Workshop on New Frontiers in Internet of Things

(Trieste, Italy, 17 March 2016)

ITU-R Study Groups Activities and Standardization towards IMT-2020

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International Telecommunication Union

ITU Overview

Committed to connecting the world

193 Member States
673 Sector Members
168 Associates
108 Academia

ITU-T

Telecommunication standardization - network and service aspects

ITU-D

Promote and assist the extension of ICTs to all the world's inhabitants - narrowing the digital divide

ITU-R

Global radio spectrum management and radiocommunication standardization

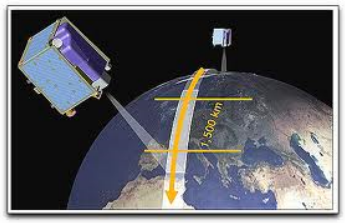
Role of the ITU-R

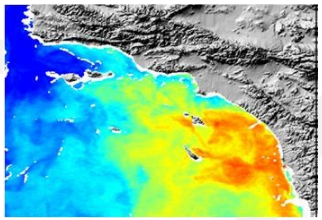
- **Spectrum management**
- Ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services

- **Radiocommunication standardization**
- Carry out studies without limit of frequency range, adopting Recommendations on radiocommunication matters

Some key areas of ITU-R standardization

- Spectrum Monitoring
- Broadband wireless access (terrestrial and satellite)
- IMT - International Mobile Telecommunications
- Broadcasting technologies
- Emergency communications
- Environmental monitoring





ITU-R Study Groups

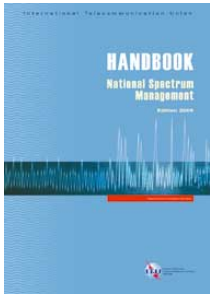
SG 1: Spectrum management
SG 3: Radiowave propagation
SG 4: Satellite services
SG 5: Terrestrial services
SG 6: Broadcasting service
SG 7: Science services

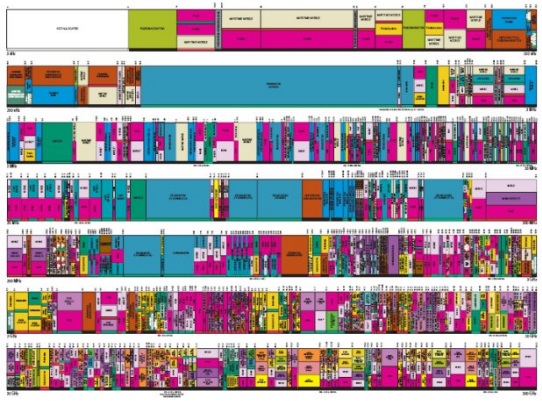
CPM: Conference Preparatory Meeting
CCV: Coordination Committee for Vocabulary

- ✓ >900 Recommendations
- ✓ "Standards" in areas of spectrum management and radio technology
- ✓ Result of consensus from meetings of world-wide experts
- ✓ Some referred to in RR
- ✓ Used by spectrum planners and system designers

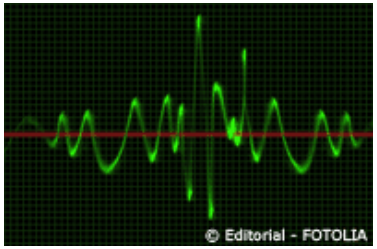
http://www.itu.int/ITU-R/go/rsg

Study Group 1
Spectrum management





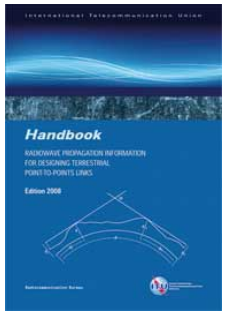
- Spectrum Management (SM) -principles and techniques
- General principles of sharing
- Spectrum monitoring
- Long-term strategies for spectrum utilization
- Economic approaches to national SM



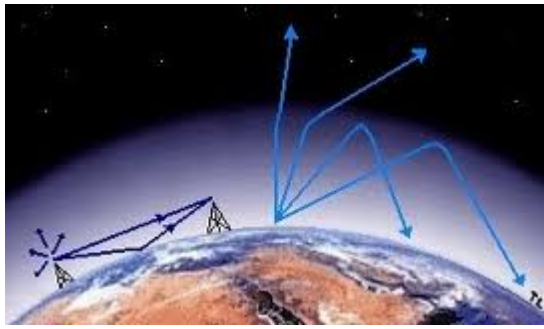
International spectrum regulatory framework

