Importance of 5G for Developing Countries

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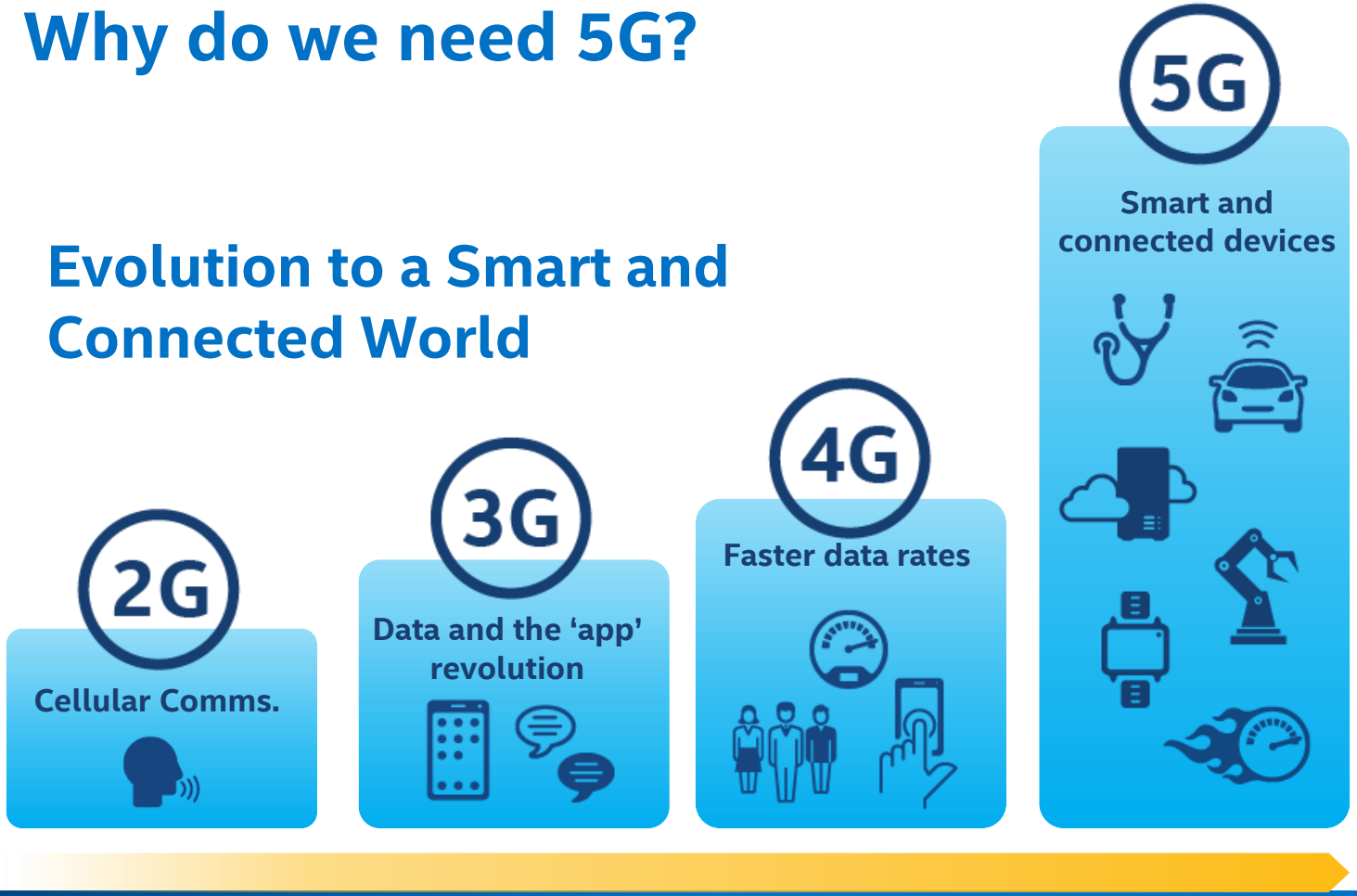
Agenda

