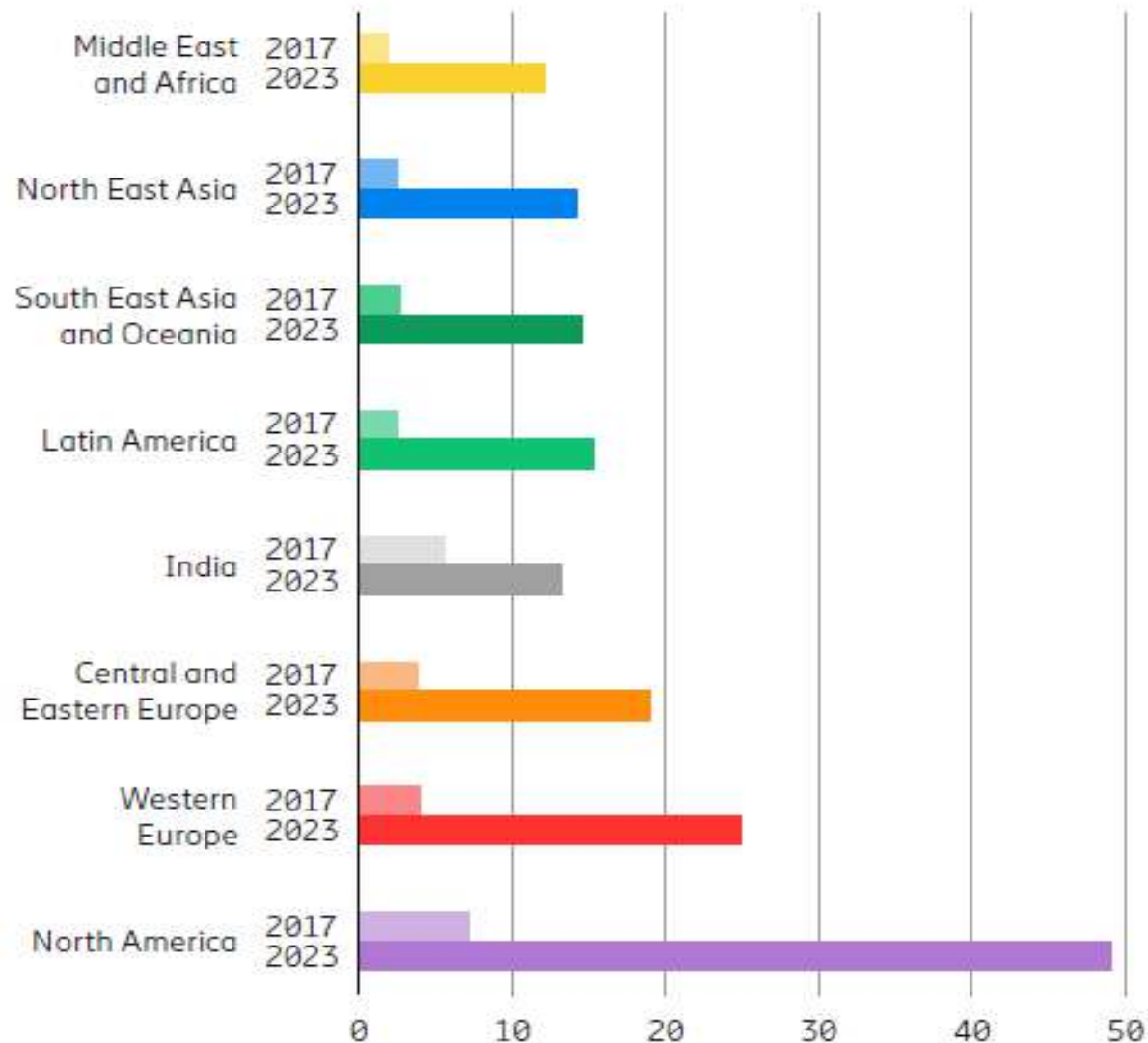
**South Korea has completed auction of spectrum for 5G** to telecom operators and is set to begin its rollout in December.

South Korea's auction of **3.5 GHz and 28 GHz spectrum for 5G** was conducted in **June 2018**. SK Telecom and KT Corp. each won 100 MHz of the 3.5 GHz spectrum, with LG Uplus obtaining 80 MHz. All three companies secured 800 MHz of the 28 GHz spectrum. Operators in South Korea will be able to use 3.5 and 28 GHz spectrum starting in December.

Countries like the **USA, China, South Korea, China, Japan, Sweden and Estonia** have already started deploying some form of 5G though these are trials mostly and not commercial or mass market in nature.