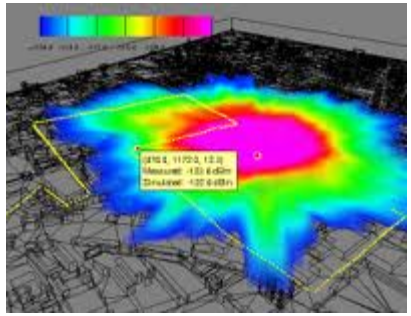
Short Range radio Devices (SRD)

Study Group 3
Radiowave propagation



- Propagation in ionized and non-ionized media
- Point-to-point and Earth-space propagation
- Modelling and development of prediction methods
- Radio noise
- Major support to other SGs

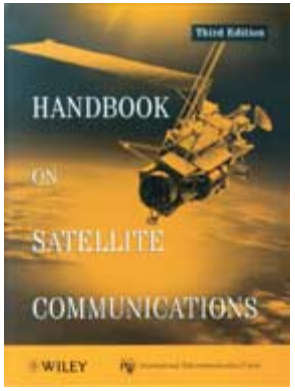




Characteristics and mapping of propagation medium

Propagation prediction methods

Study Group 4
Satellite services



- Systems and performance in FSS, BSS, MSS and RDSS
- Efficient orbit/spectrum utilization for FSS, BSS, MSS and RDSS
- IP Global broadband Internet access via satellite
- Early warning and relief operations

Technical characteristics for systems and networks in the RNSS

Satellite radio interface of IMT-2000

Study Group 5
Terrestrial services

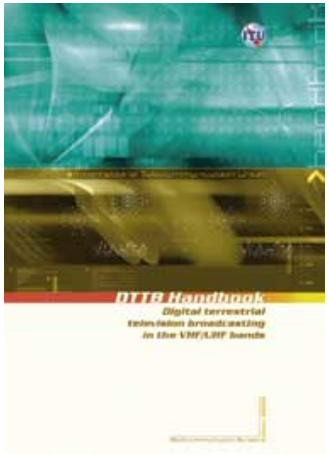
- IMT-2000, IMT-Advanced and IMT-2020
- Fixed, mobile, portable and nomadic communications, including BWA, RLANs, HAPS
- Maritime and aeronautical services
- Radiodetermination service
- Amateur service
- SDR and CRs

Next generation mobile access "IMT-Advanced"

Spectrum issues for maritime and aeronautical services

Study Group 6
Broadcasting service

- Programme production
- Programme assembly
- Delivery
- Reception quality
- Audio/Video quality



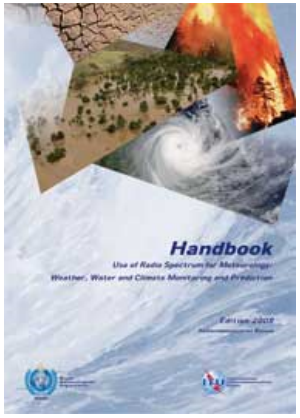
Sharing issues at UHF

Multimedia and data broadcasting for mobile reception

UHDTV – 3DTV

Accessibility

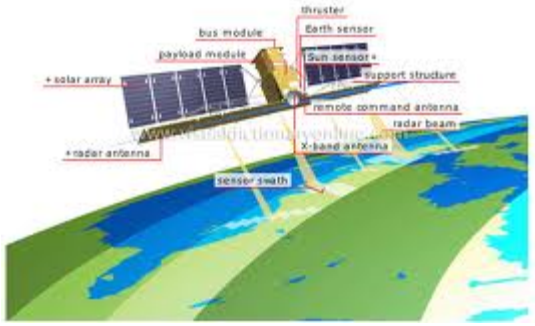
Study Group 7
Science services



- Systems for space operation, space research, Earth exploration and meteorology
- Standard frequency and time signals
- Radio astronomy

EESS including meteorological satellite service for disaster prediction and detection, and for climate monitoring

Protection of passive services, e.g. radioastronomy



Final products

- ITU Radiocommunication Sector represents the global focal point for standardization of radiocommunication services and systems
- **ITU-R Study Groups** are the "home" for the technical studies required for the standardization activities
- Principal products:
  - Recommendations, Reports and Handbooks
  - Technical bases for Radiocommunication Conferences

Growth of mobile broadband - IMT

- ITU has a rich history in the development of radio interface standards for mobile communications as IMT.