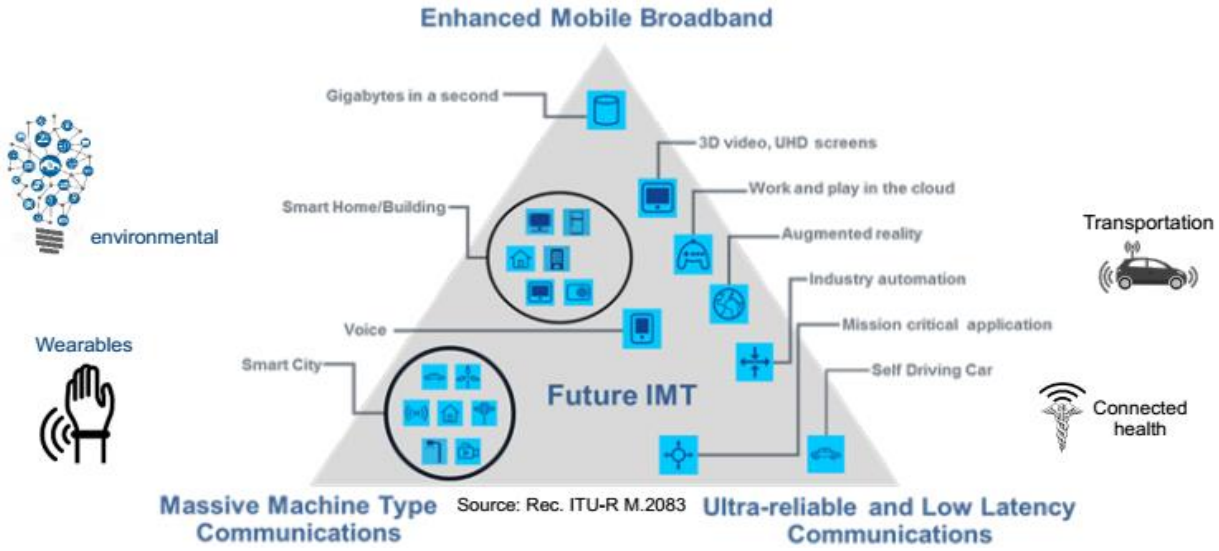
- 5G and Roadmap
- Importance of 5G and Access to Spectrum
- Recommendations

Why do we need 5G?