# Global Experience: 5G

Mobile data traffic per active smartphone  
(gigabytes per month)

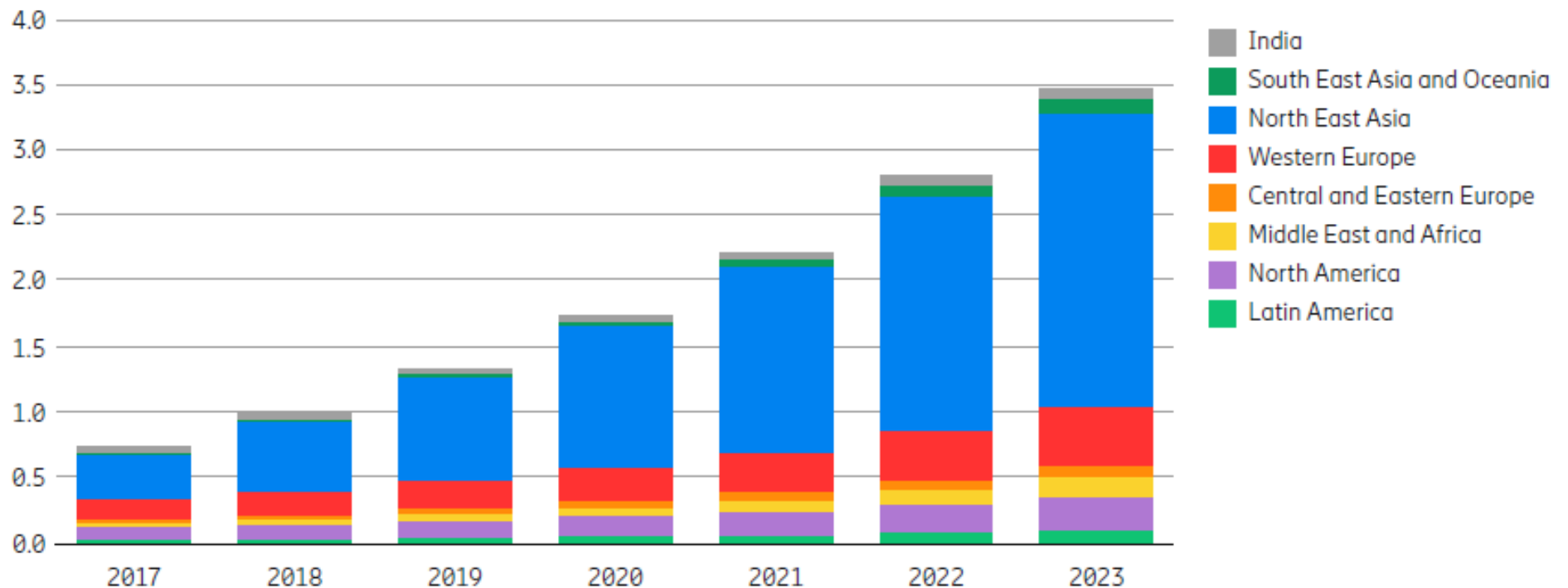


**Total mobile data traffic is expected to increase by nearly eight times**

Source: Ericsson Mobility Report, June 2018

# IoT Connections Outlook

Cellular IoT connections per region (billion)



The number of Cellular IoT connections is expected to reach 3.5 billion in 2023 – increasing with an annual growth rate of 30 percent.



# Use Cases

Three main use cases (defined by ITU, under IMT-2020) demands are in the process of taking shape, and will make it possible to meet the sector-specific needs referred to in the introduction.

