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Digital terrestrial broadcasting systems

Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

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ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from https://www.itu.int/ITU-R/go/patents/en where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

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***Note**: This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.*

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REPORT ITU-R BT.2295-5

Digital terrestrial broadcasting systems

(2013-2015-2017-2020-2022-2025)

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1 Introduction

This Report summarises the ITU-R Recommendations on systems for digital terrestrial sound, multimedia and television broadcasting for fixed, portable and mobile reception.

A set of Recommendations comprising descriptions of various digital terrestrial broadcasting systems (sound, multimedia and television) for use in different frequency bands have been developed. These Recommendations are aimed at providing the Administrations with the guidance needed to choose national and regional broadcasting systems that meet technical and service requirements for various possible systems.

There is an increasing worldwide demand for suitable means of broadcasting high-quality sound, multimedia and television programmes to vehicular, portable and fixed receivers.

Digital terrestrial broadcasting offers potential for new and improved services to consumers. Digital terrestrial broadcasting has several advantages, including high reliability of service for a practically unlimited number of users, free-to-air access and possibility of fixed and mobile reception.

Interoperability between digital television, multimedia and sound broadcasting systems may be desired. The division of broadcasting systems into sound, multimedia and TV becomes increasingly irrelevant in present-day conditions. For example, even digital narrowband sound broadcasting systems in frequency bands below 30 MHz can transmit video and multimedia information. Also, digital television broadcasting systems can be used not only for television but also for multimedia and sound broadcasting, using different operational modes.

The choice of a broadcasting system should depend on specific conditions such as spectrum availability, regulatory policy, coverage requirements, structure of the existing network, reception conditions, types of required services and cost for customers and broadcasters.

Table 1 summarises terrestrial digital broadcasting systems for sound, television and multimedia specified in ITU-R Recommendations for ease of reference to related existing ITU documentation.

Table 2 lists the ITU-R Recommendations that relate to aspects and features of ITU-R terrestrial digital broadcasting systems.

TABLE 1

ITU-R digital terrestrial broadcasting systems

Category	1st generation DTTB	2nd generation DTTB	DTSB in LF/MF/HF	DSB in VHF/UHF	Multimedia broadcasting in VHF/UHF
	System A (ATSC)				
	System B (DVB-T)				Multimedia System H (DVB-H)
					Multimedia System I (DVB-SH)
	System C (ISDB-T)			Digital System F (ISDB-Tsb)	Multimedia System F (ISDB-Tmm)
	System D (DTMB)				
		ATSC 3.0			
		DVB-T2			
		DTMB-A			

TABLE 1 (*end*)

Category	1st generation DTTB	2nd generation DTTB	DTSB in LF/MF/HF	DSB in VHF/UHF	Multimedia broadcasting in VHF/UHF
		[ISDB-T3]			
				Digital System A (DAB)	Multimedia System A (T-DMB/AT-DMB)
			IBOC	Digital System C (IBOC)	
			DRM	Digital System G (DRM)	
				Digital System H (CDR)	
				Digital System I (RAVIS)	Multimedia system R (RAVIS)
					Multimedia System L (LTE-based 5G)
					Multimedia System N (5G NR MBS)

Note: Identical or inclusive systems are shown in the same row.

TABLE 2

Recommendations relating to aspects and features of ITU-R terrestrial digital broadcasting systems

Category	1st generation DTTB	2nd generation DTTB	DTSB in LF/MF/HF	DSB in VHF/UHF	Multimedia broadcasting in VHF/UHF
Service requirements			Rec. ITU-R BS.1348	Rec. ITU-R BS.774	Rec. ITU-R BS.1892 Rec. ITU-R BT.1833
System characteristics	Rec. ITU-R BT.1306	Rec. ITU-R BT.1877	Rec. ITU-R BS.1514	Rec. ITU-R BS.1114	Rec. ITU-R BT.2016
Multiplexing and transport					Rec. ITU-R BT.2054
Content elements					Rec. ITU-R BT.2055
Planning criteria	Rec. ITU-R BT.1368	Rec. ITU-R BT.2033	Rec. ITU-R BS.1615	Rec. ITU-R BS.1660	Rec. ITU-R BT.2052

2 Summaries of digital terrestrial broadcasting systems

2.1 First generation DTTB systems

ATSC standards are a set of standards developed by the Advanced Television Systems Committee for digital television transmission over terrestrial, cable and satellite networks.

