IMT-2020 progress in ITU-R

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Course Objectives:

Gain basic knowledge of ITU-R, and IMT-2020 progress on both spectrum aspect and technology aspect

1 Overall introduction of ITU-R

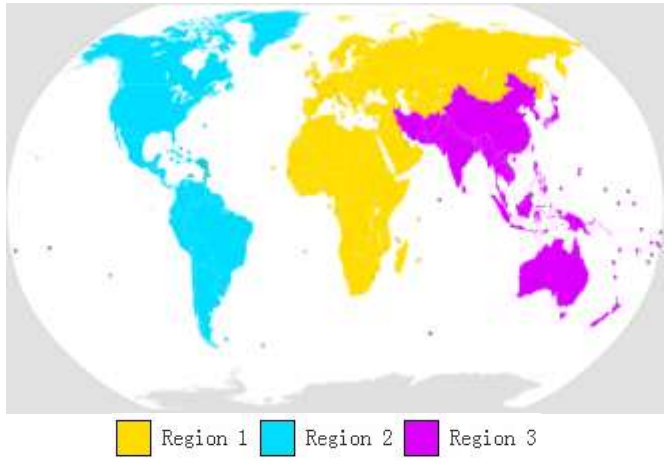
2 Spectrum aspects of IMT-2020

3 Technology aspects of IMT-2020

4 Conclusion & Summary

Overall introduction of ITU-R

Committed to connecting the world



193 Member States
673 Sector Members
168 Associates
108 Academia

ITU-T

Telecommunication standardization - network and service aspects

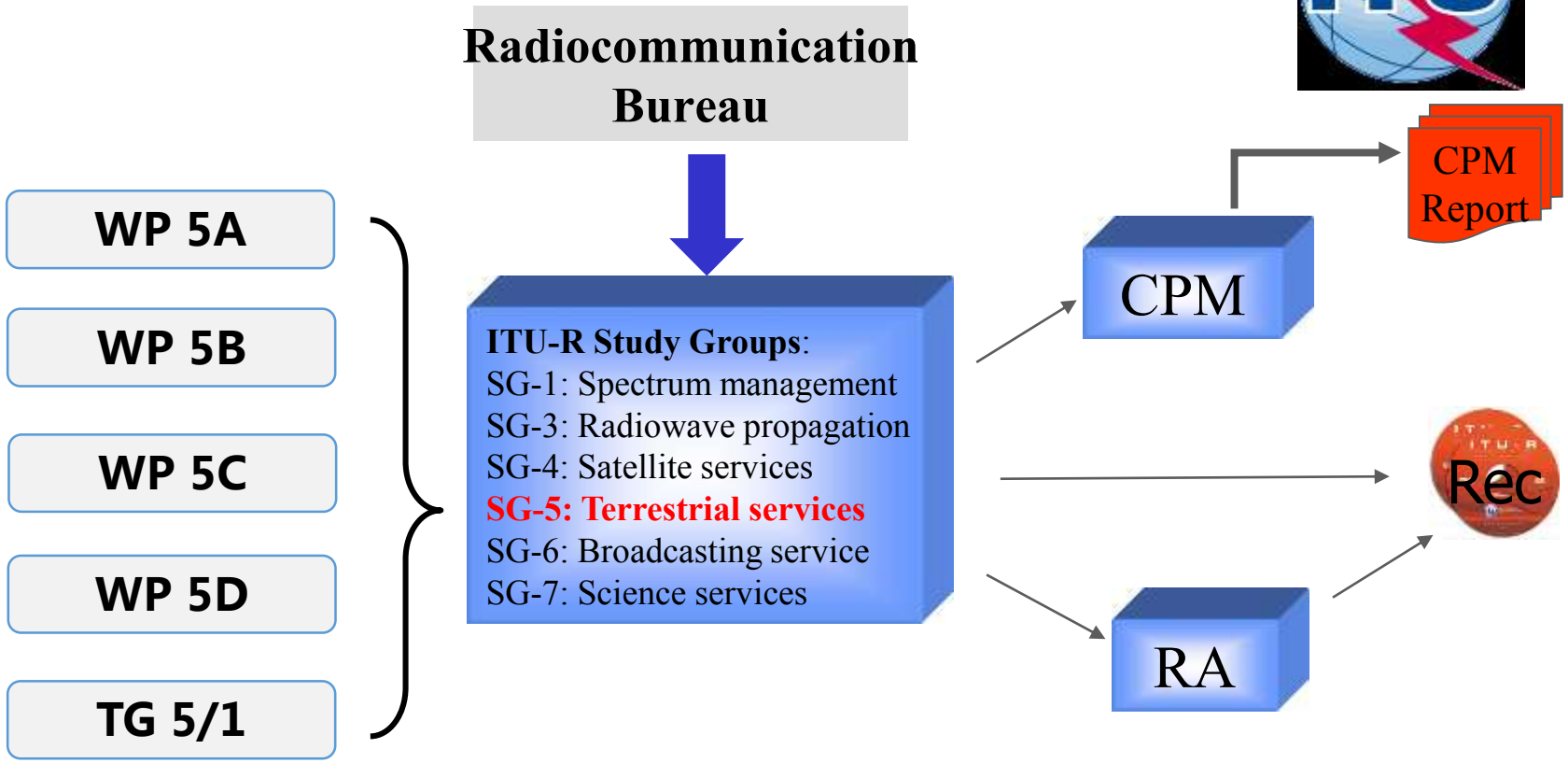
ITU-D

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

Overall introduction of ITU-R



APT ASMG ATU CEPT CITEL RCC

Spectrum aspects of IMT-2020

International Mobile Telecommunications:

International Telecommunication Union (ITU) develops the framework of standards for IMT, encompassing IMT-2000 and IMT-Advanced, spans the 3G and 4G industry perspectives and will continue to evolve as 5G with IMT-2020

ITU Spectrum Management

- The mission of ITU-R is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including those using satellite orbits, and to carry out studies and approve Recommendations on radiocommunication matters.