**mMTC – Massive Machine Type Communications**

**eMBB – Enhanced Mobile Broadband**

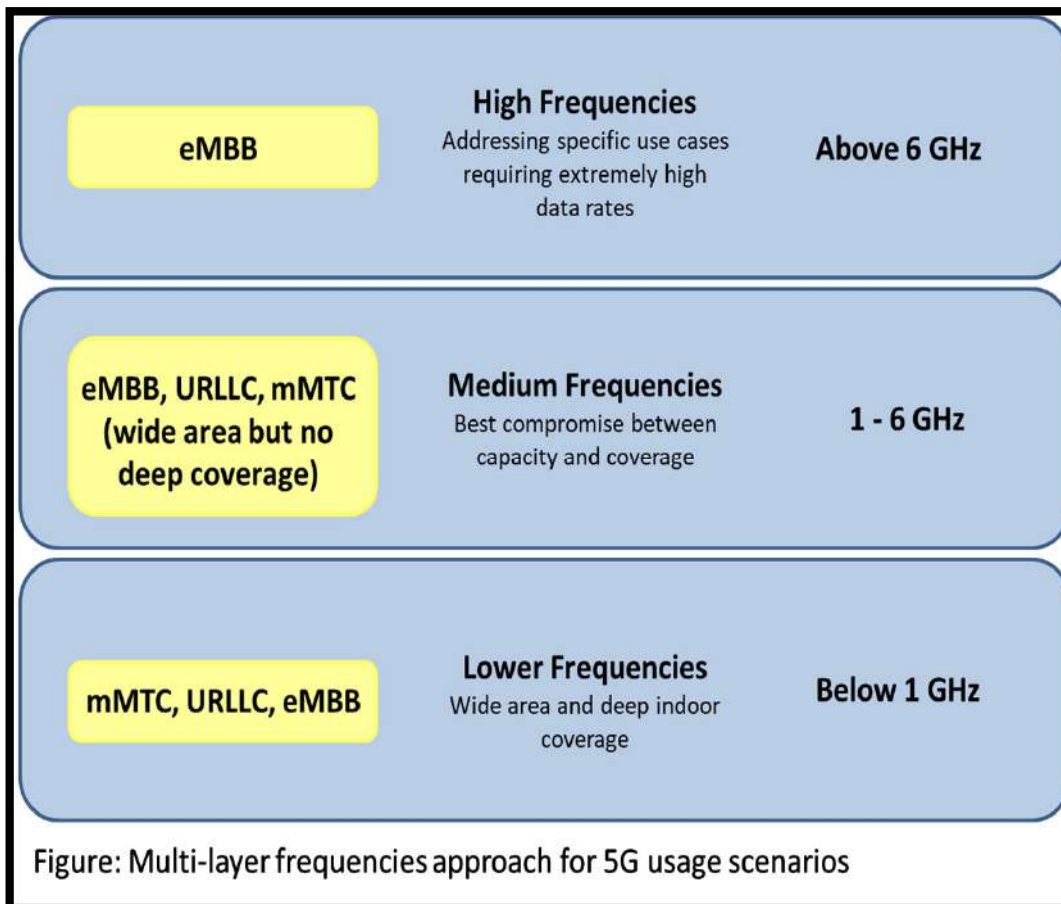
**uRLLC – Ultra-reliable and Low Latency Communications**

5G Use Cases → 5G Requirements → 5G Network demand means MORE OF ALL



Latency(ms)	<b>Fiber</b>
Data Traffic	<b>Radio Channel</b>
Peak Data Rates (Gbps)	<b>Cells</b>
Available Spectrum	<b>Complex Antenna (MIMO)</b>
Connections Density (Million connections/km <sup>2</sup> )	<b>Network Coordination (Hetnet)</b>
Device Mobility	<b>Centralisation Virtualization</b>

**5G spectrum focus on the areas where governments, regulators and the mobile industry cooperate to make this next-generation network technology a success.**



**i) Significant new widely harmonised mobile spectrum is needed to ensure 5G services meet future expectations and deliver the full range of potential capabilities.**

**ii) 5G needs spectrum within three key frequency ranges to deliver widespread coverage and support all use cases. The three ranges are: Sub-1 GHz, 1-6 GHz and above 6 GHz.**

