
**ITU-D Regional Development Forum
for the Arab Region:
"NGN and Broadband, Opportunities and Challenges"**

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Broadband wireless standards

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**Terrestrial Wireless
Broadband**




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Terrestrial BWA

- Studies on terrestrial BWA in ITU-R are carried out in **Study Group 5**:
- **Working Party 5A** – non- IMT BWA (fixed and mobile)
- **Working Party 5C** – FWA systems not related to public access systems for potentially mass market coverage (e.g. P-MP fixed systems)
- **Working Party 5D** – IMT systems


Some key publications on terrestrial BWA

- **Rec. ITU-R F.1763** - Radio interface standards for broadband wireless access systems in the fixed service operating below 66 GHz
- **Rec. ITU-R M.1801** - Radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHz
- **Rec. ITU-R M.1457** - Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)
- **Land Mobile Handbook** (including Wireless Access)
Volume 1: Fixed Wireless Access
Volume 5: Broadband Wireless Access Systems.
- **Handbook on deployment of IMT-2000 systems** (and revision 1 to Supplement 1)

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Many more texts on terrestrial BWA


	Num	Rev	Title	WP
F	757	3	Basic system requirements and performance objectives for fixed wireless access using mobile-derived technologies offering telephony and data communication services	5A
F	1399	1	Vocabulary of terms for wireless access	5C
F	1400	0	Performance and availability requirements and objectives for fixed wireless access to public switched telephone network	5C
F	1401	1	Considerations for the identification of possible frequency bands for fixed wireless access and related sharing studies	5C
F	1402	0	Frequency sharing criteria between a land mobile wireless access system and a fixed wireless access system using the same equipment type as the mobile wireless access system	5C
M	1454	0	E.i.r.p. density limit and operational restrictions for RLANS or other wireless access transmitters in order to ensure the protection of feeder links of non-geostationary systems in the mobile-satellite service in the frequency band 5 150-5 250 MHz	5A
M	1457	7	Detailed specifications of the radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)	5D
SF	1486	0	Sharing methodology between fixed wireless access systems in the fixed service and very small aperture terminals in the fixed-satellite service in the 3 400-3 700 MHz band	SG4, 5C
F	1488	0	Frequency block arrangements for fixed wireless access systems in the range 3 400-3 800 MHz	5A
F	1489	0	A methodology for assessing the level of operational compatibility between fixed wireless access and radiolocation systems when sharing the band 3.4-3.7 GHz	5A
F	1490	1	Generic requirements for fixed wireless access systems	5A
F	1499	0	Radio transmission systems for fixed broadband wireless access based on cable modem standard	5A
F	1518	0	Spectrum requirement methodology for fixed wireless access and mobile wireless access networks using the same type of equipment, when coexisting in the same frequency band	5A
F	1568	1	Radio-frequency block arrangements for fixed wireless access systems in the range 10.15-10.3/10.5-10.65 GHz	5A, 5C
....				

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Some recent studies on terrestrial BWA

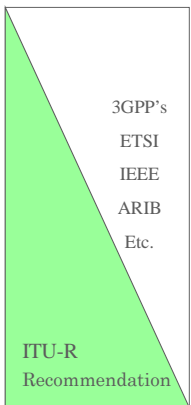
- Draft revision of Recommendation ITU-R M.1652 - Dynamic frequency selection (DFS) in wireless access systems including radio local area networks for the purpose of protecting the radiodetermination service in the 5 GHz band
- Draft revision of Recommendation ITU-R F.757-3 - Basic system requirements and performance objectives for fixed wireless access using mobile-derived technologies offering telephony and data communication services
- Report ITU-R M.2116-1 - Characteristics of broadband wireless access systems operating in the land mobile service for use in sharing studies
- Report ITU-R M.2198 ([IMT.RADIO]) - The outcome of the evaluation, consensus building and decision of the IMT-Advanced process (steps 4-7), including characteristics of IMT-Advanced radio interfaces

Scope of BWA Standardization



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Protocol stack		Specified items
Higher Layer	Application	—
	TCP	—
Network layer (IP)		<ul style="list-style-type: none"> • Network routing • Mobility management
Data Link Layer	DLC Sub-layer	<ul style="list-style-type: none"> • Send-receive flow control • ARQ control • QoS control
	MAC Sub-layer	<ul style="list-style-type: none"> • Medium access control • Error detection & correction
Physical Layer (PHY)		<ul style="list-style-type: none"> • Radio frequency arrangement • Modulation/Demodulation • Transmission bit rate • Necessary bandwidth • Frequency sharing criteria




3GPP's
ETSI
IEEE
ARIB
Etc.