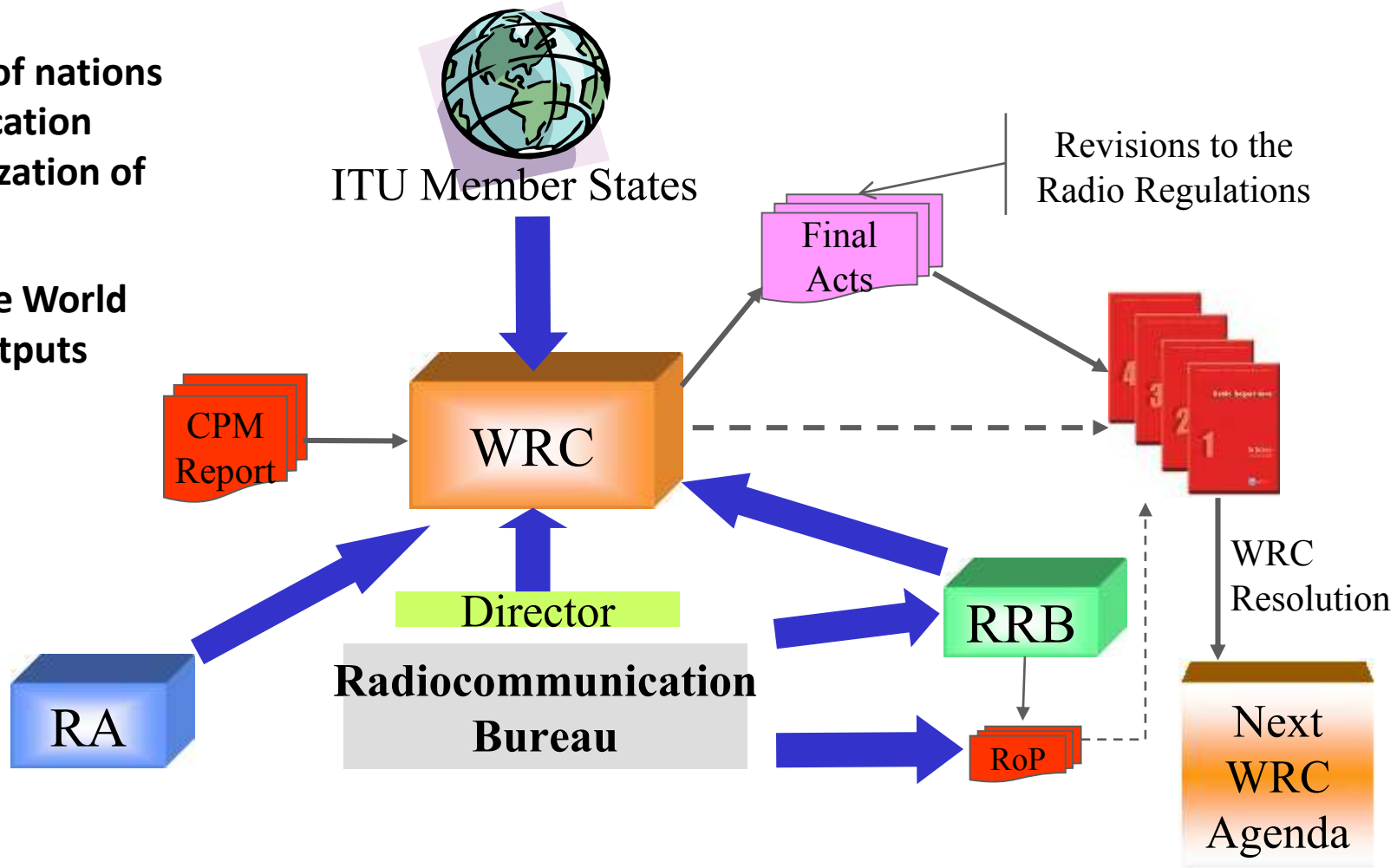
3GPP Spectrum

- The project covers cellular telecommunications network technologies, including radio access, the core transport network, and service capabilities - including work on codecs, security, quality of service - and thus provides complete system specifications , especially definition of bands, RF specification.

Spectrum aspects of IMT-2020

ITU Radio Regulation---Global Frequency Planning

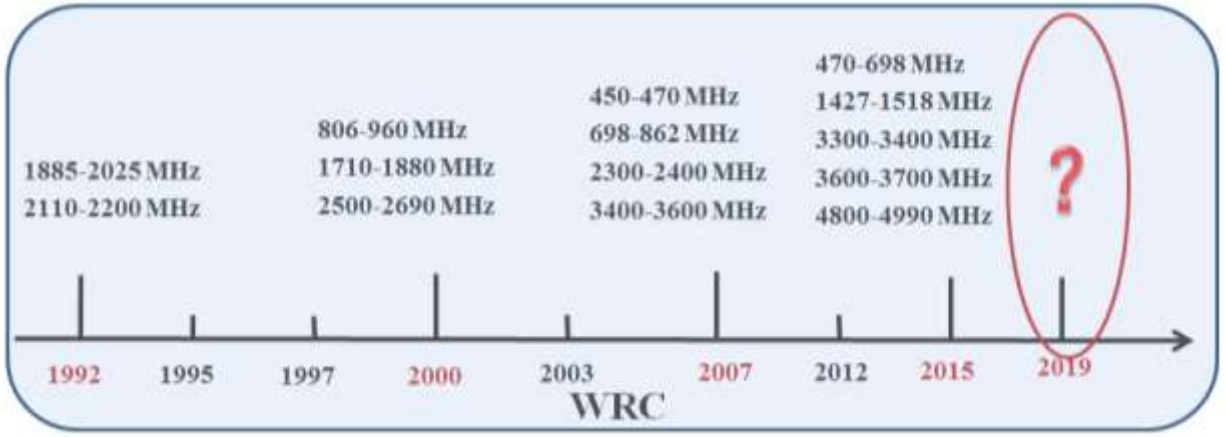
- **RR regulates on law of nations scale radiocommunication services and the utilization of radio frequencies.**
- **Revised regarding the World Radio Conference outputs every 3 to 4 years.**