Evolution to a Smart and Connected World

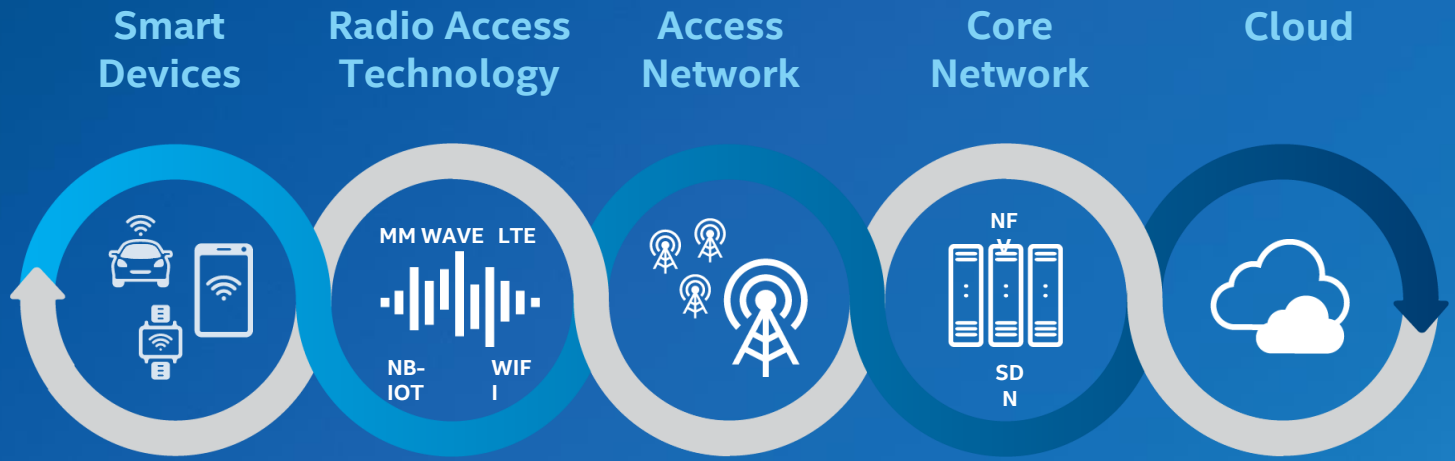


ITU-R's 5G Triangle includes IoT



5G will be a key enabler for IoT and based on Cloud/SDN/NFV

BEYOND JUST WIRELESS, 5G INCORPORATES COMPUTING AND CLOUD TECHNOLOGIES TO MAKE EVERYTHING SMART AND CONNECTED



Intel Powers 5G End-to-End

NFV/SDN/MEC is essential to 5G Networks

Moving the Network at Cloud Pace

COMPUTE, NETWORK & STORAGE POOLED RESOURCES

Standardized Commercial Grade Solutions

