



5G: The Connected World of Tomorrow

ITU Regional Seminar for Europe and CIS on "Spectrum Management and Broadcasting"
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Turhan Muluk, Regional Manager & ITU-D Representative
turhan.muluk@intel.com



Agenda

- Importance of 5G
- Spectrum
- Recommendations



5G: Evolution to a Smart and Connected World



5G applications drive usages, radio & network requirements, deployments conditions, and revenue streams

2G

Cellular Comms.

3G

Data and the 'app' revolution

4G

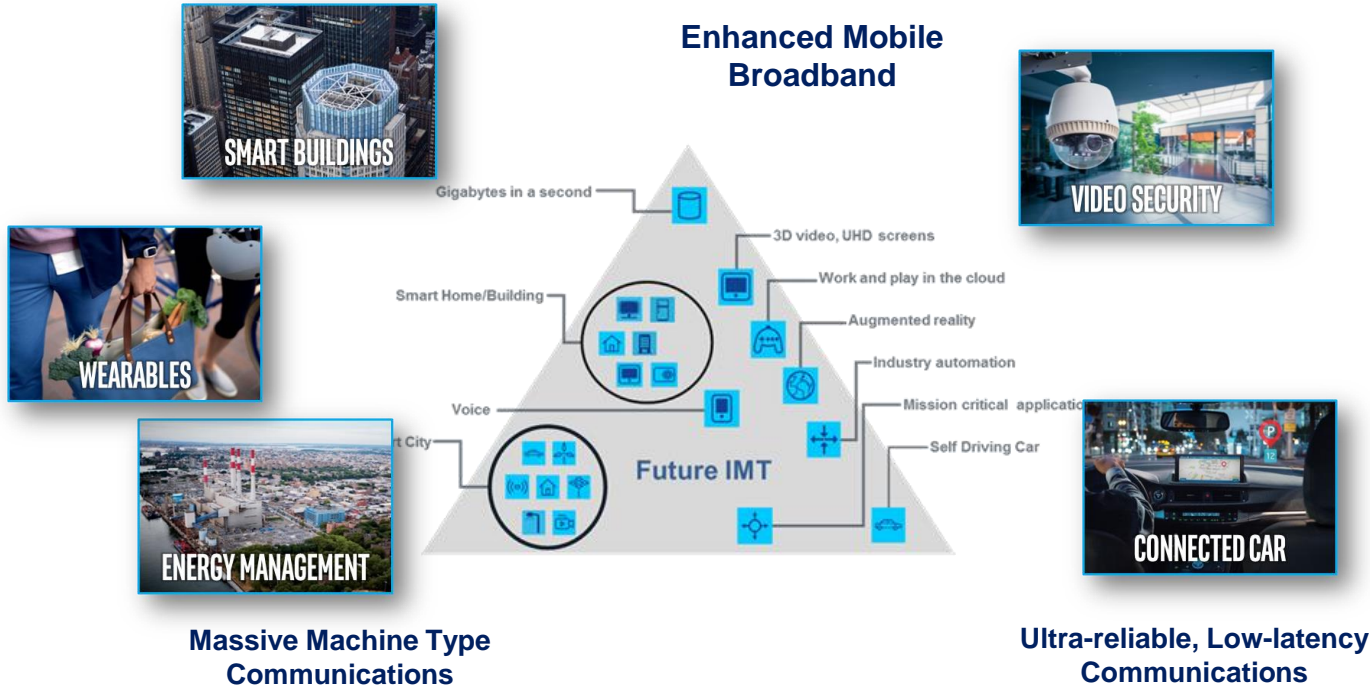
Faster data rates

5G

