

Technical Review

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in an Era of 5G NTN** (Page 3)

The ABU Digital Broadcasting Symposium 2026
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ABU Technical Bureau Updated from Ulaanbatar, Mongolia



Asia-Pacific
Broadcasting
Union

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Cover: ABU Technical Bureau updated from Ulaanbatar, Mongolia

from The Editor

As we conclude the final quarter of 2025, the ABU Technology and Innovation department continues to witness an extraordinary pace of change across the global broadcasting landscape. We are trying our best to make the Technical Review serve as a mirror to this transformation, meticulously balancing high-level policy shifts with practical, firsthand technical insights.

A primary highlight of this edition is the transition in our leadership. We are proud to introduce the ABU Technical Bureau for the 2026-2027 term. With this renewed leadership team and our newly appointed Vice Chairpersons in place, the Bureau is exceptionally well-positioned to navigate the technical complexities of the coming years. This strategic vision is further supported by the comprehensive Topic Area Reports featured in this issue, which offer in-depth analyses of the current states of Spectrum, Training, Distribution, and Production.

On the technical front, our lead feature on Resilient Digital Broadcast Services in an Era of 5G NTN explores one of the most exciting frontiers for our industry: the expansion of services through non-terrestrial networks, backed by a compelling proof of concept. Our journey through modern innovation continues with a report on the VOV-ABU Technology Workshop, where we examine the practicalities of Shaping the Future of Broadcasting with AI. From the radio production technologies discussed at IPPTAR to our recent online seminar series on maximizing cellular network capacities for broadcast centres, this issue underscores how ABU members are leveraging cutting-edge tools to optimize their workflows.

We also maintain our global perspective with a report on the World Broadcasting Unions Technical Committee meeting held in October, alongside our essential updates on equipment trends and regional news.

Looking ahead to the ABU Digital Broadcasting Symposium (DBS) 2026, our roadmap is clear. We remain dedicated to providing a premier platform where technology intersects with strategy. This year's DBS theme, "The Rising Synthetic Era", has been chosen to perfectly reflect the current technological landscape and the profound impact of generative and synthetic media on our craft.

I would like to extend my sincere gratitude to our contributors for sharing their expertise and to our members for their unwavering dedication to technical excellence. We hope this issue provides the insights necessary to navigate the evolving digital ecosystem as we step into a new year of innovation.

Warm regards,
Dr Veyssel Binbay
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The Asia-Pacific Broadcasting Union (ABU) is a professional union of broadcasting organisations in the Asia-Pacific area which aims to co-ordinate and promote the development of radio, television and allied services in the region. It is non-governmental, non-political and non-commercial.

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RESILIENT DIGITAL BROADCAST SERVICES IN AN ERA OF 5G NTN

Smartphones are the world's most pervasive communication platform, with penetration exceeding 100% in many markets – a success driven by 3GPP global standardization. 3GPP now extends this framework to include satellite-based Non-Terrestrial Networks (NTN), enabling direct Satellite-to-Device (S2D) connectivity for resilient, ubiquitous service delivery. S2D enhances communication continuity and supports critical applications such as emergency radio and television broadcasting. This paper presents the case for S2D broadcasting via 3GPP 5G NTN Broadcasting, demonstrating its potential to strengthen communication resilience and disaster preparedness across wide geographic areas.

5G NTN BROADCASTING RESILIENCY OVER L-BAND

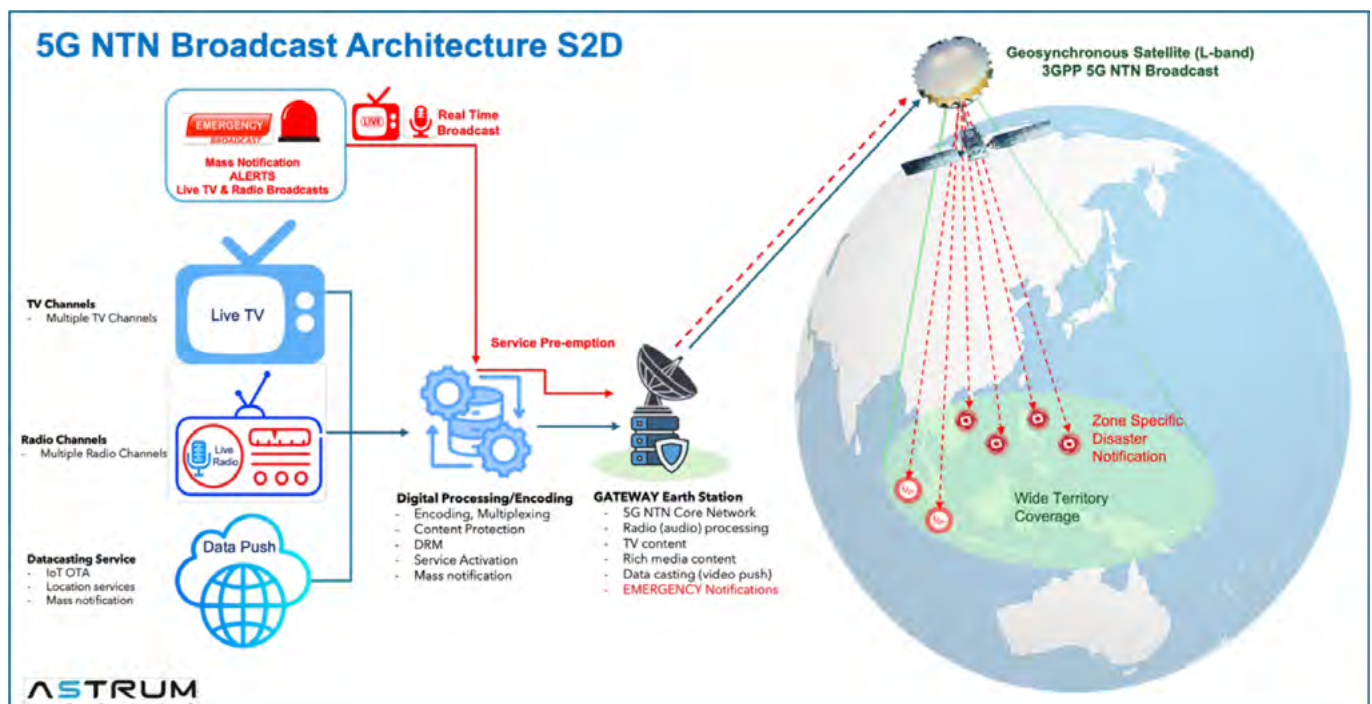
3GPP Releases 17 (2022) and 19 (2025)^{[1][2]} standardize Satellite-to-Device (S2D) capabilities, enabling geosynchronous satellite networks to provide seamless wide-area coverage. These Non-Terrestrial Networks (NTN) complement terrestrial mobile systems in underserved regions – including rural, border, and maritime zones. With Release 19, the introduction of 5G Band 246 designates the 1.4 GHz L-band for S2D NTN in Region 3, delivering reliable, all-weather connectivity and resilient service continuity even under severe conditions.

SATELLITE-TO-DEVICE 5G BROADCASTING ARCHITECTURE

The following architecture illustrates end-to-end delivery of

radio, television, and rich media services over an S2D network.

Regular live services – including digital radio, television, and rich media broadcasts – are transmitted directly to smartphones through a 5G NTN Broadcasting network. Content is routed to a gateway for digital processing, uplinked to a geosynchronous satellite, and broadcast across wide areas. Smartphones can receive these signals seamlessly, even without access to mobile data, Wi-Fi, or the Internet, ensuring uninterrupted service availability anytime, anywhere. In addition, specific disaster area notifications can be targeted to affected zones in real time, enabling the rapid delivery of emergency alerts and broadcasts when they are needed most.



CASE STUDY PILOT – RESILIENCY IN SATELLITE-TO-DEVICE (S2D) EMERGENCY BROADCASTING

Astrum Mobile successfully conducted a live 5G NTN Broadcasting pilot demonstration in Singapore, in collaboration with Qualcomm, the Singapore University of Technology and Design (SUTD), A*STAR, and with support from the 5G-MAG, Bitstem and ORS Group.^[3]

Leveraging Astrum's Asiastar satellite operating in the L-band (1.4 GHz), the pilot provided a validated proof-of-concept for Satellite-to-Device (S2D) service delivery. Smartphones from Oppo^(a) and Xiaomi^(b), equipped with Qualcomm Snapdragon™ chipsets, successfully received live radio, television, and emergency alert broadcasts directly from Asiastar.

As a 5G Broadcast service, the system demonstrated the ability to reach an unlimited number of smartphones simultaneously – a true massively multi-user network delivering consistent quality and coverage across wide geographic areas.

Further verification tests were conducted in remote locations, and during extreme weather conditions, including active typhoon situations, reaffirmed the resilience and reliability of L-band 5G NTN Broadcasting, ensuring continuous and uninterrupted reception of broadcast services.

MARKET SHIFTS TO S2D

The past two years have marked a transformative shift in the industry toward direct to device S2D services powered by 3GPP 5G Non-Terrestrial Networks (NTN). This evolution redefines how connectivity is delivered – extending service access beyond the reach of terrestrial infrastructure.

Realizing the full potential of this paradigm shift requires the collaboration of global standards bodies, national regulators, and emergency management agencies to ensure NTN integration into national resilience frameworks. With 3GPP standards now enabling these capabilities, it is the right moment for governments and industry to adopt S2D networks as a core component of future-ready, satellite-augmented communication systems – ensuring continuous, nationwide coverage and robust disaster communication.

CONCLUSION

5G NTN using L-band satellite services such as Asiastar makes disaster resilience and real-time emergency communication a practical reality. By enabling direct Satellite-to-Device (S2D) connectivity through everyday smartphones, it ensures continuous communication before, during, and after disasters. This capability complements existing terrestrial systems and should be recognized as a critical component of national disaster risk reduction and resilience strategies.

To fully realize this potential, countries should accelerate the adoption and implementation of 3GPP Release 19 devices and network standards, ensuring that next-generation S2D services are integrated into national communication and emergency response frameworks.

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- [a] [b] – **Trademark disclaimer** – All trademarks, logos, and brand names mentioned herein are the property of their respective owners. Their inclusion does not imply any direct endorsement, sponsorship, or affiliation. References are provided for informational purposes only and are used solely as part of a testing program.

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Mr Wai Hoong Tham is an accomplished executive with over 33 years of experience in satellite communications, telecommunications, and digital broadcast technologies across the Asia-Pacific region.

His career spans complex systems engineering, satellite network design, broadband solutions, digital broadcast DTH and pay-TV operations, IPTV and OTT platforms, and – more recently – spectrum strategy and the development of 3GPP-based telecom and Non-Terrestrial Network (NTN) products and services.

He has held senior positions in leading international organizations such as Echostar, Nokia, Cap Gemini, Alcatel-Lucent, and DISH HD. He has also served in advisory roles to TV networks and DTH operators, shaping their technology strategies, service evolution, and market development across the Asia-Pacific region.

Having lived and worked in Brunei, Indonesia, Taiwan, Malaysia, the Philippines, and Singapore, he brings extensive regional insight that blends technical, commercial, and regulatory perspectives across the satellite, broadcast, and telecom ecosystem.

He holds a Master of Science in Technology Management and a Bachelor of Engineering (Honours) from the National University of Singapore, as well as a Diploma in Business Administration from Henley (UK).

ASTRUM MOBILE

Astrum's Mission is to deliver the next generation of standards-based 5G NTN Satellite-to-Device (S2D) services offering seamless, ubiquitous coverage to massively multi-users in an efficient and affordable manner to our partners and the public. In collaboration with 3GPP wide ranging ecosystem partners, Astrum's geosynchronous satellite provides rich media services, emergency notifications, IoT, and datacasting capabilities across the Asia Pacific region.

Further information, visit www.astrum-mobile.com ■

ABU TECHNICAL BUREAU EMBARKS ON NEW TERM WITH RENEWED LEADERSHIP

The ABU Technical Bureau has commenced its new term under the leadership of **Mr Masashi Kamei** of Nippon Hoso Kyokai (NHK-Japan), who continues as Chairperson for a second term. Supporting him is a fresh team of Vice Chairpersons: **Mr Zhang Wei** of Radio and Television of the People's Republic of China (RTPRC-China), succeeding Mr Sheng Zhifan; **Dr Mohieddin Moradi** of Islamic Republic of Iran Broadcasting (IRIB-Iran) and **Mr Nguyen Duc Tue** of Vietnam Television (VTV-Vietnam).



Mr Masashi Kamei



Mr Zhang Wei



Dr Mohieddin Moradi

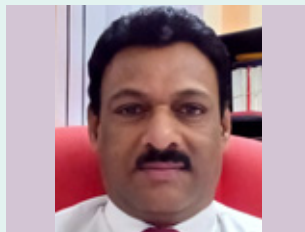


Mr Nguyen Duc Tue

This term, the Bureau welcomes several new members: **Mr Francisco Cheang Kong Pou** from Teledifusao de Macau, S.A (TDM-Macau, China); **Mr Kapila Dasanayake** from Sri Lanka Rupavahini (TV) Corporation (SLRC-Sri Lanka); **Mr Bander Alrasheedi** from Saudi Broadcasting Authority (SBA-Saudi Arabia) and representatives from the Bureau of Broadcast Services-Philippine Broadcasting Service (PBS-Philippines).



Mr Francisco Cheang Kong Pou



Mr Kapila Dasanayake



Mr Bander Alrasheedi

We extend our sincere appreciation to the outgoing members for their contributions and commitment throughout their tenure. Our gratitude goes to former Vice Chairpersons **Mr Sheng Zhifan** of the National Radio and Television Administration (NRTA-China) and **Mr Ashok Kumar** of Prasar Bharati (PB-India), as well as **Mr Ismail Sulaiman** of Radio Televisyen Malaysia (RTM-Malaysia); **Mr Muhammad Asghar** of Pakistan Broadcasting Corporation (PBC-Pakistan) and **Mr Muhamad Sujai** of Radio Republik Indonesia (RRI-Indonesia).



Mr Sheng Zhifan



Mr Ashok Kumar



Mr Ismail Sulaiman



Mr Muhammad Asghar

The updated Bureau structure reflects the ongoing cooperation and shared commitment that continue to propel the ABU's technical community forward. ■



ABU TECHNICAL BUREAU

2026-2027



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MR KAZIM PEKTAS
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REPORT OF TOPIC CHAIRMAN

TOPIC AREA: SPECTRUM

Chairperson: Dr Li Leilei (NRTA-China)

Introduction about scope of the work:

This report is on the Topic Area Spectrum Issues which includes the related WRC-27 Agenda Items concerning broadcasting service and ABU spectrum issues.

Project Topic 1: To consider a possible new primary allocation to the fixed-satellite service (space-to-Earth) in the frequency band 17.3-17.7 GHz and a possible new primary allocation to the broadcasting-satellite service (space-to-Earth) in the frequency band 17.3-17.8 GHz in Region 3, while ensuring the protection of existing primary allocations in the same and adjacent frequency bands, and to consider equivalent power flux-density limits to be applied in Regions 1 and 3 to nongeostationary-satellite systems in the fixed-satellite service (space-to-Earth) in the frequency band 17.3-17.7 GHz, in accordance with Resolution 726 (WRC-23); (WRC-27 AI 1.4)

The following tasks were considered for this project:

1. Follow developments of studies in WP 4A to identify and possible impact on Broadcasting Services.
2. Possible impact on broadcasting service in the Asia-Pacific Area.

This report was provided by Dr Li Leilei

BACKGROUND

Working Party 4A has been designated as a “Responsible group” for WRC-27 Agenda Item 1.4. The tasks of Working Party 4A are shown as follows:

- studies on sharing and compatibility between the FSS (space-to-Earth), the BSS (space-to-Earth) and the FSS (Earth-to-space) designated by No. 5.516 in order to consider a possible new primary allocation to the FSS (space-to-Earth) in the frequency band 17.3-17.7 GHz for Region 3 and to the BSS (space-to-Earth) in the frequency band 17.3-17.8 GHz for Region 3, while ensuring the protection of existing primary allocations in the same and adjacent frequency bands, and without adversely affecting the existing allocations to the FSS (Earth-to-space) designated by No. 5.516, including assignments to the BSS feeder links contained in Appendix 30A.
- consideration of the applicability of Region 2 non-GSO FSS epfd limits (see noting e)) pertaining to the frequency band 17.3-17.7 GHz to Regions 1 and 3, so as to ensure the protection of GSO networks.