**iii) WRC-19 will be vital to realize the ultra-high-speed vision for 5G with low cost devices.**

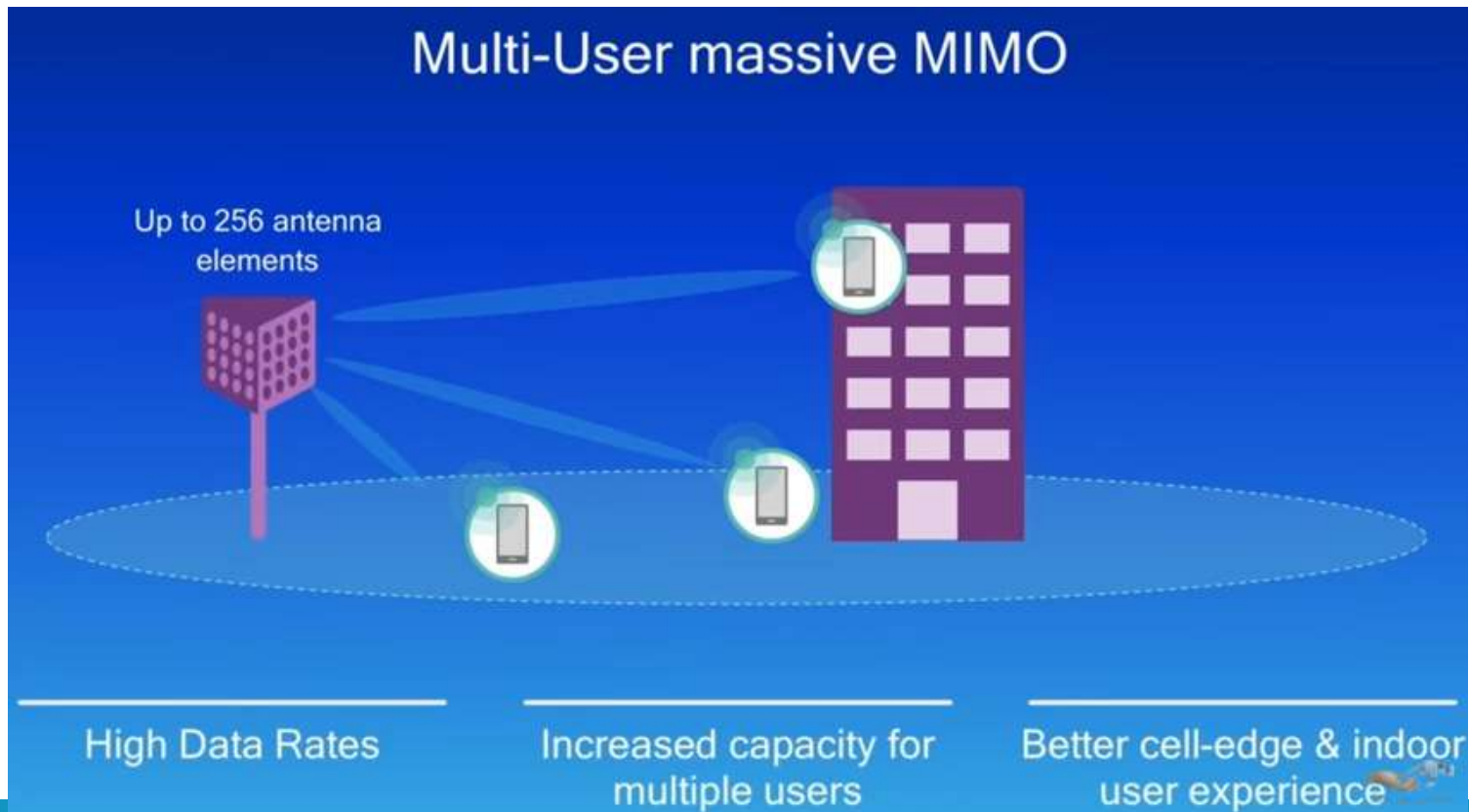
# 5G Spectrum and Coverage Implications

1. There are number of spectrum bands which could potentially be used in meeting some of the 5G requirements - currently a substantial focus on higher frequency radio spectrum.
2. **Higher Spectrum Bands => Capacity vs Range.** Technical solutions for 5G that could use frequencies above 6GHz and reportedly as high as 300 GHz. However, higher frequency bands offer smaller cell radiuses and so achieving widespread coverage using a traditional network topology model would be challenging.
3. **Beam-forming** - the focussing of the radio interface into a beam which will be usable over greater distances – is an important part of any radio interface definition that would use 6GHz or higher spectrum bands.



# 5G Spectrum and Coverage Implications

1. High-order MIMO (Multi-Input, Multi-Output) is another method for increasing bandwidth.
2. This is where an array of antennae is installed in a device and multiple radio connections are established between a device and a cell.



# 5G Spectrum and Coverage Implications

1. However, high-order MIMO can have issues with radio interference. This tends to focus on a need for the radio network to adjust its beam to take into account the specific orientation of the antenna at any given time.
2. Ways to include beam forming and MIMO technology in mobile devices is being researched.
3. As a result, the process of identifying and aligning internationally around common bands for 5G will have a clear dependency on the technology that can be identified to overcome band usage in high frequencies for wide area coverage



# Key Technologies/Functions that Underpin the 5G

## Following Technology to enable efficient resource Sharing:

- **Software Defined Network (SDN):** Approach to control the Network (switches & routers) through software programming.
- **Network Function Virtualization (NFV):** Concept of replacing dedicated network appliances (routers and firewalls) with software running on servers

## Network Functions:

- **Network Slicing:** Creating a dedicated virtual networks for different services over a common network infrastructure.
- **Mobile Content Delivery Network as Service:** interconnected system of servers that use geographical proximity as a criteria for delivering web content.