ITU-R Recommendation

TCP : Transmission Control Protocol IP : Internet Protocol
MAC : Media Access Control DLC : Data Link Control

Fixed BWA

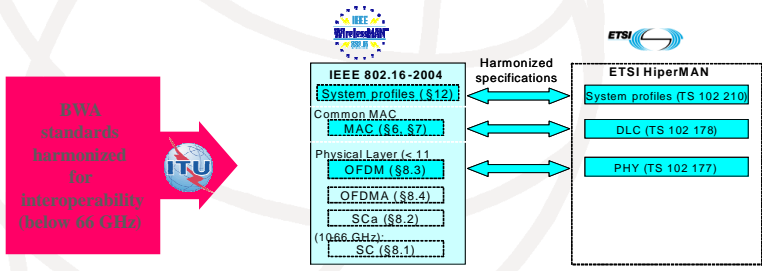


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Rec. ITU-R F.1763 - Radio interface standards for broadband wireless Access systems in the fixed service operating below 66 GHz

The Recommendation identifies specific radio interface standards for BWA systems in the FS, addressing profiles for the recommended interoperability standards.

The **interoperability** standards referenced in the Recommendation include the following specifications: system profiles; PHY layer parameters, i.e. channelization, modulation scheme, data rates; MAC layer messages and header fields; conformance testing methods:



The diagram illustrates the harmonization of specifications between IEEE 802.16-2004 and ETSI HiperMAN. On the left, IEEE 802.16-2004 specifications include System profiles (§12), Common MAC (MAC (§8.5, §7)), Physical Layer ($s.1.1$) with OFDM (§8.3), OFDMA (§8.4), SCA (§8.2), and SC (§8.1) for 10.66 GHz. On the right, ETSI HiperMAN specifications include System profiles (TS 102 210), DLC (TS 102 178), and PHY (TS 102 177). Double-headed arrows labeled 'Harmonized specifications' connect the corresponding sections of both standards.

Mobile BWA

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Rec. ITU-R M.1801 - Radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHz

This Recommendation identifies specific radio interface standards for BWA systems in the mobile service operating below 6 GHz.

- Broadband radio local area networks
- IMT-2000 terrestrial radio interfaces
- Harmonized IEEE and ETSI radio interface standards
- ATIS WTSC radio interface standards
- Next-generation PHS

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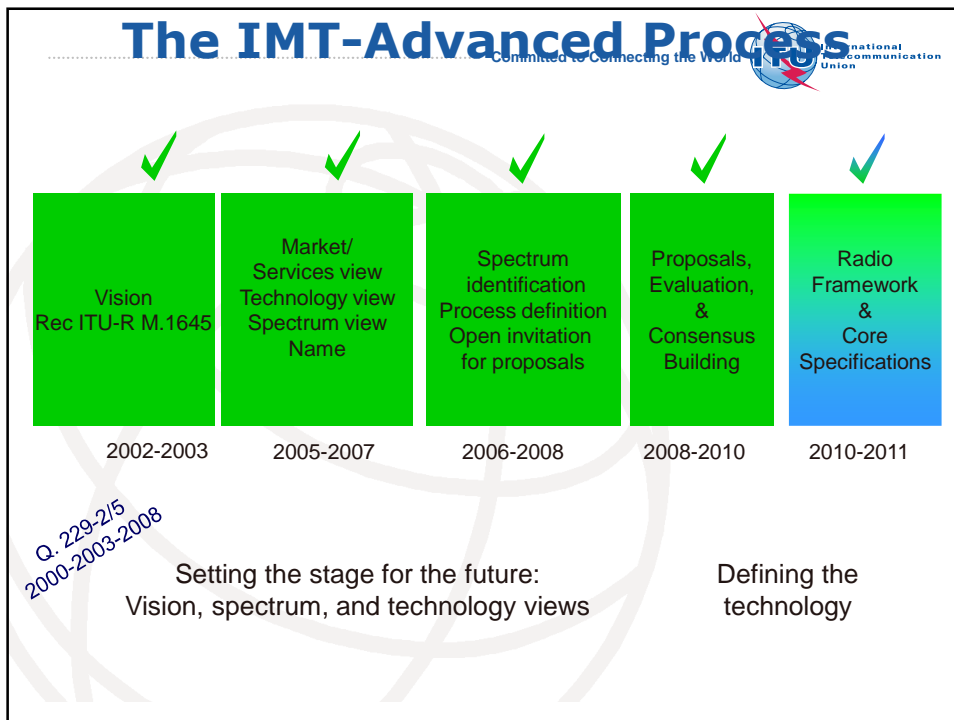
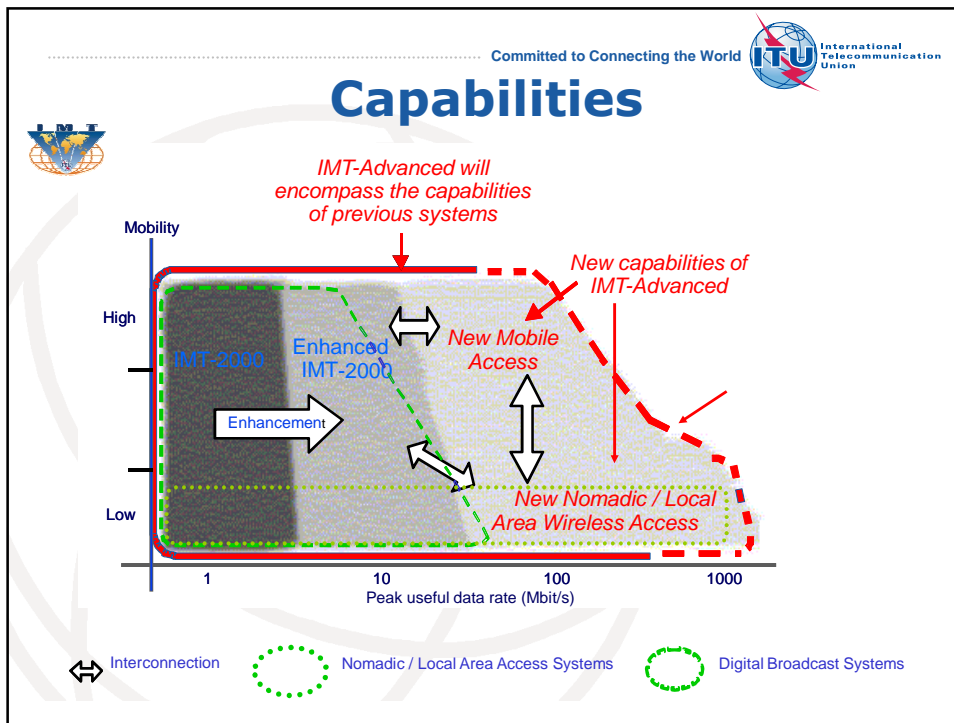