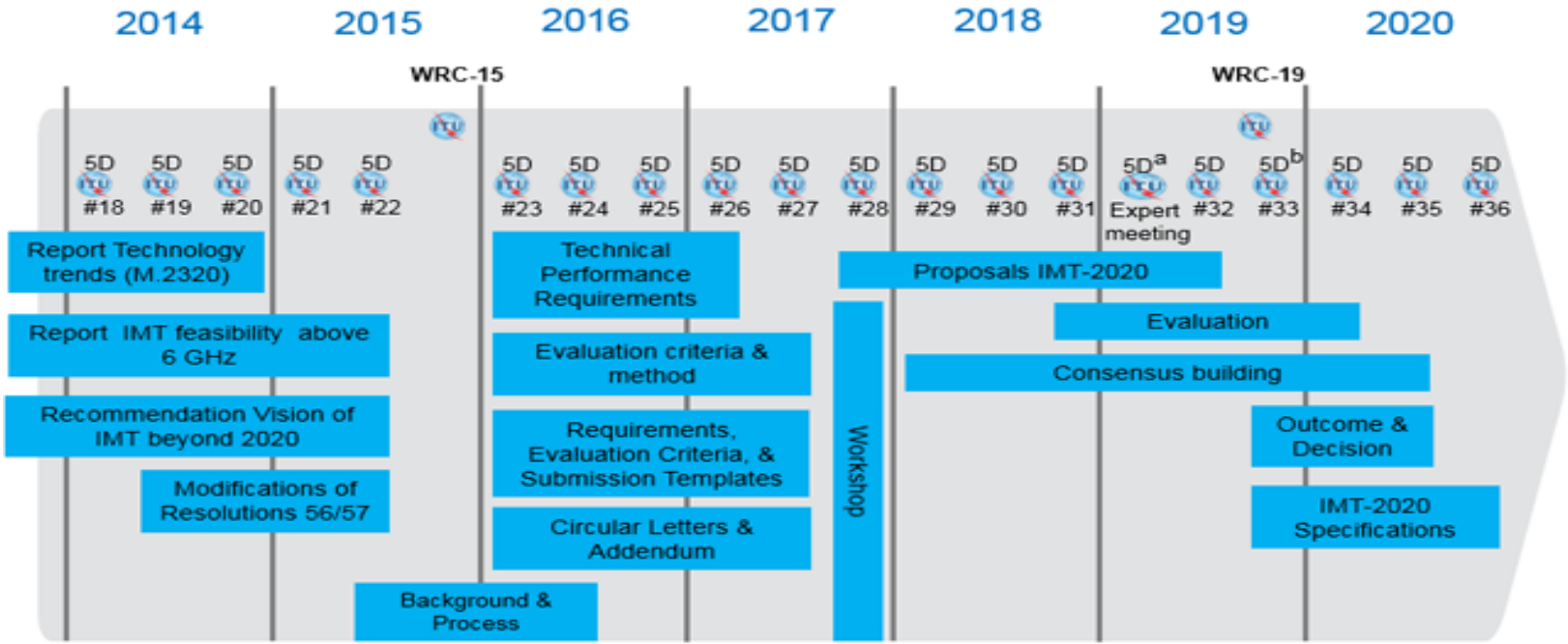
DYNAMIC FLEXIBLE NETWORKS

Next-Generation Network Architectures

SERVICES DELIVERY AND AGILITY

Business Process Transformation

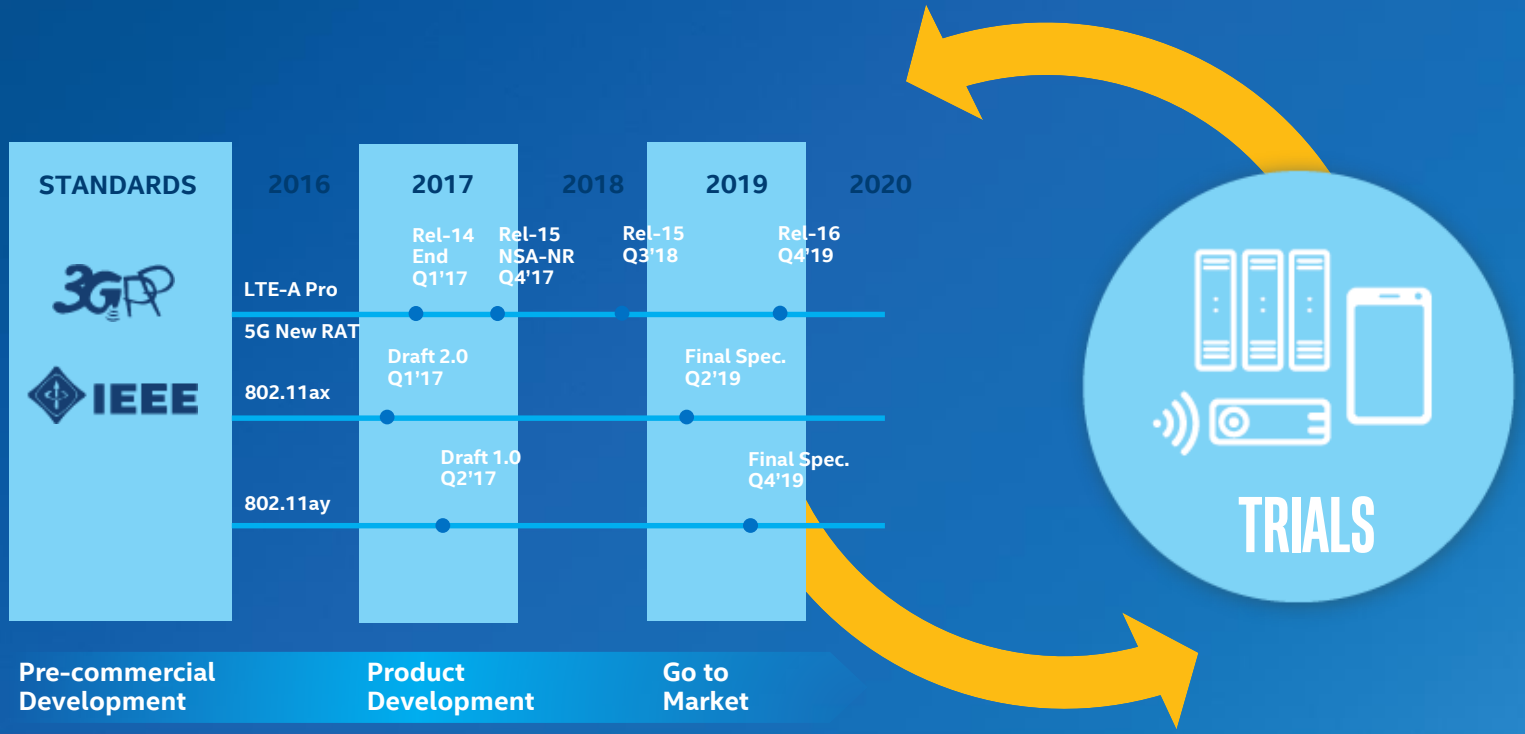
Detailed Timeline & Process for IMT-2020 in ITU-R



(a) – if needed focus meeting towards WRC-19 (non-Technology), (b) – focus meeting on Evaluation (Technology)

Note: While not expected to change, details may be adjusted if warranted.