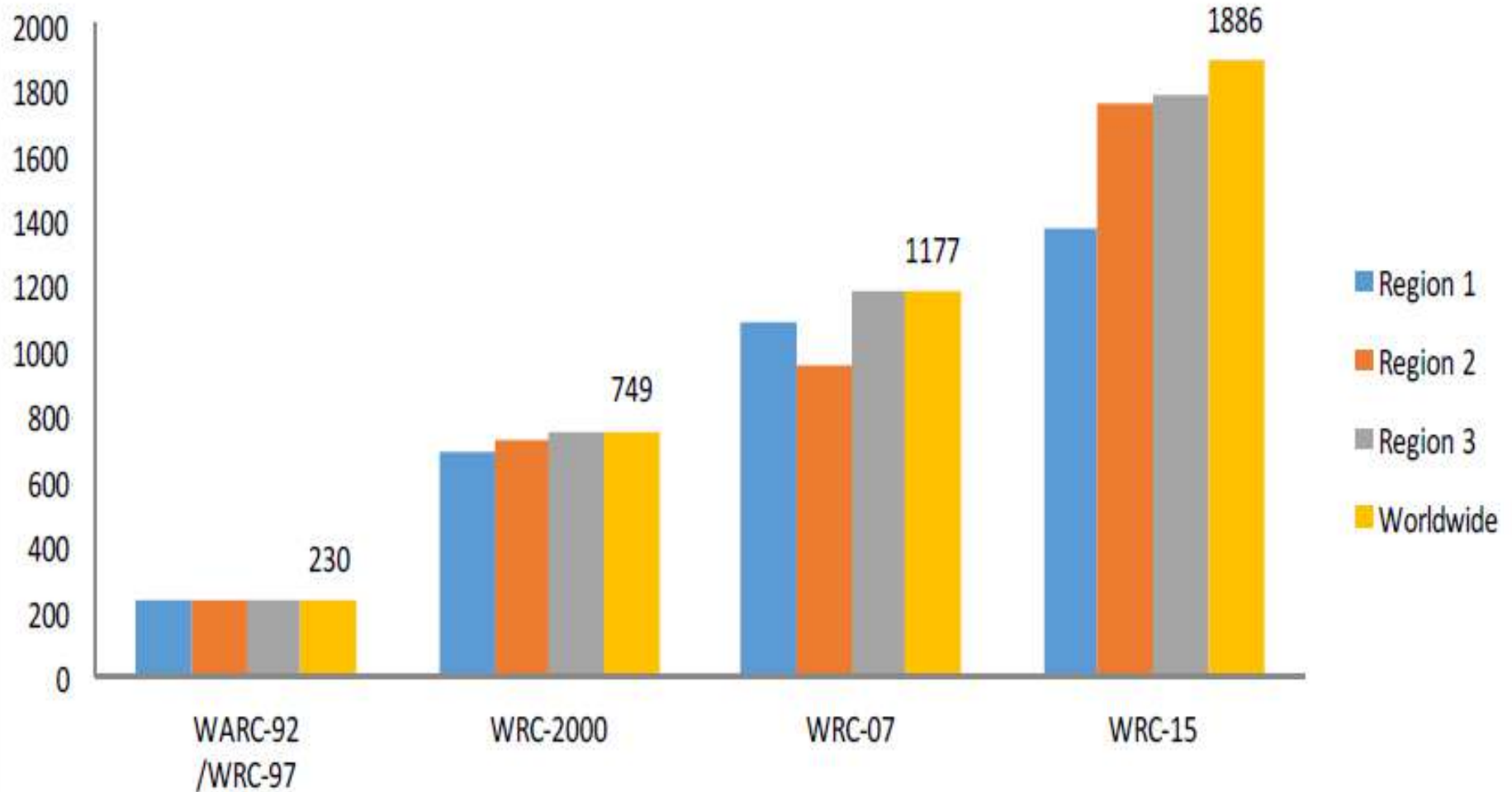
Varying kind of Network Functions to be provided as services, dynamically and on demand at pay-as-you-go' prices.

## Outcomes of WRC-2015 for India

<b>Sl. No.</b>	<b>Band (MHz)</b>	<b>Amount (MHz)</b>	<b>Remarks</b>
<b>1</b>	<b>470-698</b>	<b>228</b>	<b>Supported at WRC-15, but not included in Footnotes.</b>
<b>2</b>	<b>1427-1452</b>	<b>25</b>	<b>Supported at WRC – 2015</b>
<b>3</b>	<b>1452-1492</b>	<b>50</b>	<b>Supported at WRC – 2015</b>
<b>4</b>	<b>1492-1518</b>	<b>26</b>	<b>Supported at WRC – 2015</b>
<b>5</b>	<b>3300-3400</b>	<b>100</b>	<b>Supported at WRC – 2015</b>
<b>6</b>	<b>3400-3600</b>	<b>200</b>	<b>Supported at WRC – 2015</b>