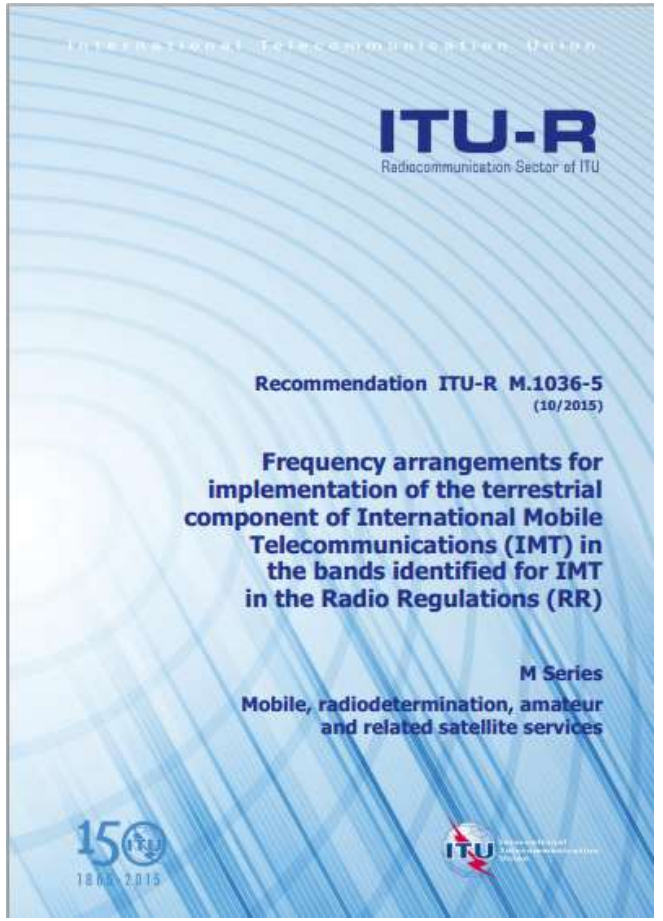


Spectrum aspects of IMT-2020

Frequency arrangement for IMT systems

- IMT frequency bands utilization is globalized
- Frequency bands are identified for IMT at WRCs
- Frequency arrangements for IMT is detailed in the Rec ITU-R M.1036





Spectrum aspects of IMT-2020

ITU-R M.1036 Footnotes

Band (MHz)	Footnotes identifying the band for IMT
450-470	5.286AA
698-960	5.313A, 5.317A
1 710-2 025	5.384A, 5.388
2 110-2 200	5.388
2 300-2 400	5.384A
2 500-2 690	5.384A
3 400-3 600	5.430A, 5.432A, 5.432B, 5.433A

"Also, administrations may deploy IMT systems in bands allocated to the mobile service other than those identified in the RR, and administrations may deploy IMT systems only in some or parts of the bands identified for IMT in the RR"

WRC-19 Agenda Item 1.13

to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 238 (WRC-15)

CPM19-1 Decision to establish Task Group 5/1 and ToR Invites ITU-R SG 5 to establish TG 5/1

ITU-R SG 5 Establishes Task Group 5/1 and approves ToR Elects Chairman

Relevant ITU-R Working Parties

Terrestrial component of IMT:
- Spectrum needs
- Technical and operation characteristics including protection criteria
- Deployment scenarios

Existing services (also adjacent bands):
- Technical characteristics
- Protection criteria

All services and relevant frequency bands:
- Propagation models for sharing studies

31 March 2017

TG 5/1 Terms of Reference

- Conduct sharing and compatibility studies in accordance with Res. 238 (WRC-15)
- Develop draft CPM-text under WRC-19 AI 1.13

13 September 2018

WRC-19 Agenda Item 1.13

Groups in TG5/1	Scope
WG 1 – CPM	Development of draft CPM text under WRC-19 agenda item 1.13, based on: – Input contributions – Information on IMT spectrum needs – Sharing and compatibility study results from other Working Groups under TG 5/1
WG 2 – 30 GHz	To conduct the sharing and compatibility studies between IMT and existing primary services allocated in, or adjacent to as appropriate, the following bands: – 24.25-27.5 GHz – 31.8-33.4 GHz
WG 3 – 40/50 GHz	To conduct the sharing and compatibility studies between IMT and existing primary services allocated in, or adjacent to as appropriate, the following bands: – 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
WG 4 – 70/80 GHz	To conduct the sharing and compatibility studies between IMT and existing primary services allocated in, or adjacent to as appropriate, the following bands: – 66-76 GHz – 81-86 GHz