- **IMT** has become an essential foundation of society.
- **IMT** brings the world to people in all countries – it is truly a global force for change and empowerment.
- **IMT** is increasingly becoming *the* sole means for accessing communication, information, and entertainment.
- **IMT** contributes significantly to national economies & jobs.
- **IMT** continues to grow at unprecedented rates and supports connectivity, applications, and services that were not envisioned even a few years or sometimes even a few months ago.

Technology evolution and additional spectrum are a must if the societal benefits are to continue

- **IMT** voice usage remains a key communication medium and most importantly, data traffic volumes have become unbounded and show no signs of scaling back.
- **IMT** systems, technologies, and architectures supporting mobile broadband
  - have continued to evolve to improve on spectrum efficiency & utilization.
  - might be approaching theoretical limits in the ability to find significant additional gains in spectrum capability through technology alone.
  - are adopting new deployment architectures which help but are not the total solution.
- **IMT** must continue to seek new ways to advance the capabilities and push out the boundaries of the technology.
- **IMT** must be accorded significant additional spectrum if these society benefits are to continue.

IMT standardization

- High-speed, affordable broadband connectivity to the Internet is a foundation stone of modern society, offering widely recognized economic and social benefits.

- High-speed broadband is no longer just cutting-edge technology for an elite few; instead, the steady march of connectivity among the broader population is rapidly transforming our society with new ways of accessing services and information.

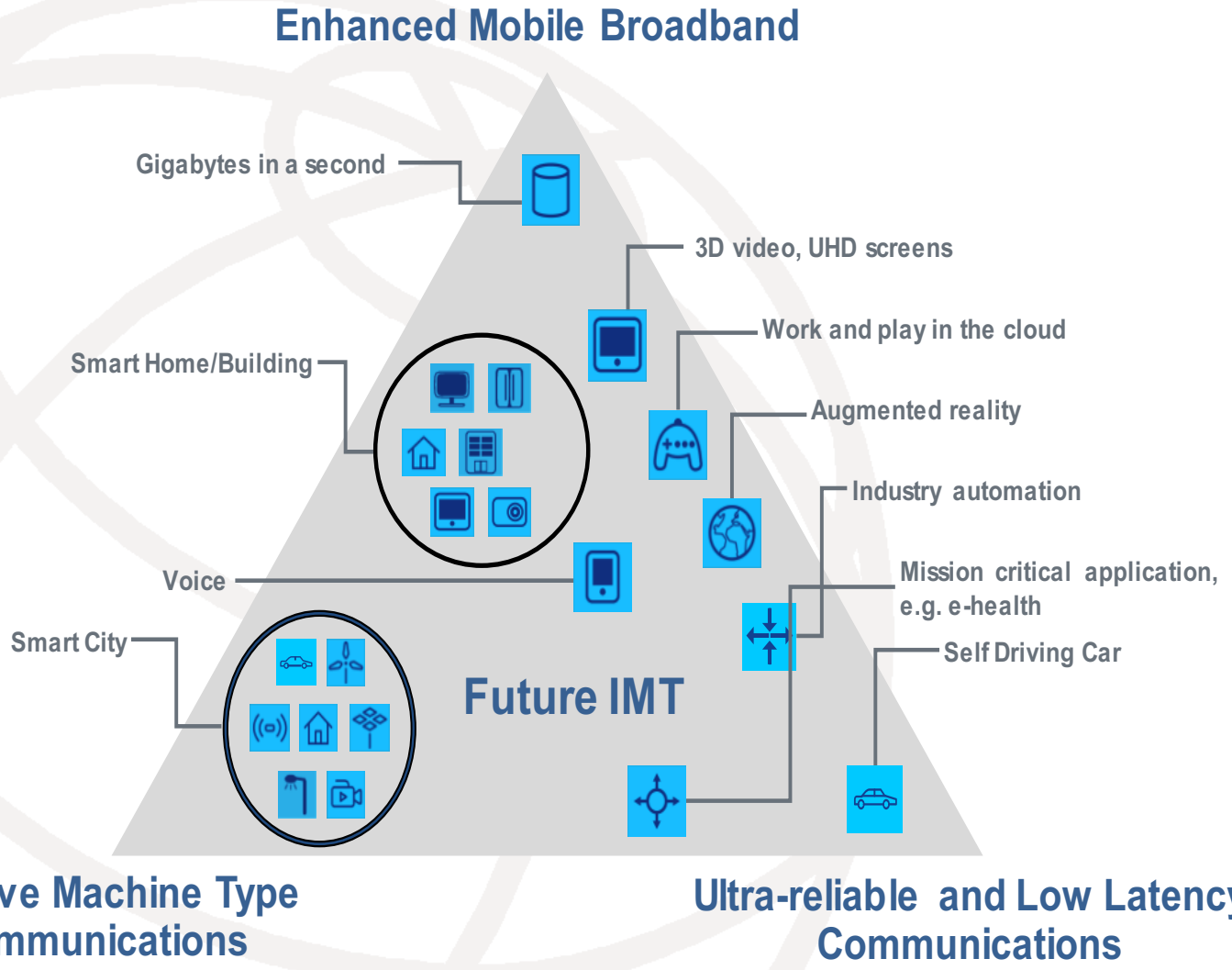
- IMT provides the global platform on which to build the next generations of mobile broadband connectivity and Internet of Things (IoT)