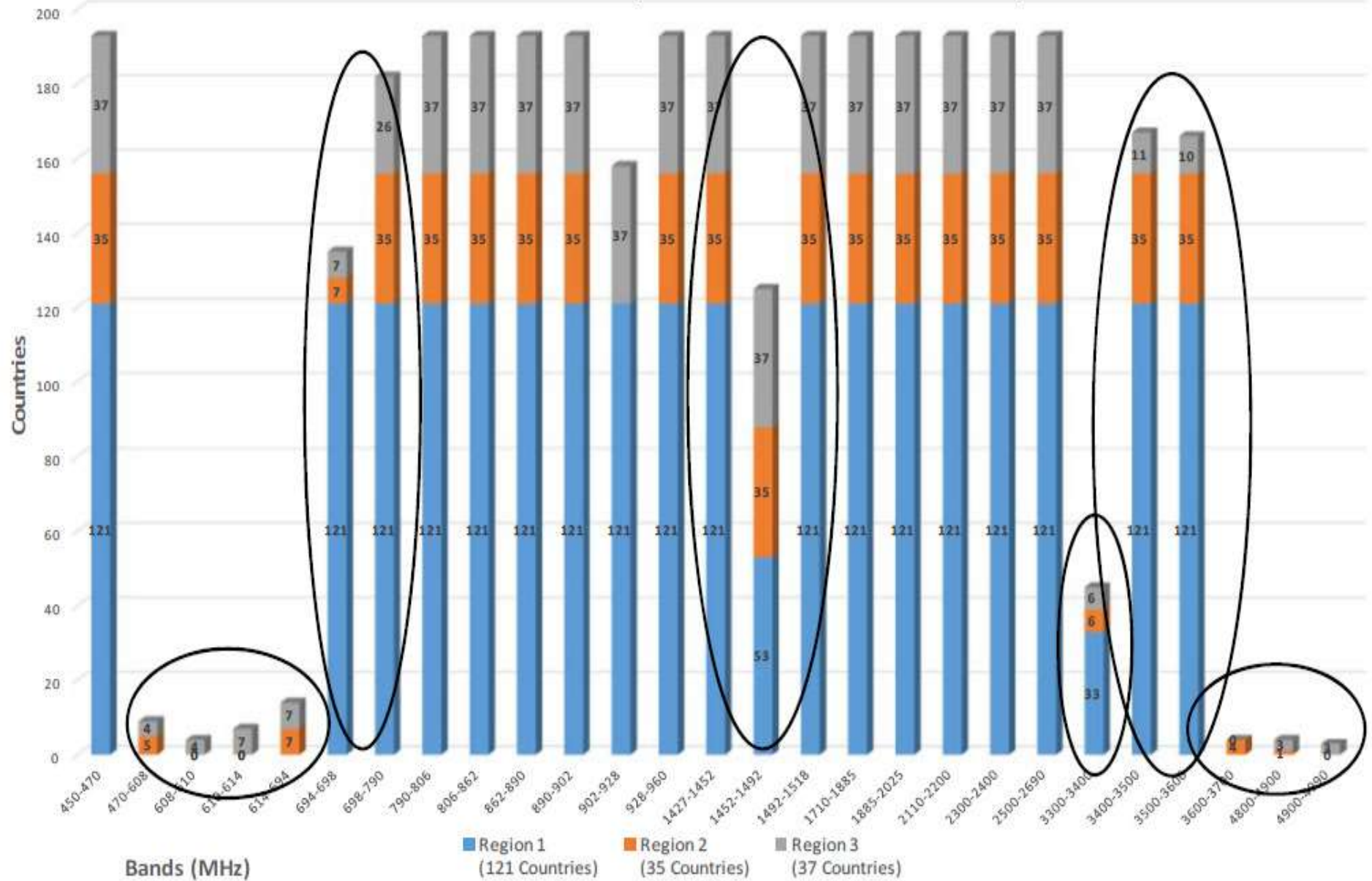
Need coordination with Defence on L Band (1427- 1470 MHz and 1475- 1518 MHz)

## Total amount of spectrum identified for IMT (MHz)



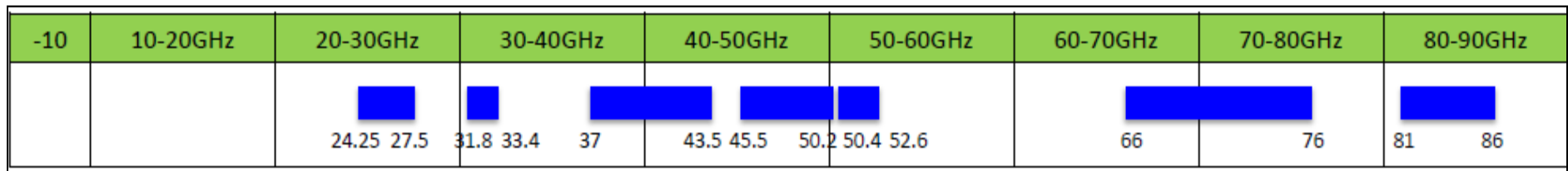


IMT Bands after WRC-15 (Number of Countries Identified)