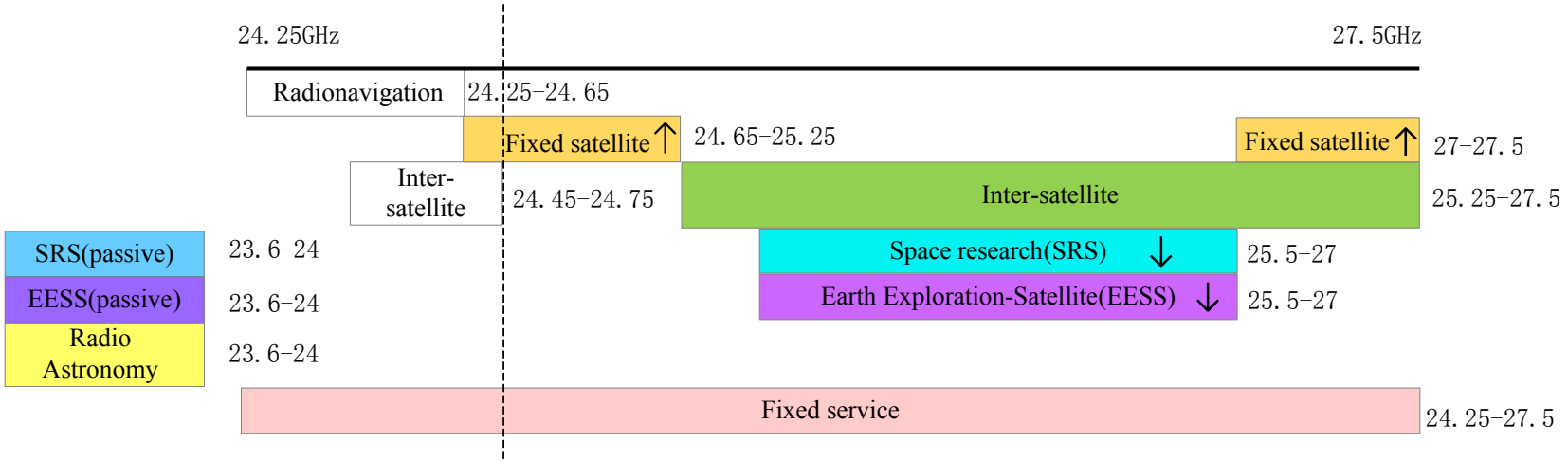
CPM text for AI 1.13

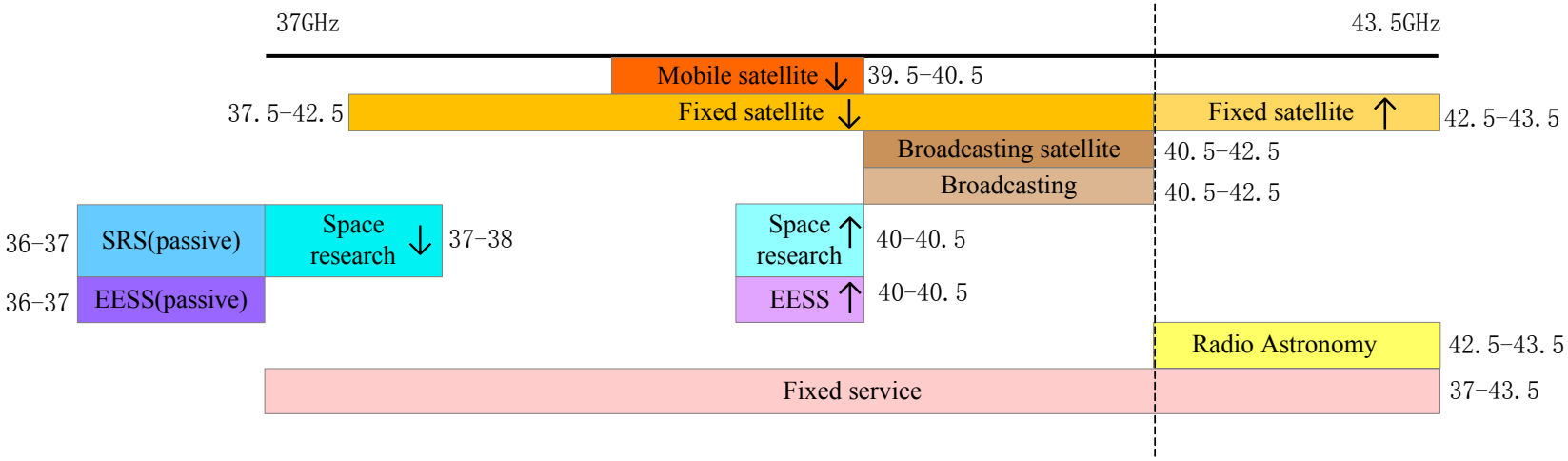
Sharing and compatibility studies between IMT-2020 and other incumbent services in the following frequency bands:

- 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

WRC-19 Agenda Item 1.13

Sharing and Compatibility studies





Technology aspects of IMT-2020

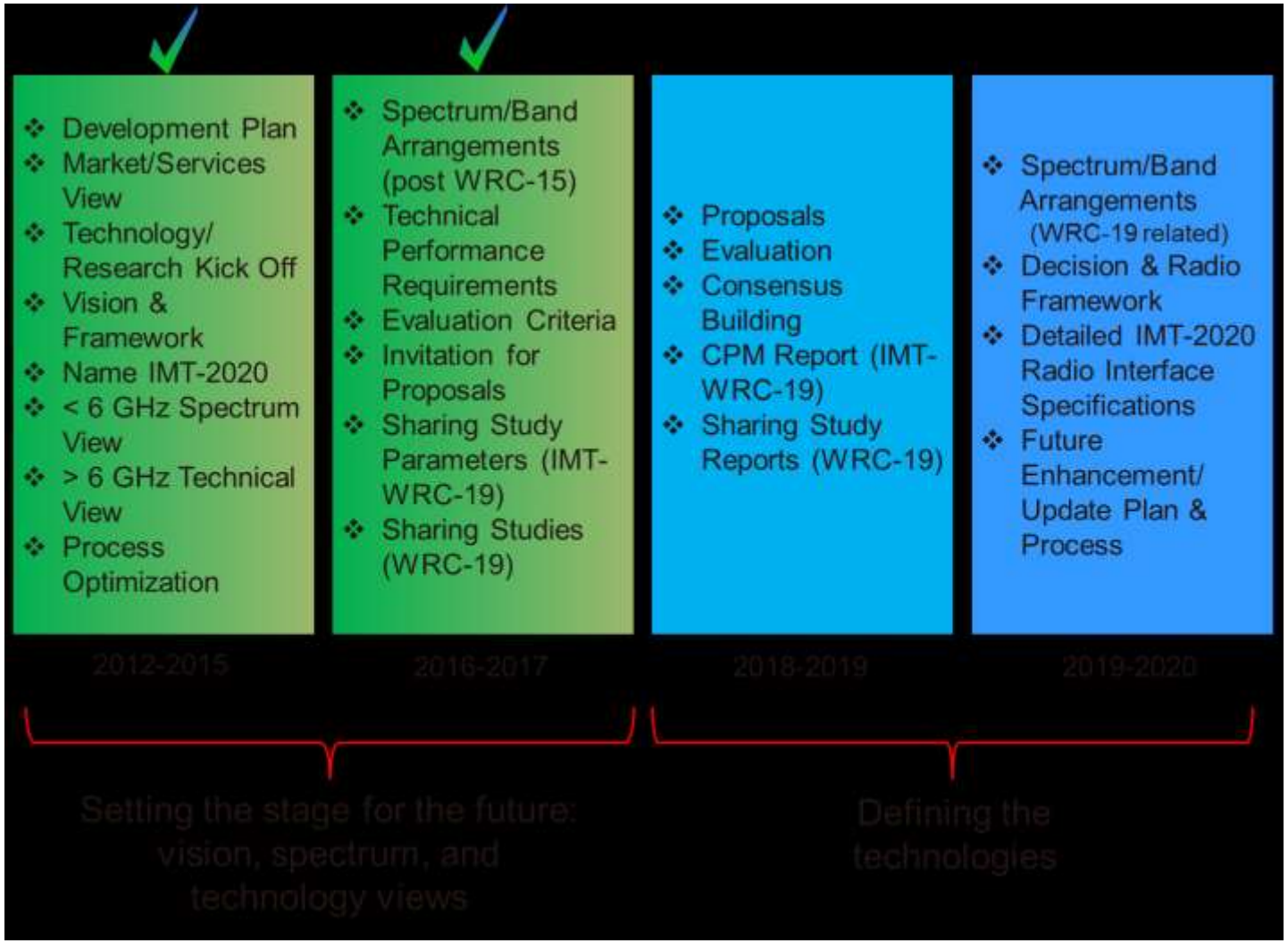
IMT-2020, IMT-Advanced, IMT-2020, …

The history of IMT

- All of today's 3G and 4G mobile broadband systems are based on standards contained in ITU Recommendations on IMT.
- 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 with 4G 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.
- IMT provides the global platform on which to build the next generations of mobile broadband connectivity