IMT-2000, IMT-Advanced, IMT-2020

- All of today's 3G and 4G mobile broadband systems are based on the ITU's IMT standards.
- ITU established the detailed specifications for **IMT-2000** and the first "3G" deployments commenced around the year 2000.
- In January 2012, ITU defined the next big leap forward in wireless cellular technology – **IMT-Advanced** – and this is now being progressively deployed worldwide.
- The detailed investigation of the key elements of **IMT-2020** is already well underway, once again using the highly successful partnership ITU-R has with the mobile broadband industry and the wide range of stakeholders in the 5G community.

Additional spectrum required for IMT

- We are witnessing a very rapid increase in the volume of mobile data traffic, spurred on by the introduction of advanced multimedia devices and applications.
- The substantially increased spectrum efficiency provided by IMT-Advanced will go some way towards meeting this demand, but this alone will not be sufficient – additional radio frequency spectrum will be required.
- The issue of additional spectrum for mobile broadband wireless access has been addressed at the World Radiocommunication Conference (WRC-15) and is in the agenda for the next WRC-19.


Enhanced Mobile Broadband
Gigabytes in a second
3D video, UHD screens
Work and play in the cloud
Smart Home/Building
Augmented reality
Industry automation
Voice
Mission critical application, e.g. e-health
Smart City
Self Driving Car
Future IMT
Massive Machine Type Communications
Ultra-reliable and Low Latency Communications

Outline of requirements

- The IMT-2020 requirements will provide the industry with a technical baseline for 5G
- (Examples, not exhaustive, of some minimum requirements)
  - Spectral efficiency
  - Bandwidth
  - Throughput; Peak & User Data Rates
  - Mobility
  - Latency
  - Capacity
  - Support of IoT
  - QoS
  - Energy Efficiency

8 Key Capabilities of IMT-2020

- **Peak data rate**

Maximum achievable data rate under ideal conditions per user/device (in Gbit/s).

- **User experienced data rate**

Achievable data rate that is available ubiquitously across the coverage area to a mobile user/device (in Mbit/s or Gbit/s).

- **Latency**

The contribution by the radio network to the time from when the source sends a packet to when the destination receives it (in ms).

- **Mobility**

Maximum speed at which a defined QoS and seamless transfer between radio nodes which may belong to different layers and/or radio access technologies (multi-layer/-RAT) can be achieved (in km/h).

- **Connection density**

Total number of connected and/or accessible devices per unit area (per km^2).

- **Energy efficiency**

– on the network side, energy efficiency refers to the quantity of information bits transmitted to/ received from users, per unit of energy consumption of the radio access network (RAN) (in bit/Joule);

– on the device side, energy efficiency refers to quantity of information bits per unit of energy consumption of the communication module (in bit/Joule).