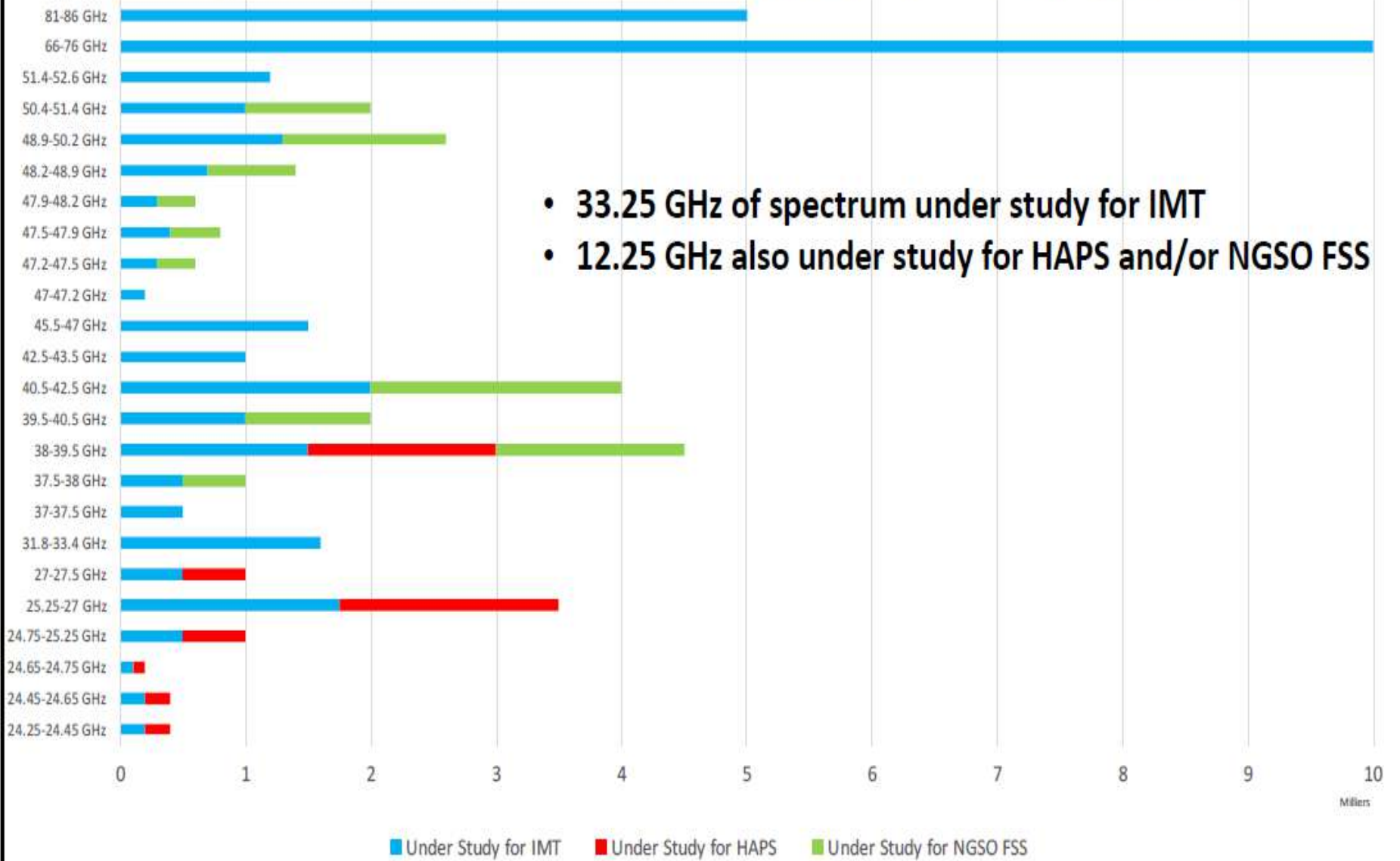


# Spectrum Considerations for 5G at WRC – 2019

Sl. No.	Working Group	Scope
1.	WG 2 – 30 GHz	Sharing and compatibility studies: 24.25 – 27.5 GHz, 31.8 – 33.4 GHz
2.	WG 3 – 40/50 GHz	Sharing and compatibility studies: 37 – 40.5 GHz, 40.5 – 42.5 GHz, 42.5 – 43.5 GHz, 45.5 – 47 GHz, 47 – 47.2GHz, 47.2 – 50.2GHz, 50.4 – 52.6GHz
3.	WG 4 – 70/80 GHz	Sharing and compatibility studies: 66 – 76 GHz, 81 – 86 GHz



## Spectrum (GHz) under study for IMT identification by WRC-19



- 33.25 GHz of spectrum under study for IMT
- 12.25 GHz also under study for HAPS and/or NGSO FSS

# Status of 5G Spectrum Bands in India

Sl. No	Frequency Ranges (GHz)	Sub Ranges (GHz)	India Remarks	Applications
1	24.25-27.5	24.5-26.5	IND79	LMDS (Local Multipoint Distribution Service)
		25.5-27	IND79	EEES (Earth Station Downlink Operation)
2	31.8-33.4	NA for Mobile	NA for Mobile	NA for Mobile
3	37-43.5	37-40	IND80	HCDN(High Capacity Dense Network)
4	45.5-50.2	-	-	-
	50.4-52.6	51.4-52.6	IND80	HCDN
5	66-76	64-66	IND80	HCDN(High Capacity Dense Network) FDD(Frequency Division Duplex)
	81-86	71-76	IND81	
		81-86	IND81	

# Status Role of Security & Privacy in future technology & services

## Security in 2G, 3G & 4G

### Targeted protection

- Only few basic services to protect - initially voice only, later on data.

