

ITUEvents

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## Technical and Regulatory Evolution of Radio and TV

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# Why digital?

**Efficient use of Spectrum**

## New possibilities to the viewers:

- **Additional number of programs**
- **Additional reception modes**
- **Improved quality of image and sound**
- **Additional type of services: interactivity, Electronic Program Guides, etc.**

**Attractive**

## for Regulators :

- **Fair competition: To develop a terrestrial platform competitive with the other platforms**
- **Efficiency of spectrum (1 frequency for multiple programs)**
- **Possibility to free a part of the Band for other usage**

## TV operators/content providers:

Significant decrease in transmission costs comparing to analogue.

- **Power costs: DTT requires less energy to ensure the same coverage as for the analogue,**
- **Investment and transmission cost: One transmitter to broadcast multiple channels/programs.**
- **Development of new services without spectrum constraints.**
- **Offering of new innovative services (mobile TV , data, games, interactivity, VoD,...).**

**Good for the environment**

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Digital

Radio

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# ITU-R Documents on DSB

## Recommendations

- BS.774: Service requirements for digital sound broadcasting to vehicular, portable and fixed receivers using terrestrial transmitters in the VHF/UHF bands.
- BS.1114: Systems for terrestrial digital sound broadcasting to vehicular, portable and fixed receivers in the frequency range 30-3 000 MHz.
- BS.1514: System for digital sound broadcasting in the broadcasting bands below 30 MHz.
- BS.1660: Technical basis for planning of terrestrial digital sound broadcasting in the VHF band
- ...

## Reports:

- BS.2214: Planning parameters for terrestrial digital sound broadcasting systems in VHF bands
- BS.2384: Implementation considerations for the introduction and transition to digital terrestrial sound and multimedia broadcasting
- ...

# Digital Sound standards

(See ITU-R Recommendation BS. 1114-7)

<b>DRM</b> Digital Radio Mondiale	<b>ISDB-TSB –</b> Integrated Services Digital Broadcasting- Terrestrial Sound Broadcasting	<b>T-DAB/T-DMB</b> Terrestrial Digital Audio Broadcasting/ Multimedia Broadcasting	<b>HD Radio™</b> <i>proprietary standard from iBiquity</i>	<b>IBOC</b> In-band on- channel
<ul style="list-style-type: none"><li>• <b>DRM30:</b> Designed to operate on 150kHz to 30 MHz</li><li>• <b>DRM+:</b> in VHF Bands I, II, and III</li><li>• Allows to broadcast up to 4 different services in an ITU channel (9 or 10 kHz).</li></ul>	<ul style="list-style-type: none"><li>• consists of one or three OFDM-segments;</li><li>• The bandwidth of the system is approximately 500 kHz or 1.5 MHz</li></ul>	<ul style="list-style-type: none"><li>• <b>DAB/DAB+:</b> operates at any frequency up to 3 000 MHz</li><li>• <b>DMB:</b> Suitable for mobile radio and TV as it supports MPEG 4 AVC. (designed to be carried on a DAB subchannel.</li></ul>	<ul style="list-style-type: none"><li>• The only standard approved by the FCC for AM/FM in the US.</li><li>• 200 kHz-wide channels.</li><li>• uses a codec based upon the MPEG-4 HE-AAC standard.</li></ul>	<ul style="list-style-type: none"><li>• &lt; 3MHz</li><li>• Described in Annex 4;</li></ul>

# DRM transmission modes

Mode	QAM	Bandwidth (kHz)	Typical uses	
A	16, 64	4.5, 5, 9, 10, 18, 20	LF & MF ground-wave, 26MHz band line-of-sight	DRM30
B	16, 64	4.5, 5, 9, 10, 18, 20	HF & MF transmission on sky-wave	
C	16, 64	10, 20	Difficult sky-wave channels on HF	
D	16, 64	10, 20	NVIS sky-wave (highest Doppler & delay spread)	
E	4, 16	100	VHF transmissions in the bands above 30 MHz	DRM+

Mode A is designed to deliver the highest bit rate possible within the context of ground-wave or line-of-site coverage.

