ITU Asia-Pacific CoE Training

Broadband Quality of Service - End User Experience

27-30 October, 2015

Bangkok, Thailand

ITU: A brief overview

193 Member States
567 Sector Members
159 Associates
60 Academia

Headquartered in Geneva,
4 Regional Offices
7 Area Offices.

ITU-R: ITU's Radio-communication Sector globally manages radio-frequency spectrum and satellite orbits that ensure safety of life on land, at sea and in the skies.

ITU-T: ITU's Telecommunication Standardization Sector enables global communications by ensuring that countries' ICT networks and devices are speaking the same language.

ITU-D: ITU's Development Sector fosters international cooperation and solidarity in the delivery of technical assistance and in the creation, development and improvement of telecommunication/ICT equipment and networks in developing countries.

ITU: Elected Officials

Mr. Houlin Zhao
ITU Secretary-General

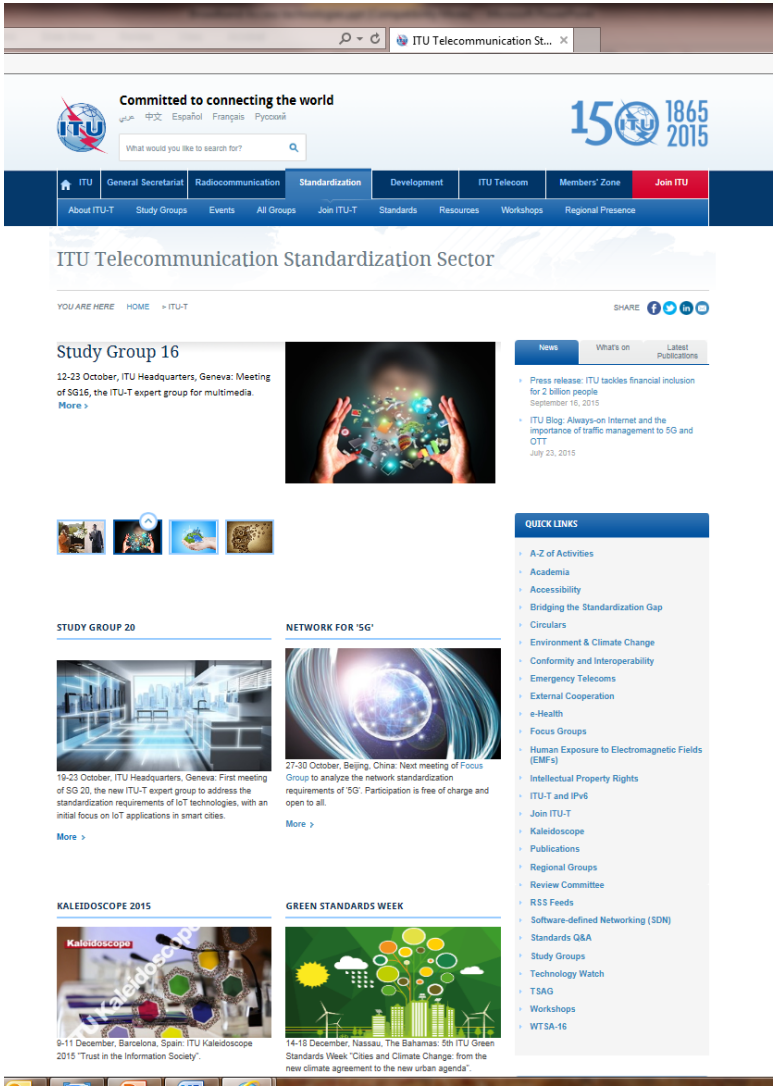
Mr. Malcolm Johnson
ITU Deputy Secretary-General

Mr. Brahima Sanou
Director
Telecommunications Development Bureau

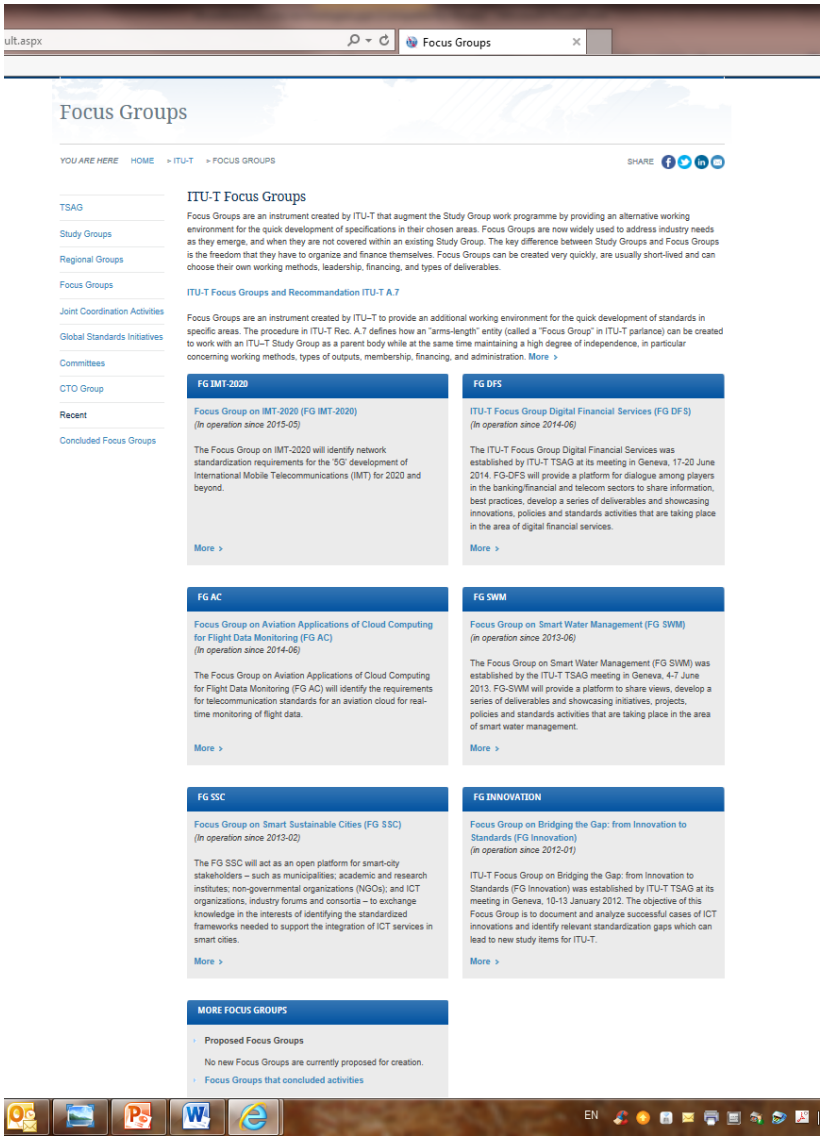
Mr. Francois Rancy
Director
Radiocommunications Bureau