IMT

For the last 25 years, ITU has been coordinating the development of a global broadband multimedia international mobile telecommunication system, known as IMT.

Since 2000, the world has seen the introduction of the first family of standards derived from the IMT concept - IMT-2000 (commonly referred to as 3G). 3G is now widely deployed and being rapidly enhanced.

“IMT-Advanced” provides a global platform on which to build the next generations of mobile services - fast data access, unified messaging and broadband multimedia - in the form of exciting new interactive services and applications.






Decision

- **LTE-Advanced** and **WirelessMAN-Advanced** technologies were each determined to have successfully met all of the criteria established by ITU-R for the first release of IMT-Advanced.
- **LTE-Advanced** is developed by 3GPP as LTE Release 10 and Beyond (LTE-Advanced).
- **WirelessMAN-Advanced** is developed by IEEE as the WirelessMAN-Advanced specification incorporated in IEEE Std 802.16 beginning with approval of IEEE Std 802.16m.
- Full details of the submissions and evaluation process are contained in the recently Approved Report ITU-R M.2198
- The detailed technical specifications of these radio interfaces will be contained in Recommendation ITU-R M.[RSPEC] to be finalized in 2011.


Satellite Wireless Broadband



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Satellite BWA

- **Studies on satellite BWA in ITU-R are carried out in Study Group 4:**
- **Working Party 4A** – Efficient orbit/spectrum utilization for FSS and BSS
- **Working Party 4B** – Systems, air interfaces, performance and availability objectives for FSS, BSS and MSS, including IP-based applications and satellite news gathering
- **Working Party 4C** – Efficient orbit/spectrum utilization for MSS and RDSS

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Some key publications on satellite BWA

- **Recommendation ITU-R S.1782** - Possibilities for global broadband Internet access by fixed-satellite service systems;
- **Recommendation ITU-R S.1709-1** - Technical characteristics of air interfaces for global broadband satellite systems;
- **Recommendation ITU-R S.1711-1** - Performance enhancements of transmission control protocol over satellite networks;
- **Recommendation ITU-R S.1783** - Technical and operational features characterizing high-density applications in the fixed-satellite service.

Some key publications on satellite BWA


- **Report ITU-R S.2148** - Transmission control protocol (TCP) over satellite networks);
- **Report ITU-R M.2176** - Vision and requirements for the satellite radio interface(s) of IMT-Advanced;
- **Report ITU-R S.2199** - Studies on compatibility of broadband wireless access (BWA) systems and fixed-satellite service (FSS) networks in the 3 400-4 200 MHz band;
- Other texts on satellite BWA addressing system characteristics, maximum emission requirements and off-axis e.i.r.p. densities.