- Mode B will generally be the first choice for sky-wave services.
- Where propagation conditions are more severe, such as for long paths with multiple hops, or near vertical incidence, where several very strong reflections may occur, Mode C or Mode D may need to be employed.
- Finally, Mode E is used for the VHF frequency bands from 30 MHz up to Band III (DRM+).

# DAB+ transmission modes

	<b>Mode 1 VHF</b>	<b>Mode 2 UHF</b>	<b>Mode 3 L- Band</b>
<b>bandwidth DAB+ frequency block</b>	<b>1.536 MHz</b>	<b>1.536 MHz</b>	<b>1.536 MHz</b>
<b>number of carriers in frequency block</b>	<b>1536</b>	<b>768</b>	<b>384</b>
<b>carrier spacing</b>	<b>1 kHz</b>	<b>2 kHz</b>	<b>4 kHz</b>
<b>data rate (incl. overhead)</b>	<b>2.4 Mbit/s</b>	<b>2.4 Mbit/s</b>	<b>2.4 Mbit/s</b>
<b>transmitter distance in SFN</b>	<b>75 km</b>	<b>48 km</b>	<b>18.8 km</b>

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Introduction of digital  
sound broadcasting

according to Regional  
Broadcasting Agreements  
And HFBC

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# Introduction of Digital Sound in Regional Agreements (LF/MF)

## RJ81

MF: 535 - 1605

R2



Does **not provide** the possibility of introducing digital modulation in the bands concerned.

Question ITU-R 120/6 (2006) "Digital sound broadcasting in Region 2" has been adopted by Study Group 6E.

## RJ88

1 605 – 1 705 kHz

R2



CCRR/20(6 September 2002), the BR concluded that the formulations in the RJ88 Agreement would permit the introduction of digital modulation DRM A3 or B3 and also perhaps that of IBOC DSB

subject to completion of the studies related to co-channel, first and second adjacent channel protection ratios and subject to further limitations at the band edges in order to be consistent with RR 4.5.

## GE75

LF:150 –285 kHz; MF –  
525 –1 605 kHz;

R1 and R3



Rule of Procedure (RRB): Transmission systems DRM A2 and B2. Radiation reduced by at least 7 dB in all directions w.r.t analogue assignment

Temporary measure until the decision from a competent conference

# Introduction of Digital Sound in Regional Agreements (VHF/UHF)

## ST61

41-68 MHz

R1 & 3



under RoP Part A2/ST61 paragraph 5 – same coordination distances as analogue systems

No submission or notification to date

## GE84

87.5 –108 MHz: FM

R 1&3



possible under 3.1 of Chapter 3 of Annex 2 to GE84: not cause greater interference, Nor require higher

Problematic to introduce new digital assignments in **congested bands**

## GE06

174 –230 MHz (Band III)

1.536 kHz T-DAB  
R1&Iran



Adopted T-DAB as planned standard for digital sound broadcasting

Implementation of alternative standards under envelope of Plan entries : DVB-T → 1–4 T-DAB blocks (Prov. 5.1.2 e + RoP A10)

- T-DAB → Other digital systems (Prov. 5.1.3)

# Introduction of digital HFBC

**12.7 § 6 of RR: Other modulation techniques recommended by ITU-R**



shall be permitted in place of double-sideband or single-sideband emissions, provided that the level of interference caused to existing emissions is not increased.

**Res. 517 (Rev.WRC-15)**

Introduction of digital modulation schemes 5 900 – 26 100 kHz

Entry into force July 2003

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Digital

Television

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# ITU-R Documents on DTT

## Handbook

- Guidelines for the transition from analogue to digital broadcasting
- ITU-R Handbook on Digital terrestrial television broadcasting in the VHF/UHF bands

## Reports

- **BT.2035**: Guidelines for DTT implementation
- **BT.2049**: Mobile DTT
- **BT.2137**: Coverage prediction methods and planning software for digital terrestrial television broadcasting (DTTB) networks
- **BT.2140**: TRANSITION FROM ANALOGUE TO DIGITAL

## Recommendations

- **BT.1125**: Basic objectives for the planning and implementation of digital terrestrial television broadcasting systems
- **BT.1306**: Error correction, data framing, modulation and emission methods for digital terrestrial television broadcasting
- **BT.1368**: Planning criteria for digital terrestrial television services in the VHF/UHF bands

# DTT System standards-FX

## ATSC

- Advanced Television Systems Committee (System A)

## DTMB

- Framing structure, channel coding and modulation for DTTB system: designed for fixed and mobile reception.