Mr. Chaesub Lee
Director
Telecom Standardization Bureau

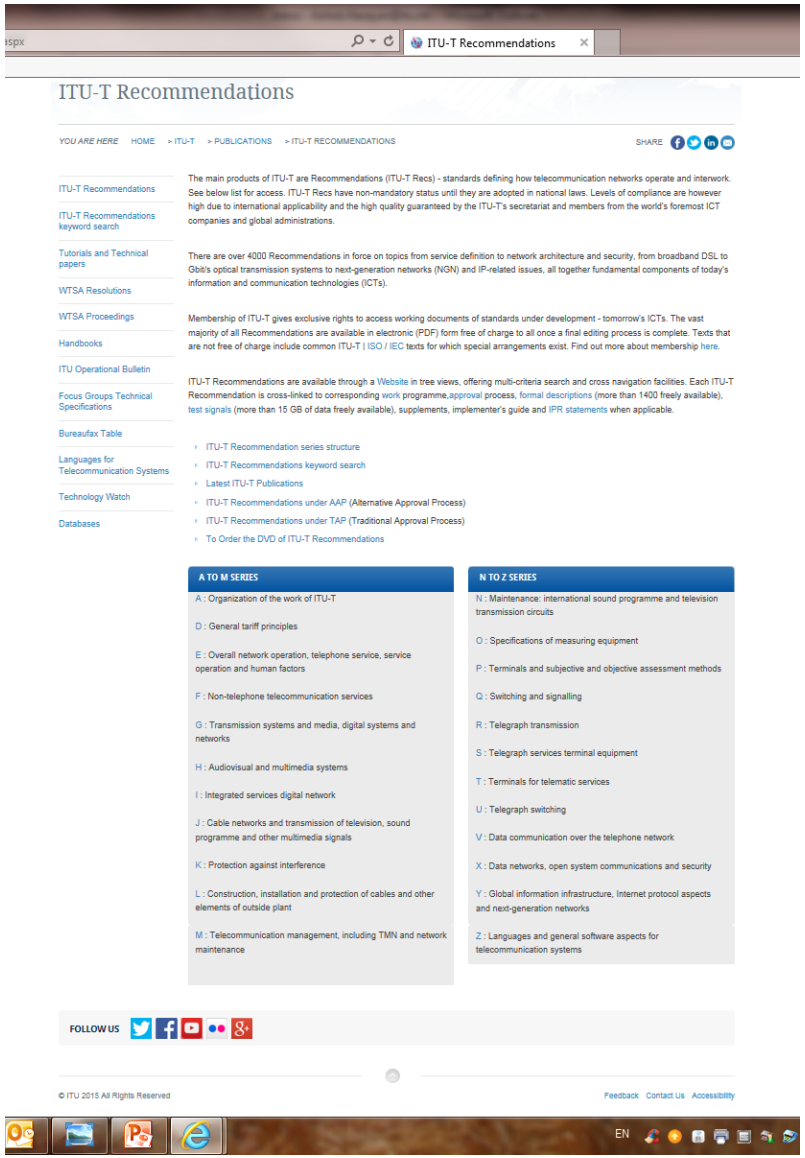
ITU and Telecommunication Standards



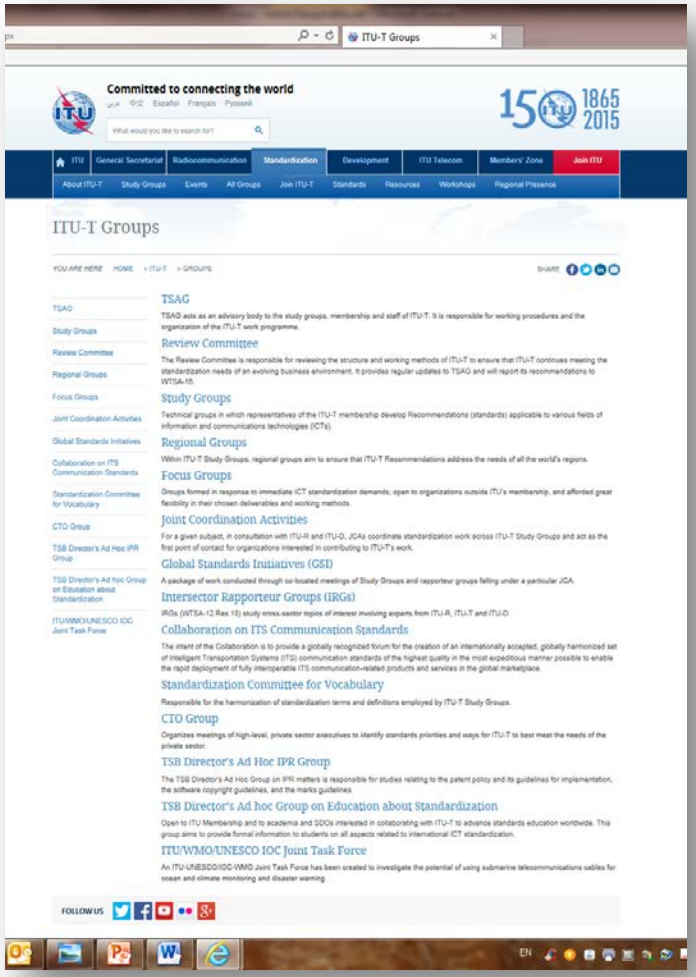
ITU-T Focus Groups



Where can I find ITU-T Rec.?



ITU-T GROUPS



ITU-T STUDY GROUPS

SG2 - Operational aspects

SG3 - Economic and policy issues

SG5 - Environment and climate change

SG9 - Broadband cable and TV

SG11 - Protocols and test specifications

SG12 - Performance, QoS and QoE

SG13 - Future networks (& cloud)

SG15 - Transport, Access and Home

SG16 - Multimedia

SG17 - Security SG20 - IoT and applications, smart cities

ITU-T Standards Development Work Flow

1. Organization X becomes a member of ITU-T and identifies an ICT issue in need of standardization.
2. X submits the suggested research item to the relevant ITU-T Study Group
3. Study Group approves the idea as study Question and allocates the work to a Working Party (WP).
4. The WP assigned to work on X's Question starts work on the development of a new ITU-T Rec.
5. The draft Rec is submitted to an SG/WP meeting and if considered mature it is given Consent to move forward into the Alternative Approval Procedure (AAP).

ITU-T Standards Approval Process

Alternate Approval Process (AAP)

Traditional Approval Process (TAP)

1. A draft Recommendation considered mature by SG/WP meeting (given consent), becomes subject for AAP.
2. Following consent is a period - Last Call (LC) - for 4 weeks in which members review and comment on the draft if necessary.
3. If no comments other than editorial are received in LC, the draft is considered approved.
4. If substantive comments are received next step is 'Additional review' (AR) - 3 weeks - where the LC text and comments (not necessarily in one document) are posted online for an additional review.
5. If no comments, other than editorial, are received in AR the draft is considered approved.
6. If comments are received the draft is sent to the next SG plenary for further discussion and possible approval.
7. The Recommendation is APPROVED. An ITU-T Recommendation is a set of guidelines. It is adopted on a voluntary basis and can be used in supply contracts.

This dramatic overhaul of standards-making by streamlining approval procedures was implemented in 2001 (estimated to cut the time involved in this process by 80 to 90 per cent.)

An average standard which took around four years to approve and publish until the mid nineties, and two years until 1997, can now be approved in an average of two months, or as little as five weeks

How are ITU Standards classified?

A : Organization of the work of ITU-T
D : General tariff principles
E : Overall network operation, telephone service, service operation and human factors
F : Non-telephone telecommunication services
G : Transmission systems and media, digital systems and networks
H : Audiovisual and multimedia systems
I : Integrated services digital network
J : Cable networks and transmission of television, sound programme and other multimedia signals
K : Protection against interference
L : Construction, installation and protection of cables and other elements of outside plant
M : Telecommunication management, including TMN and network maintenance
N : Maintenance: international sound programme and television transmission circuits
O : Specifications of measuring equipment
P : Terminals and subjective and objective assessment methods
Q : Switching and signalling
R : Telegraph transmission
S : Telegraph services terminal equipment
T : Terminals for telematic services
U : Telegraph switching
V : Data communication over the telephone network
X : Data networks, open system communications and security
Y : Global information infrastructure, Internet protocol aspects and next-generation networks
Z : Languages and general software aspects for telecommunication systems

Broadband Technologies

Operator Strategies for Promoting Broadband Deployment

Item	Operator needs and rationale[55]
Costs	Costs should be minimized as much as possible because the vast majority of the population has little discretionary budget for telecommunications/entertainment. Recovery of evolution/migration capital expenditure (CAPEX) and operating (OPEX) costs
Fixed wireless access	Some operators may provide fixed wireless access for IMT services in urban areas
Coverage and deployment obligations	Target coverage/service penetration and roll-out schedule set by regulators in some cases. The goal for coverage for IMT systems, which will be realized over time, should be consistent with existing pre-IMT-2000 systems. Roll-out obligations must be set keeping in view the business case of the operator and the user's interest
Transition time	Time frame for transition from existing "mobile"/"fixed" towards IMT. Operators should have maximum flexibility in determining and finalizing the transition
Mass application	Applications such as tele-education, telemedicine, e-government may require IMT technologies
Government support	Role of government subsidy for infrastructure and/or advanced applications (not for infrastructure but for affordability of services by all including universal service obligations)
Value depreciation	Possible obsolescence of new infrastructure investments while waiting for IMT demand
IMT bands	Access to appropriate frequency bands and adequate spectrum is required. Use of frequencies below 1 GHz and allocation of future frequency bands as per WRC/WARC decisions may be advantageous in providing cost-efficient coverage. Use of harmonized IMT bands decreases equipment costs and facilitates worldwide roaming

Source: ITU-D SG QUESTION 25/2: *Access technology for broadband telecommunications including IMT, for developing countries available at* http://www.itu.int/dms_pub/itu-d/opb/stg/D-STG-SG02.25-2014-PDF-E.pdf

Item	Operator needs and rationale[55]
Technical and administrative conditions	Conditions for use of spectrum (licensing/roaming/coverage/other operator obligations)
Infrastructure sharing	Sharing of (radio/network) resources for rapid rollout and coverage (VNO – virtual network operator) can be encouraged to facilitate speedy deployment of new technologies and lower the costs to operators
Satellite component	Usage of satellite component of IMT-2000
Market analysis and business cases	How to develop market analysis/business case? (population literacy, disposable income, . . .)
Services and applications	- Low entry fees would reduce the entry cost of service provider - Use of IMT for access to education in remote villages, rural economic development, access to Internet at affordable price
Availability of equipment from multiple vendors	- Existence of multiple vendors increases competition with positive price effects for operators - Dependency of operators on vendors is reduced - Multivendor systems require standardization by a broad community and leads to open standards

Note 55: Rev.1 of Supplement 1 to Handbook on Migration to IMT-2000 Systems (Document 25/2/2) with editorial change from IMT-2000 to the broader term, IMT