RECOMMENDATION ITU-R S.1782


**Possibilities for global broadband
Internet access by fixed-satellite
service systems**

- **Satellite telecommunication technology has the potential to accelerate the availability of high-speed Internet services in developing countries, including the least-developed countries, the land-locked and island countries, and economies in transition;**
- **FSS frequency allocations can be used in the short, medium and long term for the global provision of high-speed Internet services;**
- **Studies into possibilities for providing global access to the Internet at a high data-rate via satellite have been carried out and are contained in ITU-R standards.**

- **First example:** suitable fixed-satellite service (FSS) bands are identified and up and downlink characteristics are developed for direct satellite links from user terminals with 30 cm antennas;
- **Second example:** up and downlink characteristics are developed for a system that would provide direct satellite links for user terminals with 1.2 m antennas;
- **Third example:** the characteristics are developed of an example system based on user access via terrestrial radio links to “community” earth stations and thence via a satellite to a single central earth station.

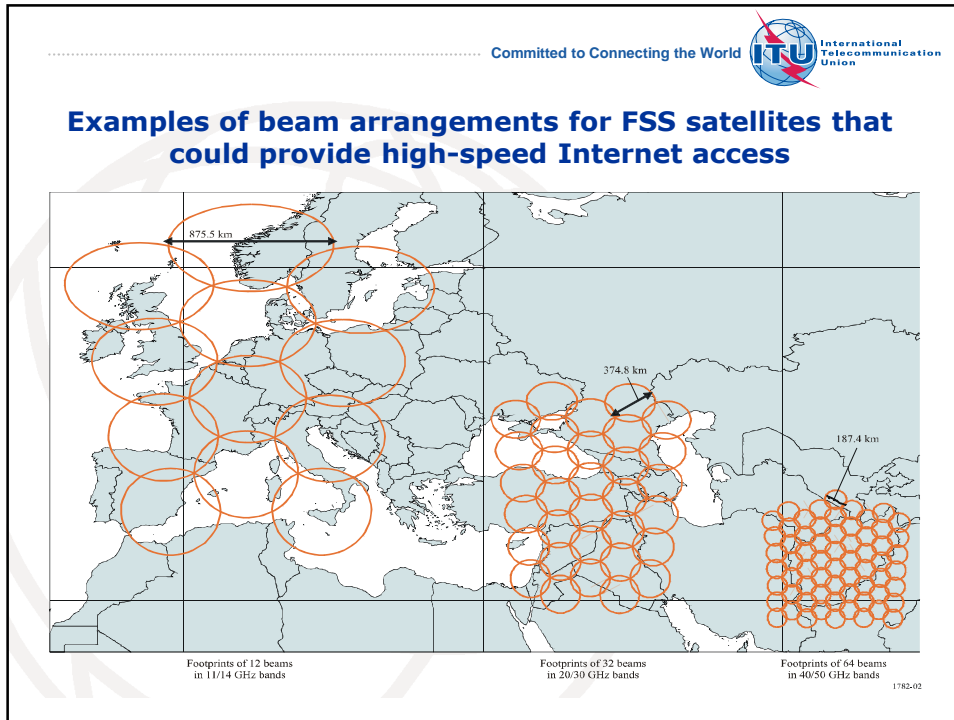
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**Possibilities for global broadband
Internet access by FSS systems
designed for ultra small earth station
antennas**

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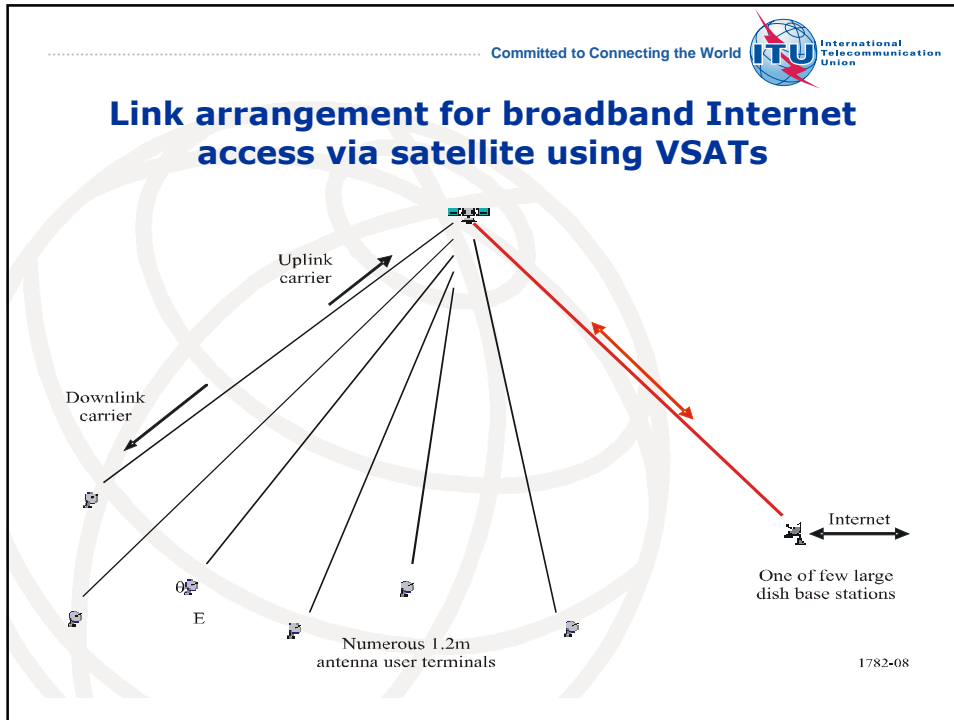
Frequency band considerations