The results of Working Party 4A's May 2025 meeting at [4A/567](#), pertaining to WRC-27 Agenda Item 1.4 are detailed in Annex 7 - Working document on WRC-27 Agenda Item 1.4, Annex 8 - Elements for a working document towards draft CPM text for WRC-27 Agenda

Item 1.4, and Annex 9 - Draft work plan for WRC-27 Agenda Item 1.4. The document of Annex 7 had reflected that during the discussion at this meeting, concerns and questions were raised regarding the studies and proposals to update of the epfd value in Table 22-1D to protect the potential new Region 3 BSS in the 17 GHz band as that would impose additional limitations to the non-GSO FSS. Those concerns and the clarification received are reflected in the working document to be further considered at future meetings. In addition, in response to the request at the October 24 WP 4A meeting, BR has provided its suggestions and comments for WP 4A's future work in order to ensure the stability and integrity of RR Appendix 30A Plan.

PRELIMINARY VIEWS

If this Agenda Item can promote the new satellite broadcasting service (space-to-Earth) in the 17.3-17.8 GHz band, it would significantly enhance the directive broadcasting satellite services in the Asia-Pacific region by additional frequency resource. The new spectrum will lay the foundation for business development and also facilitate more flexible transponders for subsequent directive broadcasting satellite systems. Therefore, it is necessary to pay attention to the positions and viewpoints of relevant countries in the world, carry out relevant compatibility analysis in a timely manner, and study the strategies and positions of participating in corresponding international and regional conferences.

Project Topic 2: to consider technical and regulatory measures for fixed-satellite service satellite networks/systems in the frequency bands 37.5-42.5 GHz (space-to-Earth), 42.5-43.5 GHz (Earth-to-space), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) for equitable access to these frequency bands, in accordance with Resolution 131 (WRC 23) (WRC-27 AI 1.6)

The following tasks were considered for this project:

1. Follow developments of studies in WP 4A to identify and possible impact on Broadcasting Services.
2. Possible impact on broadcasting service in the Asia-Pacific Area.

This report was provided by Dr Li Leilei

BACKGROUND

Working Party 4A has been designated as a “Responsible group” for WRC-27 Agenda Item 1.6. The results of Working Party 4A’s May 2025 meeting can be found at [4A/567](#) and are outlined below: **Annex 12** – Elements for a working document on WRC-27 Agenda Item 1.6; **Annex 13** – Elements of working document towards draft CPM text on WRC-27 agenda item 1.6; **Annex 14** – Draft work plan for WRC-27 Agenda Item 1.6.

On November 2024, WP6A sent a Liaison Statement to WP 4A regarding AI 1.6, outlining the following three points:

- To date, Working Party 6A has no information on technical and operational characteristics and protection criteria for any Broadcasting services in these bands.
- The results from the recent ITU-R terrestrial BR IFIC indicated there are no terrestrial broadcast entries in the official MIFR between 40.5 GHz and 42.5 GHz.
- Working Party 6A would appreciate being kept informed of any requirements for additional support it can provide and of progress regarding WRC-27 Agenda Item 1.6.

The results of Working Party 4A’s May 2025 meeting at [4A/567](#), pertaining to WRC-27 Agenda Item 1.6, are detailed in Annex 12-Elements for a working document on WRC-27 Agenda Item 1.6. But, there is little progress on this Agenda Item during this meeting as compared with the results of previous WP 4A’s November 2024 meeting. All results are available at- [4A/567](#). This document was just still focusing on technical and

regulatory measures to ensure equitable access for fixed-satellite service (FSS) networks/systems in the Q/V bands (37.5 - 42.5 GHz, 42.5 - 43.5 GHz, 47.2 - 50.2 GHz, and 50.4 - 51.4 GHz). Challenges include limited spectrum reserved under Radio Regulations (RR) Appendices 30/30A/30B, which favor “first-come, first-served” allocations, disadvantaging developing nations. Current statistics reveal dense orbital occupancy (e.g., 500+ GSO submissions with $\leq 2.1^\circ$ separations) and fast growing non-GSO systems (e.g., 10,000+ satellites), complicating equitable access. Proposed solutions include reserving orbital positions and 5 GHz bandwidth per ITU member, enabling national/regional coverage plans, and prioritizing submissions post-WRC-27. Protection of existing services (GSO/non-GSO) is emphasized, alongside technical hurdles in implementing regional plans (e.g., non-GSO global coverage conflicts). The document critiques past approaches (e.g., C/Ku-band plans) for inflexibility and suggests revising notification procedures. Final measures will be refined in following three WP 4A meetings, balancing equitable access with spectrum efficiency and existing service protection under Resolution 131 (WRC-23).

The next meeting of Working Party 4A will take place from October 27 to November 6, 2025, in Geneva, Switzerland.

PRELIMINARY VIEWS

This Agenda Item pertains to the allocation of both satellite and terrestrial broadcasting services within the 40.5-42.5 GHz band, necessitating consideration of the positions and perspectives of relevant international countries.

Project Topic 3: to consider appropriate regulatory actions to update Appendix 26 to the Radio Regulations in support of aeronautical mobile (OR) high frequency modernization, in accordance with Resolution 411 (WRC 23)(WRC-27 AI 1.9)

The following tasks were considered for this project:

1. Follow developments of studies in WP 5B to identify and possible impact on Broadcasting Services.
2. Possible impact on broadcasting service in the Asia-Pacific Area.

This report was provided by Dr Li Leilei

BACKGROUND

Working Party 5B has been designated as the “Responsible group” for WRC-27 Agenda Item 1.9. The tasks of Working Party 5B are outlined as follows:

- Conduct studies on the introduction of new technologies to enhance performance, including, but not limited to, new classes of emission, wideband systems (see recognizing c), d), and e)), for the aeronautical mobile (OR) service systems in the frequency ranges considered in Appendix 26.
- In order to fulfill the resolve to invite the ITU Radiocommunication Sector to complete the relevant work in time for the 2027 World Radiocommunication Conference, define the relevant technical and operational characteristics and conduct sharing and compatibility studies with existing aeronautical mobile (OR) service systems and other incumbent services allocated on a primary basis in the same or adjacent frequency bands.
- Based on ITU Radiocommunication Sector (ITU-R) studies, identify any potential modifications to Appendix 26 without altering the existing area allotments in recognizing f), and ensure that the current use of narrowband systems remains unchanged and is neither impacted nor precluded by the revision of Appendix 26.

The results of Working Party 5B’s May 2025 meeting, pertaining to WRC-27 Agenda Item 1.9, can be found at [5B/315](#). With regard to AI 1.9, WP 5B agreed to develop one new Rec. ITU-R M. [AMRS_VDL] and one new [Recommendation/Report] ITU-R M. [Modernization of HF AM(OR)S].

In this meeting, Working Party (WP) 5B received a reply liaison statement from WP 5C. WG 5B had considered 2 contributions proposing modifications to the working document towards a preliminary draft new Report ITU-R M.[MODERNIZATION OF HF AM(OR)S]. The proposals were discussed and included in the working document when agreed. The main topics for discussion included the appropriate terminology for existing AM(OR)S systems, further explanation of how 4G ALE is expected to work for these systems, and review of the technical characteristics provided by other Working Parties. For the terminology discussion, the term “legacy” to describe AM(OR)S was not agreeable and the meeting was invited to consider alternative wording such as “analog” or “narrowband” or some other alternative. For the discussion on 4G ALE, there was a request to further expand on the usage of 4G ALE and to provide an explanation of how 4G ALE properly functions for AM(OR)S usage. Finally, regarding the review of technical characteristics, it was highlighted by the meeting that Appendix 27 was updated at the previous WRC-23 and AM(R)S could have channel bandwidths larger than 2.8 kHz, but no upper limit is specified. Due to this information, future should review all parameters in the relevant tables and confirm the information is documented properly.

The next meeting of Working Party 5B will take place from November 18 to 27, 2025, in Geneva, Switzerland.

PRELIMINARY VIEWS

WP 5B was still engaged in this Agenda Item for developing the new Rec. ITU-R M. [AMRS_VDL] and the new [Recommendation/Report] ITU-R M. [Modernization of HF AM(OR)S], and currently, there is not the study from WP 5B on sharing and compatibility with broadcasting service.

Project Topic 4: to consider developing power flux density and equivalent isotropically radiated power limits for inclusion in Article 21 of the Radio Regulations for the fixed-satellite, mobile-satellite and broadcasting-satellite services to protect the fixed and mobile services in the frequency bands 71-76 GHz and 81-86 GHz, in accordance with Resolution 775 (Rev.WRC 23)(WRC-27 AI 1.10).

The following tasks were considered for this project:

1. Follow developments of studies in WP 5C to identify and possible impact on Broadcasting Services.
2. Possible impact on broadcasting services.

This report was provided by Dr Li Leilei

BACKGROUND

Working Party 5C has been designated as a “Responsible group” for WRC-27 Agenda Item 1.10. The task of Working Party 5C is to complete the appropriate studies to determine power flux-density (pfd) and equivalent isotropically radiated power (e.i.r.p.) limits to be included in Article 21 for satellite services (fixed-satellite service (FSS), mobile-satellite service (MSS) and broadcasting-satellite service (BSS)) to protect the current and planned fixed and mobile services in the frequency bands 71-76 GHz and 81-86 GHz.

On November 2024, WP 6A sent the following liaison statement to WP 5C on AI 1.10, outlining the following three points:

- To date, Working Party 6A has no information on technical and operational characteristics and protection criteria for the Broadcasting services in these bands.
- The results from the recent ITU-R terrestrial BR IFIC indicated there are no terrestrial broadcast entries in the official MIFR between 74 GHz and 76 GHz.
- Working Party 6A would appreciate being kept informed of any requirements for additional support it can provide and of progress regarding WRC-27 Agenda Item 1.10.

The results of WP 5C’s May 2025 meeting at [5C/206](#), pertaining to WRC-27 Agenda Item 1.10, was the Chairman Report’s Annex 2.1-Working document on sharing studies under Agenda Item 1.10. In this document, WP 5C had updated the working document on sharing studies and the work plan on WRC 27 agenda item 1.10. The methodology aspects for sharing studies under this agenda item have yet to be fully discussed. Some initial discussions have taken place, and a comparative table of key assumptions and a list of questions and answers on the different input documents have been compiled to facilitate discussions at the next WP 5C meeting.

The next meeting of WP 5C will take place from November 17 to November 28, 2025, in Geneva, Switzerland.

PRELIMINARY VIEWS

On the one hand, this Agenda Item will directly study and determine the power flux density and equivalent omnidirectional radiated power of satellite broadcasting services, and at the same time consider the protection of terrestrial broadcasting services. Therefore, it is necessary to pay attention to the positions and viewpoints of relevant countries in the world.

Project Topic 5: to consider studies on possible new allocations to the mobile-satellite service for direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage, in accordance with Resolution 253 (WRC-23)(WRC-27 AI 1.13).

The following tasks were considered for this project:

1. Follow developments of studies in WP 4C to identify and possible impact on Broadcasting Services.
2. Possible impact on broadcasting services.

This report was provided by Dr Li Leilei

BACKGROUND

Working Party 4C has been designated as the “Responsible group” for WRC-27 Agenda Item 1.13. The tasks of Working Party 4C are shown as follows:

- studies on possible allocations to the MSS in the frequency range between 694/698 MHz and 2.7 GHz, taking into account the IMT frequency arrangements addressed in the most recent version of Recommendation ITU R M.1036.
- studies on spectrum requirements and on technical, operational and regulatory matters related to the implementation of the mobile-satellite service for direct connectivity to the IMT user equipment to complement the terrestrial IMT network coverage.

On October 22, 2024, WP 6A received a liaison statement WP 4C. In this letter, WP 4C agreed on the list of frequency bands to be used for sharing and compatibility studies in accordance with Resolution 253 (WRC-23) as contained in **Table 1**.

TABLE 1 : List of the possible IMT frequency arrangements for MSS direct communication with IMT UE

Directionality	
Uplink (MHz)	Downlink (MHz)
807-849	852-894
880-915	925-960
832-862	791-821
698-716	716-746
776-798	746-768
698-748	753-803
1 427-1 470	1 475-1 518
1 920-1 980	2 110-2 170
1 710-1 785	1 805-1 880
1 850-1 920	1 930-2 000
1 710-1 780	2 110-2 180
2 000-2 020	2 180-2 200
2 010-2 025	1 880-1 920
2 305-2 320	2 345-2 360
2 500-2 570	2 620-2 690

For some of the bands in the table above, the directionality may not fully necessarily be in line with Recommendation ITU-R M.1036. Working Party 4C invites Working Parties (WPs) 3L, 3M, 4A, 4B, 5A, 5B, 5C, 6A, 7B, 7C and 7D to provide any additional information on technical and operational characteristics, protection criteria (which includes any methodology on how to apply it and performance objectives), with respect to systems operating in, or adjacent to, the frequency bands in Table 1, based on the terms of reference of each Working Party.

The results of Working Party 4C’s May 2025 meeting at [4C/356](#), pertaining to WRC-27 Agenda Item 1.13, are detailed in Annex 6 - Working document on the possible description and functionality of MSS systems for direct connectivity between space stations and IMT user equipment, Annex 7 - Working document on sharing and compatibility studies under WRC-27 agenda item 1.13, Annex 8 - Work plan for WRC-27 agenda item 1.13, and Annex 9 - Terms of Reference for Working Party 4C Correspondence Group on WRC-27 agenda item 1.13.

Regarding the matters on sharing and compatibility studies, the discussion during this WP 4C meeting mainly focused on DC-MSS-IMT characteristics. Most of the orbital configuration, technical and operational characteristic items are agreed, and relevant proponents have provided information to most of these items to support future studies. However, views were also expressed that characteristics such as antenna patterns, especially for the adjacent band, ACLR, OOB, and cross-border interference management still need further inputs and discussion. The following issues are identified that require further discussion:

- 1 Proper in-band / out-of-band antenna pattern
- 2 Out-of-band emission density distribution within the first adjacent channel, particularly at frequency offsets near the edge of the transmitted DC-MSS-IMT channel
- 3 Antenna polarization in individual sharing and compatibility studies
- 4 Mitigation techniques to deal with cross-border interference issues
- 5 How to use these parameters in sharing and compatibility studies

Regarding the matters the development of functionality and description for DC-MSS-IMT, the discussion mainly focused on the term of direct connectivity between space stations and IMT user equipment, and finally the meeting agreed on the term as Direct Connectivity between Mobile-Satellite Service space station and IMT UEs (DC-MSS-IMT). The working document consists of 5 sections and two ANNEXES and the contents in the sections and the ANNEXES were not discussed and agreed.

- 1 Terms and definitions
- 2 Introduction
- 3 General description of DC-MSS-IMT systems
- 4 [Operational Concept of the envisaged DC-MSS-IMT system / DC-MSS-IMT Operational Model]
- 5 Responsibilities of SNO/MNO and its corresponding administration
- 6 ANNEX 1: Technical Functionality
- 7 ANNEX 2: Managing and resolving interference scenarios that may arise from satellite network transmissions

Further extensive review is required on this above-mentioned document. In this regard, it was agreed by WP 4C to establish the Correspondence Group (CG) to

continue the work on the document of description and functionality by holding two virtual meetings before WP 4C meeting in October 2025. However, since there was a notable concern raised during the Plenary about the short interval between #3 and #4 indicated in the ToR, the exact schedule will be decided considering this concern and will be circulated through the CG 1.13 emailing list once it is decided. The outcome of the meeting will be an updated Working Document, which will serve as a contribution for further discussions at the WP 4C meeting in October 2025.

In response to WP 5D's inquiries regarding beam management, the aggregate factor, duty cycle and related topics, while WP 4C extensively discussed the matters, it was agreed that WP 4C is still conducting its analysis and will provide a detailed response to WP 5D in due course. WP 4C agreed to send a liaison statement accordingly. The following issues are to be addressed in future meetings of WP 4C:

- Sharing studies principles and methodologies that will be followed by the group
- Several parameters need to be clarified, updated and additionally agreed
- Definitions and functionality concepts of DC-MSS-IMT including responsibilities, authorization, definitions and other issues
- Beam management, aggregate factor and duty cycle to be clarified and send to WP 5D once available

- Harmonization of parameters including protection criteria with other agenda items

In discussion on AI 1.13, it was requested that the proponents of DC-MSS-IMT systems provide information on the ITU filings that may be associated with the systems. This would help the members understand the regulatory status around the systems, which may be useful in future discussion on AI 1.13.