ITU-D SG QUESTION 25/2: *Access technology for broadband telecommunications including IMT, for developing countries available at* http://www.itu.int/dms_pub/itu-d/opb/stg/D-STG-SG02.25-2014-PDF-E.pdf

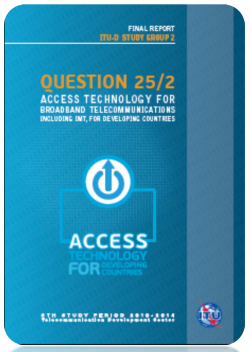
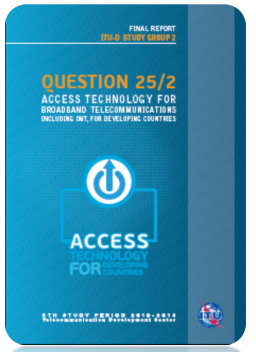


Table 3.1-1: Strengths and weakness of broadband approaches

	Strength	Weakness
Cellular mobile broadband	Constant connectivity. Broadband capability across wide areas. Good access solution for areas lacking wireline infrastructure. Capacity/coverage enhancement options via femto cells.	Lower capacity than wireline approaches. Future evolution to serve high-bandwidth applications such as IP TV.
Wireline broadband	High capacity broadband at very high data rates. Evolution to extremely high throughput rates.	Expensive to deploy new networks, especially in developing economies lacking infrastructure.

ITU-D SG QUESTION 25/2: *Access technology for broadband telecommunications including IMT, for developing countries available at* http://www.itu.int/dms_pub/itu-d/opb/stg/D-STG-SG02.25-2014-PDF-E.pdf



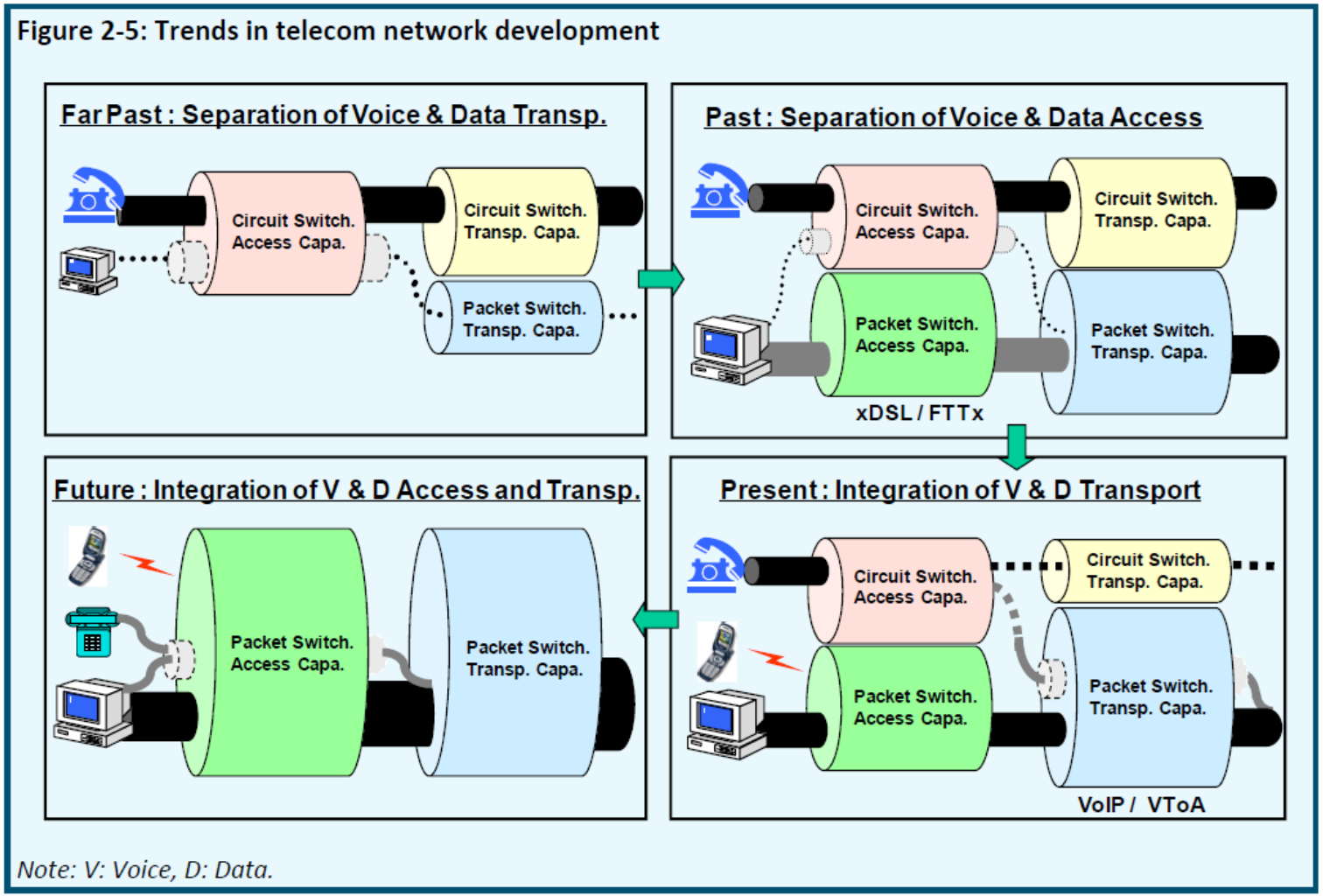
Wireline Broadband Technologies

Access network wireline data transmission standards

Modem	Data rate*	Application	Recommendation
ITU-T V.90	56 kbit/s	Data and Internet access	ITU-T V.90
ISDN BRI	144 kbit/s	2B (2 x 64 kbit/s) + D (16 kbit/s)	ITU-T I.432.x series
HDSL	2,048 kbit/s	1.5 – 2.0 Mbit/s symmetrical service on two-three pairs	ITU-T G.991.1
SHDSL	768 kbit/s	HDSL on a single pair	ITU-T G.991.2
ADSL	6 Mbit/s / 640 kbit/s	Access to Internet and multimedia databases, video distribution	ITU-T G.992.1
ADSL2	8 Mbit/s / 800 kbit/s		ITU-T G.992.3
ADSL2+	16 Mbit/s / 800 kbit/s		ITU-T G.992.5
VDSL	52 Mbit/s / 2.3 Mbit/s	Internet Access + HDTV	ITU-T G.993.1
VDSL2	100 Mbit/s		ITU-T G.993.2
VDSL2 vectoring		Internet Access + HDTV over longer loops with more users	ITU-T G.993.5

* *Downstream (network to subscriber) / upstream (subscriber to network). Single values are symmetric. DSL speeds are "up to" the values in the table.*

ITU-D SG QUESTION 25/2: *Access technology for broadband telecommunications including IMT, for developing countries available at* http://www.itu.int/dms_pub/itu-d/opb/stg/D-STG-SG02.25-2014-PDF-E.pdf



ITU-D SG QUESTION 26/2: *Migration from existing networks to next-generation networks for developing countries: technical, regulatory and policy aspects available at* http://www.itu.int/dms_pub/itu-d/opb/stg/D-STG-SG02.26-2014-PDF-E.pdf

G.FAST

"G.fast, the new ITU broadband standard designed to deliver access speeds of up to 1Gbit/s over existing telephone wires. The standard answers to service providers' need for a complement to fibre to the home (FTTH) technologies in scenarios where G.fast proves the more cost-efficient strategy.

G.fast, within the fibre to the distribution point (FTTdp) architecture, combines the best aspects of fibre and DSL."

With these functionalities and capabilities, the technology specified in **Rec. ITU-T G.9701 (12/2014) – Pre-published version** 13 targets the following aggregate net data rates over a 0.5 mm straight wire-pair:

- 500 to 1000 Mbit/s for FTTB deployments shorter than 100 m, straight loops;
- 500 Mbit/s at 100 m; (Values achieved in tests 700 Mbps)
- 200 Mbit/s at 200 m; (Values achieved in tests 500 Mbps)
- 150 Mbit/s at 250 m; (Values achieved 200 Mbps at 400 m)

Summary of ITU FTTx Standards

ITU-T G.982	Optical access networks to support services up to the ISDN primary rate or equivalent bit rates
ITU-T G.983.x	Broadband optical access systems based on Passive optical networks (PON)
ITU-T G.984.x	Gigabit-capable passive optical networks (GPON)
ITU-T G.985	100 Mbit/s point-to-point Ethernet-based optical access system
ITU-T G.986	1 Gbit/s point-to-point Ethernet-based optical access system
ITU-T G.987.x	10-Gigabit-capable passive optical network (XG-PON) systems
ITU-T G.988	ONU management and control interface specification (OMCI)

ITU-T G.989 Series NG-PON2 supports 40 Gbps

Sources: ITU-D SG QUESTION 25/2: *Access technology for broadband telecommunications including IMT, for developing countries available at* http://www.itu.int/dms_pub/itu-d/opb/stg/D-STG-SG02.25-2014-PDF-E.pdf & ITU