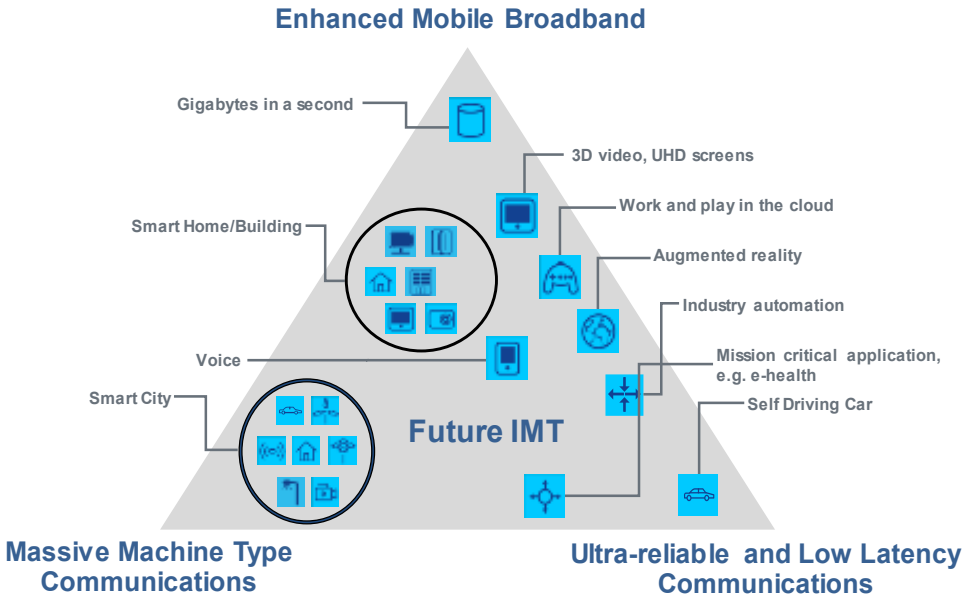
Technology aspects of IMT-2020

IMT-2020 Standardization Process

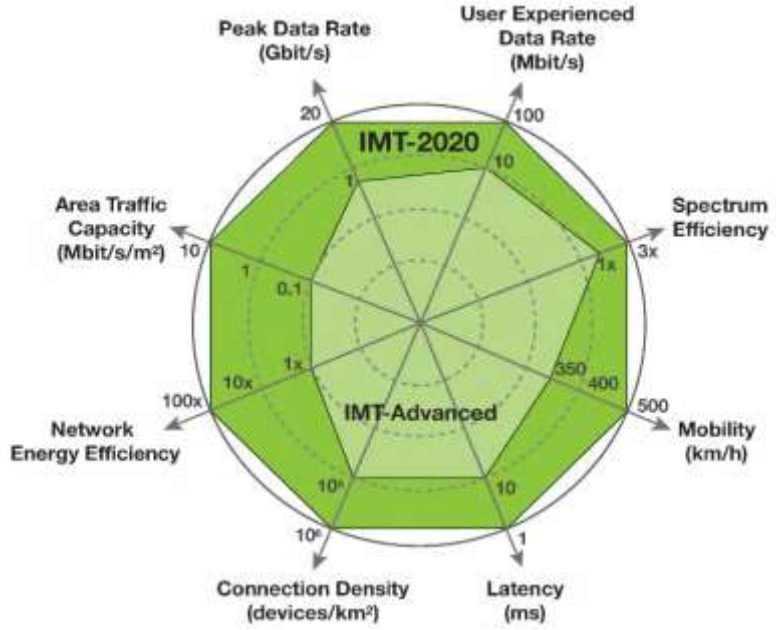


Technology aspects of IMT-2020

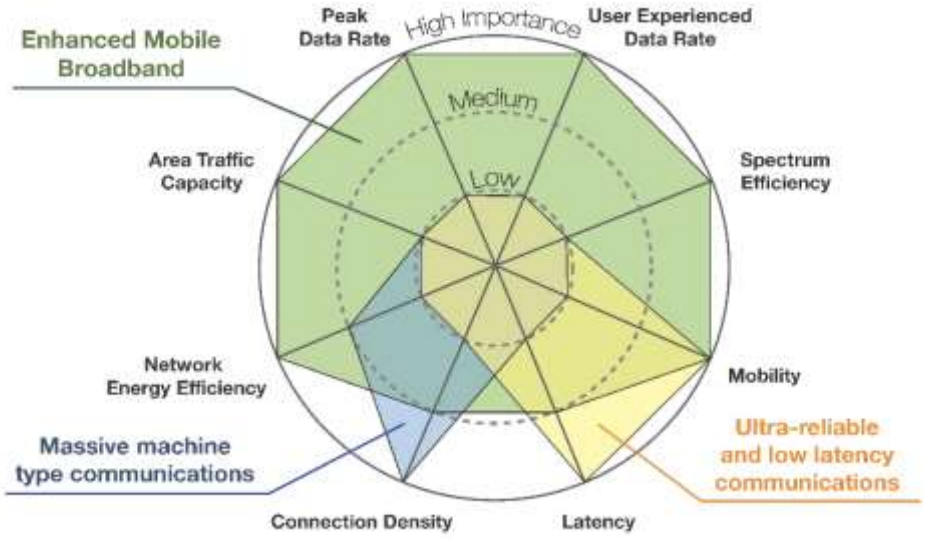
Vision



5G usage scenarios



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



The importance of key capabilities in different usage scenarios

Technology aspects of IMT-2020

Methodology

Targets:

1. **Defined Evaluation Process**

   Output Report:IMT-2020 “Submission, evaluation process and consensus building for IMT-2020”

2. **Discussion Technology requirements**

   Output Report: M.2410 “Minimum requirements related to technical performance for IMT-2020 radio interface(s)”

3. **Clarified Evaluation methodology and Configuration**

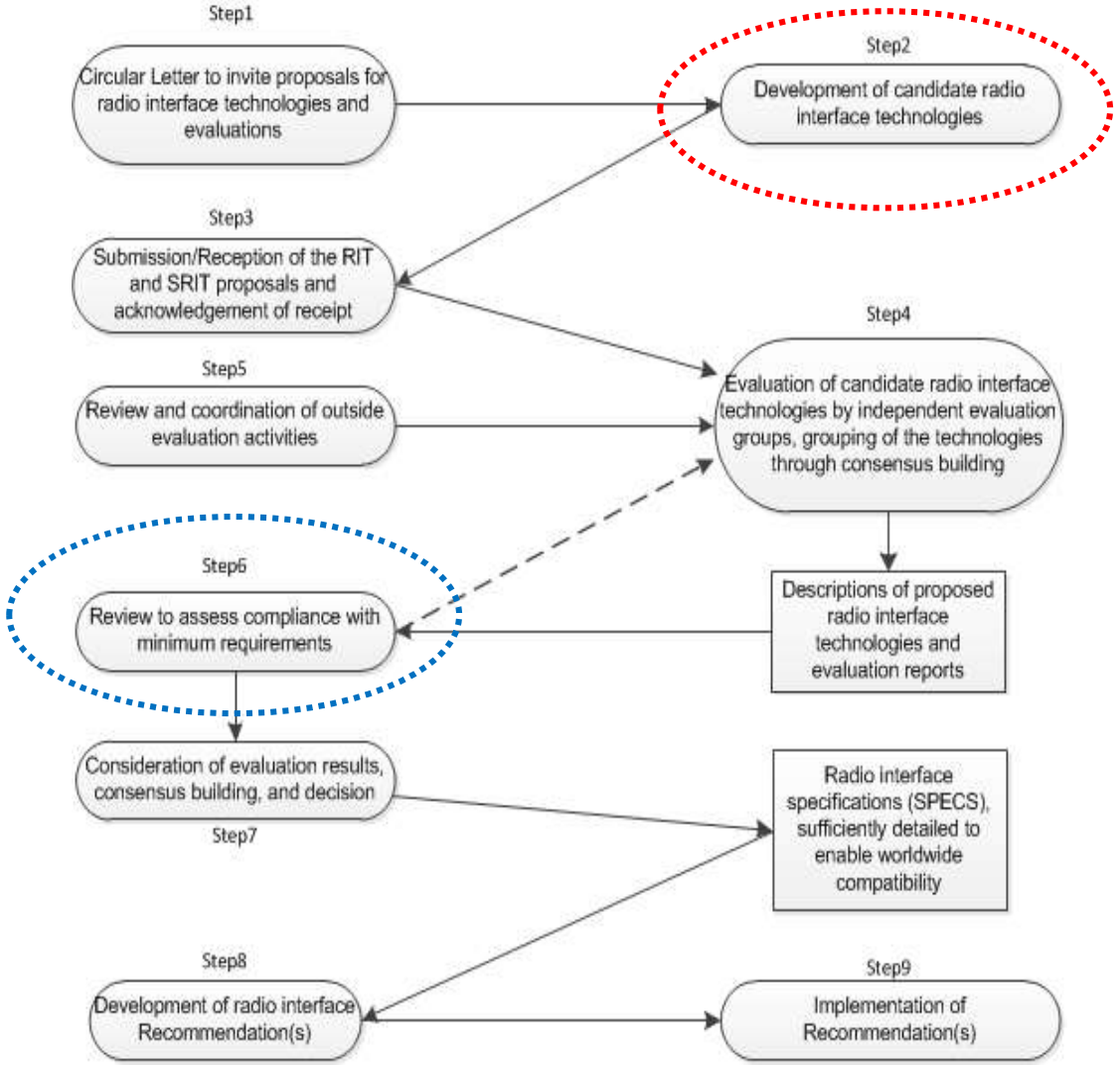
   Output Report: M.2412 “Guidelines for evaluation of radio interface technologies for IMT-2020”

4. **Approved Submission templates for proponent, such China, 3GPP and so on.**

   Output Report: M.2411 “Requirements, evaluation criteria and Submission templates for the development of IMT-2020”

Technology aspects of IMT-2020

ITU-R | Outside ITU-R



Methodology

---Evaluation process

Step 2 – Development of candidate RITs or SRITs

- An RIT needs to fulfil the minimum requirements for at least three (3) test environments; two (2) test environments under eMBB and one (1) test environment under mMTC or URLLC.
- An SRIT consists of a number of component RITs complementing each other, with each component RIT fulfilling the minimum requirements of at least two (2) test environments and together as an SRIT fulfilling the minimum requirements of at least four (4) test environments comprising the three (3) usage scenarios.