- **4/6 GHz:** not suitable for low cost, very small antennas and already heavily used;
- **11/14 GHz:** already heavily used;
- **20/30 GHz:** most suitable in the near term, technology reasonably well developed;
- **40/50 GHz:** technology still not well developed.



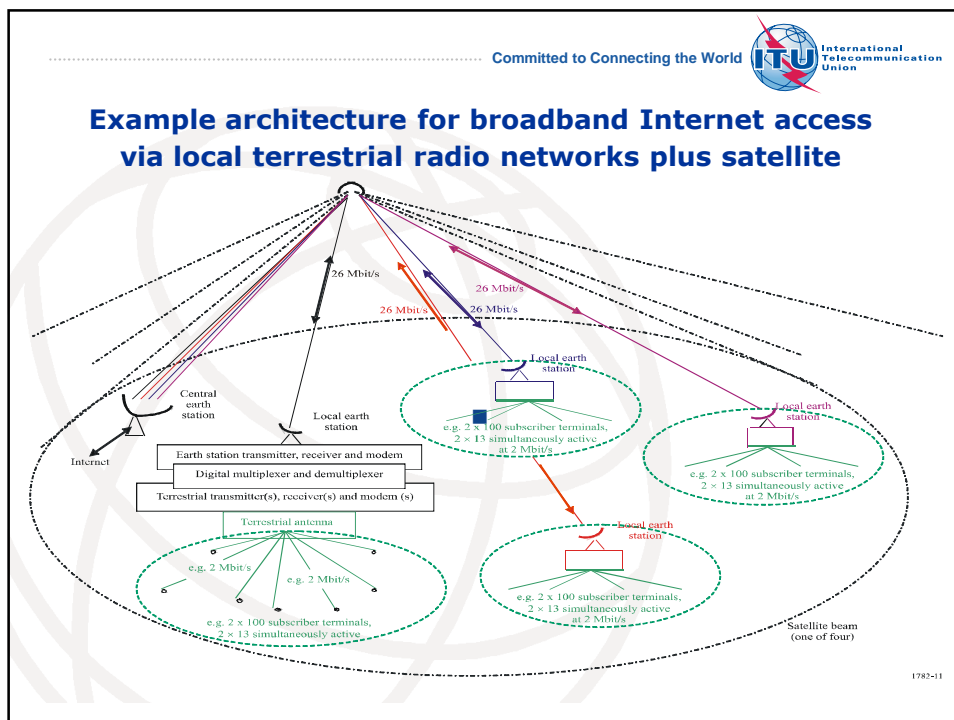
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Possibilities for global broadband Internet access by FSS systems designed for larger earth station antennas



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Example of global broadband Internet access by an FSS system designed for “community” earth station antennas and local terrestrial distribution



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Broadband applications

- **Entertainment**
 - Video-on-demand;
 - TV distribution;
 - Interactive games;
 - Music applications;
 - Streaming.

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Broadband applications

- **Internet access**
 - High-speed Internet access;
 - Electronic messaging;
 - Multimedia applications;
 - Distance learning;
 - Telemedicine.

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Broadband applications

- **Business**
 - Videoconferencing;
 - Business-to-business;
 - Home security.
- **Voice and data trunking**
 - IP-transport;
 - Voice-over-IP;
 - File transfers.