## DVB

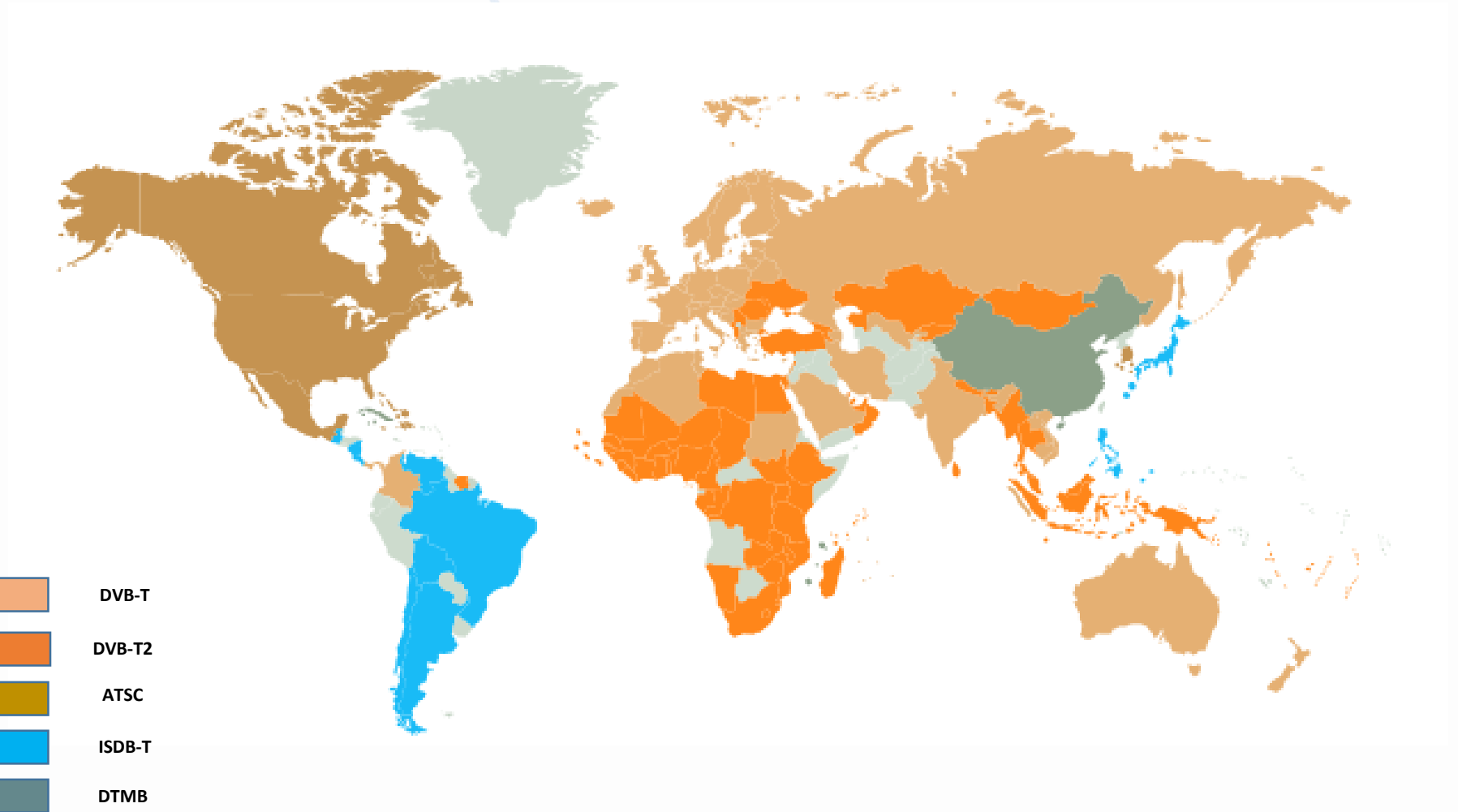
- DVB-T : Digital Video Broadcasting Terrestrial (System B)
- DVB-T2 : Second Generation of DVB-T (at least 30% higher transmission capacity and improved SFN performance)