The next meeting of WP 4C is planned for 15 October – 24 October 2025, in Geneva, Switzerland.

PRELIMINARY VIEWS

This Agenda Item will explore the potential new allocation of satellite mobile services in the 694/698 MHz-2.7GHz band to enable direct connectivity between space radios and IMT user equipment, thereby supplementing IMT terrestrial network coverage. This involves the allocation of terrestrial broadcasting services in the 694-702MHz band. If approved, the issue will affect several services used by Asia-Pacific countries in this frequency band. Therefore, it is necessary to pay attention to the positions and viewpoints of relevant countries in the world, study the strategies and positions of participating in corresponding international conferences, and prevent the formation of adverse international restrictions on the development of terrestrial television services in the Asia-Pacific region.

Project Topic 6: to consider regulatory provisions for receive-only space weather sensors and their protection in the Radio Regulations, taking into account the results of ITU Radiocommunication Sector studies, in accordance with Resolution 682 (WRC 23) (WRC-27 AI 1.17).

The following tasks were considered for this project:

1. Follow developments of studies in WP 7C to identify and possible impact on Broadcasting Services.
2. Possible impact on broadcasting services.

This report was provided by Dr Li Leilei

BACKGROUND

Working Party 7C has been identified as the "Responsible group" for WRC-27 Agenda Item 1.17. The tasks of Working Party 7C are shown as follows:

- studies on spectrum needs and appropriate protection criteria for receive-only space weather sensors, as well as system characteristics, as appropriate, taking into account noting a).
- sharing and compatibility studies pertaining to potential

new primary allocations to MetAids (space weather) in the following frequency bands for receive-only sensors, taking into account resolves 2: 27.5-28.0 MHz, 29.7-30.2 MHz, 32.2-32.6 MHz, 37.5-38.325 MHz, 73.0-74.6 MHz, 608-614 MHz.

- studies on possible regulatory provisions of the Radio Regulations to accommodate the possibility for an administration that desires to notify a receive-only space weather sensor station to be included in the Master International Frequency Register.

On November 2024, WP 6A sent a liaison statement to WP 7C regarding AI 1.17. In this letter, WP 6A shared its views and information for WP 7C.

With respect to the frequency band 608-614 MHz, WP 6A provided in Document 7C/32 information on the system characteristics, sharing methodologies, and other applicable reference documents for the 608-614 MHz band. Working Party 6A notes the Radio Regulations of 2024 recognise a number of provisions for radio astronomy in the 608-614 MHz band in a number of countries in Region 1 – RR Nos 5.306 and 5.307, and in Region 3 RR Nos 5.306 and 5.307. Otherwise, the band is deployed by many countries for terrestrial television broadcasting. With respect to deployment scenarios of terrestrial television in the 608-614 MHz band, the Attachment in Document 7C/32 provides information on the terrestrial broadcasting service allocated on a primary basis. The terrestrial IFIC can provide additional information on actually filed broadcasting stations in the 608-614 MHz band.

With respect to the frequency band 73.0-74.6 MHz, Working Party 6A has received advice with a search query across Regions 1 and 3, encompassing both northern and southern hemispheres, for example IFIC 3030; shows 206 entries which are recorded in the MIFR for Frequency Modulation sound broadcasting, notified in accordance with RR Article 11. The Broadcasting services Division of the BR Terrestrial Services Department has confirmed there are 206 terrestrial broadcast entries in the official MIFR between 73.0 to 74.6 MHz for Region 1. Review of the entries in IFIC 3030 indicate the latest such notifications were received in 2017 and 2023, which indicates use of the 73.0-74.6 MHz band. Further individual information on these filings is available in the MIFR. These MIFR filings for these Frequency Modulation sound broadcasting stations include locations, radiated powers and antenna heights for potential use in studies by WP 7C. Please note, there may be further instances of these stations which do not have any potential to cause terrestrial cross border interference and have not therefore been entered into the MIFR. Working Party 6A advises WP 7C to consider the following ITU-R Recommendations which should provide considerable information on the Terrestrial broadcasting service allocated on a primary basis, in the 73-74.6 MHz band, for technical and operational characteristics for the Broadcasting services, noting broadcasting stations are usually operational non-stop, for 24 hours a day.

Recommendation ITU-R	Title
BS.412	Planning standards for terrestrial FM sound broadcasting at VHF
BS.450	Transmission standards for FM sound broadcasting at VHF
BS.641	Determination of radio-frequency protection ratios for frequency-modulated sound broadcasting
BS.704	Characteristics of FM sound broadcasting reference receivers for planning purposes
BS.1195	Transmitting antenna characteristics at VHF and UHF

The up-to-date results of Working Party 7C's March 2025 meeting at [7C/236](#), pertaining to WRC-27 Agenda Item 1.17, were: Annex 5 - Working document towards a preliminary draft new Recommendation ITU-R RS.[RXSW_PROTECT_CRITERIA], Annex 6 - Working document towards a preliminary draft new Report ITU-R RS.[SW_STUDIES], Annex 7 - Proposed draft CPM text for WRC-27 Agenda Item 1.17, Annex 8 - Working document towards preliminary draft revised Report ITU-R RS.2456-1.

The next meeting of WP 7C will take place from September 16 to September 25, 2025, in Geneva, Switzerland.

PRELIMINARY VIEWS

This Agenda Item relates to the allocation of terrestrial broadcasting services in the frequency bands 608-614 MHz and 73.0-74.6 MHz But, the studied service of space weather sensors on this Agenda Item is receive-only. Therefore, it is necessary to pay attention to the positions and viewpoints of relevant countries in the world, study the strategies and positions of participating in corresponding international conferences, and prevent the formation of adverse international restrictions on the development of terrestrial television services in the Asia-Pacific region. ■

REPORT OF TOPIC CHAIRMAN

TOPIC AREA: TRAINING & SERVICES

By **Prakash Veer (PB-India)**

I. OUTCOME OF THE ABU SURVEY ON TRAINING NEEDS

- A new survey form on Training and Services has been circulated to ABU members.
- On 30 June 2025, ABU distributed the survey to all members.
- The survey results will be presented at the upcoming Technical Committee Meeting in Mongolia.

II. TRAINING ACTIVITIES UNDERTAKEN

1. Workshop on Cloud Service and Remote Tools for Broadcasters

- Date: 26–28 November 2024
- Venue: Dewan Cendekiawan, IPPTAR
- Overview: Introduced emerging cloud technologies to broadcasters.
- Participants: Over 35 attendees from RTM, government agencies, ABU members, and RTHK.

2. ABU-VYPA-NETSTAIRS Webinar – AI TV: The Future of Television!

- Date: 23 January 2025
- Platform: Zoom Webinar
- Overview: Focused on the future impact of AI in television broadcasting.
- Participants: 95 participants from 18 organizations.

3. Engineering Fundamentals for Broadcasters – Level 1

- Start Date: 17 March 2025
- Overview: Multi-level training program aimed at junior engineers and new entrants to broadcast engineering.
- Participants: 52 selected from 138 nominees across 14 ABU member organizations.
- Fee: Free and exclusively for ABU members.

4. ABU-DRM Webinar : DRM Latest Development and Aspect of Implementation

- Start Date: 6 May 2025
- Overview: The webinar brought together digital radio experts and regional broadcasters to explore the latest advancements in Digital Radio Mondiale (DRM) technology and its strategic implementation, particularly across the Asia-Pacific.
- Participants: 15 participants attended the webinar, representing 7 member organisations.
- Fee: Free and exclusively for ABU members.

5. ABU-ASBU-WorldDAB Technical Workshop – New Development for DAB+ Systems

- Start Date: 15-17 July 2025
- Overview: The webinar covered a broad range of topics, including the business case, technical standards, network design, and implementation strategies for DAB+ digital radio.
- Participants: A total of 66 participants joined the session from 9 ABU member organisations.
- Fee: Free for all

6. Webinar Series on Members' Innovation: Powering Simless Remote Evolving Media Integration (REMI) TV Production

- Start Date: 31 July 2025
- Overview: The webinar highlighted Malaysia's leadership in developing hybrid 5G broadcast solutions, especially in its role as ASEAN Chair in 2025.
- Participants: A total of 66 participants joined the session from 9 ABU member organisations.
- Fee: Free for all

III. TECHNICAL ADVISORY SERVICE (TAS) MISSIONS

- VOV-Vietnam has requested a workshop for the VOV Technical Staff and a workshop on “Using AI on producing radio programs”.
- Still in discussion and waiting for confirmation date.

IV. TRAINING UNDERTAKEN WITH ABU MEDIA ACADEMY (AMA)

Technology-Related Workshops/Webinar:

- Introduction to TV Production Styles – Hassan Jamalnik London TV Training (The UK) (143 Attendees)
- Latest Techniques in TV Production – Hassan Jamalnik London TV Training (The UK) (85 Attendees)
- Unlocking the Power of Data: Big Data, and Business Intelligence for Smarter Decisions – Dr. Didar Yedilkhan (Kazakhstan) (34 Attendees)
- Enabling seamless broadcasting by APPEAR - Andy Rayner (The UK) (44 Attendees)
- Next Generation Leaders Initiative - Shaping the Future of Media & Technology - Dr Veysel Binbay (ABU) (41 Attendees)
- Lean and Ready: Smart Strategies for Cost-Conscious Production - David Balfour (Australia) (62 Attendees)

V. COLLABORATIVE COURSES WITH OTHER INSTITUTES

1. Institut Penyiaran dan Penerangan Tun Abdul Razak (IPPTAR)

- Workshop on Cloud Services and Remote Tools for Broadcasters (mentioned in Section II)
- Held in collaboration with IPPTAR from 26-28 November 2024 in Kuala Lumpur.
- 30 participants are from members among 71 attendees.

2. Digital Radio Mondiale (DRM) Consortium

- ABU-DRM Webinar on “DRM Latest Developments and Aspects of Implementation”
- Date: 6 May 2025 | Time: 3:00 - 5:00 PM (MYT)
- 15 participants from 7 ABU member organizations across 6 countries.

3. WorldDAB and ASBU

- ABU-DRM Webinar on “DRM Latest Developments and Aspects of Implementation”
- Date: 6 May 2025 | Time: 3:00 - 5:00 PM (MYT)
- A total of 167 participants joined the sessions, with 32 attendees representing 11 ABU member organisations out of the 51 organisations participating overall.

VI. NON-TECHNICAL AND MANAGERIAL TRAINING VIA AMA

- Please refer to the attached workshop list for detailed training sessions targeting non- technical and managerial staff.

REPORT OF TOPIC CHAIRMAN

TOPIC AREA: DISTRIBUTION

By **Hirokazu Kamoda (NHK-Japan)**

The Distribution Topic area comprises four projects, each addressing technological aspects of digital broadcasting. These projects undertake the study and investigation of digital terrestrial television broadcasting, digital satellite broadcasting, and digital sound broadcasting. This topic area encompasses research related to Integrated Broadcast-Broadband (IBB) and Over-the-Top (OTT) services.

1. DIGITAL TERRESTRIAL TELEVISION BROADCASTING (D/DTTB)

- 1.1 Second-Generation Digital Terrestrial Television Broadcasting Systems
- 1.2 Terrestrial Multimedia Broadcasting Systems for Mobile Reception
- 1.3 Latest Topics on Next-Generation DTTB in Japan
- 1.4 Latest Topics on Next-Generation DTTB in Korea
- 1.5 Other Topics

See **Annex 1** for the project report.

2. INTEGRATED BROADCAST-BROADBAND AND OTT (D/IBBOTT)

- 2.1 Studies on Integrated Broadcast-Broadband Systems
- 2.2 Technological Trends on Video Streaming Services
- 2.3 Progress of ChinaDRM Technical Standards and Industrialization
- 2.4 Cybersecurity

See **Annex 2** for the project report.

3. SATELLITE BROADCASTING (D/SB)

- 3.1 ITU-R Documents Related to Satellite Broadcasting Systems
- 3.2 Latest Topics on Satellite Broadcasting in Japan

See **Annex 3** for the project report.

4. DIGITAL SOUND BROADCASTING SYSTEMS (D/DSBS)

- 4.1 Digital Sound Broadcasting Systems within Frequency Range 30-3000 MHz
- 4.2 Digital Sound Broadcasting Systems below 30 MHz
- 4.3 Recent Standardization Activities and Trends

See **Annex 4** for the project report.

Annex 1

DIGITAL TERRESTRIAL TELEVISION BROADCASTING (D/DTTB)

Project Manager: **Dr Shingo Asakura** (NHK, Japan)
Co-project Manager: **Dr Jeon Sungho** (KBS, Korea)

This Annex reports the current status of the next generation television broadcasting systems and the recent updates on relevant technologies and standardizations.

1.1 Second-Generation Digital Terrestrial Television Broadcasting Systems

1.1.1 Overview (Recommendation ITU-R BT.1877-3)

The evolution of digital terrestrial television broadcasting (DTTB) has reached a pivotal stage with the emergence of second-generation systems, designed to meet the growing demands for higher data capacity, improved spectral efficiency, and robust mobile reception. These systems – DVB-T2, ATSC 3.0, and DTMB-A – represent significant advancements over their first-generation predecessors, offering enhanced flexibility, performance, and service diversity.

DVB-T2

Developed primarily for Europe and other regions, DVB-T2 supports both fixed and mobile reception through two profiles: T2-Base and T2-Lite. It utilizes multiple Physical Layer Pipes (PLPs), allowing service-specific modulation and coding. DVB-T2 is highly configurable, supporting bandwidths from 1.7 MHz to 10 MHz, and is compatible with the GEO6 spectrum planning agreement. It enables hierarchical transmission of SDTV, HDTV, and UHD TV, and is well-suited for Single Frequency Networks (SFNs) and mobile broadcasting scenarios.

ATSC 3.0

ATSC 3.0, developed by the Advanced Television Systems Committee, is a non-backward-compatible system designed for the U.S., Canada, Korea, and other regions. It integrates IP-based delivery, enabling interactive services, personalized content, and advanced emergency alerting. The system supports robust mobile reception and high-capacity fixed services, with layered architecture (Physical, Protocol, Application) that allows broadcasters to tailor configurations. ATSC 3.0 is also positioned to complement 5G ecosystems through hybrid broadcast-broadband integration.

DTMB-A

As an evolution of China's DTMB standard, DTMB-A enhances transmission robustness and efficiency. It supports a wide range of services including UHD TV, HDTV, SDTV, and multimedia data, across both fixed and mobile environments. DTMB-A employs advanced channel coding and modulation techniques, and is optimized for high-performance delivery in complex urban and rural terrains. It is also designed to support future extensions and flexible deployment strategies.

Common Features and Strategic Importance

All three systems leverage modern error correction (e.g., LDPC, BCH codes), OFDM modulation, and adaptive frame structures. They are engineered to withstand multipath interference, impulse noise, and varying reception conditions. Importantly, these systems enable broadcasters to deliver high-quality content to both fixed and mobile devices, supporting handheld services and portable reception – key for future media consumption

trends.

As administrations and broadcasters consider upgrades or new deployments, the selection among these systems depends on regional spectrum policies, service goals, infrastructure readiness, and consumer needs. The Recommendation ITU-R BT.1877-3 provides detailed guidelines to help evaluate and select a specific system.

1.1.2 Recent Standardization Activities

ISDB-T3

Advanced ISDB-T (Integrated Services Digital Broadcasting - Terrestrial) is a next-generation digital terrestrial television broadcasting system developed to enhance transmission capacity, flexibility, and service diversity. Building upon the original ISDB-T standard widely used in Japan and parts of South America, Advanced ISDB-T introduces significant improvements in segment structure, modulation, error correction, and service adaptability ^[1]. Unlike ISDB-T's 13-segment structure, Advanced ISDB-T divides a channel into 35 segments, with 9 central segments forming a "partial reception band" for mobile services. This allows mobile receivers to access content efficiently while maintaining high-quality service for fixed reception. The Advanced ISDB-T has been standardized as ISDB-T3 in Japan (ARIB STD-B80) in March 2025. The drafting for the revision of Recommendation ITU-R BT.1877-3 to include ISDB-T3 is underway at WP 6A.