Step 6 – Review to assess compliance with minimum requirements

- the evaluated proposal for an RIT/SRIT is assessed as a qualifying RIT/SRIT, if an RIT/SRIT fulfils the minimum requirements for the five (5) test environments comprising the three (3) usage scenarios.

Technology aspects of IMT-2020

Methodology--- Requirements

Requirements for eMBB	Value(s)
Peak data rate	Downlink 20 Gbit/s; Uplink 10 Gbit/s.
Peak spectrum efficiency	Downlink 30 bit/s/Hz; Uplink 15 bit/s/Hz.
User experience data rate	100Mbps – Dense urban
5th percentile user spectral efficiency	3 times higher compared to IMT-Advanced
Average spectral efficiency	3 times higher compared to IMT-Advanced
Area traffic capacity	10Mbps/m^2 – Indoor
Energy efficiency	Support Efficient data transmission in a loaded case; and Low energy consumption when there is no data.
Mobility	Up to 500km/h
User plane latency	4ms
Control plane latency	10ms
Mobile interruption time	0ms

Technology aspects of IMT-2020

Methodology--- Requirements

Requirements for URLLC	Value(s)
User plane latency	1 ms
Control plane latency	4 ms
Mobile interruption time	0 ms
Reliability	99.999% within 1ms

Requirements for mMTC	Value(s)
Connection density	1million/km^2

General Requirement	Value(s)
Bandwidth	at least 100 MHz

Technology aspects of IMT-2020

Methodology--- Evaluation Methodology and Configuration

Five Test environments

1. Indoor Hotspot-eMBB: An indoor isolated environment at offices and/or in shopping malls based on stationary and pedestrian users with very high user density.
2. Dense Urban-eMBB: An urban environment with high user density and traffic loads focusing on pedestrian and vehicular users.
3. Rural-eMBB: A rural environment with larger and continuous wide area coverage, supporting pedestrian, vehicular and high speed vehicular users.
4. Urban Macro–mMTC: An urban macro environment targeting continuous coverage focusing on a high number of connected machine type devices.
5. Urban Macro–URLLC: An urban macro environment targeting ultra-reliable and low latency communications.

Technology aspects of IMT-2020

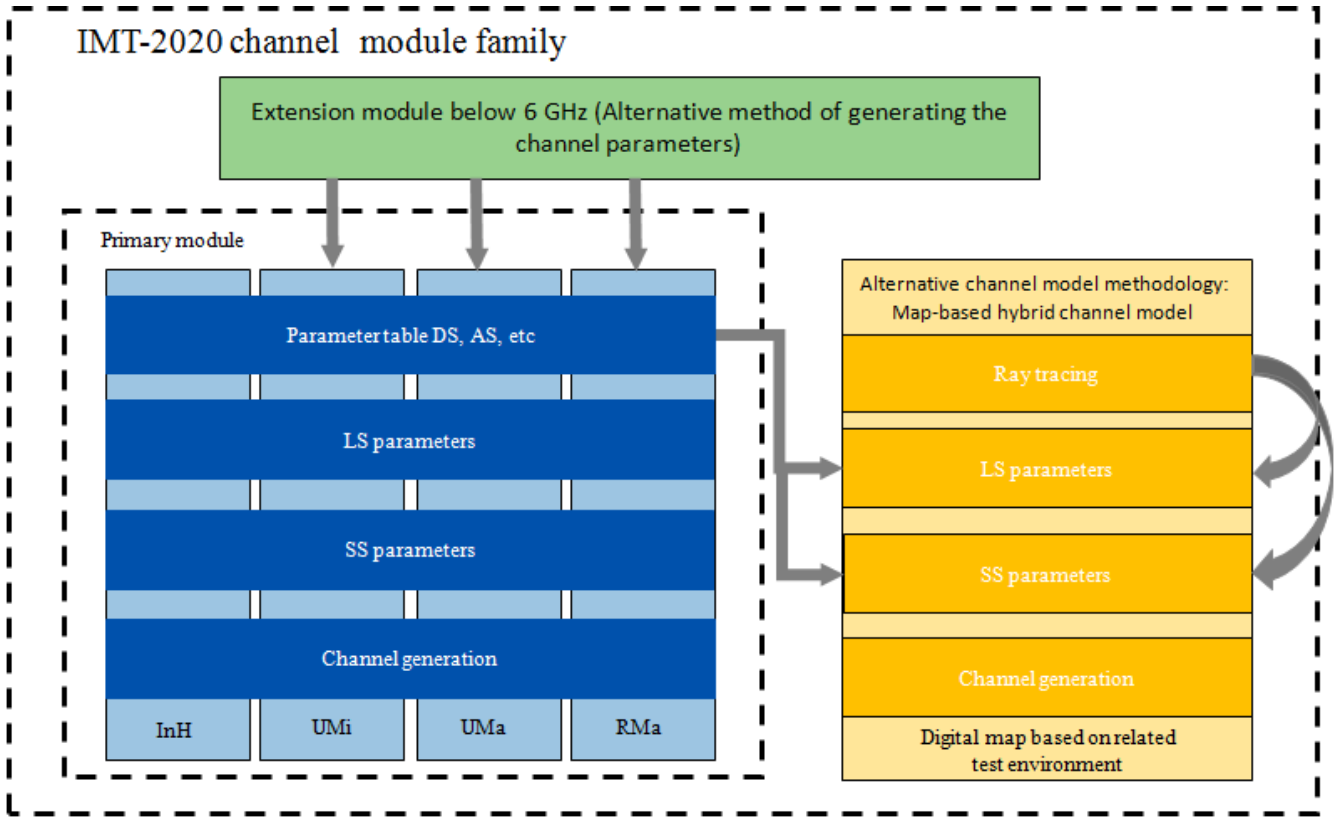
Methodology--- Channel Model

Stochastic model (Primary model)

- Below 6GHz->M.2134 from IMT-Advanced & 36.873 from 3GPP.
- Above 6GHz-> 38.900 & 36.901 from 3GPP.