Hybrid Fiber Coax: Cable TV & Modem

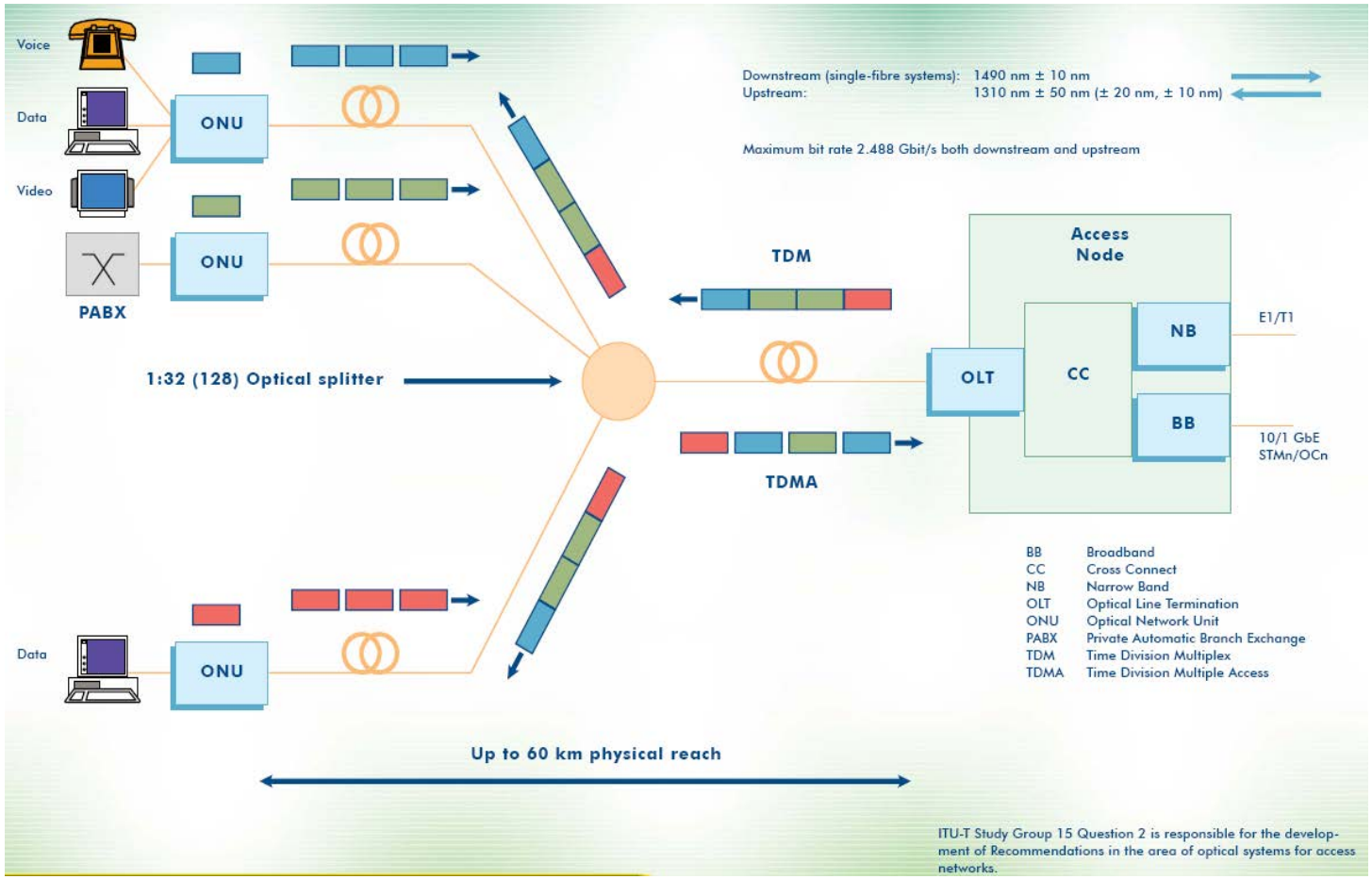
- Digital cable TV networks permits the addition of high-bandwidth data transfer to an existing Cable TV system
- Architecture Cable modem in customer premise, Cable Modem Termination System (CMTS) at the network's head-end, the well established HFC standard, DOCSIS 2.0/3.0/3.1.
- It can provides data transmission service with speeds depending upon its version on one 8 MHz channel.
- DOCSIS 3.0 was ratified as ITU-T Recommendation J.222
- Advantage - Relatively high bandwidths can be provided to the end user without distance limitations
- Disadvantage - Shared network architecture limits the amount of bandwidth delivered to customer

Gigabit – Capable Passive Optical Networks

- Full service support – including voice, TDM, Ethernet (10/100/1000 BaseT), xDSL, leased lines, wireless extension and more
- Physical reach of up to 60 km
- Support for bit-rate options using the same protocol, including 2.5 Gbit/s downstream and 1.25 Gbit/s upstream, and symmetrical 2.5 Gbit/s
- Strong Operation, Administration, Maintenance and Provisioning (OAM&P) capabilities offering end-to-end service management
- Security at the protocol level for downstream traffic due to the broadcast nature of PON

G.984.1	General Characteristics
G.984.2	Physical Media Dependent (PMD) Layer Specification
G.984.3	Transmission Convergence Layer Specification
G.984.4	ONT management and control interface specification
G.984.5	Enhanced Band

Gigabit – Capable Passive Optical Networks



Summary of ITU Home Networking Standards

ITU-T G.9901, ITU-T G.9902, ITU-T G.9903, ITU-T G.9904	Home networking transceivers for operation over powerlines
ITU-T G.9954	Home networking transceivers for operation over phone line and coaxial cables
ITU-T G.996x	Home networking transceivers for operation over phoneline, coaxial cables and power lines
ITU-T G.9972	Coexistence mechanism for wireline home networking transceivers (phone line, coaxial cable and powerline)
ITU-T G.9970	Generic home network transport architecture
ITU-T G.9971	Requirements of transport functions in IP home networks

Narrowband PLC with focus on smart grid

Source: ITU-D SG QUESTION 25/2: Access technology for broadband telecommunications including IMT, for developing countries available at http://www.itu.int/dms_pub/itu-d/opb/stg/D-STG-SG02.25-2014-PDF-E.pdf