## ISDB-T

- Integrated Services Digital Broadcasting Terrestrial- (System C)
- SBTVD: Adapted by Brazil

Standard	Channels	Band	Modulation
ATSC	6 MHz	UHF/VHF	8-VSB
DTMB	8 MHz	UHF/VHF	OFDM
DVB-T	6, 7 and 8 MHz	UHF/VHF	OFDM
DVB-T2	6, 7 and 8 MHz	UHF/VHF	OFDM
ISDB-T	6, 7 and 8 MHz	UHF/VHF	Segmented OFDM

# Adopted DTT standards



# DTT System standards-MO & H

## ATSC-M/H

- Advanced Television Systems Committee (System A)

## DTMB

- Framing structure, channel coding and modulation for DTTB system: designed for fixed and mobile reception.

## DVB-H

- Digital Video Broadcasting Terrestrial – Handheld

## ISDB-Tmm

- Integrated Services Digital Broadcasting Terrestrial- (System C)

## T-DMB

- Terrestrial Digital Multimedia Broadcasting system: enables video services using T-DAB networks for handheld receivers in a mobile environment

Standard	Modulation	Transport stream	RF channel size (MHz)	Frequency bands	Region/origin
DVB-H	QPSK or 16-QAM COFDM	IP/MPE-FEC/ MPEG2 TS	8	IV and V	Region 1 (Europe)
ISDB-Tmm	QPSK or 16-QAM COFDM	MPEG2 TS	0.433	IV and V	Region 3 (Japan)
DTMB	DQPSK COFDM	MPEG2 TS	1.75	III and 1.5 GHz	Region 3 (Korea)
ATSC-M/H	8-VSB		1.834	UHF/VHF	Region 2
T2-lite	QPSK	H.264	8	IV and V	Region 1 (Europe)



# Introduction of Digital TV in Regional Agreements (VHF/UHF)

## ST61

41-68 MHz (Sound and TV)

87.5-100 MHz (TV)

162-174 MHz (TV)



Digital Modulation :  
RoP Part A2

under Art 4 or Art 5, the relevant coordination distances of the Agreement **shall be equally applied to analogue and digital systems.**

An appropriate symbol shall be used to identify the television standard.

## GE89

41-68 MHz

R1 & 3



Digital modulation systems can be used under provision 2.3

*RoP Part A6  
for a modification under Article 4 of the agreement*

## GE06

174-230/470-896 MHz

R1&Iran



Adopted DVB-T as planned standard for DTT

Implementation of alternative standards under envelope of Plan entries :

- DVB-T → Other digital systems (Prov. 5.1.3)

# Digital Broadcasting Not under Regional Agreements



**Frequency to be in conformity with article 5 of the RR (11.31)**



**System: No standard imposed**



**Conditions: for ex.: 5.86 In Region 2, in the band 525-535 kHz the carrier power of broadcasting stations shall not exceed 1 kW during the day and 250 W at night.**



**Notification and recording in the MIFR Article 11 of the RR**

# Thanks to the introduction of digital television

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# IBB systems (HbbTV, Hybridcast and others)



Terrestrial  
interaction channel  
implementations

## HbbTV, Hybridcast and others

Recommendations ITU-R :

- **BT.2037**: General requirements of IBB systems
- **BT.2053**: Technical requirements for IBB systems and various aspects of IBB systems including App. types and App. control are analyzed and defined

# Better viewer experience



- Ultra High Definition Television (UHDTV)
- High Dynamic Range (HDR): result will be a greater sense of realism for viewers, giving television images a richer and more dynamic quality
- Wide Colour Gamut and High Frame Rate  
**(Recommendation ITU-R BT.2020)**

# Advanced Immersive Audio-Visual (AIAV) systems, which include Virtual Reality and Augmented Reality (AR/VR).

- Trials have taken place at major international events such as the 2016 Rio Olympics, the 2018 PyeongChang Winter Olympics and of course, the recent 2018 Football World Cup in Russia...
- [Report ITU-R BT.2420](#) describes the technical background and the definitions used for AIAV systems.
- [Recommendation ITU-R BS.2051](#), Advanced sound systems for programme production, to include headphones associated with metadata, which are a vital part of the AIAV systems experience.