TRIALS AND STANDARDS



Importance of 5G for Developing Countries

- **Smart Transportation Systems:** According to WHO, 90% of the world's fatalities on the roads occur in low- and middle-income countries, even though these countries have approximately half of the world's vehicles.
  -Road Accidents Cost to Egypt EGP 30.5 Billion in 2015 and **the death and injury of around 25,500 persons** (Source: CAPMAS-*Central Agency for Public Mobilization and Statistics)*
- **e-health:** Remote surgery will reduce the latency to enable remotely assisted surgery. Specialists are not available in many hospitals and could join a local surgeon remotely to perform procedures which require expert skills (5G's latency will be around one millisecond -unperceivable to a human and about 50 times faster than 4G).
- **Smart Learning:** 5G will enter the classroom and bring new ways of learning to students. Augmented Reality, Virtual Reality and Virtual Presence will mean that students will be immersed in a more visual and interactive learning experience where students and teachers may not necessarily be in the same location.
- **Water Management and Agriculture**: 5G will also bring a solution for smart water management and smart agriculture systems in developing countries. Such as sensors with wireless connectivity for crop fields can help optimize growing and minimize use of water and fertilizers through more targeted application.
- **And others.**

5G Vertical Industry

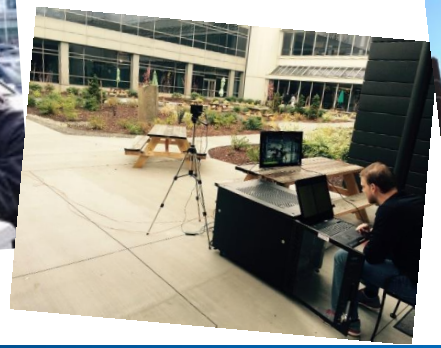
Vertical industry	Example use cases and applications	Partners
Healthcare	Connected Care, Precision Medicine, Imaging and Diagnostics, Genomics/Big Data, Remote Surgery	Medical Device Manufacturers, Insurers (public or private), Researchers, Ministries of Health
Automotive	Engine alert and automatic maintenance scheduling, autonomous driving, collision avoidance, V2V	OEM's, Researchers, Ministries of Transportation
Public Safety	Enhanced Incident/disaster alert and response, real time traffic management	Venues (i.e. stadiums, etc.), municipalities and governments, infrastructure vendors, operators, OEMs, etc.
Sustainability/ Environmental	Adaptive air sensors, water management systems, energy	Researchers, Government Parks services, Agriculture
Education	wireless real-time interactions, virtual and augmented reality interactions without visual delay	School Districts, OEM's, Ministries of Education, Regulators, Researchers
Smart City	Remote monitoring of roads and city infrastructure, smart meters/parking	Service Providers, Universities, Local Municipalities, Federal Policy Makers, Utilities, etc.
Public Transportation	Flexible/adaptive bus/fleet management, Allowing more efficient routes	Transit Systems, Operators, Municipal Governments, Researchers, etc.
Wearables	Fully connected devices (no need for a smartphone tether), tagged devices to assist with inventory management	OEM's
Smart Homes	Remote security monitoring and controls (i.e. locks, hi res camera surveillance, etc.)	Infrastructure Vendors, Heating and Cooling Systems, Cable Companies, etc.
Smart Grid	Smart 'end to end' power distribution networks with predictive analytics	See Smart City
Industrial	Sensors with wireless connectivity for crop fields can help optimize growing and minimize use of water and fertilizers through more targeted application.	Farmers/Agriculture, Ministries of Agriculture, etc.