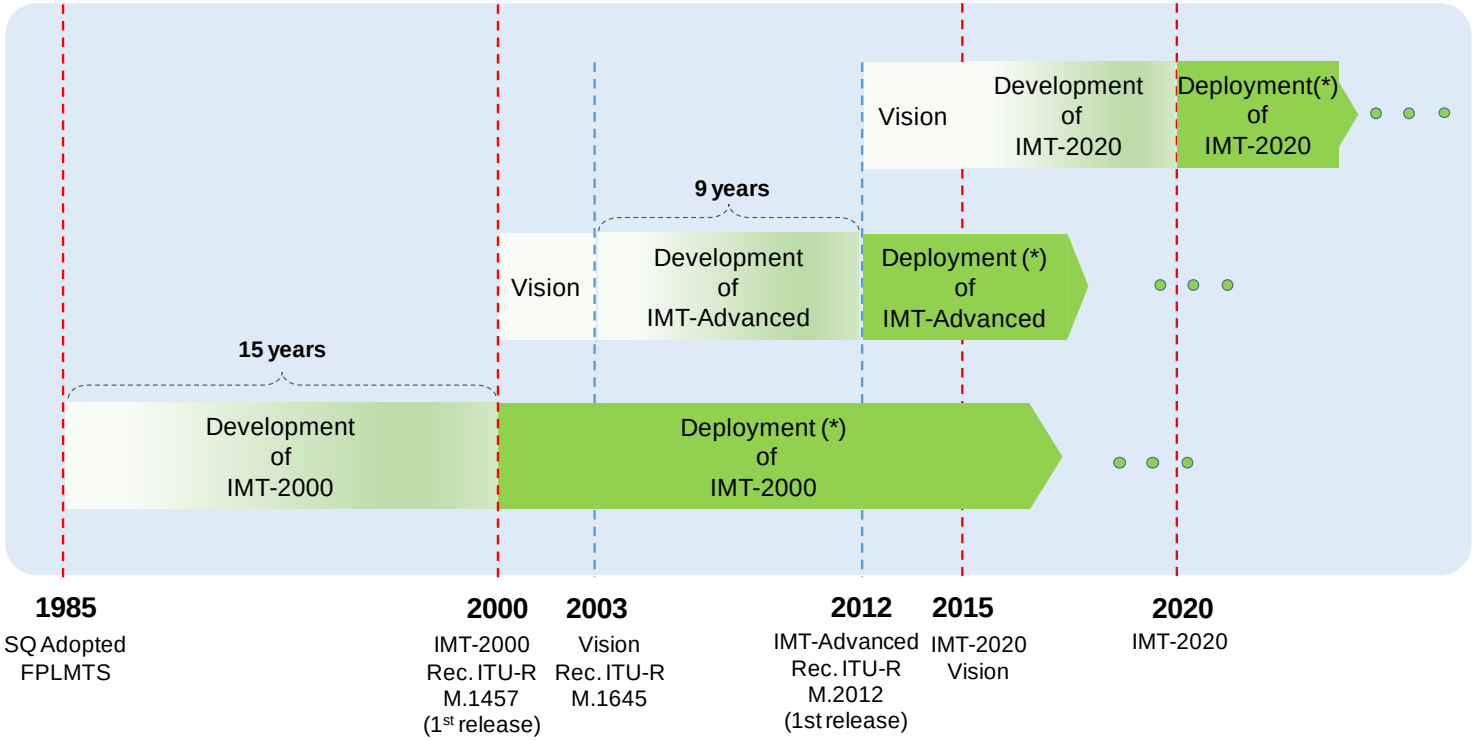
Wireless Broadband Technologies

Radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHz

1. Broadband Radio LANs (IEEE 802.11, ETSI BRAN HIPERLAN, ARIB HiSWANa)
2. IMT-2000 terrestrial radio interfaces
3. IMT-Advanced terrestrial radio interfaces
4. Harmonized IEEE and ETSI radio interface standards, for broadband wireless access (BWA) systems including mobile and nomadic applications in the mobile service (IEEE Std 802.16-2009 and ETSI HiperMAN)
5. ATIS WTSC radio interface standards for BWA systems in the mobile service
6. “eXtended Global Platform: XGP” for broadband wireless access (BWA) systems in the mobile service
7. IEEE 802.20: Standard air interface for mobile broadband wireless access supporting vehicular mobility
8. Air interface of SCDMA broadband wireless access system standard

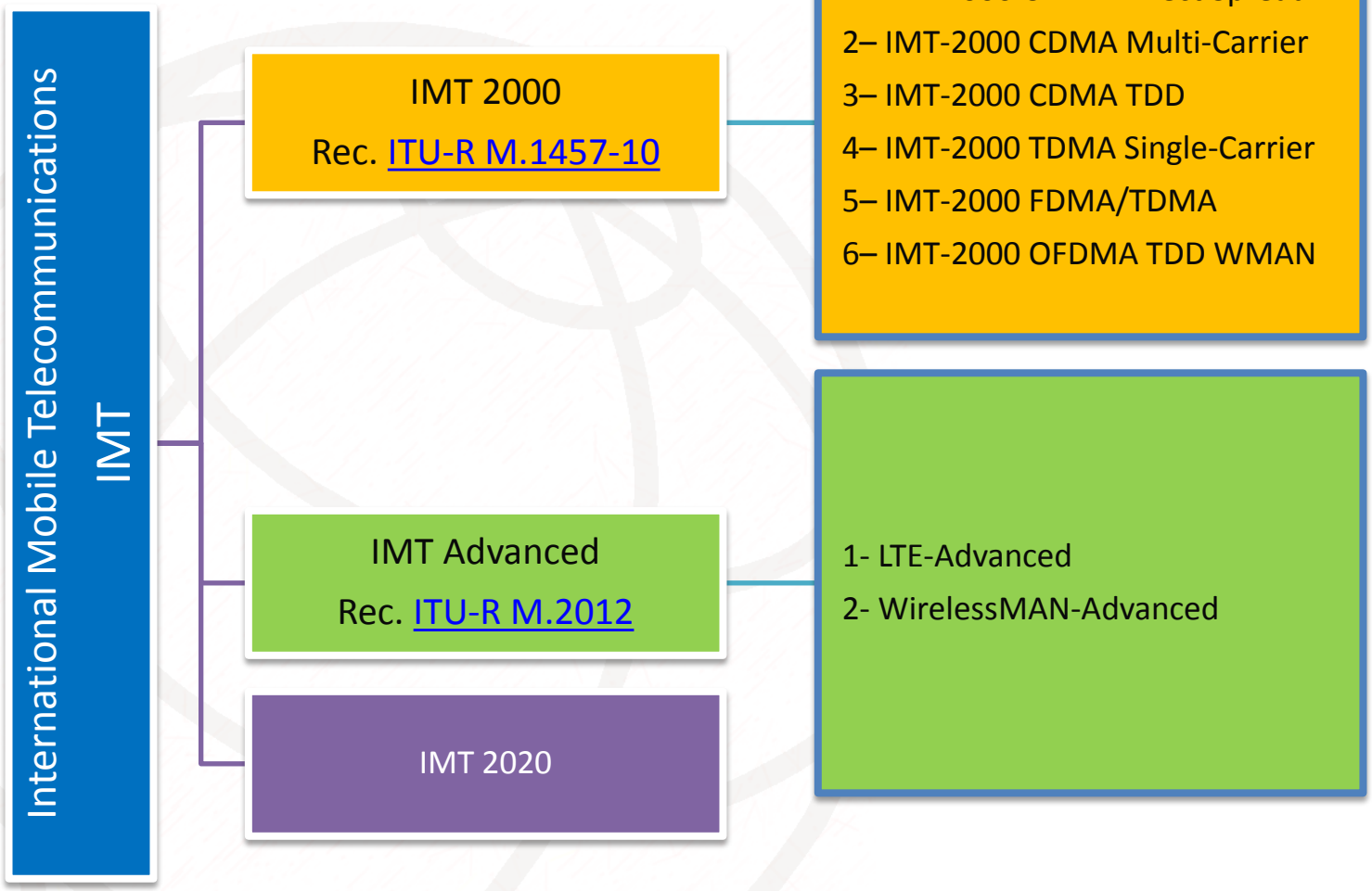
Source: ITU-R **Recommendation ITU-R M.1801-2 (02/2013))** http://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.1801-2-201302-I!!PDF-E.pdf

Overview of timeline for IMT development and deployment



(*) Deployment timing may vary across countries.

IMT Definitions



Source: http://www.itu.int/ITU-D/tech/broadband_networks/WirelessBDMasterPlans_ASP/Masterplan%20guidelines%20EV%20BAT1.pdf

IMT 2000 Vs IMT – Advanced

	IMT-2000	IMT-Advanced
ITU-R Recommendation	ITU-R M.1457-10 (06/2011): Detailed specifications of IMT-2000	ITU-R M.2012 (01/2012): Detailed specifications of IMT-Advanced
Main Technical Criteria	1- high degree of commonality of design worldwide; 2- compatibility of services within IMT-2000 and with the fixed networks; 3- high quality; 4- small terminal for worldwide use; 5- worldwide roaming capability; 6- capability for multimedia applications, and a wide range of services and terminals.	1- a high degree of commonality of functionality worldwide while retaining the flexibility to support a wide range of services and applications in a cost-efficient manner; 2- compatibility of services within IMT and with fixed networks; 3- capability of interworking with other radio access systems; 4- high-quality mobile services; 5- user equipment suitable for worldwide use; 6- user-friendly applications, services and equipment; 7- worldwide roaming capability; 8- enhanced peak data rates to support advanced services and applications (100 Mbit/s for high and 1 Gbit/s for low mobility were established as targets for research; (rates sourced from ITU-R M.1645)