TV 3.0 (Brazil)

TV 3.0 is Brazil's next-generation digital terrestrial television system, designed to merge traditional broadcasting with the flexibility of digital streaming. It builds on the legacy of ISDB-TB (TV 2.0) and introduces ultra-high-definition (4K/8K) video, immersive MPEG-H audio, and advanced interactivity. The system integrates Over-the-Air (OTA) and Over-the-Top (OTT) delivery using IP-based protocols and ROUTE/DASH transport layers. Key technologies include VVC and LCEVC video codecs for efficient bandwidth use, ATSC 3.0 for the physical layer, and support for HDR formats and VR/AR experiences ^[2].

Following extensive evaluations by the SBTVD Forum, the Brazilian government is finalizing the adoption of ATSC 3.0 as the physical layer standard. Pilot stations in São Paulo and Brasília will begin broadcasting in August 2025, with testing continuing through 2026. A prototype reference receiver is expected by August 2025, followed by commercial models in 2026 ^[3].

1.2 Terrestrial Multimedia Broadcasting Systems for Mobile Reception

Mobile reception using handheld devices requires specialized technical design due to unique propagation conditions and device constraints such as small antennas, limited screen size, low power consumption, and reduced processing capabilities.

References:

- [1] Hiroaki MIYASAKA, et al., "The Transmission Systems for Advanced Terrestrial Broadcasting," The Journal of IEICE, Vol.107, No.1, pp.48-54, 2024.
- [2] A. S. S. Chaubet, et al., "TV 3.0: an overview," IEEE Transactions on Broadcasting, Vol. 71, No. 1, Mar. 2025.
- [3] https://forumsbtvd.org.br/tv3_0/

1.2.1 User Requirements

(Recommendation ITU-R BT.1833-5)

To ensure effective mobile multimedia broadcasting, the following user requirements are considered:

- Delivery of high-quality multimedia content (video, audio, data)
- Flexible configuration of diverse services (AV, auxiliary data)
- Content protection via conditional access and DRM
- Seamless access across different networks
- Fast channel acquisition and service switching
- Efficient power usage and compact device compatibility
- Stable and reliable reception in various environments
- Support for interactivity and return channel capabilities
- Efficient transport mechanisms
- Interoperability between broadcast and telecom networks (e.g., IP-based services)

1.2.2 Technical Systems

(Recommendation ITU-R BT.2016-4)

ITU-R BT.2016-4 defines multiple systems suitable for mobile reception via handheld devices in VHF/UHF bands.

These systems include Systems A, F, H, I, T2, etc., and are characterized by the following technical components:

a. Modulation and Error Correction

- Modulation: QPSK, 16QAM, 64QAM, DQPSK, etc.
- Error correction: Convolutional codes, Turbo codes, LDPC + BCH
- Interleaving: Time and frequency interleaving for robustness

b. OFDM-Based Transmission

- Subcarrier configurations: 1k to 32k modes
- Guard intervals: Configurable from 1/128 to 1/4
- Symbol durations: Ranging from hundreds of microseconds to several milliseconds

c. Frame Structure and Synchronization

- Frame duration: Up to 250 ms, depending on system
- Synchronization: Pilot carriers, guard intervals, P1/P2 symbols

d. Data Rates

- Net data rates: Vary from hundreds of kbps to tens of Mbps depending on modulation, coding rate, and system configuration

Table 1-1: Representative systems

System	Standard / Origin	Modulation	Coding	Bandwidth	Max Data Rate	Key Features
A (T-DMB / AT-DMB)	Korea / DAB-based	DQPSK, BPSK/QPSK over DQPSK	Convolutional + Turbo	1.712 MHz	Up to 2.88 Mbps	Backward compatible with T-DMB
F (ISDB-T)	Japan	DQPSK, QPSK, 16QAM, 64QAM	Convolutional	6/7/8 MHz	Up to 2.38 Mbps per segment	Hierarchical transmission
I (DVB-SH)	Europe	QPSK, 16QAM	Turbo Code	1.7–8 MHz	Up to 17.26 Mbps	Satellite + terrestrial hybrid
H (DVB-H)	Europe	QPSK, 16QAM, 64QAM	Convolutional + MPE-FEC	5–8 MHz	Up to 23.82 Mbps	IP datacast, MPE-FEC
T2 (DVB-T2 Lite)	Europe	QPSK, 16QAM, 64QAM	LDPC + BCH	1.7–8 MHz	Up to 4 Mbps	Optimized for mobile
R (RAVIS)	Russia	QPSK, 16QAM, 64QAM	LDPC + BCH	100–250 kHz	Up to 900 kbps	Low Bitrate Channel and Reliable Data Channel apart from Main Service Channel
S (ATSC 3.0)	USA	QPSK to 4096-NUC	LDPC + BCH	6–8 MHz	Up to 77.2 Mbps	Bootstrap, LDM multiplexing, IP multicast
L (5G Broadcast)	3GPP / LTE	QPSK to 256QAM	Turbo	1.4–20 MHz	Up to 24.8 Mbps	Supports DASH, CMAF, HLS, IP-based services
N (5G NR MBS)	3GPP / NR	QPSK to 256QAM	Polar + LDPC	5–40 MHz	Up to 55.7 Mbps	Seamless unicast/broadcast switching
M (DTMB-A)	China	QSPK to 256APSK	LDPC + BCH	6–8 MHz	Up to 51.7 Mbps	Time-domain synchronous OFDM

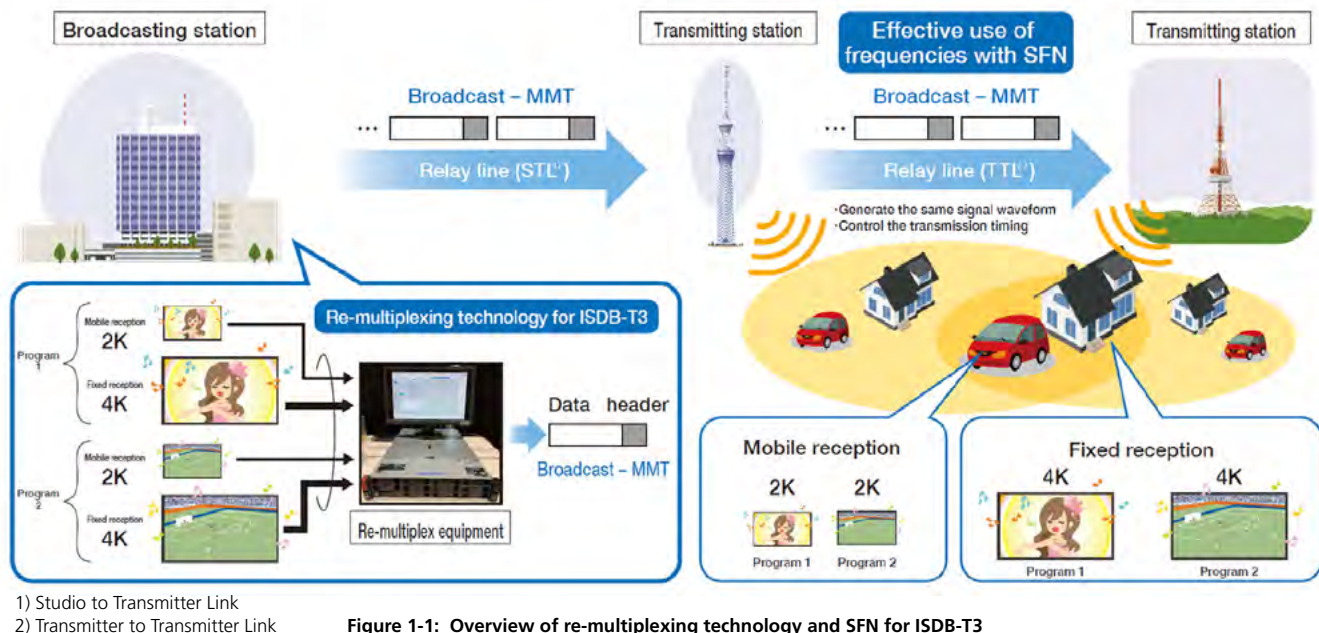


Figure 1-1: Overview of re-multiplexing technology and SFN for ISDB-T3

1.3 Latest Topics on Next-Generation DTTB in Japan

1.3.1 Introduction

In March 2025, the transmission system for advanced digital terrestrial television broadcasting based on Integrated Services Digital Broadcasting for Terrestrial Television Broadcasting, 3rd generation (ISDB-T3) was standardized by the Association of Radio Industries and Businesses (ARIB) [4]. As well as the current ISDB-T system, ISDB-T3 provides a single-frequency network (SFN) that contributes to spectral efficiency. For the SFN construction, an IP-based re-multiplexing scheme for ISDB-T3 was developed as Broadcast - MPEG Media Transport (MMT) as a scheme.

Figure 1-1 shows an overview of re-multiplexing technology and the effective use of frequencies with the SFN for ISDB-T3. Multiple programs are multiplexed into a single packet stream on the basis of the Broadcast - MMT format. To construct an SFN, the Broadcast - MMT scheme enables multiple modulators to generate the same signal waveform. The Broadcast - MMT scheme and verification are briefly introduced in the report.

1.3.2 Process of Re-multiplexing Equipment and ISDB-T3 Modulator

Figure 1-2 shows the process of the re-multiplexing equipment in the broadcasting station and ISDB-T3 modulator in the transmitting station with the Broadcast - MMT scheme, which is the IP-based signal format. In the broadcasting station, each program including coded video, audio, and other data is input to the re-multiplex equipment through an MMT protocol (MMTP) packet over Ethernet. The length and bit rate of the MMTP packet are variable. In the re-multiplex equipment, each MMTP packet is arranged in an Orthogonal Frequency Division Multiplexing (OFDM) frame of frequency division multiplexing (FDM) or time division multiplexing (TDM), the length of which is constant. The control-information packet including Transmission and Multiplexing Configuration Control (TMCC) and transmission timing is added to the beginning of each frame. The output of the re-multiplex equipment, i.e., Broadcast - MMT, is transmitted to the ISDB-T3 modulator with a constant bit rate. In the transmitting station, the ISDB-T3 modulator configures the transmission parameters with the control

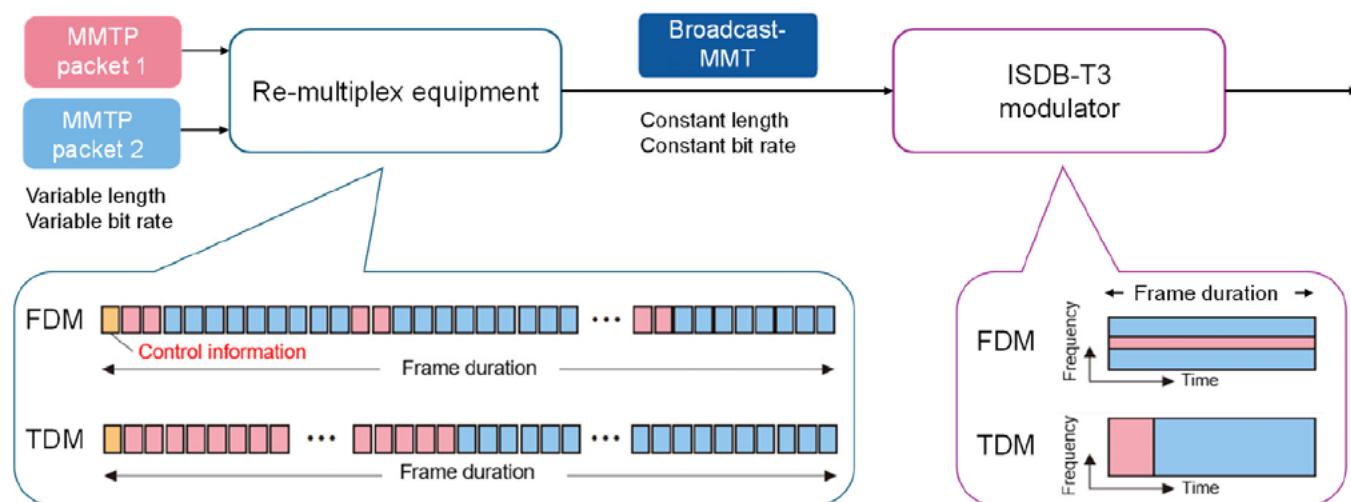


Figure 1-2: Process of re-multiplexing equipment and ISDB-T3 modulator

Reference:

[4] ARIB standard: "Transmission system for advanced digital terrestrial television broadcasting based on ISDB-T3," ARIB STD-B80 ver.1.0, Mar. 2025.

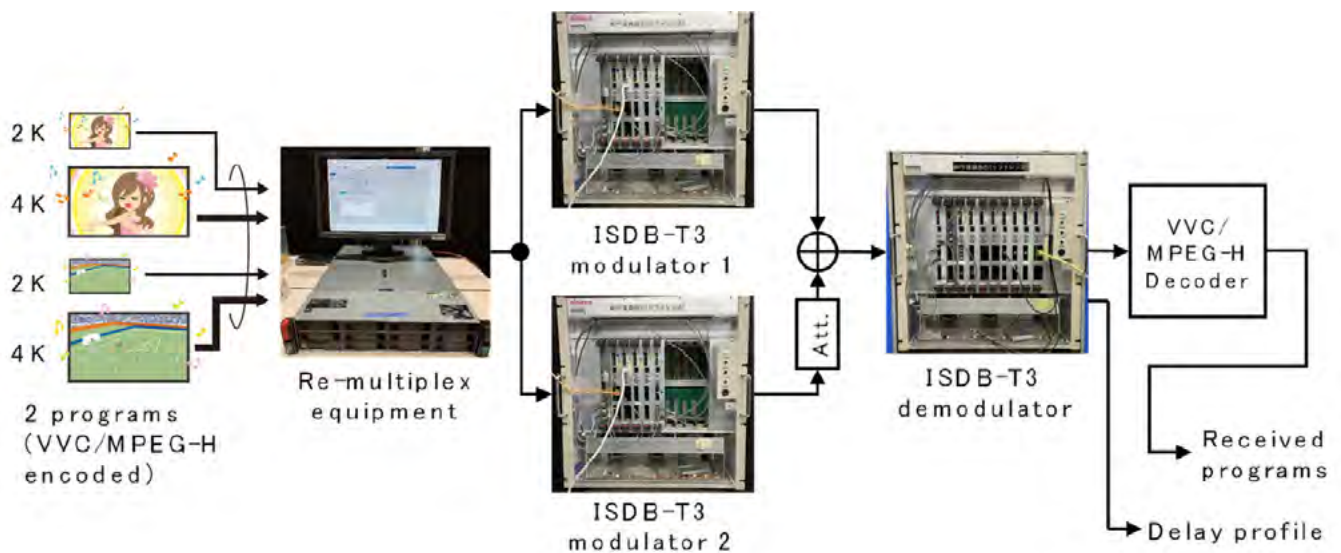


Figure 1-3: Block diagram of laboratory test

information packet and generates an OFDM frame on the basis of the received Broadcast – MMT. The ISDB-T3 modulator also adjusts the transmission timing to construct an SFN.

1.3.3 Verification

The Broadcast - MMT format was installed on the interface of the re-multiplex equipment and ISDB-T3 modulator, and the feasibility was verified through a laboratory test. Two 4K programs for fixed reception and two 2K programs for mobile reception were compressed using a VVC/MPEG-H encoder and input to the re-multiplex equipment. Assuming an SFN with two transmitters, the re-multiplex equipment and two modulators were connected by Ethernet. The transmission timing of modulator 2 was set to 10- μ s delay compared with that of modulator 1. The output OFDM waveforms of both modulators in the intermediate-frequency band

were combined, and it was confirmed by monitoring the delay profile that the transmission timing was set properly. The SFN signal was then received by the demodulator and two 4K and 2K programs were output to displays.

Program multiplexing and transmission technologies for next-generation terrestrial broadcasting with Broadcast - MMT was demonstrated at STRL Open House 2025 [5]. **Figure 1-4** shows the exhibition booth. It was confirmed that the Broadcast - MMT enables the synchronization of multiple modulators and construction of an SFN.