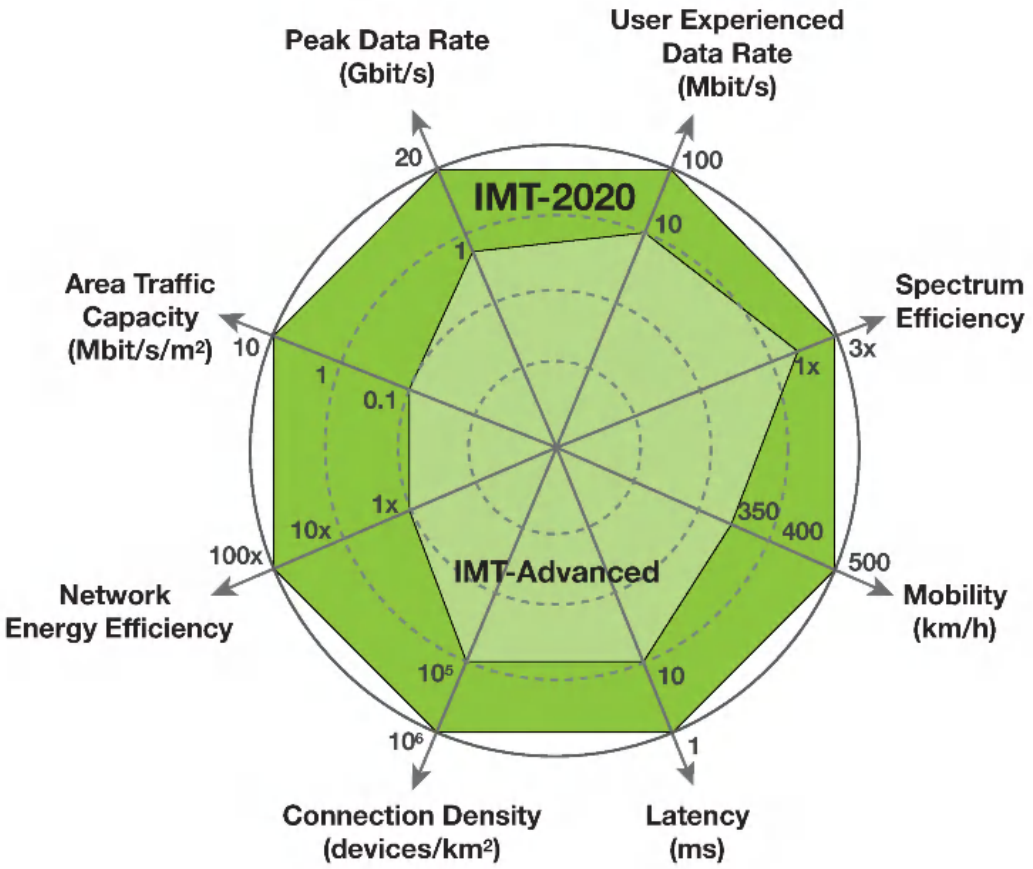
- **Spectrum efficiency**

Average data throughput per unit of spectrum resource and per cell (bit/s/Hz).

- **Area traffic capacity**

Total traffic throughput served per geographic area (in $Mbit/s/m^2$).