IMT Specifications and Related Recommendations

IMT related documents

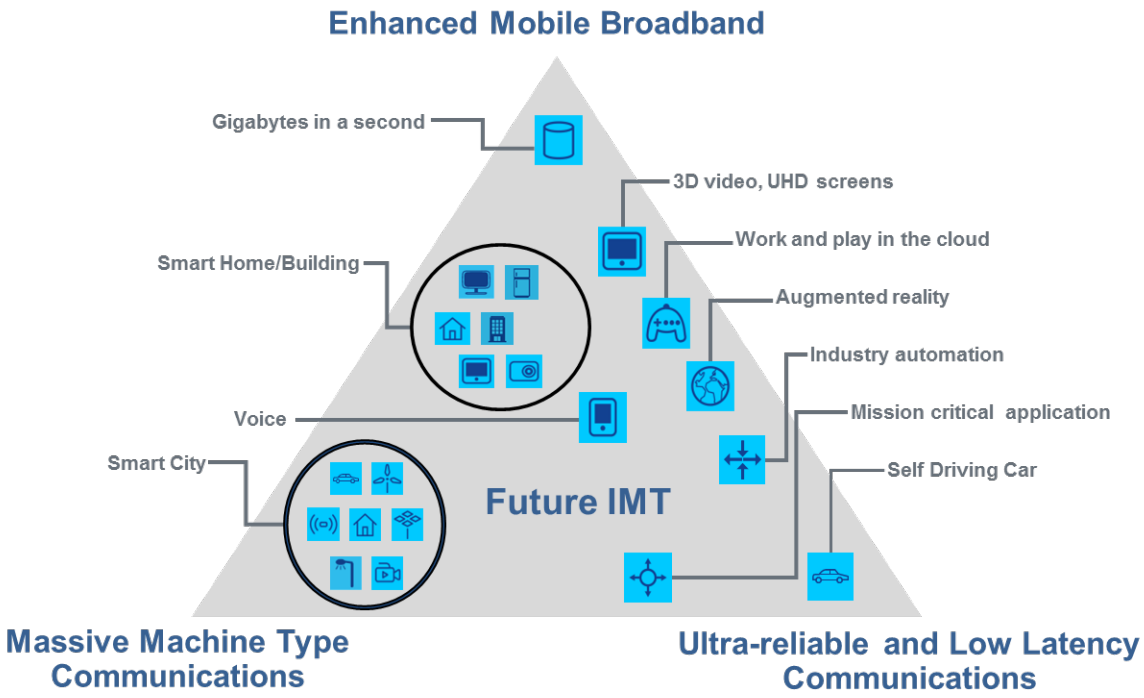
- **ITU-R Specifications for terrestrial Component**
  - **Rec. ITU-R M.2012 for IMT-Advanced** – 'Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications Advanced (IMT-Advanced)'.
  - **Rec. ITU-R M.1457 for IMT-2000** - 'Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)'.
- **Frequency Arrangement of IMT**
  - recommended frequency arrangement can be found in Recommendation ITU-R M.1036
  - frequency bands supported by LTE-Advanced are found in the Table 5.5-1 E-UTRA operating bands in ETSI TS 136 101 V10.14.0 (2014-04)
  - The frequency bands supported by WiMax MAN Advanced are found in Annex D of IEEE Std 802.16.1-2012
- **ITU-R Specifications for Satellite Component**
  - **Rec. ITU-R M.1850 for IMT-2000** (widely referred to as 3 G mobile technology) - 'Detailed specifications of the radio interfaces for the satellite component of International Mobile Telecommunications-2000 (IMT-2000)'. An ITU-R Recommendation dealing with the satellite component of IMT-Advanced is currently being developed.
- **ITU-R Recommendations related to satellite component of IMT**
  - Rec. ITU-R M.818 - Satellite operation within International Mobile Telecommunications-2000 (IMT-2000);Rec. ITU-R M.1167 - Framework for the satellite component of International Mobile Telecommunications-2000 (IMT-2000);Rec. ITU-R M.1182 - Integration of terrestrial and satellite mobile communication systems;Rec. ITU-R M.1850 - Detailed specifications of the radio interfaces for the satellite component of International Mobile Telecommunications-2000 (IMT-2000) and Rec. ITU-R M.2014 - Global circulation of IMT-2000 satellite terminals.

Source: http://www.itu.int/ITU-D/tech/broadband_networks/WirelessBDMasterPlans_ASP/Masterplan%20guidelines%20EV%20BAT1.pdf

IMT Specifications and Related Recommendations

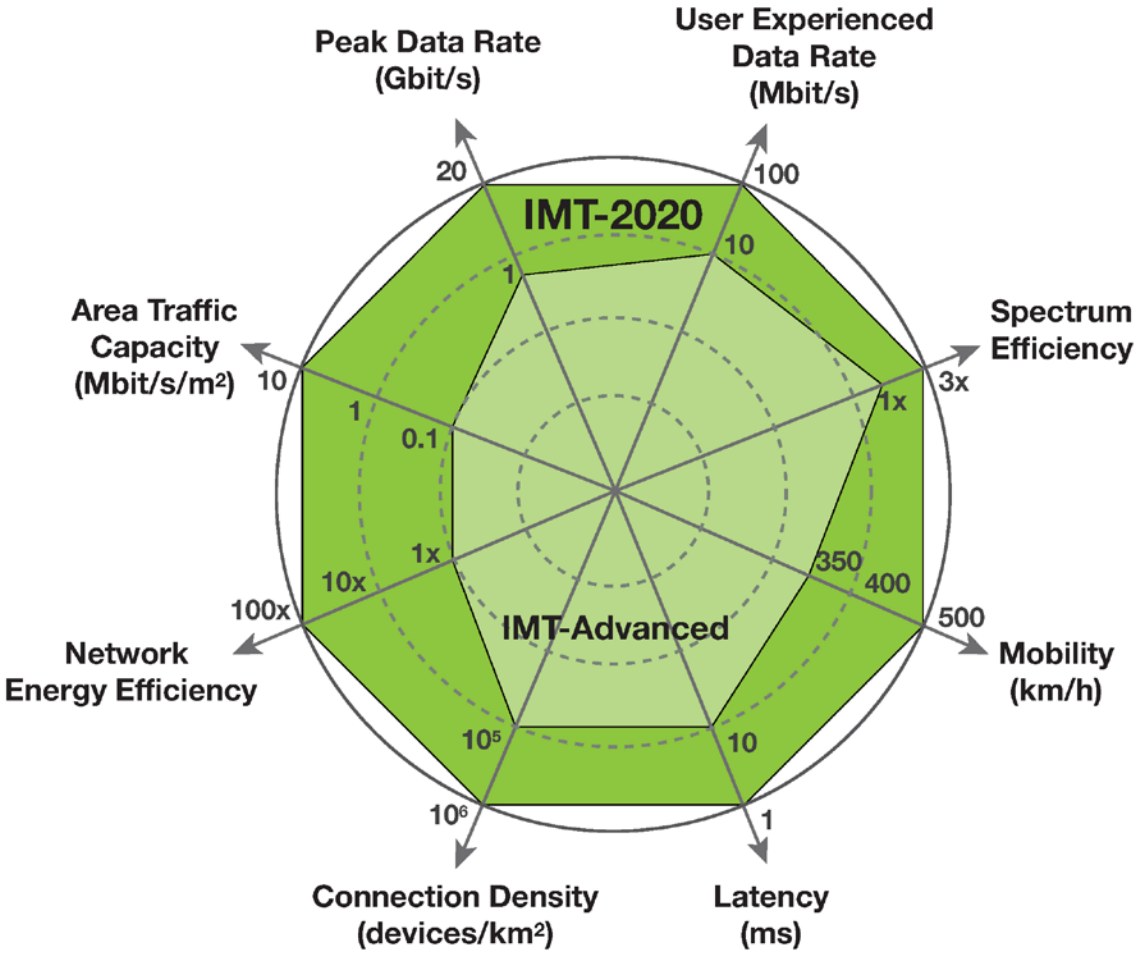
- ITU-R maintains a categorical definition of clusters of wireless broadband terrestrial and satellite technologies as IMT-2000 (3G) and IMT-Advanced (encompassing most 4G technologies), while IMT- 2020 will establish the technical criteria for 5G technologies.
- The most salient requirement for IMT-Advanced included peak service data rates of 100 Mbit/s for high mobility users and 1 Gbit/s for low mobility users.
- For the future IMT-2020, it is expected that the peak data rate will increase several times more compared with IMT-Advanced. Wireless broadband data traffic is projected to increase by a thousand-fold by 2020 and beyond.

Usage Scenarios for IMT 2020



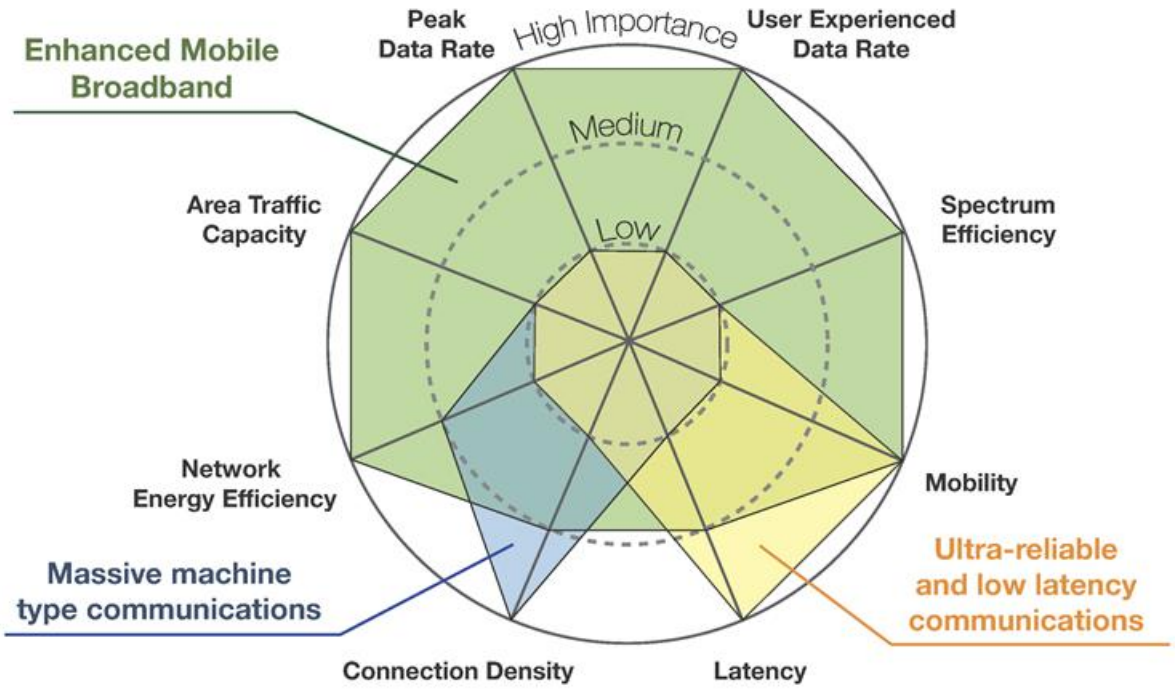
DRAFT NEW RECOMMENDATION ITU-R M.[IMT.VISION]