1.3.4 Conclusion

NHK developed an IP-based re-multiplexing scheme from a broadcasting station to transmitting stations as the Broadcast – MMT scheme. The feasibility of SFN construction with the Broadcast – MMT was confirmed through a laboratory test with prototype equipment.



Figure 1-3: Block diagram of laboratory test

Reference:

[5] <https://www.nhk.or.jp/strl/english/open2025/tenji/16/index.html>

Acknowledgements:

Part of this research was conducted as part of the “Survey and Studies on Technical Conditions of Broadcasting Networks for Effective Use of Broadcasting Frequencies” for the Technical Examination Services Concerning Frequency Crowding of the Ministry of Internal Affairs and Communications.

1.4 Latest Topics on next-generation DTTB in Korea

1.4.1 Performance Comparison of Antenna Diversity for SFN Reception

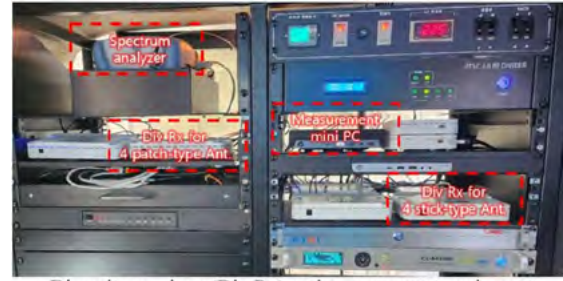
1.4.1.1 Background

The rapid advancement of autonomous vehicle technologies has significantly increased the demand for reliable in-car entertainment services. Broadcast networks, particularly those utilizing the Advanced Television Systems Committee (ATSC) 3.0 standard, are crucial for delivering such services, as they perform effectively even under weak signal conditions. Single Frequency Networks (SFNs), commonly used in mobile environments, enhance broadcast efficiency in challenging scenarios.

Previous research has predominantly focused on single-antenna systems, which are vulnerable to significant signal degradation. Utilizing multiple antennas for diversity reception has been shown to improve signal reliability. Traditional stick-type magnetic antennas, typically mounted on vehicle roofs, are functional but may be visually unappealing for consumer vehicles. This study compares the reception performance of more aesthetically appealing patch-type transparent antennas with conventional stick-type magnetic antennas in SFN environments through extensive field testing.

1.4.1.2 Field Test Setup

The test vehicle was equipped with both stick-type magnetic and patch-type transparent antennas (**Figure 1-5**). Four stick-type magnetic antennas (3 dBi gain, passive) were installed at the corners of the vehicle roof, while four patch-type transparent antennas (1.5 dBi gain, active with a 20 dB Low Noise Amplifier (LNA)) were mounted on the front and rear windshields. Two GPS-synchronized ATSC 3.0 diversity receivers, utilizing Maximal Ratio Combining (MRC), were used, one for each antenna type.



<Diversity receivers(Div Rx) and measurement equipment>



Figure 1-5: Test vehicle setup for field test

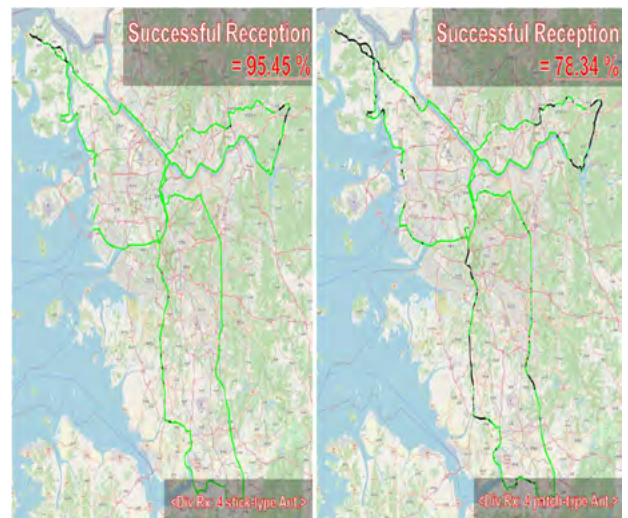


Figure 1-6: Test routes and reception success/failure with transparent-patch vs. stick antennas (Green: Successful decoding, Black: Decoding failure)

Center Frequency		768 MHz (Channel 56)	
Preamble Parameters	FFT Size	8k	
	Guard Interval	1536 (222 us)	
	Pilot Pattern	SP_Dx = 4	
	L1-Basic	Mode 1	
	L1-Detail	Mode 1	
		Subframe 0 (PLP-0)	Subframe 1 (PLP-1)
Payload Parameters	FFT Size	8k	32k
	Guard Interval	1536 (222 us)	1536 (222 us)
	# of Payload Symbols	46	32
	Pilot Pattern	SP_Dx = 4, SP_Dy = 2	SP_Dx = 8, SP_Dy = 2
	Frequency Interleaver	On	On
	Time Interleaver	CTI depth of 512	CTI depth of 1024
	FEC Type	BCH + 16K LDPC	BCH + 64K LDPC
	Code Rate	6/15	9/15
	Modulation Order	64-NUC	256-NUC
	Data Rate	2.82 Mbps	17.09 Mbps
	Required CNR (AWGN)	9.29 dB	16.82 dB

Table 1-2: Physical layer configuration for field trials

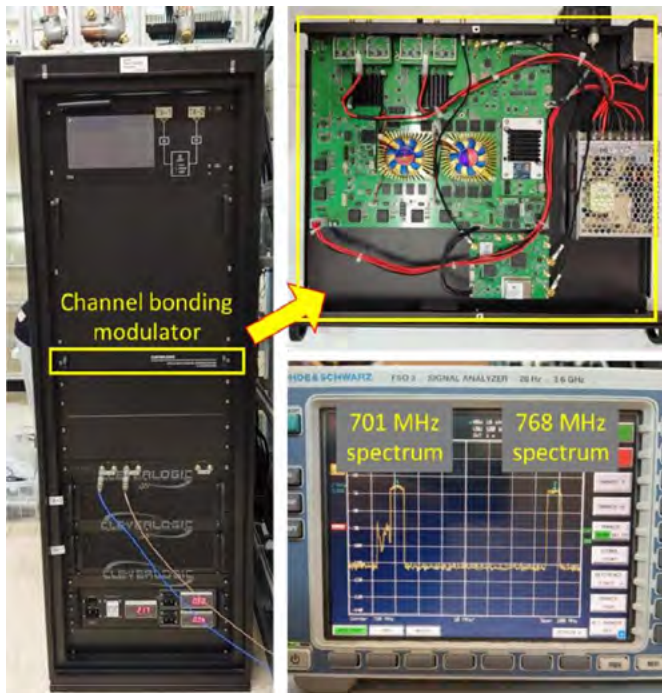


Figure 1-7: The implemented channel bonding transmitter and modulator and the received signal spectrum measured at the transmission site.

1.4.1.3 Field Test Results

Field tests were conducted near the Korean Broadcast System (KBS) Channel 56 in South Korea, focusing on mobile reception with a physical layer pipe (PLP)-0 configuration. The 450 Km route included areas with challenging reception conditions.

- The reception success rates were as follows:
- Stick-type magnetic antennas: 95.45%
 - Patch-type transparent antennas: 78.34%

Despite the lower success rate, the patch-type antennas provided acceptable reception for mobile environments, balancing performance with aesthetic considerations. Factors influencing the reception rates include:

- Installation Location:
- Roof-mounted stick-type antennas minimized signal blockage.
- Windshield-mounted patch-type antennas were more susceptible to signal reflections and absorption.
- External vs. Internal Environment:
- External stick-type antennas received signals omnidirectionally without interference from vehicle components.
- Internal patch-type antennas faced interference due to the vehicle’s glass and metal components.

Patch-type transparent antennas offer durability and aesthetic advantages, making them particularly suitable for high-end vehicles where appearance is a key consideration.

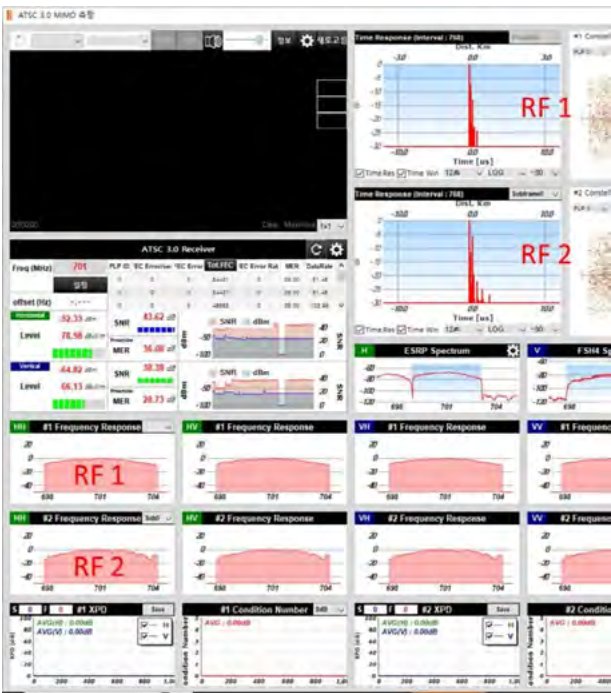


Figure 1-8: The screenshot of the measurement software for the channel bonding field verification

1.4.2 Field Verification of ATSC 3.0 Channel Bonding

1.4.2.1 Background

The growing demand for high-quality video and data services has led to significant advancements in broadcast systems. ATSC 3.0’s channel bonding and Multiple-Input Multiple-Output (MIMO) technologies address spectrum limitations and increase system capacity. Channel bonding combines two RF channels, with plain and SNR-averaged modes offering distinct benefits. This study evaluates the performance of these modes in a real-world environment using FPGA-based systems.

1.4.2.2 Implementation and Field Verification

Real-world tests were conducted at the KBS Gyeonggi Gamak experimental transmission site, using a system fully compliant with ATSC 3.0 (A/322) and utilizing two 6 MHz RF channels at 701 MHz and 768 MHz. The test assessed the performance of plain and SNR-averaged channel bonding for the delivery of 8K UHD content at approximately 100 Mbps.

The results indicated that SNR-averaged channel bonding outperformed plain bonding, particularly when one channel experienced signal loss. SNR-averaged channel bonding efficiently utilized the stronger channel, ensuring reliable performance under adverse conditions.

Table 1-3: Physical layer configuration for field trials

Parameters	Configuration 1	Configuration 2
FFT Size	32k	16k
Guard Interval	GI4_768 (111.111 us)	GI4_768 (111.111 us)
Pilot Pattern	SP16_2	SP8_2
Time Interleaver	CTI (1024)	CTI (1024)
Outer Code	BCH	BCH
Inner Code	LDPC (64800) 12/15	LDPC (64800) 4/15
Constellation	4096 NUC	QPSK
Data rate	102.9 Mbps	5.37 Mbps
Required SNR	30.7 dB	-2.63 dB

Table 1-4: Measurement data for each measurement point and channel bonding modes

Point No.	Modes	Plain Channel Bonding		SNR averaged Channel Bonding	
	RF #	RF 1	RF 2	RF 1	RF 2
1 (LP) for Config.1	ACI [dBm]	-84.59	-87.04	-84.59	-87.04
	RSS [dBm]	-40.14	-47.1	-40.03	-49.7
	ToV [dB]	41.94	34.89	39.91	30.65
	mRSS [dBm]	-58.22	-65.28	-63.29	-70.65
2 (LP) for Config.1	ACI [dBm]	-97.44	-97.36	-97.44	-97.36
	RSS [dBm]	-55.24	-57.44	-54.59	-57.85
	ToV [dB]	35.31	33.21	34.76	31.92
	mRSS [dBm]	-64.25	-66.24	-67.13	-69.65
2 (Omni) for Config.1	ACI [dBm]	-93.72	-95.83	-93.72	-95.83
	RSS [dBm]	-43.3	-55.66	-43.59	-56.24
	ToV [dB]	Fail	Fail	47.49	35.18
	mRSS [dBm]	Fail	Fail	-52.33	-64.82
3 (LP) for Config.1	ACI [dBm]	-99.99	-99.99	-99.99	-99.99
	RSS [dBm]	-35.08	-37.82	-35.38	-38.98
	ToV [dB]	34.48	32.66	36.9	31.34
	mRSS [dBm]	-60.89	-63.71	-64.49	-67.87
4 (Omni) for Config. 2	ACI [dBm]	-95.25	-94.78	-95.25	-94.78
	RSS [dBm]	-46.34	-59.37	-48.08	-64.08
	ToV [dB]	15.64	0.87	11.41	-5.17
	mRSS [dBm]	-86.47	-95.94	<-100	<-100

1.4.2.3 Features and Applications

SNR-averaged channel bonding provides improved reception reliability by leveraging frequency diversity. However, it requires synchronization between RF channels and identical physical layer parameters across both channels. This mode is particularly suitable for delivering 8K-UHD content and for emergency broadcasts, where service reliability is most important.

Plain channel bonding, on the other hand, offers greater flexibility in resource allocation and is backward-compatible with legacy receivers. It is suitable for dynamic scheduling and the efficient distribution of resources in varying conditions.

1.4.3 Conclusion

Antenna diversity and channel bonding significantly enhance the reception and capacity of ATSC 3.0 broadcasts. Patch-type transparent antennas offer a balance between performance and aesthetics, making them a suitable choice for consumer vehicles. SNR-averaged channel bonding delivers superior performance in fluctuating signal conditions, ensuring reliable, high-quality service delivery.

1.5 Other Topics

1.5.1 Latest Activities at ITU-R

1.5.1.1 DTT Planning (Report ITU-R BT.2485)

MISO technology that can reduce transmission degradation in single frequency networks is being discussed at WP 6A meetings. The revised report (Report ITU-R BT.2485) is being drafted.

1.5.1.2 Multimedia Mobile Broadcasting (Report ITU-R BT.2526)

WP 6A meeting had been drafting the revised report for Report ITU-R BT.2526 to outline how to plan for LTE-based 5G broadcast. Field experiment results of 5G NR MBS conducted in Wuhan, China had also been added to the revision. The revision was approved at Study Group 6 in March 2025.

1.5.1.3 UHDTV Field Transmission Experiment (Report ITU-R BT.2343)

WP 6A meeting had been drafting the revision of Report ITU-R BT.2343 (Collection of field trials of UHDTV over DTTB networks) regarding the information on the verification of an ATSC 3.0 and 1.0 integrated MATV system in Korea and the 4K terrestrial transmission experiment with Brazilian TV 3.0 Project. The draft revision was approved at Study Group 6 in March 2025.

INTEGRATED BROADCAST-BROADBAND AND OTT (D/IBBOTT)

Project Manager: **Dr Go OHTAKE** (NHK, Japan)
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Mr Hiroki Endo (NHK, Japan)
Mr Wang Lei (ABS, China)

This annex describes recent updates on Integrated Broadcast-Broadband (IBB) and Over-the-Top (OTT) standards and related technologies. It also covers recent updates on standards and technologies of content protection and cybersecurity in broadcasting industry.

2.1 Studies on Integrated Broadcast-Broadband Systems

2.1.1 Studies in ITU-R

ITU-R Working Party 6B (WP 6B) is conducting studies on IBB systems. The working party has been studying harmonization of IBB systems by comparing Hybridcast (Japan), HbbTV2.0 (Europe), TOPSmedia (South Korea) and Ginga (Brazil). It is also studying the system architecture of a global platform for broadcasting to enable interoperability between broadcast and broadband. Additionally, WP 6B addresses content provenance to ensure authenticity and traceability of media content.

At its meeting held in April 2019 in Geneva, the WP 6B developed a comparison of the application life-cycles and application transition among the IBB systems, and revised Report ITU-R BT.2267 “Integrated broadcast-broadband systems” to add a new part on the harmonization of applications among different IBB systems. Harmonizing the IBB systems and ensuring compatibility of applications and interoperability between systems is essential for enabling the exchange and deployment of services across regions using different IBB systems.

At the same meeting, WP 6B revised Report ITU-R BT.2342 to replace information on TTML Text and Image Profiles for Internet Media Subtitles and Captions 1.0 (IMSC1.0) with the updated IMSC1.1. It also updated the list of EBU specifications pertinent to the content of the Report.