Smart and connected devices



5G: Usage Scenarios & Spectrum



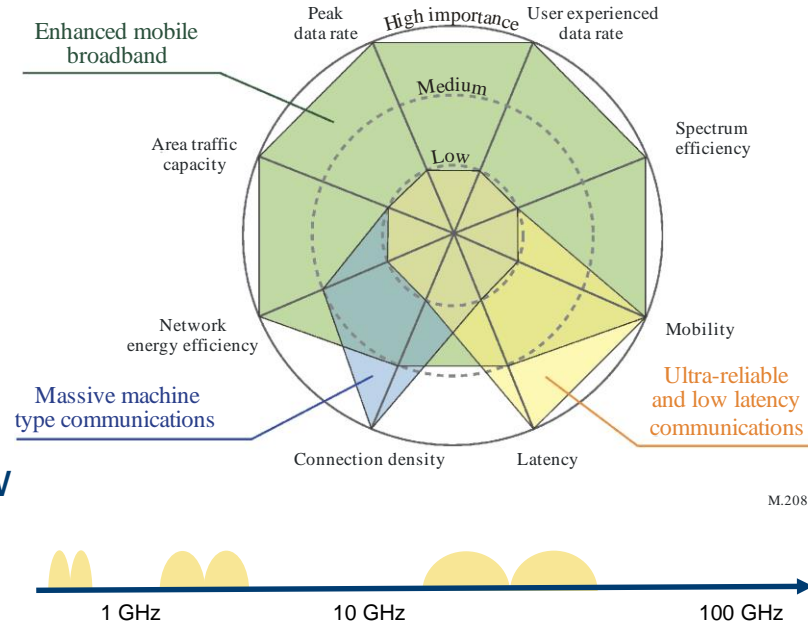
Source: Recommendation ITU-R M.2083 “IMT Vision - Framework and overall objectives of the future development of IMT for 2020 and beyond”



Spectrum Needs of 5G

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

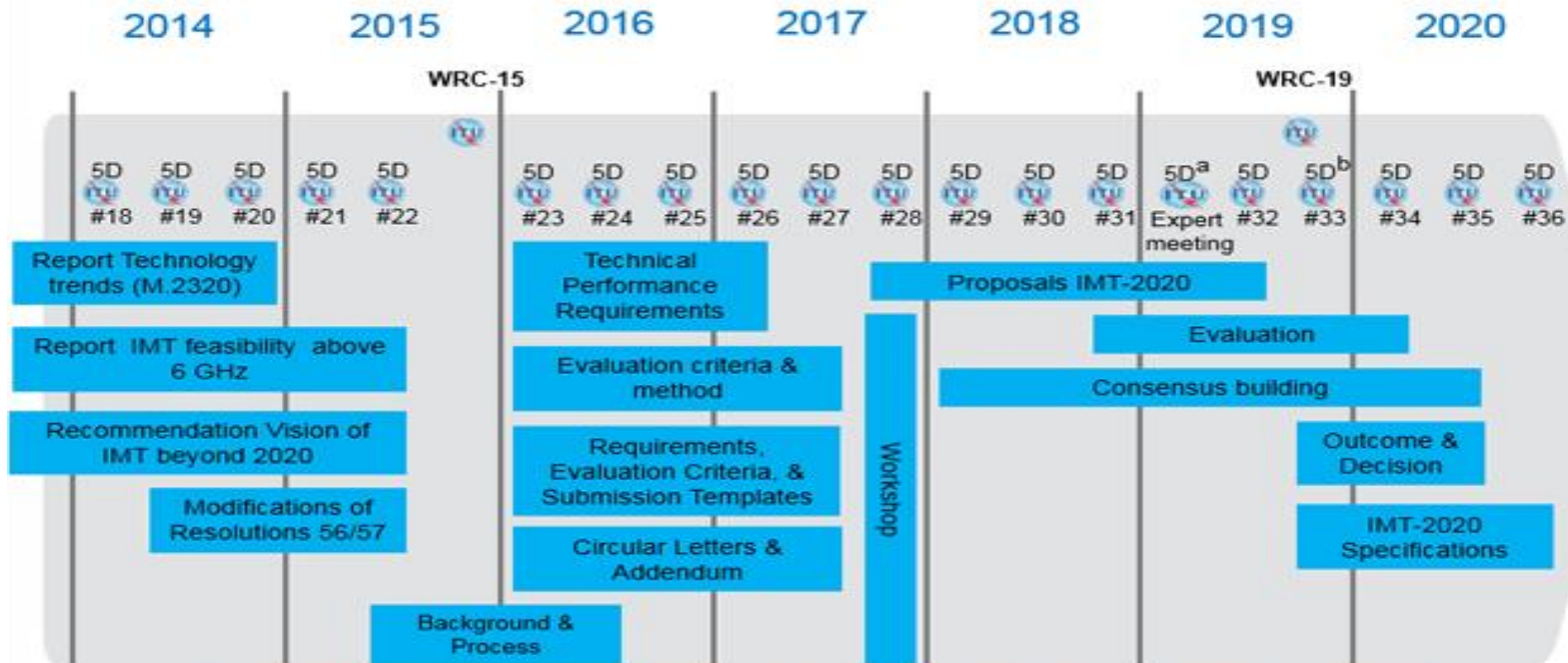
- Ultra-wide channels for eMBB → higher bands (e.g. mm-wave for peak data rates)
- Reliable links for obstacle penetration → low frequencies (e.g. <1 GHz for IoT)
- Coverage/capacity tradeoffs → mid-range spectrum (e.g. C-band for small cells)