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



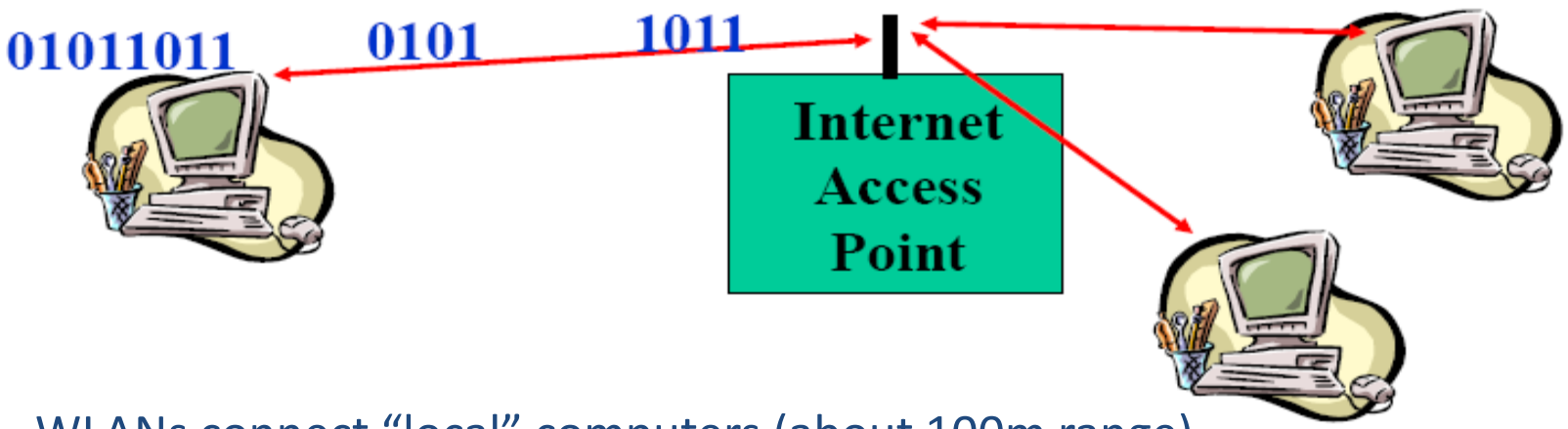
DRAFT NEW RECOMMENDATION ITU-R M.[IMT.VISION]

The importance of key capabilities in different usage scenarios



DRAFT NEW RECOMMENDATION ITU-R M.[IMT.VISION]

Wireless Local Area Networks (WLANs)



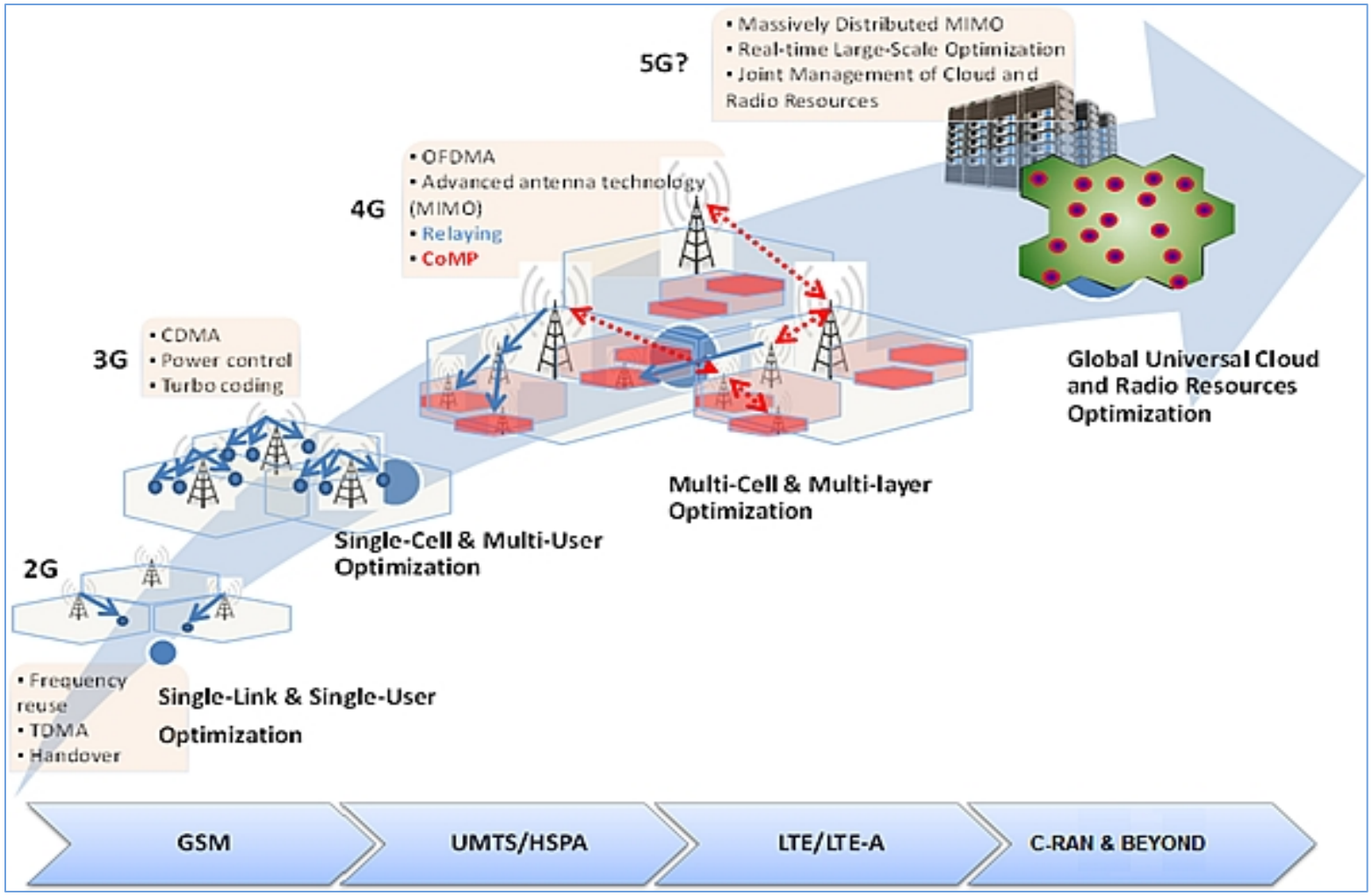
- WLANs connect “local” computers (about 100m range)
- Breaks data into packets
- Channel access is shared (random access)
- Backbone Internet provides best-effort service Poor performance in some apps (e.g. video)

WLAN Standards Comparison

	802.11b	802.11g	802.11a	802.11n	
IEEE Ratified	1999	2001	1999	2008	
Frequency	2.4GHz	2.4GHz	5GHz	2.4GHz	5GHz
Non-overlapping Channels	3	3	12	3	12
Baseline Bandwidth Per Channel	11Mbps	54Mbps	54Mbps	65Mbps	65Mbps
Number of Spatial Streams	1	1	1	2, 3* or 4*	2, 3* or 4*
Channel Bonding	No	No	No	No	Yes
Max Bandwidth Per Channel	11Mbps	54Mbps	54Mbps	130Mbps	270Mbps

Wireless Standards Comparison Table, Available Online at http://www.air-stream.org.au/wireless_standards

Wireless Standard Evolution



- LTE (Long Term Evolution) has been developed by 3GPP as a data transmitting part of IMT-2000.
- Generally LTE refers to the 3GPP UMTS standard Release 8 which was developed in 2008 and Release 9.
- LTE was approved by ETSI in 2009 and included in Rec. ITU-R M.1457-10 in 2011 as a part of IMT-2000 CDMA Direct Spread and IMT-2000 CDMA TDD specifications.
- LTE has evolved to LTE-Advanced (3GPP Standard Release 10, 11 and 12)
- LTE-Advanced supports
  - Increased peak data rate, DL 3 Gbps, UL 1.5 Gbps (design objective)
  - Higher spectral efficiency, from a maximum of 16bps/Hz in R8 to 30 bps/Hz in R10
  - Increased number of simultaneously active subscribers
  - Improved performance at cell edges, e.g. for DL 2x2 MIMO at least 2.40 bps/Hz/cell.