At its meeting held in July 2019 in Geneva, WP 6B revised Report ITU-R BT.2267 to add a companion application that enables the execution of IBB applications on receivers. The working party also developed new use cases of IBB systems, where object-based sound services are provided via MPEG-DASH streams.

WP 6B also developed the “global platform”. The working party revised Report ITU-R BT.2400 “Usage scenarios, requirements and technical elements of a global platform for the broadcasting service” to add the specific reference to the ATSC 3.0 standard and some examples to show its Internet Protocol-based capabilities to integrate broadcast and broadband services. New digital terrestrial transmission standards such as ATSC 3.0 system can help effectuate a converged broadcast and broadband platform, which is an important aspect of a global platform for broadcasting services. At its meeting held in October 2020, WP 6B revised

Recommendation ITU-R BT.2075 “Integrated broadcast-broadband system” to update the application execution mechanism of Hybridcast, which introduced a feature that allows a companion device to send a command to a receiver to tune to a designated channel and launch a Hybridcast application.

At its meeting held in March 2021, WP 6B prepared a revised draft report of Recommendation BT.2075 by adding information regarding commonality among IBB systems and equivalency of their functions as described in Report BT.2267 Part 3. The working party also prepared a draft revision to report BT.2267 on IBB systems to align with Recommendation ITU-T J.208 on harmonization of applications between IBB systems.

At its meeting held in September 2022, WP 6B revised Recommendation ITU-R BT.2075 “Integrated broadcast-broadband system” and Report ITU-R BT.2267 “Integrated broadcast-broadband systems” to add a Broadcast-independent managed application, which is an application that can be launched when broadcast services are not selected but is still authenticated by broadcasters.

At its meeting held in May 2023, WP 6B:

- revised Recommendation ITU-R BT.2075-5 “Integrated broadcast-broadband system” to add broadcast-independent managed applications.

At its meeting held in March 2025, WP 6B:

- prepared a preliminary draft new Report BT[GP] “High-level system architecture for content delivery and reception on a global platform for broadcasting” to describe the overall architecture and functional blocks of a global broadcasting platform.
- prepared a preliminary draft revision of Report ITU-R BT.2400-4 “Usage scenarios, requirements and technical elements of a global platform for the broadcasting service” to update usage scenarios and technical requirements.
- prepared a preliminary draft new Report ITU-R BT.[APPBASDTV] “Application-oriented television broadcasting” to describe frameworks and requirements for application-driven TV services.
- prepared a working document towards a preliminary draft new Report ITU-R BT.[PROVENANCE] “Content provenance for programme production, international exchange and distribution of content” to address methods for ensuring authenticity and traceability of media content.

2.1.2 Studies in ITU-T

ITU-T Study Group 9 (SG9) is also conducting studies on IBB system applied to Cable Digital TV. At its meeting held in November 2018 in Bogota, Colombia, the Study Group started to revise IBB system Recommendation (Recommendation ITU-T J.207 “Specification for integrated broadcast and broadband digital television application control framework”) to add the function of device collaboration with companion devices in Hybridcast. Recommendation ITU-T J.207 is a twin of IBB system Recommendations in ITU; Recommendation ITU-R BT.2075 is another twin on this topic. Therefore, the Study Group continues to revise the Recommendation ITU-T J.207 in line with the revision of Recommendation ITU-R BT.2075. The Study Group is studying smart TV operating systems for hybrid cable Digital TV services including IBB DTV services provided by cable television operators and third-party providers. At the Bogota meeting, the Study Group made progress the work on the architecture of smart TV operating system. The Study Group consented to the Recommendation of “The functional requirements of smart TV operating system” as Recommendation ITU-T J.1201.

At the meeting held in June 2019 in Geneva, the SG9 consented to Recommendation ITU-T J.207 to add the function of device collaboration in Hybridcast. The Study Group also made progress the work of drafting new Recommendation “Harmonization of Integrated Broadcast-Broadband DTV application control framework”. As for the smart TV operating system, the Study Group consented to the Recommendation of “The architecture of smart TV operating system” as Recommendation ITU-T J.1202. In addition, the Study Group has begun developing a new Recommendation for the specification of smart TV operating systems.

At the meeting held in November 2023, SG9 reached the AAP consent for the draft new Recommendation ITU-T J.1206. It has been approved and is now part of the set of already approved Recommendations as follows:

- J.1201: Functional requirements of a smart TV operating system
- J.1202: The architecture of a smart TV operating system
- J.1203: The specification of a smart TV operating system
- J.1204: The security framework of a smart TV operating system
- J.1205: The hardware abstract layer application programming interface of a smart TV operating system
- J.1206: The application programming interface of a smart TV operating system

SG9 also consented to new Recommendation ITU-T J.208 “Harmonization of Integrated Broadcast-Broadband DTV application control framework” at its November 2020 meeting. The recommendation was created based on Report ITU-R BT.2067 which defined the methods

to harmonize IBB systems by identifying commonalities across the IBB systems.

At its meeting held in October 2024, SG9 approved new Recommendation ITU-T J.1207 “Smart television operating system – Conformance test” to specify conformance testing for smart TV operating systems based on J.1201 to J.1206.

A new Study Group 21 (SG21) was established in WTSA-24 (October 2024) as a consolidation of SG9 and SG16. SG21 is responsible for studies previously covered by SG9, including integrated broadcast-broadband systems and smart television operating systems.

2.1.3 Standardization of Integrated Broadcast-Broadband System in Japan

IPTV Forum Japan standardizes the specifications of Hybridcast in Japan. The technical specification of Hybridcast is composed of two technical standards and one operational guideline, as listed below. These latest versions were published in January 2022.

- IPTVFJ STD-0010 ‘Integrated Broadcast-Broadband System Specification’, version 2.4
- IPTVFJ STD-0011 ‘HTML5 Browser Specification’, version 2.7
- IPTVFJ STD-0013 ‘Hybridcast Operational Guideline’, version 2.10

In the November 2020 revision, several new features were added to the Hybridcast technical specifications. Major updates were as follows:

- **Addition of the new application type named “Broadcast-independent managed application”**
An application of this type runs in the state that no broadcast channel is being tuned so that service providers can offer application services regardless of their broadcasting area.
- **Enhancement to the streaming video playback function**
The CMAF^{*1} is added as a supported container format of streaming video, including low-latency playback features. Support for stream event delivery mechanisms such as an ‘event message’ (emsg) box and an ‘Event’ XML element of MPEG DASH^{*2} are also added.
- **Enhancement to the companion device function**
UHDTV broadcasting services, i.e. 4K and 8K satellite broadcasting in Japan, are added to the available channels for tuning from a companion device.
- **Addition of the three-dimensional audio codec support**
The enhanced AC-3^{*3} is added to the available audio codecs for video streaming.

In the January 2022 revision, several features related to discontinued VOD services were removed from the Hybridcast technical specifications.

References:

- *1 ISO/IEC 23000-19 “Multimedia application format (MPEG-A) – Part 19: Common media application format (CMAF) for segmented media”.
- *2 ISO/IEC 23009-1 “Dynamic adaptive streaming over HTTP (DASH) – Part 1: Media presentation description and segment formats”.
- *3 ETSI TS 102 366 “Digital Audio Compression (AC-3, Enhanced AC-3) Standard”.

2.2 Technological Trends on Video Streaming Services

When video streaming over the Internet first began around 1998, the mainstream approach was push-type delivery from dedicated servers to viewing devices using video delivery protocols such as Microsoft Media Server Protocol (MMSP), Real Time Streaming Protocol (RTSP), and Real Time Messaging Protocol (RTMP). Around 2006, a shift to HTTP streaming, a pull-type approach, began, instead of using these video delivery protocols. HTTP streaming uses the Hypertext Transfer Protocol (HTTP), the same protocol used to deliver text and images that make up web pages. This approach not only eliminates the need for dedicated video delivery servers, but also allows for the use of Content Delivery Networks (CDNs), which are used to speed up and scale websites. This approach enabled lower-cost, larger-scale delivery than traditional video streaming systems. Furthermore, around 2008, a new approach called HTTP adaptive streaming began to be used, which dynamically adjusts video quality based on network congestion, ensuring stable delivery. Today, the most popular international standards are MPEG-DASH (MPEG Dynamic Adaptive Streaming over HTTP) and HLS (HTTP Live Streaming) developed by Apple Inc. The emergence of these technologies has led to the explosive growth of today's video streaming services.

However, these methods also have their drawbacks, the most significant of which is increased latency. While UDP (User Datagram Protocol)-based delivery methods such as RTSP were capable of delivering content with a latency of approximately one second, when the transition to HTTP adaptive streaming was first made, latency of several tens of seconds was commonplace. Even today, typical “real-time” streaming services typically experience latency of 10 seconds or more. While some argue that this is not a concern because the same video is not viewed simultaneously on different media platforms, such as television and the Internet, it is not uncommon for viewers to find out the results of a sports game online before they see it, due to cheers from a neighbor or a social media post. This could be said to lead to a loss of communication opportunities between users watching on different media platforms. Furthermore, as we strive to deliver reliable information to all audiences using a variety of transmission paths, reducing latency, in addition to ensuring video and audio quality, is an extremely important issue.

Meanwhile, on the internet, dis/misinformation such as fake news are spreading on social media, becoming a social problem. In particular, during national elections and large-scale natural disasters, a large amount of content containing false and misleading information is distributed, forcing users to discern true information from the vast amount of information available online. Furthermore, generative AI can easily be used to create fake videos impersonating broadcasters. Since the internet is open and anyone can become a source of information, it is difficult to identify the source, making it important to ensure the reliability of content broadcasters publish.

This report outlines the latest trends in technologies

for stabilizing and reducing latency in video streaming and ensuring the reliability of content, as technological elements needed to realize a video streaming service that reliably delivers information as reliable as broadcasting.

(This section is based on the article published in NHK STRL R&D No.200 in 2025, available at <https://www.nhk.or.jp/strl/public/rd/200/3.html> (in Japanese))

2.2.1 Stabilizing and Reducing Latency in Video Streaming

This section discusses technological trends related to stabilizing and reducing latency in video streaming. First, an overview is provided of the currently mainstream MPEG-DASH and HLS, including explanations of the causes of latency and methods for its mitigation. Trends in adaptive bitrate control technology, which is important for stabilizing viewing, are also introduced. In addition, push-based low-latency distribution methods, which are expected to further reduce latency, are discussed, along with trends in video player technology.

2.2.1.1 Overview of MPEG-DASH and HLS

MPEG-DASH and HLS are conceptually similar. They consist of video files called “segments”, which are encoded video files divided into several-second chunks, and a “manifest file”, a metadata file containing information necessary for streaming playback, such as video encoding parameters (e.g., encoding method and bitrate) and segment information (e.g., segment division unit and URL). **Figure 2-1** shows an overview of adaptive streaming. Video service providers generate multiple videos of different qualities (resolution and bitrate) from a single video source, divide them into segments at time intervals, and generate a manifest containing information about all the videos. These files are provided to a web server. The viewing device first obtains the manifest from the web server and understands the segment structure (**Figure 2-1** (1)). It then selects and receives segments of a quality appropriate for the internet traffic and viewing environment (e.g., the device's screen resolution) (**Figure 2-1** (2)), and then splices and plays them back in the order in which they were split (**Figure 2-1** (3)). Repeating this process allows for uninterrupted viewing, even under constantly changing internet congestion conditions.

MPEG-DASH commonly uses the ISO Base Media File Format (ISO-BMFF) (also known as the MP4 format) for its segments. Initially, HLS only used the MPEG-2 Transport Stream (TS format), but in 2016, it added support for MP4. Furthermore, the Common Media Application Format (CMAF) was standardized in 2018, based on MP4, to standardize segment formats and reduce latency. Currently, CMAF can be used with both MPEG-DASH and HLS. CTA-WAVE, an industry group dedicated to improving the interoperability of video streaming services, specifies encoding and segmentation methods for CMAF to ensure interoperability between MPEG-DASH and HLS. However, in actual streaming environments, HLS still often uses the TS format to ensure compatibility with older operating systems. The manifest for MPEG-DASH is in an XML (Extensible Markup Language) format called MPD (Media Presentation Description), while for HLS it is in a

Encode a single video stream at multiple qualities and divide it into segments with aligned edges

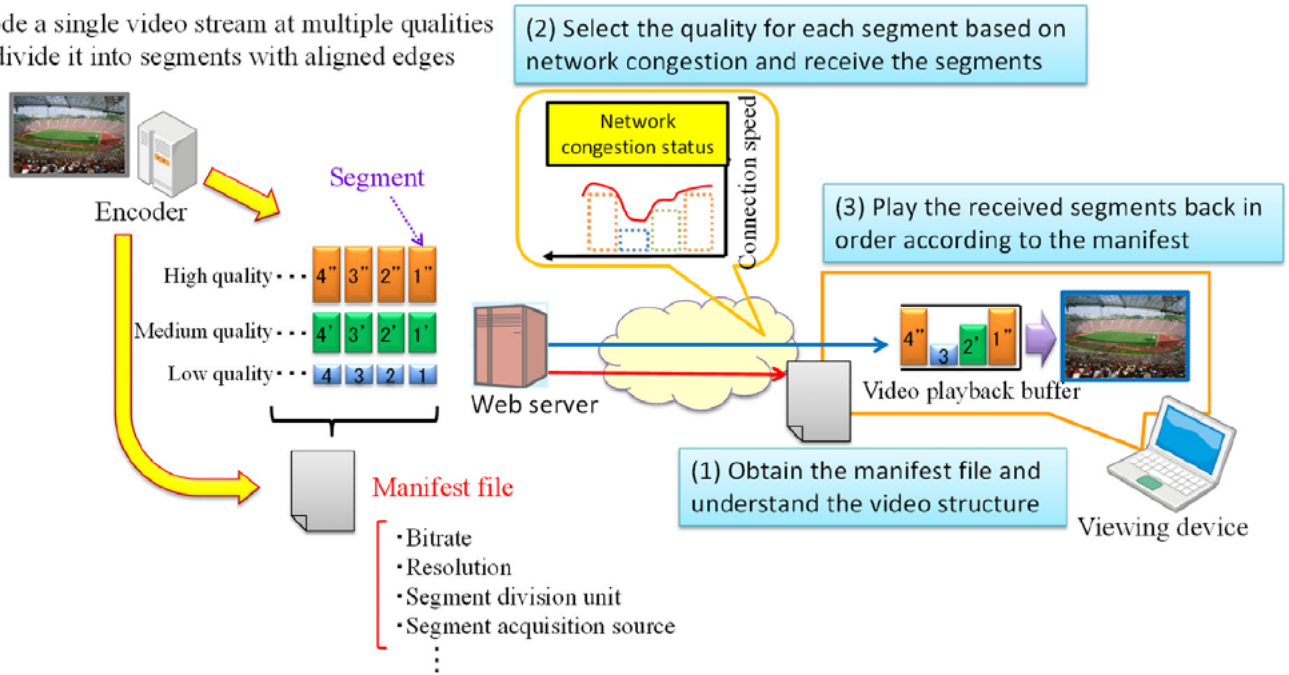


Figure 2-1: Overview of the adaptive streaming operation

text format called m3u8. Although the two formats are not compatible, they can describe similar information in many cases.

2.2.1.2 Causes of Delays and How to Deal with Them - CMAF, HTTP Chunk Transmission, Fetch –

The causes of delays and methods for improving them are explained by dividing the components of live streaming shown in **Figure 2-2** into three stages: (1) stream generation, (2) transmission/relay, and (3) reception.

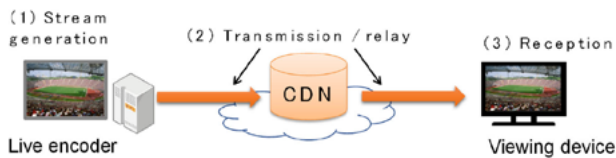


Figure 2-2: Live streaming components

(1) Stream generation

As shown in **Figure 2-3**, the MP4 format used for segments has a format called a Box structure, which concatenates the "data size, data type, and data" from the beginning. Therefore, the "size" at the beginning of the Box is not determined until the data is completely created, and transmission is not possible. This is the root cause of delays, and the larger the data, the longer the waiting time. In other words, delays can be reduced by reducing the "data". **Figure 2-4** shows two methods for reducing the size of data.