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



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.



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.

*See also Working Document towards Preliminary Draft New Report [IMT.BY.INDUSTRIES]- 5D/530 Annex 3, section 3.13

The Coming Flood of Data

BY 2020...



The average internet user will generate
~1.5 GB OF TRAFFIC PER DAY



Smart hospitals will be generating over
3,000 GB PER DAY



Self driving cars will be generating over
4,000 GB PER DAY... EACH



A connected plane will be generating over
40,000 GB PER DAY



A connected factory will be generating over
1,000,000 GB PER DAY



1. <http://www.cisco.com/c/en/us/solutions/service-provider/vni-network-traffic-forecast/infographic.html>
2. http://www.cisco.com/c/en/us/solutions/collateral/service-provider/global-cloud-index-cv1606_index_White_Paper.html
3. <http://data.intel.com/handbook/self-driving-car-traffic-forecast-by-2020-10-17-20>
4. http://www.cisco.com/c/en/us/solutions/collateral/service-provider/global-cloud-index-cv1606_index_White_Paper.html
5. http://www.cisco.com/c/en/us/solutions/collateral/service-provider/global-cloud-index-cv1606_index_White_Paper.html



Bands above 6 GHz to be studied towards WRC-19

- ITU-R will study the following bands to prepare for WRC-19 (AI 1.13):
 - 24.25-27.5 GHz, 37-40.5 GHz, 42.5-43.5 GHz, 45.5-47 GHz, 47.2-50.2 GHz, 50.4-52.6 GHz, 66-76 GHz and 81-86 GHz, which have allocations to the mobile service on a primary basis; and
 - 31.8-33.4 GHz, 40.5-42.5 GHz and 47-47.2 GHz, which may require additional allocations to the mobile service on a primary basis
- If approved by WRC-19, timeframe of availability ~2020
- Some countries are making spectrum available domestically in the 2016-2018 timeframe



Harmonization

Harmonization crucial to enable:

- Global roaming
- Economies of scale
- Harmonization of radio tuning ranges, rather than exact bands



Recommendations

- Allocate sufficient low-band, mid-band and high-band spectrum for 5G
 - Include licensed and license-exempt bands,
 - Consider economies of scale; global harmonization based upon tuning range approach
- Adopt policies needed to facilitate 5G
 - For example, ensuring sufficient backhaul spectrum for 5G (71-76 GHz/81-86 GHz)
- Allocate license-exempt spectrum at 66-71 GHz to enable systems such as Wireless Gigabit Networks (See Rec. ITU-R M.2003).
- Consider establishing a National 5G Committee to accelerate the 5G and vertical applications.