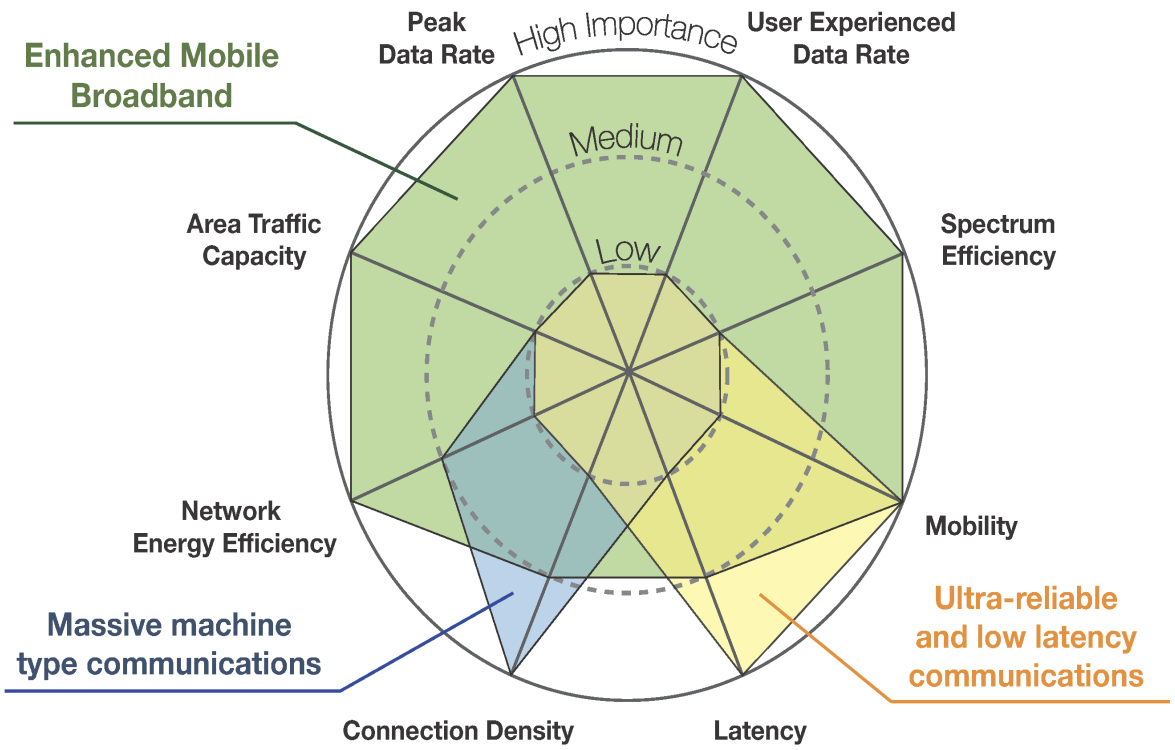
5G Capability Perspectives from the ITU-R IMT-2020 Vision Recommendation



Enhancement of key capabilities from IMT-Advanced to IMT-2020

The values in the figure are targets for research and investigation for IMT-2020 and may be further developed in other ITU-R Recommendations, and may be revised in the light of future studies..