More information about the system and standards can be found at http://www.atsc.org/

2.1.2 System B (DVB-T)

DVB-T is the standard for the broadcast transmission of digital terrestrial television. The system transmits compressed digital audio, digital video and other data in an MPEG transport stream, using COFDM modulation.

More information about the system and standards can be found at http://www.dvb.org/

2.1.3 System C (ISDB-T)

ISDB-T was designed on the basis of the OFDM band-segmented transmission scheme. One OFDM segment corresponds to 1/13 of the bandwidth of a television channel. The number of segments can be chosen in accordance with the available bandwidth and application; 13 for television service.

More information about the system and standards can be found at http://www.dibeg.org/

2.1.4 System D (DTMB)

Digital Terrestrial Multimedia Broadcast (DTMB) is the TV standard for mobile and fixed terminals. Besides the basic functions of traditional television services, the DTMB allows additional services. DTMB system is compatible with fixed reception (indoor and outdoor) and mobile digital terrestrial television. Mobile reception is compatible with standard definition digital TV broadcasting, digital audio broadcasting, multimedia broadcasting and data broadcasting service. Fixed reception in addition to the previous services also supports high-definition digital TV broadcasting.

2.2 Second generation DTTB systems

2.2.1 DVB-T2

DVB-T2 is a 2nd generation terrestrial broadcast transmission system developed since 2006. The main purpose was to increase capacity, ruggedness and flexibility to the DVB-T system. The first version was published in 2009.

More information about the system and standards can be found at http://www.dvb.org/

2.2.2 ATSC 3.0

ATSC 3.0 is a suite of voluntary technical Standards and Recommended Practices that is fundamentally different from, and an operational replacement for, the predecessor ATSC Standard (known as ATSC 1.0), which was essentially limited to video and audio.

The ATSC 3.0 standard is intended to allow substantial improvements in performance, functionality and efficiency sufficient to warrant implementation of a non-backwards-compatible system. With higher capacity to deliver dramatically improved quality for video services, robust mobile reception on a wide range of devices, improved efficiency, IP transport, advanced emergency information, personalization features and interactive capability, the ATSC 3.0 suite of standards provides much more capability than previous generations of terrestrial broadcasting in the same spectrum bandwidth. It also provides a means to integrate broadcast and broadband services and thus can be part of the 5G transmission ecosystem.

2.2.3 DTMB-A

Digital Television Terrestrial Multimedia Broadcasting-Advanced (DTMB-A) is the advanced version of digital television terrestrial broadcasting (DTTB) system D (DTMB) (see § 2.1.4). It can support higher data throughput than that of DTMB with more robust performance. DTMB-A supports ultra-high definition, high-definition, standard-definition TV and data broadcasting services under indoor/outdoor and fixed/mobile reception conditions and can be used for large-area coverage within both multiple and single frequency networks. DTMB-A adopts multi-carrier modulation methods and

advanced coding and modulation scheme with fast system synchronization, high receiving sensitivity, better performance against multi-path effect, high spectrum efficiency and the flexibility for the future extension.

2.3 DTSB systems in LF/MF/HF

2.3.1 IBOC

In-band on-channel (IBOC) digital terrestrial sound broadcasting (DTSB) system was designed to provide vehicular, portable and fixed reception using terrestrial transmitters. Although IBOC system can be implemented in unoccupied spectrum, a significant feature of the system is its ability to offer simulcasting of analogue and digital signals in the existing AM and FM sound broadcasting bands.

The system offers improved performance in multipath environments resulting in greater reliability than is offered by existing analogue AM and FM operations. IBOC system (also called HD Radio system) offers enhanced audio quality comparable to that obtained from consumer digital recorded media, new data-casting services in addition to the enhanced audio programming. In addition, the system allows for allocation of bits between audio and data-casting capacity to maximize the data-casting capabilities.

More information about the system and standards can be found at http://www.hdradio.com

2.3.2 DRM

Digital Radio Mondiale (DRM) system has been developed for terrestrial broadcasting applications in all the frequency bands allocated worldwide for analogue sound broadcasting. It respects the ITU-defined spectrum masks, allowing a smooth transition from analogue to digital broadcasting. The system is designed as a digital-only system. In addition, DRM system also offers various data services, including images and electronic programme guides, and the capability of dynamically rearranging the various services contained in the multiplex without loss of audio.