[Source]	Link	LTE (Rel.8)	LTE-Adv (Rel.10)	IMT-Adv
Peak data rate	DL	300 Mbps	1 Gbps	1 Gbps
	UL	75 Mbps	500 Mbps	
Spectrum efficiency	DL	15 bps/Hz	30 bps/Hz	15 bps/Hz
	UL	3.75 bps/Hz	15 bps/Hz	6.75 bps/Hz

Mobile WiMAX

- Mobile WiMAX, is IEEE 802.16e - Wireless Metropolitan Area Network (MAN)
- IEEE802.16e was completed in 2005 & allows OFDMA with both FDD and TDD operations & MIMO technology in the 2 to 6 GHz licensed bands.
- It can deliver a maximum of 144Mbits/s and cover a range of 70 miles
- First commercial mobile WiMAX network launched in Rep of Korea in June 2006
- It has evolved to Wireless MAN Advanced (IEEE 802.16-2012 and IEEE 802.16.1-2012), which meets the requirements of IMT-Advanced

	WiMAX		
	Air Interface R1.0	Air Interface R1.5	
Duplex	TDD	TDD	FDD
Channel BW	10 MHz	10 MHz	2 x 10 MHz & 2 x 20 MHz
Downlink	(2x2) SU-MIMO	(2x2) SU-MIMO	
Uplink	(1x2) SIMO	(1x2) SIMO	
Permutation	PUSC	AMC	
DL OH Symbols	3	3	3
DL Data Symbols	26	26	45
DL Modulation	64QAM	64QAM	
DL FEC Coding	5/6	5/6	
UL OH Symbols	3	3	
UL Data Symbols	15	15	45
UL Modulation	64QAM	64QAM	
UL FEC Coding	5/6	5/6	

IMT for 2020 and beyond

Please visit

http://www.itu.int/en/ITU-R/study-groups/rsg5/rwp5d/imt-2020/Pages/default.aspx

ITU towards "IMT for 2020 and beyond"

YOU ARE HERE HOME > ITU-R > STUDY GROUPS > SG 5 > WP 5D > IMT-2020

SHARE

FUTURISTIC MOBILE TECHNOLOGIES FORESEE "IMT FOR 2020 AND BEYOND"

The buzz in the industry on future steps in mobile technology — "5G" — has seen a sharp increase, with attention now focused on enabling a seamlessly connected society in the 2020 timeframe and beyond that brings together people along with things, data, applications, transport systems and cities in a smart networked communications environment. In this context, ITU and its partners, sharing a common community of interest, have recognized the relationship between IMT — International Mobile Telecommunication system — and "5G" and are working towards realizing the future vision of mobile broadband communications.

In early 2012, ITU-R embarked on a programme to develop "IMT for 2020 and beyond", setting the stage for "5G" research activities that are emerging around the world.

Through the leading role of Working Party 5D, ITU's Radiocommunication Sector (ITU-R) is finalizing its view of a timeline towards "IMT-2020"[1]. The detailed investigation of the key elements of "5G" are already well underway, once again utilizing the highly successful partnership ITU-R has with the mobile broadband industry and the wide range of stakeholders in the "5G" community.

In 2015, ITU-R plans to finalize its "Vision" of the "5G" mobile broadband connected society. This view of the horizon for the future of mobile technology will be instrumental in setting the agenda for the World Radiocommunication Conference 2015, where deliberations on additional spectrum will take place in support of the future growth of IMT.

ITU has a rich history in the development of radio interface standards for mobile communications. The framework of standards for International Mobile Telecommunications (IMT), encompassing IMT-2000 and IMT-Advanced, spans the 3G and 4G industry perspectives and will continue to evolve as 5G with "IMT-2020".

[1] The use of the term "IMT-2020" is a placeholder terminology and the specific nomenclature to be adopted for the future development of IMT is expected to be finalized at the Radiocommunication Assembly 2015.

WORKING PARTY 5D STUDY AREAS AND/OR DELIVERABLES TOWARDS "IMT FOR 2020 AND BEYOND"

Working Party 5D is engaged in a wide range of activities for IMT. These activities include new information and deliverables to guide the continuing evolution of terrestrial IMT. At a high level the work is organized in these broad categories:

VISION & TECHNOLOGY TRENDS	MARKET, TRAFFIC, 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

Draft new Report ITU-R M.[FUTURE TECHNOLOGY TRENDS] *(October 2014)*

This activity is to address the terrestrial IMT technology aspects and enablers considering the approximate timeframe 2015-2020 *and beyond* for system deployment, including aspects of terrestrial IMT systems related to WRC-15 studies as part of its scope.

Draft new Recommendation ITU-R M.[IMT.VISION] *(June 2015)*

This activity is to address the longer term vision for 2020 and beyond and will provide a framework and overall

of IMT.

www.itu.int/en/ITU-R/study-groups/rsg5/rwp5d/imt-2020

KEY MESSAGES ON IMT AND THE FUTURE OF MOBILE BROADBAND WIRELESS

I) Mobile Broadband is Not Optional in Society

- IMT is an essential foundation of modern 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 ago.

II) 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 continue to evolve to improve on spectrum efficiency & utilization. They 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 requires adequate spectrum if these society benefits are to continue.

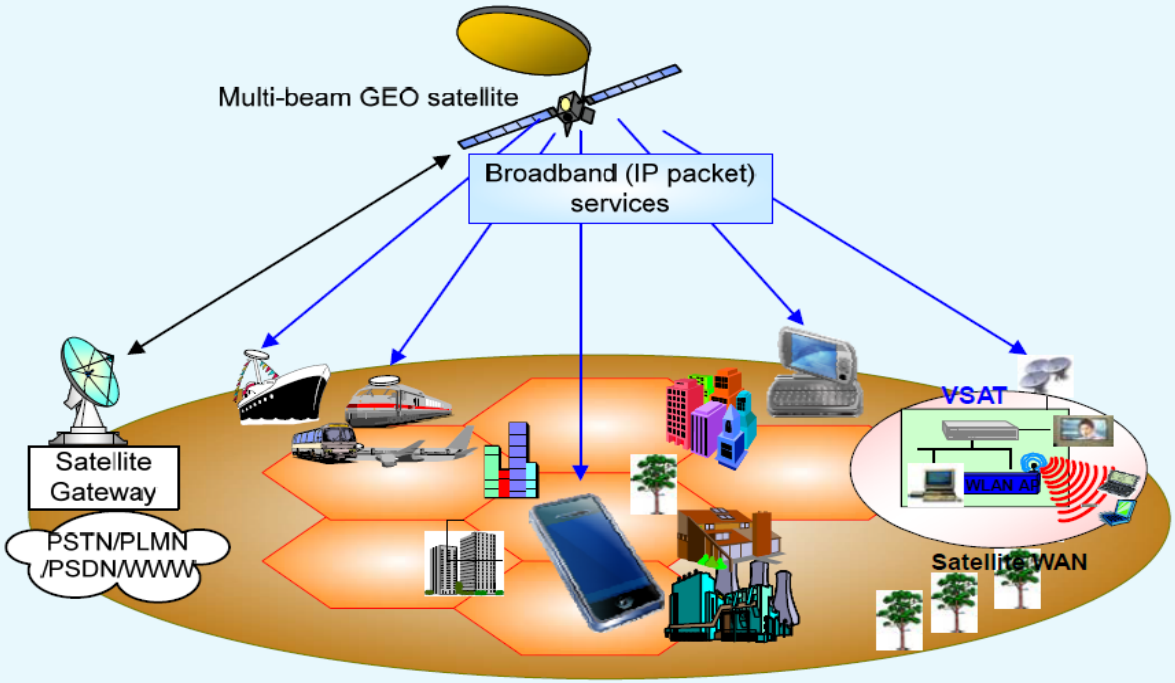
III) ITU has a rich history in the development of radio interface standards for mobile communications.

- The framework of standards for International Mobile Telecommunications (***IMT***) encompasses IMT-2000 and IMT-Advanced which spans the 3G and 4G industry perspective.
- IMT standards will expand to incorporate ***"IMT for 2020 and beyond"***.

Satellite Broadband Technologies

Satellite Broadband Access Technology

Figure 3.5.3.1-1: Multi-beam satellite system providing broadband (IP packet) services



Source: ITU-D SG QUESTION 25/2: Access technology for broadband telecommunications including IMT, for developing countries available at http://www.itu.int/dms_pub/itu-d/opb/stg/D-STG-SG02.25-2014-PDF-E.pdf

Advances in Satellite Broadband Technologies

Timeline	2005	2010	2015	2020
Generation	Ku-band satellites	First generation multi beam Ka-band satellites	Second generation multi beam Ka-band satellites	Third generation multi beam Ka-band satellites
Service capability	Internet broadband	High speed Internet broadband	Superfast Internet broadband	Very high speed Internet broadband
Maximum service rate	2-3 Mbps	10-2 Mbps	30-50 Mbps	100 Mbps
Capacity per satellite	5	50-100	150-200	>500
Users per satellite	100.000	Several 100.000s	Up to 1 million	>1 million

Source: ISI European Technology Platform.