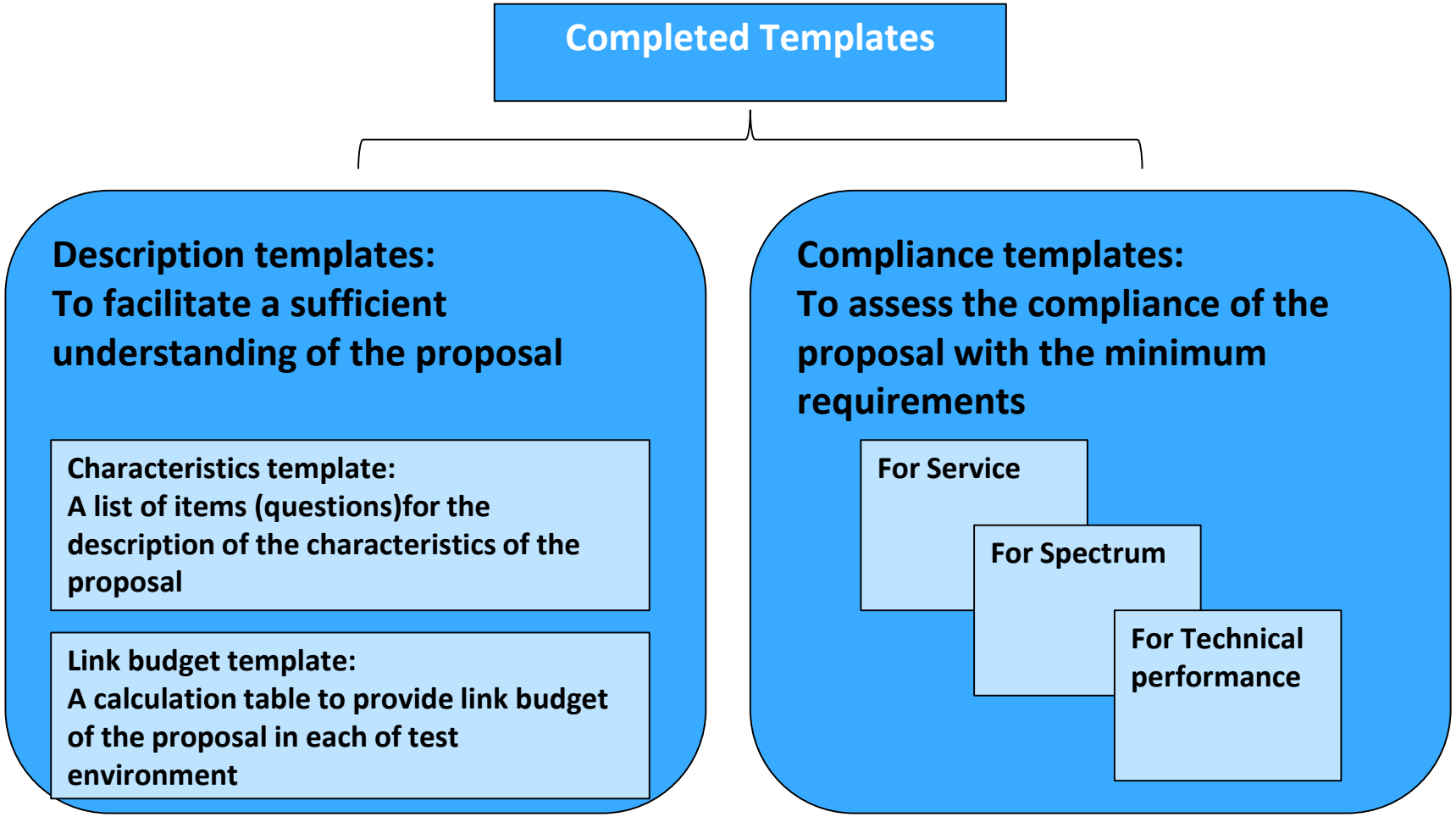
Alternative models

- TSP model proposed by Japan.
- Map-based Hybrid model proposed by China.



Technology aspects of IMT-2020

Methodology--- Submission Templates



Technology aspects of IMT-2020

Evaluation--- Self Evaluation

- A Self-Evaluation should be done by component, who is going to submit a IMT-2020 proposal
- Period: Oct 2017-July 2018
- Currently, five Components have submitted their description template, which are 3GPP(IMT-2020/3), China(IMT-2020/5), Korea(IMT-2020/4), India(IMT-2020/7) and DECT Forum(IMT-2020/6), until ITU-R WP5D #30

Evaluation--- Independent Evaluation Group(IEG)

- The ITU-R membership, standards organizations, and other organizations, who are invited to proceed with the evaluation as IEGs, evaluate IMT-2020 candidate proposal from proponent(s) .
- Period: Oct 2018-Feb 2020
- Currently, eleven IEGs have registered and shown in the ITU website.

Technology aspects of IMT-2020

Specification

Two main jobs should be achieved in the step of Specification

1. Consensus building

   Consensus building is performed during Steps 4, 5, 6 and 7 with the objective of achieving global harmonization and having the potential for wide industry support for the radio interfaces that are developed for IMT-2020. This may include grouping of RITs or modifications to RITs to create SRITs that better meet the objectives of IMT-2020.

2. Global Core Specification

   - A GCS (Global Core Specification) is the set of specifications that defines a RIT or an SRIT
   - GCS is provided by a RIT/SRIT proponent, and used by ITU to draft Recommendation M.[IMT-2020.RSPC] in step 8

Conclusion & Summary

- Global/Regional harmonisation and collaboration on 5G spectrum is crucial, ITU studies will take care of all sharing situations.
- Enough spectrum above 24 GHz is essential for further 5G development, the importance of AI 1.13 is highlighted.
- The scope of IMT-2020 is much broader than previous generations of mobile broadband communication systems. 5G is wider than just mobile industry.
- Use cases foreseen include enhancement of the traditional mobile broadband scenarios as well as ultra-reliable and low latency communications and massive machine-type communications.
- Globally harmonized standards enable global roaming and provide massive economies of scale – resulting in lower cost services and equipment usable everywhere.

Trainer information

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