### Limited protection needs

- User: data encryption, basic identity protection (temporary IDs)
- Network: strong authentication for billing (solved with SIM cards)

### Relative stability

- Threats did not change much over time

### Overall Successful

- Zero-configuration from the user's point of view



## Security in 5G

### New business and trust models:

- Authentication by networks only
- Authentication by service providers only
- Authentication by both networks and service providers

### New service delivery models - Cloud, virtualization, anything-as-a-service:

- Increase dependency on secure software

### 5G security protocols designed with attack resistance in mind:

- Phasing out traditional methods e.g. username/password authentication

### Privacy Concerns:

- Higher use of Big data analytics will increase the Privacy related concerns

# Challenges before the Industry

- **Policy & Regulatory Issues.**
  - **Cost of Compliances is quite high.**
  - **Licensing provisions are restrictive.**
  - **Adoption of Same Service Same Rule is necessary for maintaining level playing field.**
  - **Litigations-one of the highest across the industries**
- **Financial Condition of the Telcos-Govt. Levies**
  - **Highly taxed sector**
  - **LF & SUC ranges from 11-13% of operators' revenue**
  - **AGR definition**
  - **GST is 18%**
- **Investment**
  - **No major investment coming to the sector**
  - **Once the highest FDI contributor, now Foreign investors are withdrawing from the sector.**

*Will hamper the adoption of future technologies*

# Regulatory Framework & Key Requirements

1. **Rationalize the regulatory levies such as LF, SUC, USO levy and costs to promote network investments and affordable telecom services.**
2. **Simplified & flat network architecture across country with “same service, same rules” need to be adopted.**
3. **Uniform RoW policy across all the states.**
4. **Adoption of light touch regulatory policies as a enabler of the future technologies.**
5. **Making available existing and new municipal infrastructure (for e.g. street furniture/ open spaces/ etc.) for site densification (small cell deployments/ telecom infrastructure installation).**
6. **Optimal & efficient deployment of 5G is availability of short haul, medium haul and long haul networks.**
  - **These needs to be enabled by technologies viz. fixed, wireless, HAPS and satellite**
  - **Earliest allocation of E & V bands to the TSPs**

# Regulatory Framework & Key Requirements

7. Define interconnectivity between telecom & industrial networks for Massive Machine Type Communications (MMTC) such as M2M and IoT applications.
8. **Spectrum:**
  - Internationally harmonized spectrum
  - Ensure spectrum availability at affordable prices
  - Ensure speedy online on-demand allocation for 5G trials.
  - Creation of a Spectrum Exchange to facilitate speedy and transparent sharing and trading activities on spectrum.
9. **Net Neutrality:** Foster 5G by reviewing industry practices with respect to traffic prioritization
10. **EMF Exposure:** India should adopt ICNIRP specified Exposure Limits in order to efficiently deploy 5G network

*Create an investor friendly environment*



# Financial Support for Efficient 5G Deployment

- i. **Rationalisation of Taxes & Levies:** Make sector financially strong and sustainable with requisite licensing and regulatory reforms, review and reduction of costs such as SUC, USO levies.
- ii. **Spectrum Management and Pricing:** Rationalize the pricing of spectrum and modest reserve Price so that the TSPs can get the spectrum at a reasonable rate and further invest in the roll out of services.
- iii. **Restoring financial health of the sector** so as to ensure that the sector has surplus for investing in expansion of service.
- iv. Inject public money eg. grants, relief of spectrum fees and rent free access to public structures to site cells etc.
- v. **Telecom as a Critical and Essential Infrastructure: lower the GST rate.**
- vi. A tax holiday for 5 years on export based ICT production.
- vii. **Increase budget allocation** toward digital networks in **Smart Cities.**

Thank you



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For more information visit  
<http://www.coai.in>

5G information  
<https://youtu.be/LhECDSuXRDs>

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 [@ConnectCOAI](https://twitter.com/ConnectCOAI)

## Network Slicing: a 5G Concept

- Network slicing, implemented through virtualization, will allow operator to provide different services with different performance characteristics to address specific use cases.
- Each network slice operates as independent, virtualized version of the network. For an application, the network slice is the only network it sees.
- Advantage of this architecture is that the operator can create slices that are fine-tuned for specific use cases. One slice could target autonomous vehicles, another enhanced mobile broadband, another low-throughput IoT sensors, and so on.
- Different slices will have different QoS requirements, inherently invoking traffic management within each slice.