**Users will have immersive experiences with “an unprecedented degree of presence” caused by tricking the brain's perceptual systems so users believe they are really somewhere else or even someone else.**



# Accessibility features

## Technologies to improve accessibility to broadcasting services

- Real-time closed-captioning using speech recognition
- MultimediaSpeech rate conversion technology
- browsing system for the visually impaired
- Machine translation to sign language with CG-animation
- Device for evaluating broadcast background sound balance
- Easy-to-read language broadcasting service and language conversion support technology

## Disability types

- Hearing disability
- Sight impairment
- Aging audience



## Technical realisation of signing in digital television

- Real person vs Avatars
- Open vs. closed Signer
- Methods of providing Closed Signing
  - The broadcaster provides two video signals, one with and one without the signer
  - The broadcaster provides the signer video as additional stream
- Selection of an alternative video signal
- Reception of the signer video only (parallel to the TV broadcasting signal)
- Technical realization of a virtual singer using video glasses

Accessibility to broadcasting services for persons with disabilities.

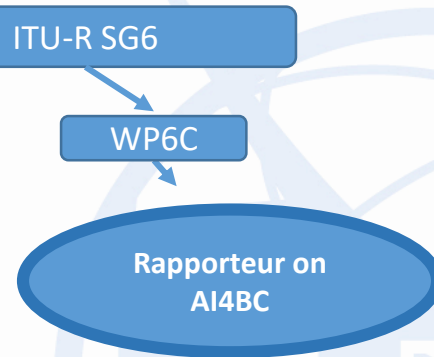
- REPORT ITU-R BT. [SIGNING]: relating to Technical realization of signing in digital television.

# Further...Future: AI in Broadcasting



## 1- Appointment of a Rapporteur on AI for Broadcasting

WP 6C has appointed a Rapporteur to investigate the use of Artificial Intelligence (AI)



## 2- Preliminary DRAFT NEW QUESTION ITU-R [AI4BC]: Use of AI for Broadcasting

Expected to be adopted in October 2018 meeting, and to launch the studies on:

- the applications, requirements and impacts of AI technologies for:
  - programme production,
  - quality evaluation, programme assembling and access
  - broadcast emission
- The contribution in increasing effectiveness of the above elements.

The results of the above studies to be completed by 2019 and included in Recommendation(s) and Reports.

## Artificial Intelligence TV Set-Top Box

AI set-top box commercialized by Korea Telecom

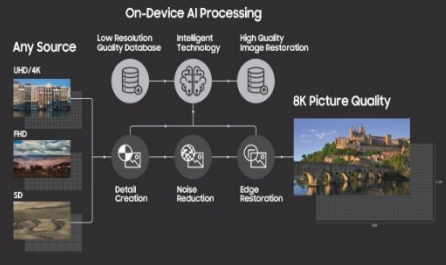


## Examples of potential applications of AI in broadcasting

(The following is a non-exhaustive list, taken from the draft new question)

1. **Programme production:** Data mining, big data analysis, Language translation, Text-voice/voice-text translation, Visual/speech recognition, Metadata extraction, Assisted editing, Autonomous, robotic shooting, Object tracking, Format conversion for video and sound, Semantic annotation of content, Automated summarization, System monitoring and diagnosis,
2. **Audio and visual quality evaluation:** Subjective evaluation, Quality of Experience metrics
3. **Programme assembling and access:** Audio and video data compression, Early warning of emergencies, disaster prevention and relief, Recommendation to audience, Access service for people with disabilities, System monitoring and diagnosis
4. **Broadcast emission:** Network planning, System monitoring and diagnosis

## AI Technology







**Thank you**

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