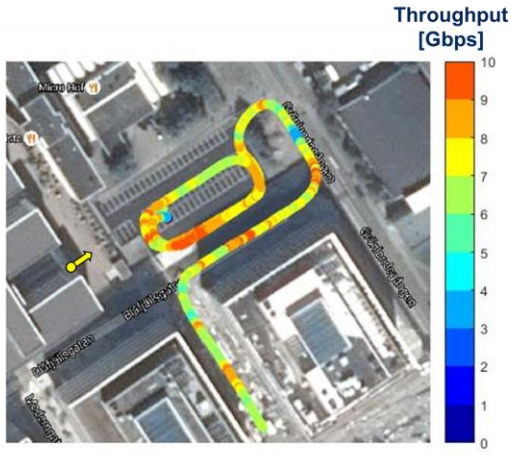
5G Field trials in various frequency bands

A number field trials are being carried out with numerous operators both in sub-6GHz and mm-wave frequency bands to assess the real-life performance of 5G

Sub-6GHz trials typically use a 100 or 200 MHz wide channel in the 3.5 or 4.5 GHz bands resulting in up to 10 Gbps downlink throughput

mm-wave band trials use a 800 MHz or 1 GHz wide channel in the 15 or 28 GHz bands resulting in 25-40 Gbps downlink throughput depending on network configuration





Examples of recent 5G trial activities

Many trials ongoing & planned around the world mainly in 3.5 GHz, 4.5 GHz and 28 GHz

- 28 GHz trials in the **United States** by Verizon and AT&T. Verizon announced commercial launch in 2017. AT&T also looking at trials in 3.5 GHz and 15 GHz.
- 28 GHz trials in **South Korea** in time for the 2018 Olympics with SK, KT and LG U+ using 1 GHz of spectrum per operator.
- Early system trials planned in **Japan** for 3600-4100 MHz, 4405-4895 MHz and 27.5-28.28 GHz, starting 2017 in Tokyo, and continuing as a larger-scale field trial through 2018 and 2019.
- The IMT-2020 Promotion Group of **China** has announced the ongoing 5G technology trial in the 3400-3600 MHz band. In addition, the bands 3300 – 3400 MHz, 4400 – 4500 MHz, 4800 – 4990 MHz, 25 GHz and 40 GHz are being considered for 5G use.
- In **Russia** operator Megafon intends to run a 5G network in 2018 (in time for FIFA World Cup).
- In **Sweden** Telia Company is conducting field trials in the Stockholm area and plans to bring 5G experience to customers in Stockholm and Tallinn in 2018.
- The **European Commission** recently published their 5G Action Plan with preliminary trials from 2017 onwards, and pre-commercial trials from 2018. Likely bands are 3400-3800 MHz and 24.25-27.5 GHz (see pioneer band discussion) and many more …

Ecosystem Collaboration

Spectrum Needs of 5G

Success requires sufficient spectrum in a variety of bands with economies of scale

5G applications drive technical requirements, including type and amount of spectrum

< 1 GHz – for wide area applications, e.g. sensor networks, e

< 6 GHz – for coverage/capacity trade-off, e.g. massive MIM outdoor-to-indoor

Higher MM Wave – for apps needing ultra-wide channels, e.g. 4k/8k video, VR, etc.

Continuous flow of sufficient, adequate, new spectrum is key to:

Expansion of wireless market to 5G and beyond

Building a strong and healthy eco-system

IMT for 2020 and Beyond

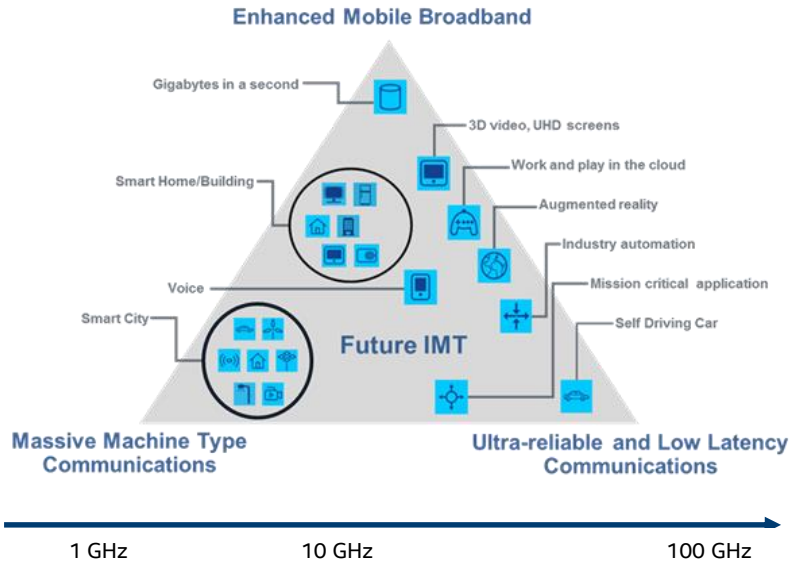


Image Source: Recommendation ITU-R M.2083 "IMT Vision - Framework and overall objectives of the future development of IMT for 2020 and beyond"