More information about the system and standards can be found at http://www.drm.org/

2.4 DTSB systems in VHF/UHF

2.4.1 Digital System A (DAB)

DAB system, also known as the Eureka 147 digital audio broadcasting (DAB) system, has been developed for both satellite and terrestrial broadcasting applications in order to allow a common low-cost receiver to be used. In January 2017, an update of the standard was published and only mode I, designed for terrestrial broadcasting in the band 30 to 300 MHz, has been retained The system has been designed to provide vehicular, portable and fixed reception with low gain omni-directional receive antennas located at 1.5 m above ground. DAB system offers improved performance in multipath and shadowing environments which are typical of urban reception conditions by the use of on-channel terrestrial repeaters to serve as gap-fillers. DAB system is capable of offering various levels of sound quality up to high quality sound comparable to that obtained from consumer digital recorded media. It can also offer various data services and different levels of conditional access and the capability of dynamically re-arranging the various services contained in the multiplex.

More information about the system and standards can be found at http://www.worlddab.org/

2.4.2 Digital System C (IBOC)

See § 2.3.1.

2.4.3 Digital System F (ISDB-Tsb)

ISDB-Tsb is a family member of ISDB-T designed on the basis of the OFDM band-segmented transmission scheme. One OFDM segment corresponds to 1/13 of the bandwidth of a television channel. The number of segments can be chosen in accordance with the available bandwidth and application; 1 or 3 for sound service.

More information about the system and standards can be found at http://www.dibeg.org/

2.4.4 Digital System G (DRM)

See § 2.3.2.

In the bands above 30 MHz, it defines Robustness Mode E (also known as DRM+) to offer audio quality comparable to that obtained from consumer digital recorded media.

2.4.5 Digital System H (CDR)

Digital terrestrial sound and multimedia broadcasting system Convergent Digital Radio (CDR), has been developed for smoothly switch-off from the currently analogue FM to digital radio. The system was designed to provide vehicular, portable and fixed reception using terrestrial transmitters. During simulcast stage, CDR can make full use the unoccupied spectrum in currently FM channel, provide several additional digital radio services, the system offers improved performance in multipath environments resulting in greater reliability than is offered by existing analogue FM operations. After switch-off is finished, CDR can provide more high-quality digital audio services (such as CD quality or 5.1 multichannel services) as well as various data services, and the system also can support the nation-wide coverage by using single frequency network (SFN).

CDR flexibly provides several spectrum-occupancy modes for different scenarios, the digital signal bandwidth can be 100 kHz or 200 kHz. During the switch-off stage, the digital signal can be simulcast with analogue FM signal, in this case, the digital signal spectrum is divided into two parts, the spectrum interval is 300 kHz or 200 kHz in which the stereo FM radio or analogue mono FM broadcasting signals can be placed. When the switch-off is finished, the digital signal can be continuous, the signal bandwidth may be 100 kHz or 200 kHz.

2.4.6 Digital System I (RAVIS)

Digital terrestrial sound and multimedia broadcasting system RAVIS have been developed for the purpose of efficiency enhancement of utilization of spectrum bands used now for audio FM broadcasting, i.e. VHF Bands I and II. RAVIS allows to deliver digital data with bit rates from 150 to 900 kbit/s through one 100, 200 or 250 kHz bandwidth radio-frequency channel. Channel capacity provides transmission of video programme with standard TV definition of several audio programmes with various quality from mono or stereo sound to multichannel or object-oriented immersive sound. RAVIS provides for steady mobile reception (up to 250 km/h) in urban environment, in the districts with difficult topography, in mountainous and dense forested areas, in water areas, that is under conditions characterized by multipath propagation, without direct visibility of transmitting antenna and so forth.

2.5 Multimedia broadcasting systems for mobile reception

2.5.1 Multimedia System A (T-DMB/AT-DMB)

Terrestrial digital multimedia broadcasting (T-DMB) system is the extended system compatible with digital terrestrial sound broadcasting system DAB, which enables video services using DAB networks for handheld receivers in a mobile environment. T-DMB provides multimedia services including video, audio and interactive data.