5G Capability Perspectives from the ITU-R IMT-2020 Vision Recommendation



The importance of key capabilities in different usage scenarios

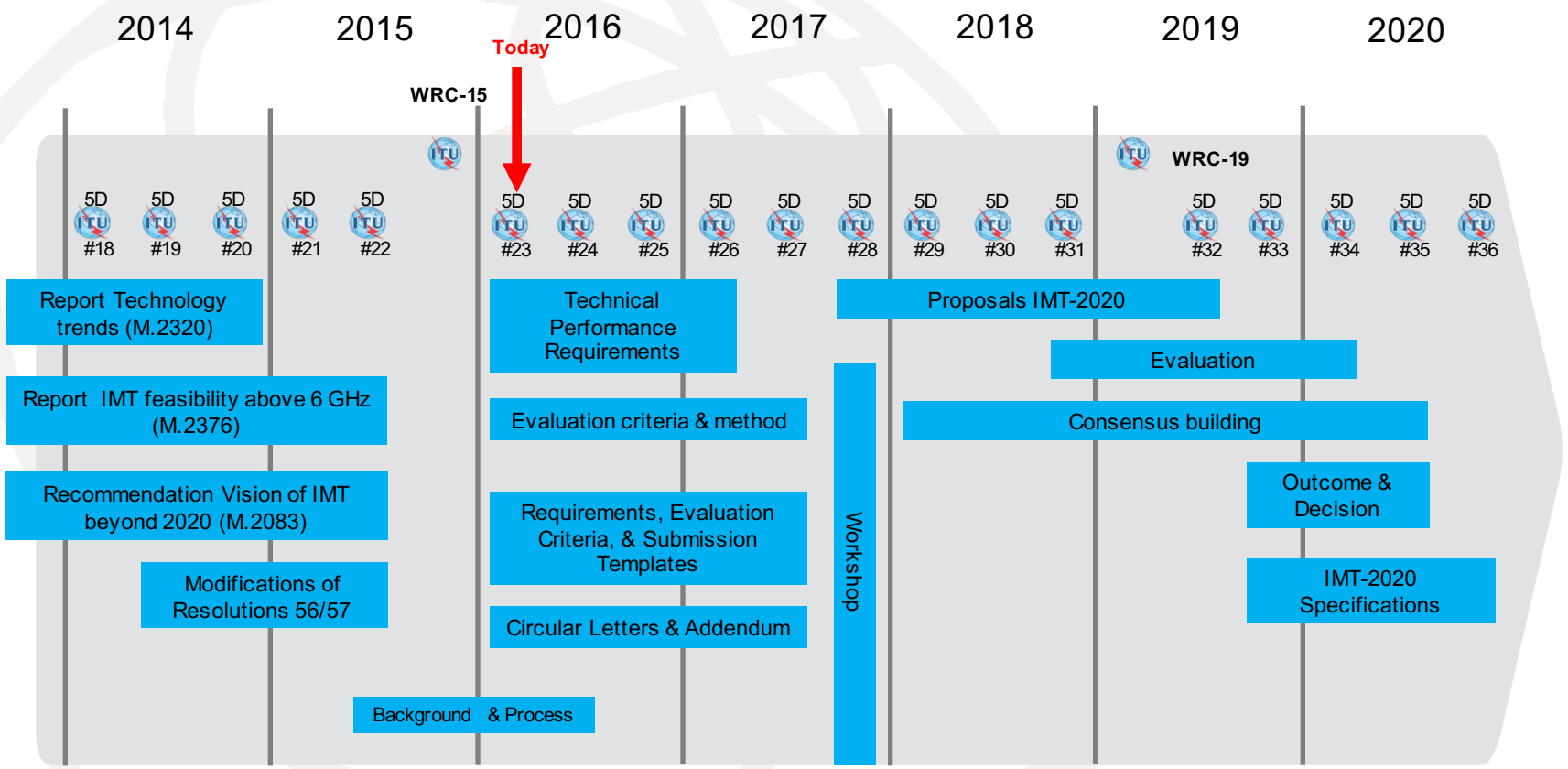
Scope of the ITU-R WP 5D Work

- At a high level the work is organized in these broad categories:
  - VISION & TECHNOLOGY TRENDS
  - MARKET, TRAFFIC ESTIMATES, AND FUTURE SPECTRUM REQUIREMENTS
  - FREQUENCY BAND CHANNELING ARRANGEMENTS & SPECTRUM SHARING AND COMPATABILITY STUDIES
  - IMT SPECIFICATIONS AND OTHER TECHNOLOGY RELATED WORK
  - SUPPORT FOR IMT APPLICATIONS & DEPLOYMENTS
  - WORKSHOPS & SEMINARS

The ITU-R "Vision"