FCC OPENS SPECTRUM ABOVE 24 GHZ

•11 GHz of spectrum above 24 GHz, more than four times larger than the total amount of licensed spectrum currently available for mobile services.

•28 GHz (27.5-28.35 GHz), 37 GHz (37-38.6 GHz), and 39 GHz (38.6-40 GHz) bands, and a new unlicensed band at 64-71 GHz.

•*28 GHz allocation in US (like Korea, Japan) can be a very good chance for global harmonization through a tuning range approach across the 26 GHz* and 28 GHz bands.

•Verizon, AT&T, T-Mobile have already begun testing 5G technologies on 28 GHz spectrum.

•FCC: Balance between new wireless services, current and future fixed satellite service operations, and federal uses. Effective sharing schemes to ensure that diverse users – including federal and non-federal, satellite and terrestrial, and fixed and mobile – can co-exist and expand.

•FCC Chairman Mr. Wheeler: "We will make ample spectrum available and then rely on a private sector-led process for producing technical standards best suited for those frequencies and use cases (that will encourage innovation and investment)"

Ref: http://transition.fcc.gov/Daily_Releases/Daily_Business/2016/db0714/DOC-340301A1.pdf

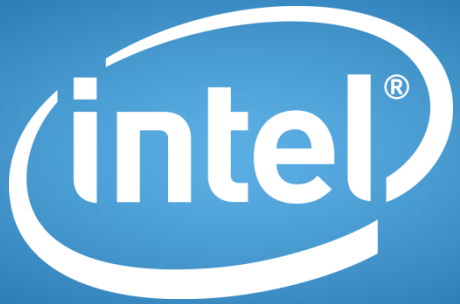
http://transition.fcc.gov/Daily_Releases/Daily_Business/2016/db0620/DOC-339920A1.pdf

Spectrum for 5G

- Harmonization of tuning ranges across wide markets is important at 26+28 GHz. A wide tuning range could span parts or all of the 26 GHz (24.25-27.5 GHz) and the 28 GHz (27.5 GHz and 29.5 GH) band.
- Mobile Industry has already committed to invest at 28 GHz to address early adopter markets in the US, Korea, Japan etc. Spectrum sharing can be possible like in US and other places. 27.5 GHz-29.5 GHz has already primary mobile allocation globally according to ITU Regulations.
- Opening door for 5G at 28 GHz (like US, Korea, Japan) through a tuning range approach across the 26 GHz and 28 GHz bands will also help for 5G innovation to attract foreign investors earlier.
- We also need unlicensed spectrum at 66-71 GHz (this is important as an extension band for Wireless Gigabit Networks as defined in the ITU).
- 71-76 GHz / 81-86 GHz is also important to provide sufficient spectrum capacity for ultra-high speed radio links for 5G fronthaul/backhaul.

Recommendations

- Establish a National 5G Committee to accelerate the 5G and vertical applications.
- Allocate low-band, mid-band and high-band spectrum for mobile broadband in collaboration with industry (prioritize 26+28 GHz tuning range, 26 GHz: 24.5-27.5 GHz and 28 GHz: 27.5-29.5GHz)
- Benefit from early introduction of 5G like other leading countries (Korea, Japan, US etc.) 28 GHz is critical for this objective.
- Launch a 5G trial network in a minimum of one city by 2020.
- Transform existing ICT networks according to 5G need (Smart City, smart government networks and networks of operators).
- Adopt policies/regulations to accelerate the 5G such as small cells and backhauls for 5G (71-76 GHz/81-86 GHz)
- Allocate unlicensed spectrum at 66-71 GHz (this is important as an extension band for Wireless Gigabit Networks as defined in the ITU).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