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RECOMMENDATION ITU-R S.1711-1

Performance enhancements of transmission control protocol over satellite networks

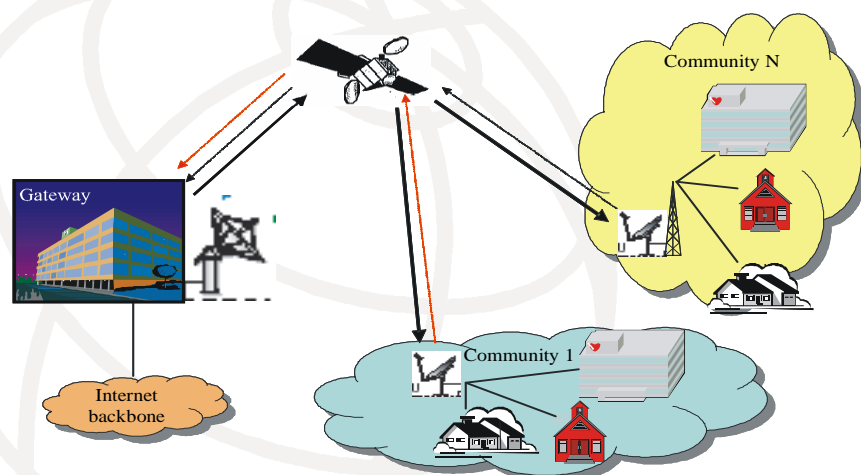
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- **satellite systems are being used increasingly for Internet Protocol (IP) packet transmissions, in particular providing broadband applications directly to users in addition to their role as backbone links;**
- **Most of the current IP transmissions use transmission control protocol (TCP) as transport protocol. However, the performance of TCP may suffer from degradation due to long satellite transmission delay, which affects the quality of service of end-users' applications;**
- **The enhancement of TCP performance is therefore critical in designing satellite links to carry IP packets. Various techniques, collectively referred to as "TCP performance enhancements" were developed to overcome satellite link limitations due to propagation delay and link errors.**

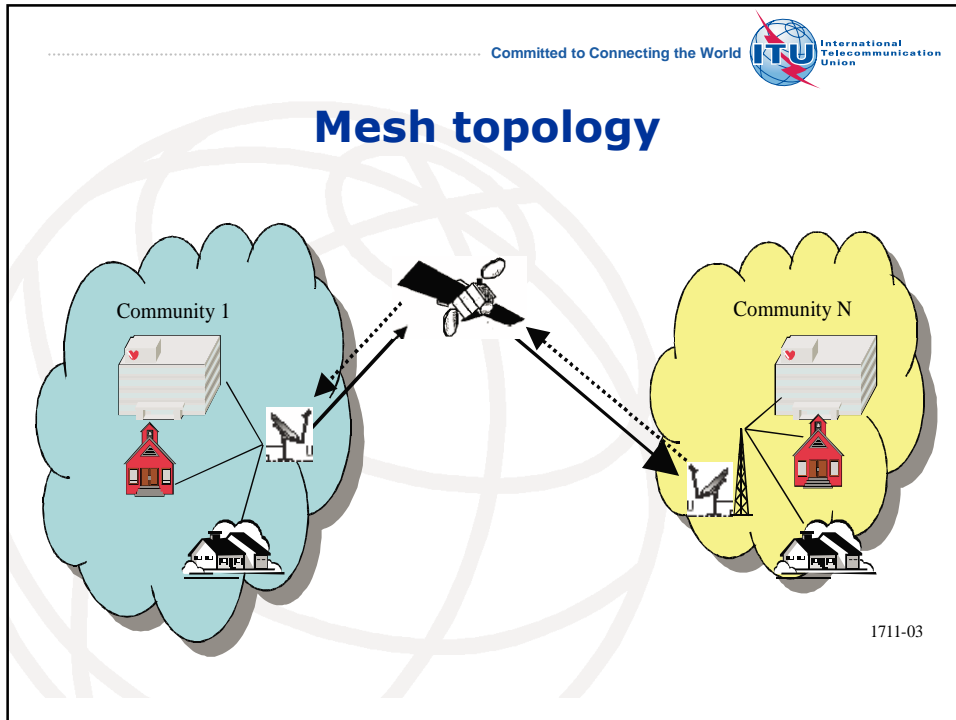
Topologies


- A star network topology is defined by the star arrangement of links between the hub station (or Internet access point) and multiple remote stations. A remote station can only establish a direct link with the hub station and cannot establish a direct link to another remote station;
- A mesh network is defined by the mesh arrangement of links between the stations, where any station can link directly to any other station. The star topology can be considered as one special case of the mesh topology.