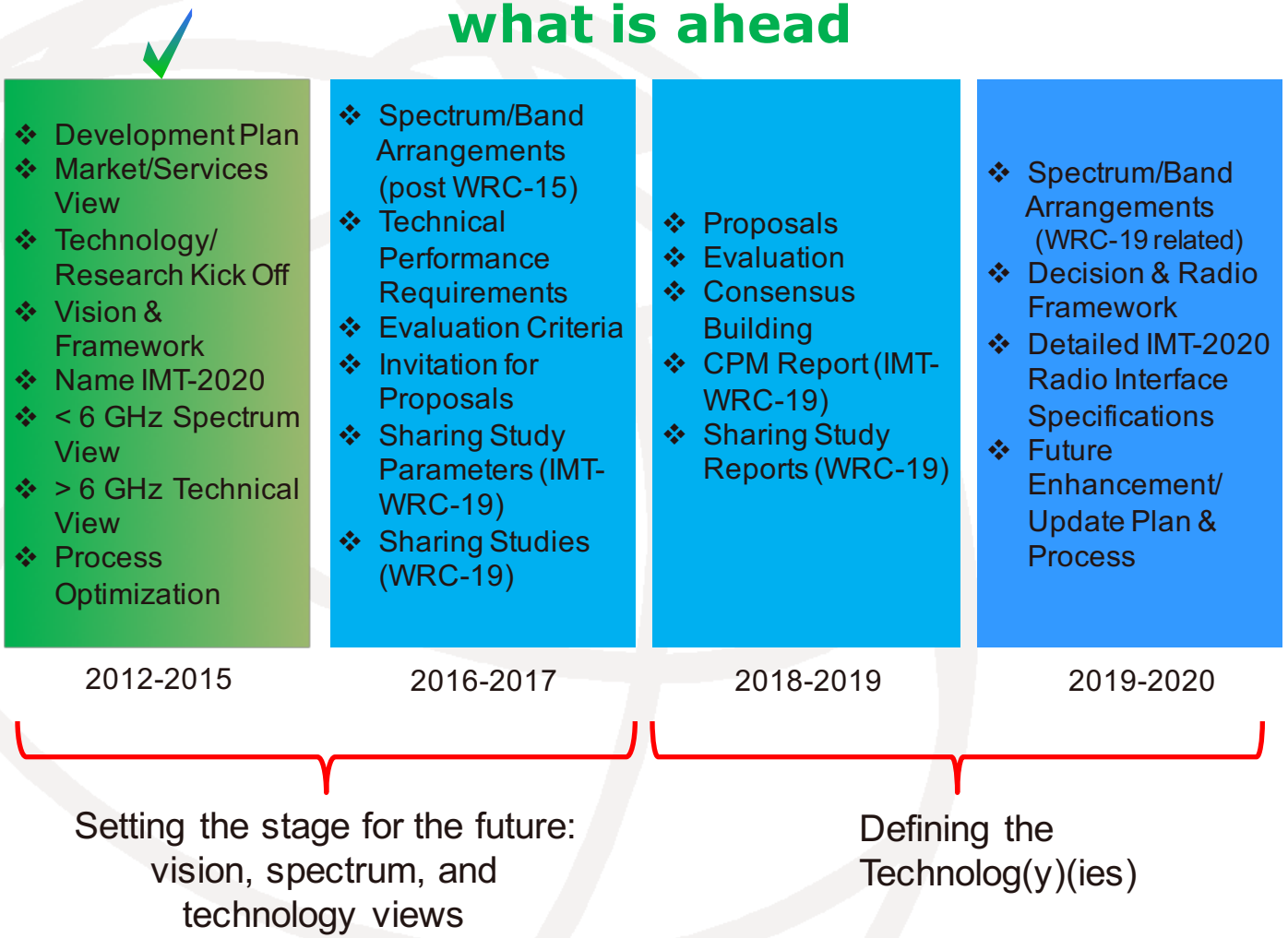
- ITU-R has finalized in 2015 its "Vision" applicable to the "5G" mobile broadband connected society and future IMT.
  - **Recommendation ITU-R M.2083**
- This Recommendation incorporates the ITU-R and other global views into a comprehensive framework of ***"IMT for 2020 and beyond"*** to provide an industry and government consensus view.
- The mission in ITU – establishing ***IMT*** as the preeminent global means for connecting people and devices everywhere will continue in the "5G" future.
- In ITU-R, the intersection of industry (ITU-R Sector Members) and government (ITU Member States) viewpoints is a unique partnering opportunity.

Detailed Timeline & Process for IMT-2020



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

IMT-2020 Standardization Process – Where we are and what is ahead



Next steps

- Work on the next phases of IMT-2020 will ramp up in 2016, with the expected adoption in 2016/17 of the following deliverables:
  - The Report on the **Technical Performance Requirements** that a technology would need to meet to satisfy "IMT-2020"
  - The Report on **Evaluation Criteria and Evaluation Methods** for "IMT-2020" technologies
  - The **Report on Specific Submission Requirements** of the candidate technology under assessment related to submissions, the evaluation criteria and submission templates
  - **Communication via Circular Letters and Liaisons** will be a key element of the work.

New spectrum: Bands under study for WRC-19

Existing mobile allocation	No global mobile allocation
24.25 GHz – 27.5 GHz	31.8 – 33.4 GHz
37 – 40.5 GHz	40.5 – 42.5 GHz
42.5 – 43.5 GHz	
45.5 – 47 GHz	47 - 47.2 GHz
47.2 -50.2 GHz	
50.4 – 52.6 GHz	
66 – 76 GHz	
81 – 86 GHz	

Final specifications

- It is expected that **the final specifications** for the "global core specification (GCS)" from the external organizations (the technology proponents) towards the work on the Recommendation ITU-R *"Detailed specifications of the terrestrial radio interfaces of IMT-2020"* would be received at the WP 5D Meeting #34 (February 2020) at the latest.
- **Transposed specifications** (from the individual regional or national transposing organizations) would be received by June 2020 at the latest.
- Finalization of the complete New Recommendation for the initial release of "IMT-2020" would be by **October 2020**.

Thank you