Data size, not determined until the end of data creation
(Larger data leads to longer latency)



Figure 2-3: Basic MP4 format

Figure 2-4 (1) shows a method for finely dividing the segment file itself. For example, dividing a 6-second

segment into three 2-second files can reduce latency by one-third. However, because segments are generally composed of GOPs (Group of Pictures), the GOP size must also be reduced. Reducing the GOP size leads to a degradation of image quality, so a practical minimum is approximately 0.5 seconds, the same as in broadcasting. Furthermore, the increased number of segment files increases the number of HTTP requests from viewing devices, which can increase the load on the CDN and lead to reduced viewing stability. **Figure 2-4** (2) shows a method for finely dividing the contents of segment files. CMAF was standardized with this type of operation in mind. While segment files are still composed of GOPs, the data can be handled in a format called "CMAF chunks", which divides the GOPs into smaller units, such as frames. This allows transmission of CMAF chunks without waiting for the entire segment file to be completed, potentially reducing the delay in live stream generation to the level of a few frames. Furthermore, because the number of segment files remains the same, a decrease in viewing stability due to an increase in the number of requests from viewing devices can be avoided.

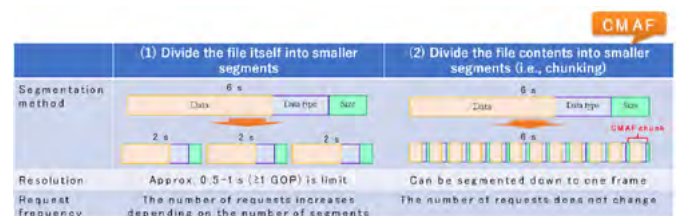


Figure 2-4: Comparison different data segmentation methods

(2) Transmission/relay

The HTTP data structure consists of an HTTP header, which is metadata, and a message body, which corresponds to the data to be transmitted. Normally, the HTTP header specifies the overall "size" of the data, as shown in Figure 2-5(1). Therefore, even if the data is divided into CMAF chunks, it cannot be transmitted until the entire segment is complete. To address this, the HTTP chunk transmission method (CTE: Chunked Transfer

Encoding) is used, which sets the HTTP header parameter Transfer-Encoding to “chunked” (**Figure 2-5 (2)**). This method allows for multiple transmissions of “chunks” consisting of “size” and “data” in a single chunk, even after an HTTP connection is established. This method is highly compatible with CMAF chunk-based transmission. By transmitting HTTP chunks consistently from the encoder to the CDN and viewing device, this method enables delivery with the lowest possible latency.

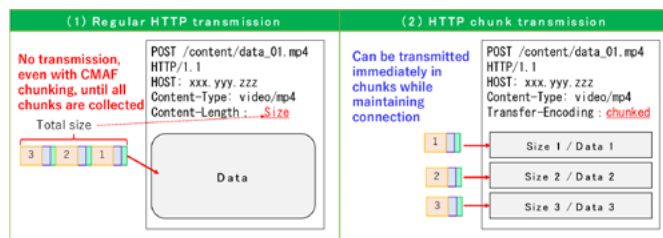


Figure 2-5: Comparison between HTTP transmission and relay methods

(3) Reception

The XMLHttpRequest API (Application Programming Interface), which has long been used for HTTP communication in JavaScript that constitutes web applications, is designed to not process received data until the entire file has been received. As a result, even if data is transmitted one chunk at a time, as shown in **Figure 2-6 (1)**, data cannot be input into the receive buffer until the entire segment file has arrived. In contrast, the Fetch API, which was introduced around 2015, is designed to process data in smaller increments, allowing data to be input into the buffer sequentially by CMAF chunk, as shown in **Figure 2-6 (2)**. This not only shortens the wait time before playback begins, but also eliminates unnecessary wait time and allows data to be continuously input into the buffer. This eliminates the need to store unnecessary segments in the buffer in case of buffer depletion, thereby further reducing latency.

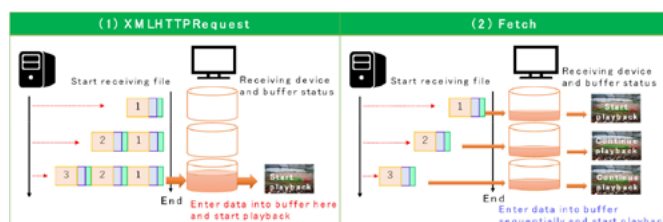


Figure 2-6: Comparison between the HTTP communication API and the receiving device buffer status

The combination of these three elements is called CMAF-ULL (Ultra Low Latency) and can be used with MPEG-DASH and the community-based HLS implementation, called LLHLS. With standard streaming, segments are accessible only once they are fully created on the server. However, servers that support CMAF-ULL also allow access to segments while they are being created. The manifest is identical to standard streaming, except for a statement that allows access to the URLs of segments being created. The frequency of manifest updates is unaffected by the number of CMAF chunks. This allows for low latency depending on the granularity of the CMAF chunks. Viewing devices that do not support CMAF-ULL can still receive the stream as if it were a standard stream.

Meanwhile, Apple has developed a low-latency specification for HLS called LLHLS (Low Latency HLS). With this method, in addition to the URLs for segments, the manifest also contains the URLs for each CMAF chunk, and viewing devices must make individual HTTP requests for each CMAF chunk in order to receive the content with low latency. Since the number of CMAF chunks increases, the number of manifest updates and viewing device requests increases, meaning that chunking cannot be performed as finely as with CMAF-ULL. However, this method enables low-latency delivery even on servers that do not support CMAF-ULL, and by making requests on a segment-by-segment basis, viewing devices that do not support LLHLS can receive the content as normal HLS.

CMAF-ULL has been used in a service that delivers video from different angles to smartphones and PCs with the same latency as broadcast, enabling users to view broadcast and online video in tandem. NHK STRL is experimentally applying it to a cloud-based linear distribution system. This system is capable of delivering 4K video end-to-end, from encoding to viewing device, with a latency of about 2 seconds, making it a transmission method with sufficient low latency to be used for simultaneous distribution between broadcast and the Internet.

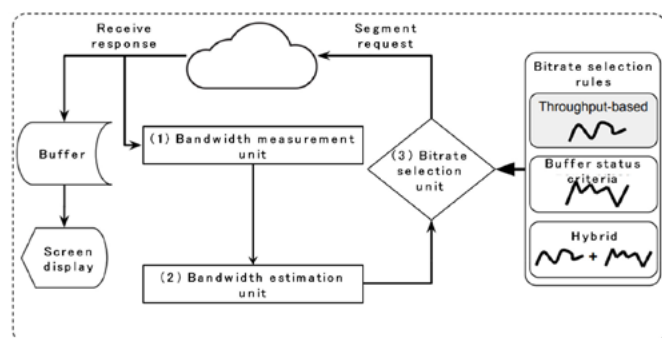
2.2.1.3 Adaptive Bitrate Control Technology

Adaptive bitrate (ABR) control technology is an extremely important feature that determines video quality and the smoothness of interruptions on viewing devices. The reason viewing devices require large buffers is because, due to factors such as network congestion, there is no guarantee that segments will arrive on time. For example, if six seconds pass while receiving a six-second segment, it is difficult to decide whether to wait a little longer until the segment is complete or to give up and cancel the current segment and request a new segment with a lower bitrate for the same time slot. Therefore, the current practice is to start playback with several segments buffered, thereby improving stability at the expense of low latency. This often occurs because segments with a higher bitrate are requested than the available network bandwidth is available. Conversely, as long as the available network bandwidth is properly understood and segments with a lower bitrate are received, segment arrival times will be stable and viewing will be uninterrupted, allowing for minimal buffering. In other words, improved stability and low latency are synonymous.

Various ABR control technologies have been proposed. As shown in **Figure 2-7**, their basic configuration consists of a bandwidth measurement unit (**Figure 2-7 (1)**) that measures the currently available network bandwidth; a bandwidth estimation unit (**Figure 2-7 (2)**) that uses the bandwidth measurement results to predict the available network bandwidth for the next request; and a bitrate selection unit (**Figure 2-7 (3)**) that determines which bitrate to request from the estimated bandwidth among the multiple bitrates offered as ABR. When watching pre-recorded videos such as VoD (Video on Demand), the Transmission Control Protocol (TCP) maximizes the

available bandwidth when receiving segments. Therefore, available bandwidth can be calculated relatively easily from the relationship between the “data volume” of a segment and the “time from the start of reception to arrival”. However, the situation is different for low-latency live streaming. For example, it takes six seconds to encode a six-second segment, so it also takes six seconds to receive it. When bandwidth is estimated using the same method as VoD, if the encoding bitrate is 6 Mbps, the available bandwidth will be calculated as 6 Mbps, and if it is 0.5 Mbps, it will be calculated as 0.5 Mbps. Therefore, an ARB control algorithm for low-latency live streaming, which differs from VoD, is needed, and various proposals have been made. Based on the method shown in **Figure 2-7** (1) and (2), which measures bandwidth while taking into account the short latency between chunks in segment transmission, thereby improving the accuracy of bandwidth measurement and bandwidth prediction compared to segment-level measurement, another method has been proposed, shown in **Figure 2-7** (3), which introduces a neural network-based algorithm based on bandwidth measurements, delay, buffer size, and QoE (Quality of Experience) values, and controls buffer size by controlling playback speed. Furthermore, a method has been proposed that selects bitrates using online convex optimization based on delay and buffer size without explicitly measuring or estimating bandwidth. These algorithms have been incorporated into the open-source MPEG-DASH player dash.js and HLS player hls.js for evaluation, and the evaluation environment has been made public.

As another approach, given the difficulty of accurately grasping network conditions on viewing devices, discussions have begun at the Internet Engineering Task Force (IETF), which promotes the standardization of Internet technologies, on how to securely notify viewing devices of network conditions. Various studies are expected to continue in the future to provide a comfortable viewing experience.



(Source) <https://doi.org/10.1145/3304112.3325611>

Figure 2-7: Basic ABR control configuration

2.2.1.4 Push-based Low-latency Delivery Method: WebRTC, Media over QUIC

WebRTC

Web Real-Time Communication (WebRTC), which enables real-time video and audio communication between web browsers, is an effective technology for reducing latency. The IETF has standardized the communication protocol, and the World Wide Web Consortium (W3C), a web standards organization, has standardized the web browser API. It enables transmission with a latency of just

a few hundred milliseconds and has been widely used in web conferencing tools such as Zoom, Microsoft Teams, and Google Meet in recent years. NHK STRL has also developed a system that enables interactive viewing of 360-degree streaming content on television. It processes video in response to user input in a cloud renderer and transmits the content to the television with low latency using WebRTC. While this system was previously considered unsuitable for large-scale distribution due to its inability to utilize a standard CDN, it has been demonstrated to reach tens of thousands of users by connecting multiple servers using a Selective Forwarding Unit (SFU) function to relay media streams. On the other hand, because the implementation of the web browsers used as viewing devices is specialized for real-time two-way communication, issues arise that depend on the implementation, such as the phenomenon of skipping immediately when there is a delay. Stability issues have also been pointed out, such as the difficulty of controlling the quality of presentation to the user when used for video viewing, which is one-way communication.

QUIC

Additionally, progress is being made in standardizing communication protocols utilizing QUIC (Quick UDP Internet Connections), which combines low latency and reliability by incorporating a TCP-like control mechanism into UDP, which is fast but does not guarantee data delivery. QUIC speeds connection establishment, encrypts communications using Transport Layer Security (TLS), and prevents head-of-line blocking (HoL), a phenomenon in which missing IP packets in TCP prevent subsequent data from being processed even if it arrives. To incorporate these advantages into HTTP, the IETF standardized HTTP/3, the third major version of HTTP, which replaces TCP with QUIC as the transport layer, in 2022. Similarly, the IETF and W3C are working on standardizing WebTransport, which is based on HTTP/3 and enables low-latency bidirectional communication, with the aim of leveraging the benefits of QUIC for WebSocket, a standard for bidirectional communication between web browsers and servers.

NHK STRL low-latency delivery technology using WebTransport

NHK STRL is developing a low-latency delivery technology that combines push-based delivery using WebTransport with server-side delivery quality control. Figure 2-8 shows the experimental system configuration. In this system, a live encoder converts video streams of multiple qualities into CMAF chunks on a frame-by-frame basis and transmits them to an origin server in the cloud using CTE. The origin server immediately relays the received CMAF chunks to the streaming server connected to the viewing device, which then pushes them to the viewing device using WebTransport, achieving low-latency delivery. By incorporating the origin server's relay function into a Pub/Sub messaging model, which can dynamically increase or decrease the number of data destinations, a configuration has been created that allows the number of streaming servers to be increased or decreased depending on the scale of delivery. Another unique feature of this system is that, unlike the method using application layer parameters described in Section

2.2.1.3, they attempt to improve estimation accuracy by using QUIC layer communication parameters for network bandwidth estimation in server-side quality control. This method estimates the available transmission bandwidth based on QUIC congestion control information when transmitting key frames, which contain the largest amount of information within a video GOP, and selects and distributes the video stream with the highest quality below the estimated value, thereby achieving stable, high-quality distribution. Using the configuration shown in Figure 2-8, they conducted a distribution experiment by setting the receive buffer time of Device 1 to 300 ms and periodically applying bandwidth restrictions to the network. As shown in Figure 2-9, they confirmed that the delay from the camera video to the viewing screen was approximately 400 ms. Furthermore, as shown in Figure 2-10, they confirmed that the bandwidth estimate calculated by the server was close to the bandwidth restriction value, and that the distribution quality could be controlled to the maximum quality that did not exceed the bandwidth estimate.

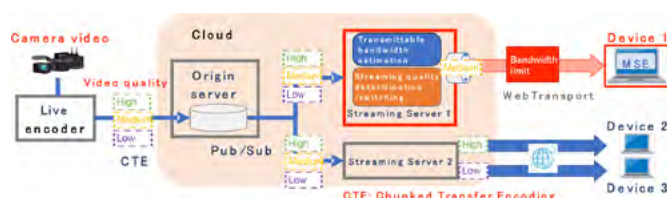


Figure 2-8: Configuration of the low-latency streaming system (NHK STRL)

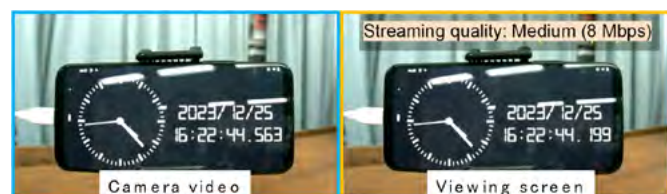


Figure 2-9: Camera video and viewing screen (NHK STRL)

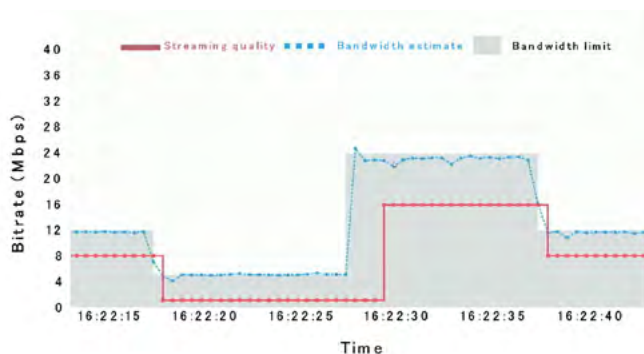


Figure 2-10: Bandwidth estimate and delivery quality trends with time (NHK STRL)

Media over QUIC

Another notable trend is the progress in standardizing MOQ (Media over QUIC), a low-latency media distribution method for use cases such as live streaming, online games, and conferences. It utilizes QUIC for all flows, from uploading live video (**Figure 2-11** (1)), relaying between servers (**Figure 2-11** (2)), and distribution to devices (**Figure 2-11** (3)). MOQ is based on QUIC-based protocol proposals such as RUSH, a live video uploading method by Facebook (Meta), Warp, a low-latency live streaming method by Twitch, and QUICR, a data relay

method between devices and servers by Cisco. **Figure 2-11** shows the protocol stack. Currently, two separate drafts are underway: MOQT (Media over QUIC Transport), which defines media transport methods over QUIC and WebTransport, and WARP Streaming Format, which defines streaming formats. Open-source implementation and testing are also underway. Video players will be developed using MSE (Media Source Extensions), a video playback control API also used in MPEG-DASH and HLS, and WebCodecs, an API capable of processing video frame-by-frame, currently being standardized by the W3C. However, features such as user presentation quality control will need to be designed, developed, and incorporated by the service provider. Open-source implementations incorporating these features are likely to emerge in the future. It will be interesting to see which will become the mainstream for media distribution: WebRTC, which has a 10-year track record despite its limited implementation flexibility, or MOQ, which has promising future developments.