Star topology



1711-02



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REPORT ITU-R M.2176

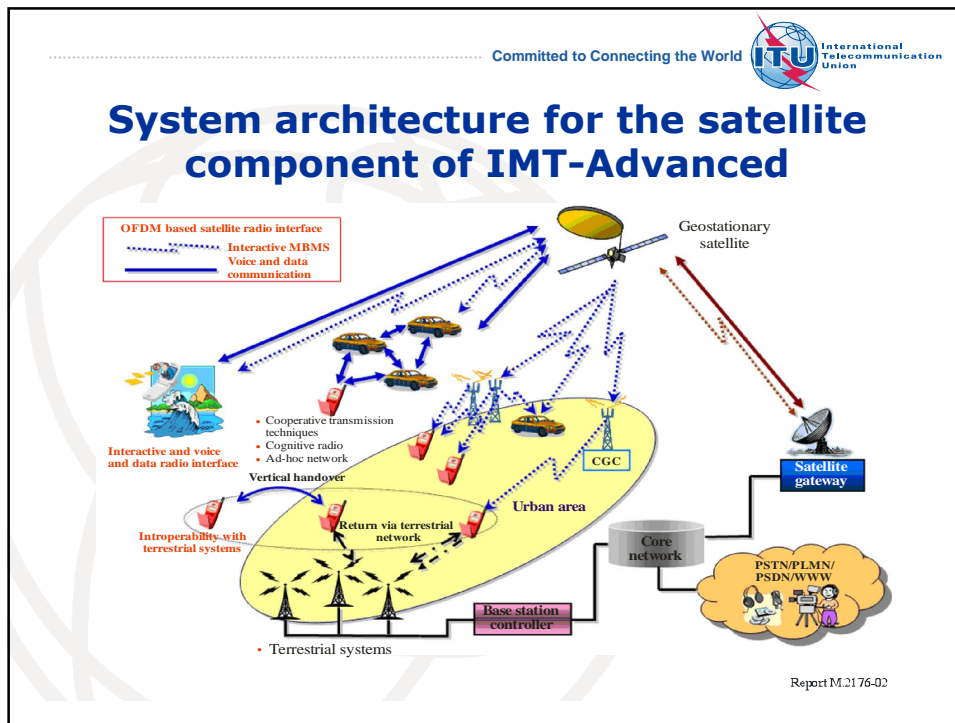
Vision and requirements for the satellite radio interface(s) of IMT-Advanced

Visions on the satellite component of IMT-Advanced

- ❖ The satellite component of IMT-Advanced will be an integral part of future IMT infrastructure with the optimized service delivery;
- ❖ In order to provide the seamless service in a global coverage, the satellite component of IMT-Advanced systems would be considered because the terrestrial component only would not be possible to be deployed all over the world.

Visions on the satellite component of IMT-Advanced

- ❖ Report ITU-R M.2176 defines visions on the satellite component of IMT-Advanced for an efficient IMT service delivery with respect to application scenarios, services, system, radio and network interface aspects and provides possible candidate system architectures;
- ❖ In addition, Report ITU-R M.2176 provides evaluation criteria and methodology on the requirements in order to produce Recommendations for development of the satellite radio interface(s) of IMT-Advanced.



<http://www.itu.int/ITU-R/go/rsg4-imt-adv-sat/>

IMT-Advanced-Satellite submission and evaluation process

Introduction

ITU-R has commenced the process of developing ITU-R Recommendations for the satellite component of the IMT-Advanced radio interface(s). This work is guided by Resolution ITU-R 57. This web page has been established to facilitate the development of proposals for the satellite component of the radio interface(s) for IMT-Advanced and their subsequent evaluation.

Background

- ▶ [Background on IMT-Advanced-Satellite \(Doc. IMT-ADV-SAT/1\)](#)

Invitation

- ▶ Invitation for submission of proposals for candidate radio interface technologies for the satellite component of the radio interface(s) for IMT-Advanced and invitation to participate in their subsequent evaluation - [\(Circular Letter 4/LCCE/102\)](#)

Requirements, evaluation criteria and submission templates for the development of IMT-Advanced-Satellite

Documents in the course of preparation

Submission and evaluation process for candidate RIT/SRITS

Submission and evaluation process and consensus building

- ▶ [\(Doc. IMT-ADV-SAT/2\)](#)

Schedule

Documents in the course of preparation

Process

Documents in the course of preparation

Intellectual Property Rights

- ▶ [Common Patent Policy for ITU-T/ITU-R/ISO/IEC](#)