AT-DMB is the extended system of guaranteeing backward compatibility with T-DMB, which increases channel capacity of T-DMB by applying hierarchical modulation mechanism. AT-DMB provides a scalable video service as well as all kinds of T-DMB services.

More information about the systems and standards can be found at http://www.worlddab.org/

2.5.2 Multimedia System F (ISDB-Tmm)

ISDB-Tmm is a family member of ISDB-T designed on the basis of the OFDM band-segmented transmission scheme. One OFDM segment corresponds to 1/13 of the bandwidth of a television channel. The number of segments can be chosen in accordance with the available bandwidth and application; 1 or more determined by the available bandwidth for multimedia service.

More information about the system and standards can be found at http://www.dibeg.org/

2.5.3 Multimedia System H (DVB-H)

DVB-H system is an end-to-end broadcast system for delivery of any types of digital content and services using IP-based mechanisms optimized for devices with limitations on computational resources and battery. It consists of a unidirectional broadcast path that may be combined with a bidirectional mobile cellular (2G/3G) interactivity path. DVB-H is a platform that can be used for enabling the convergence of services from broadcast/media and telecommunications domains (e.g. mobile/cellular).

More information about the system and standards can be found at http://www.dvb.org/

2.5.4 Multimedia System I (DVB-SH)

DVB-SH system is an end-to-end broadcast system for delivery of any types of digital content and services using IP-based mechanisms optimized for devices with limitations on computational resources and battery. It consists of a unidirectional broadcast path that may be combined with a bidirectional mobile cellular (2G/3G) interactivity path. The broadcast path of DVB-SH system uses combined or integrated satellite and terrestrial networks. DVB-SH is a platform that can be used for enabling the convergence of services from broadcast/media and telecommunications domains (e.g. mobile/cellular).

More information about the system and standards can be found at http://www.dvb.org/

2.5.5 Multimedia System L (LTE-based 5G)

Several 3GPP specifications have been extended or newly developed over several releases to address the use cases and requirements for dedicated broadcast networks. With the completion of Release 16, a comprehensive set of 3GPP specifications is available that fulfils the use cases and requirements for a Broadcast System, including:

– Support of Free-to-Air (FTA) and Receive-Only Mode (ROM) services over 3GPP.
– Network dedicated to linear television and radio broadcast.
– Single Frequency Network (SFN) deployments with Inter-Site Distance (ISD) significantly larger than a typical ISD associated with typical cellular deployments.
– Support for mobility scenarios including speeds of up to 250 km/h to support receivers in cars, with external omni-directional antennas.
– Support for common streaming distribution formats such as Dynamic Streaming over HTTP (DASH), Common Media Application Format (CMAF) and HTTP Live Streaming (HLS).
– Support for IP-based services such as IPTV or ABR multicast.
– Support for different file delivery services such as scheduled delivery or file carousels.

2.5.6 Multimedia System N (5G NR MBS)

System N (5G NR MBS (Multicast/Broadcast Services)) will evolve into a universal flexible broadcast technique serving all screens.

– Flexibly achieve dynamic and seamless switching between unicast services and broadcast/multicast services.
– Flexible servicing abilities, excellent bi-direction interaction, accurate push of broadcast and multicast services based on location, suitable for expanding new multimedia broadcast services such as public safety and emergency broadcast.
– Widely adapted to various types of 5G general-purpose terminals, and extensive supporting from major global industry manufacturers.
– Deeply and continuously cover various complex scenarios, with coordinated mixed network based on 5G cellular base stations and existing TV towers.
– Support both unicast and broadcast reception.

2.5.7 Multimedia system R (RAVIS)

See § 2.4.6.

2.5.8 Multimedia System S (ATSC 3.0)

See § 2.2.2.

2.5.9 Multimedia system T2 (DVB-T2 Lite)

DVB-T2 Lite profile is designed to make use of the same reliable features we are familiar with from DVB-T2, but by a careful selection of a sub-set of modes, allows for receivers to be implemented using much smaller and more efficient silicon chips. So T2-Lite will efficiently deliver TV and radio to mobile devices such as phones and tablets (for which power consumption is an important issue) and in-car at the same time as providing services to existing fixed receivers.

More information about the system and standards can be found at http://www.dvb.org/