Submissions

Initial submissions

Documents in the course of preparation

Evaluation Groups

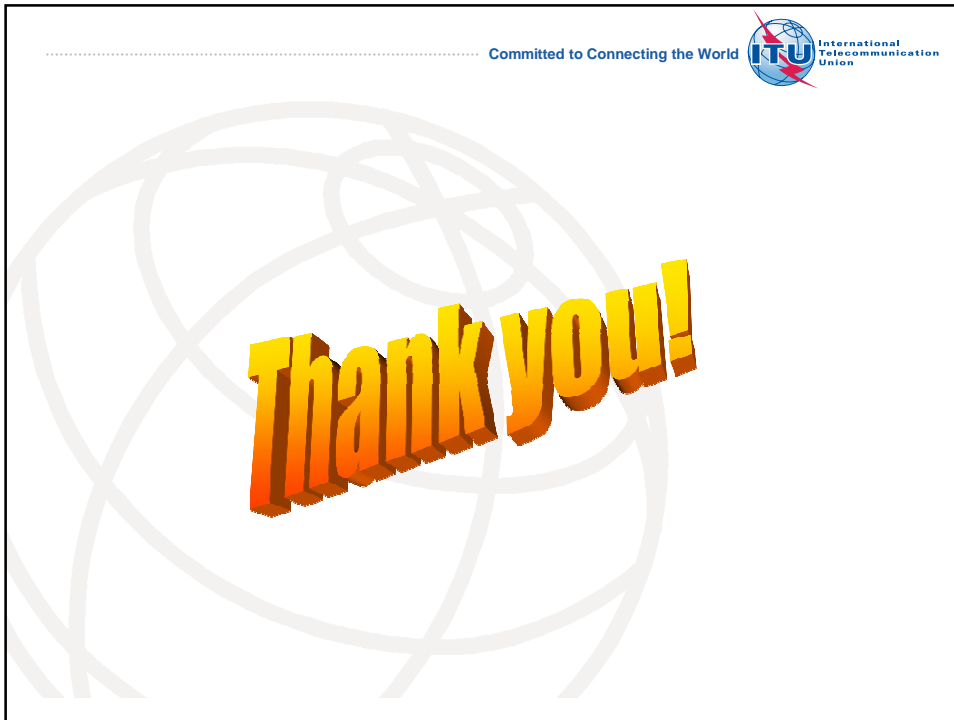
[Evaluation Group registration form](#)


Information to be provided later

REPORT ITU-R S.2199

Studies on compatibility of broadband wireless access (BWA) systems and fixed-satellite service (FSS) networks in the 3 400-4 200 MHz band

- The 3 400 - 4 200 MHz band or parts of the band can be heavily used by the fixed-satellite service (FSS) for space-to-Earth transmissions. In some regions, many administrations are introducing broadband wireless access (BWA) systems in all or portions of this frequency band;
- Report ITU-R S.2199 examines the possible compatibility between BWA and FSS networks in the range 3 400 - 4 200 MHz for both co-channel and adjacent channel operations.




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<http://www.itu.int/ITU-R/go/rsg5-imt-advanced>

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IMT-Advanced submission and evaluation process

Introduction

ITU-R has commenced the process of developing ITU-R Recommendations for the terrestrial components of the IMT-Advanced radio interface(s). This work is guided by Resolution ITU-R 57. This web page has been established to facilitate the development of proposals for the terrestrial components of the radio interface(s) for IMT-Advanced and their subsequent evaluation.

Background

- ▶ [Background on IMT-Advanced - \(Doc. IMT-ADV/1\)](#)

Invitation

- ▶ [Invitation for submission of proposals for candidate radio interface technologies for the terrestrial components of the radio interface\(s\) for IMT-Advanced and invitation to participate in their subsequent evaluation - \(Circular Letter 5/LCCE/2\)](#)
 - [Addendum 1 - to Circular Letter 5/LCCE/2](#)
 - [Addendum 2 - to Circular Letter 5/LCCE/2](#)

Requirements, evaluation criteria and submission templates for the development of IMT-Advanced

[Requirements, evaluation criteria and submission templates for the development of IMT-Advanced](#)
Report ITU-R.M.2133

Local intranet

RECOMMENDATION ITU-R S.1709-1

Technical characteristics of air interfaces for global broadband satellite systems

- **satellite telecommunications technology has the potential to accelerate the availability of broadband communications both on a global and regional basis;**
- **several different types of architectures are used in broadband satellite systems;**
- **these varying uses have led to the development of various air interface standards in order to allow seamless transportation of broadband signals over different networks.**

- This Recommendation proposes air interface characteristics which can be used as guidance by designers of broadband satellite networks.
- Annex 1 - a generic description of the network architecture of broadband satellite networks.
- The remaining Annexes each contain a summary of existing air interface standards:
 - Annex 2 - TIA-1008-A dealing with Internet protocol (IP) over satellite (IPoS);
 - Annex 3 - DVB-RCS standard as described in ETSI Document EN 301 790;
 - Annex 4 - air interface specification for global broadband communications between earth stations and regenerative satellites based on ETSI BSM/RSM-A.

RECOMMENDATION ITU-R S.1783

**Technical and operational features
characterizing high-density applications
in the fixed-satellite service**

Features relating to HDFSS

- flexible, rapid and ubiquitous deployment of earth stations;
 - large numbers of earth stations deployed with high-geographical density;
 - urban, suburban and rural earth station sites;
 - wide range of telecommunications applications;
 - different systems may employ GSO or non-GSO satellites.
- includes an Annex providing the technical characteristics of existing and planned GSO HDFSS networks.
 - administrations planning future GSO HDFSS networks are encouraged to submit their technical characteristics to ITU-R to update this data source.