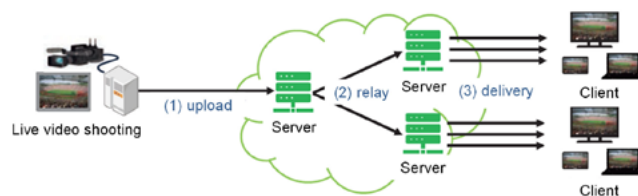
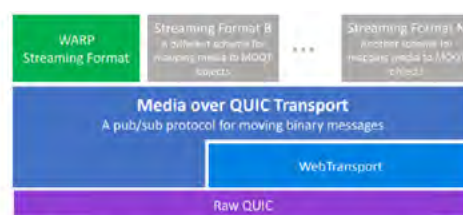


Figure 2-11: Components of Media-over-QUIC-based media delivery



(Source) <https://datacenter.ieff.org/meeting/interim-2023-moq-08/materials/slides-interim-2023-moq-08-session-warp-streaming-format-08>

Figure 2-12: Media over QUIC protocol stack

2.2.1.5 Video Player Technology - Media Source Extensions / Managed Media Source -

This section introduces trends in video playback technology for web browsers. Currently, most video streaming sites use MSE, a playback control API that began standardization at the W3C in 2013. MSE allows service providers to develop video players as web apps, potentially enabling a common viewing environment across a variety of devices, including PCs, smartphones, and TVs. However, among major devices, only the iPhone lacks MSE and instead implements a proprietary player via a web browser, preventing a common viewing environment. Apple cites high power consumption as the primary reason for not incorporating MSE. As this situation persisted, Apple announced a new API, Managed Media Source (MMS), in June 2023, which improves upon MSE. It claims to reduce power consumption by improving the network and memory control mechanisms in MSE and is available in iOS 17.2 and later. Although the two APIs have different names, their usage is similar, making it possible to make existing MSE-compatible video players compatible with MMS with only minor modifications. This has finally made it possible to create a common viewing environment that includes

the iPhone (**Figure 2-13**). MMS has now been proposed to the Working Group that is considering the next version of MSE, and active discussions are underway toward standardization.



Figure 2-13: Overall structure of a video player that can be used across multiple devices using MSE/MMS

Until now, iPhones only supported HLS, but MMS has enabled support for a variety of video distribution formats, including MPEG-DASH. In fact, NHK STRL has confirmed that MPEG-DASH video playback on iPhones can be performed by adapting basjoo.js, their open-source MPEG-DASH video player, to MMS. They are also developing and testing a technology that inserts trigger signals (Media Timed Events: MTEs) into video streams at any timing and sends push notifications to viewing devices to instantly display emergency information. Utilizing MMS on iPhones will enable the testing of such technologies in the same way as on other devices, and it is expected to enable the proactive adoption of new technologies related to video viewing control.

2.2.2 Ensuring the Reliability of Content

In the information space on the Internet, inaccurate or false information (fake news) can be intentionally or unintentionally disseminated. In particular, using generative AI, anyone can easily create fake videos impersonating broadcasters. Advances in generative AI technology have improved the quality of fake videos year by year, making it easy for anyone to create high-quality fake videos impersonating broadcasters. This has made it difficult to distinguish between accurate information provided by broadcasters and false information. As a result, users are spreading fake videos on social media, believing them to be true. While it is easy to identify the sender of a message using traditional broadcasting services over radio waves, the Internet is an open world where anyone can become a sender, making it difficult to identify the sender. For this reason, ensuring the reliability of content has become a key issue for Internet services provided by broadcasters. This section explains “content provenance technology”, one means of solving this problem.

2.2.2.1 Content Provenance Technology

Content provenance technology, which embeds provenance information (such as the source and production process) into content and presents it to users, began to be considered around 2018. For broadcasters and other content providers, this information serves as proof of their origin, allowing users to determine the reliability of the content. For provenance information to be effective in combating disinformation and misinformation, widespread adoption of provenance information attachment technology is required, and provenance information must be attached to a wide range of content circulating online. To address this issue,

the Coalition for Content Provenance and Authenticity (C2PA), an international standards organization for content origin and authenticity, was established with the aim of formulating and disseminating common technical specifications for content provenance technology, and the technical specifications have been made public. As shown in **Figure 2-14**, in C2PA, content creators attach provenance information and digital signatures to content at each stage of the process, such as capturing, editing, and publishing. Users can verify the digital signatures to check for tampering with the content and provenance information, and determine the authenticity of the content based on the provenance information and signer information.



Figure 2-14: Flow of attaching and presenting provenance information

2.2.2.2 Overview of C2PA

C2PA is an international standards organization established in February 2021 by Adobe, Microsoft, the BBC, and others to develop standards for content origin and authenticity. Two organizations served as the foundation for C2PA's founding. The first was the Content Authenticity Initiative (CAI), established by Adobe, Twitter, and others. The aim was to develop tools that display content origin (creator), editing history, copyright, and other attribution information throughout the content's lifecycle, from capturing to viewing, thereby providing users with information to assess its authenticity. Currently, CAI are developing tools based on the C2PA standard and providing open-source software to promote the adoption of C2PA standard technology. The other is Project Origin, established by the BBC, Microsoft, and others. The aim is to eliminate disinformation and misinformation on social media by verifying the origin (sender) of news content and ensuring that the content has not been altered from its origin to viewing. These efforts were integrated and C2PA was established as one of the standardization projects of the Joint Development Foundation, an umbrella organization of The Linux Foundation. Its participants include many domestic and international companies involved in content production and distribution, such as broadcasters, camera manufacturers, and IT companies, all of which are interested in providing reliable information over the Internet. C2PA develops technical specifications based on the requirements and use cases established by CAI and Project Origin, and these three organizations have a close relationship.

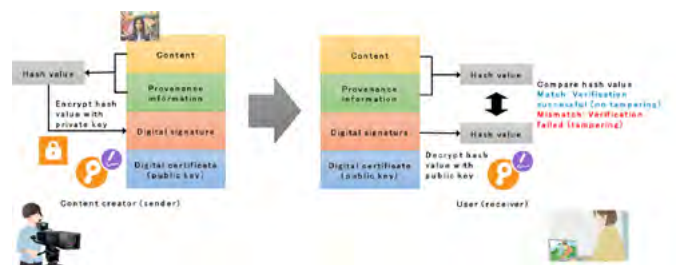


Figure 2-15: Procedure for attaching and verifying provenance information using a digital signature

The C2PA technical specifications stipulate methods for attaching, verifying, and presenting provenance information. Digital signatures are used to embed metadata into the content in a tamper-resistant format, that records who performed actions on the content, such as capturing, editing, and publishing, and when. When new actions are performed on content with provenance information, newly generated provenance information can be added, providing the user with provenance information showing the entire process of the content until it reaches the user. The provenance information includes the public key certificate used to generate the digital signature, allowing users to detect tampering with the content and provenance information by verifying the signature with the public key included in the certificate (Figure 2-15). The C2PA specification ensures that the content and provenance information have not been tampered with and that the person or organization that attached the provenance is genuine (no impersonation or other fraudulent activity) by verifying the digital signature. However, the presence or absence of provenance information does not determine the reliability of the content itself or the trustworthiness of the person or organization that attached the provenance; users must make their own judgment.

2.2.2.3 C2PA Research and Development Examples

To implement the C2PA system, each hardware or software of content producers, distributors and users viewing the content must be C2PA-compatible. Sony Corporation is developing a mirrorless single-lens camera that complies with the C2PA standard. This camera adds signed provenance information to still images in real time as they are captured, and the provenance information can be verified and displayed on a verification website provided by Sony. While this currently only supports still images, support for video is expected in the future. Adobe is developing Premiere Pro, a video editing software that complies with C2PA. When video content is edited using this software, provenance information indicating the editing process is added to the content. Furthermore, content edited using the generative AI tool “Adobe Firefly” is also added with provenance information indicating the use of generative AI. In this way, an environment is being established in which C2PA provenance information can be added to content at each stage of the content production workflow, including capturing and editing. Meanwhile, it is also important to establish an environment in which provenance information can be verified and displayed when users view content with provenance information. To identify issues in the entire ecosystem and each element based on C2PA, and to investigate and verify the important factors for users to actually determine the trustworthiness of content, NHK STRL developed a prototype system that attaches C2PA-compliant provenance information to streaming video content, as well as a prototype video player that verifies and presents provenance information in real time while the content is playing. For the provenance information attachment system, they implemented a function to add provenance information to streaming video content in MPEG-DASH format using a Rust library published by CAI. For the video player,

they incorporated a provenance information verification function into their MPEG-DASH video player, basjoo.js, using a JavaScript library published by CAI. They also added a process to present the verification results to the user. For the user presentation process, they incorporated the following four functions to provide easy-to-understand information on factors for determining the trustworthiness of content. This player can be run on both PCs and smart TVs.

- Visual indication of the presence or absence of provenance information

When playing content with provenance information, the official C2PA icon, the cr icon, is displayed in the upper right corner of the screen to indicate to the user that provenance information is available (Figure 2-16 (a)). When playing content without provenance information, the cr icon is not displayed, allowing the user to see at a glance that the content does not have provenance information.

- Display of verification results using the seek bar

The verification results for whether the video content has been tampered with can be confirmed on the seek bar (Figure 2-16 (b)). The prototype player is capable of detecting tampering for each MPEG-DASH segment and presents the verification results to the user in an easy-to-understand manner by displaying segments that were successfully verified in blue, segments where tampering was detected in red, and unplayed segments in gray. In addition, the player also has a function that notifies the user of the tampering in advance when it loads a tampered segment, even before playback, allowing the user to remain calm and take appropriate action.

- Providing provenance information

Upon user request (by clicking the CR icon or pressing a button on the remote control), the provenance information of the currently playing content can be presented (Figure 2-16 (a)). By actually checking the provenance information that has been successfully verified, the source and production process of the content can be understood, and this can be used as information to determine the reliability of the content.

- Detecting and alerting to tampering

If segment tampering is detected, the user will be notified using text and the CR icon (Figure 2-16 (b)). If the content being played has been tampered with, the user will be notified that the information may be fake or incorrect, which can encourage them to watch the content carefully or stop watching.



Figure 2-16: Example of a C2PA-compliant video-player screen

2.3 Progress of ChinaDRM Technical Standards and Industrialization

2.3.1 Standardization Status of ChinaDRM Technology

To promote high-security-level copyright protection for audiovisual content, the National Radio and Television Administration of China has issued a digital rights management standard system for audiovisual content distribution, releasing six industry standards. These standards cover multiple aspects including technical requirements, system integration, testing methods, and compliance testing, providing comprehensive technical support for digital rights management in audiovisual content distribution. The published standards are as follows:

- GY/T 277-2019 Technical specification of digital rights management for video audio content distribution
- GY/T 333-2020 Digital rights management for video audio content distribution – Digital rights management system integration for digital cable television
- GY/T 334-2020 Digital rights management of video audio content distribution – Digital rights management system integration for OTT TV
- GY/T 246-2020 Digital rights management for video audio content distribution – Digital rights management system integration for IPTV
- GY/T 335-2020 Digital rights management for video audio content distribution – Standard compliance test
- GY/T 336-2020 Digital rights management of video audio content distribution – System compliant requirements

On the basis of the aforementioned standards, to guide industry entities such as audiovisual content providers, service providers, smart terminal equipment and chip manufacturers, and DRM technology providers in accelerating the application and implementation of DRM technical standards, as well as strengthening copyright protection for audiovisual content, the National Radio and Television Administration issued the “Implementation Guidelines for Digital Rights Management (DRM) Technology in Audiovisual Content Distribution (2023 Edition)” on December 4, 2023. These guidelines provide direction for audiovisual content providers and service providers to achieve encrypted distribution and secure authorization of audiovisual content, as well as for smart terminal equipment and chip manufacturers to integrate and develop DRM client functionalities that comply with industry standards.

- As of 2025, the ChinaDRM-related technical standards have been approved and published by ITU-T, specifically:
- ITU-T J.1040 Digital rights management for video and audio content distribution - Requirements (<https://handle.itu.int/11.1002/1000/16192>).
- ITU-T J.1041 Digital rights management for video and audio content distribution - System Architecture (<https://handle.itu.int/11.1002/1000/16262>).
- ITU-T J.1042 Digital rights management for video and audio content distribution - Client (<https://handle.itu.int/11.1002/1000/16263>).

2.3.2 Industrial Application Status of ChinaDRM

In the industrialization and application of ChinaDRM

technical standards, China has established a comprehensive industrial support system encompassing four key aspects: research and development production, security evaluation, service certification, and key management.

In terms of research and development production, the ChinaDRM Laboratory of the Academy of Broadcasting Science has developed a unified DRM client SDK to facilitate the rapid deployment of DRM across various smart terminals. Regarding security evaluation, the ChinaDRM Laboratory conducts assessments of DRM technologies and products to ensure their compliance with standards and interoperability. For key management, ChinaDRM has established a DRM Trust Management Center, which ensures mutual trust between DRM servers and clients through legal agreements and a unified digital certificate technical framework. In the area of service certification, the Service Certification Center of the Academy of Broadcasting Science carries out Digital Rights Management (DRM) service certification to guarantee the secure and effective deployment of DRM technical standards across the industry.

Currently, the Chinese market has 29 DRM server products, 28 DRM client chips, and 22 DRM client devices that comply with the standards. Over 260 million terminal devices, including smart TVs, smart set-top boxes, mobile terminals, and in-vehicle entertainment systems, have integrated DRM functionality. Seven audiovisual equipment manufacturers have built DRM systems that meet industry standards and have passed the Digital Rights Management (DRM) service certification.

2.3.3 Next Steps and Recommendations

In the context of the global audio-visual industry's digitalization and ultra-high-definition development, while new technologies and business models are driving the prosperous development of the global audio-visual industry, audio-visual piracy is also showing new and diversified trends. The digitalized, networked, and globalized black-industry piracy is the biggest challenge to global copyright protection. New types of audio-visual consumption models such as short video editing, re-creation, and the application of generative artificial intelligence, have sparked new copyright disputes, which are accelerating the erosion of the copyright interests of the professional, high-quality audio-visual content creation and distribution industry chain. The end-to-end DRM ecosystem for global audio-visual content still exhibits shortcomings and weaknesses. The deployment of DRM technology at low security levels is a particularly vulnerable spot for piracy attacks. Driven by the profits of piracy, DRM cracking techniques continue to be explored and become more and more sophisticated.

Faced with the development of new technologies and business models, all parties in the global media industry chain should jointly explore solutions. We should adhere to the principles of openness, cooperation, and mutual benefit, take copyright protection as the core goal, and prioritize the healthy development of the global audio-visual industry chain. Together, we should safeguard the

international audio-visual copyright protection ecosystem. In the future, all parties in China's audio-visual copyright protection industry chain will continue to deepen exchanges and cooperation with their international counterparts. China will discuss the evolution of DRM technology, strengthen its implementation, and explore the path of international audio-visual copyright protection ecosystem evolution, which features continuous technological innovation, improving security levels, and expanding protection scopes. China will contribute to building an open, trustworthy, cooperative, and mutually beneficial international digital copyright protection ecosystem.

2.4 Cybersecurity

As broadcast infrastructures become increasingly software-based and interconnected, the importance of robust cybersecurity measures has grown significantly.

Broadcasters should now prioritize cybersecurity not only to protect content and operations but also to maintain public trust and regulatory compliance.

2.4.1 Major Cybersecurity Guidelines and Frameworks

To address the growing cybersecurity challenges, a range of influential guidelines and frameworks have been developed globally. These resources help broadcasters implement effective security measures, ensure regulatory compliance, and protect critical infrastructure. Developed by international broadcasting unions, industry-specific working groups, and standardization organizations, these frameworks reflect diverse regional and operational needs. The following **Table 2-1** highlights key guidelines and frameworks that can serve as reference points for ABU members seeking to strengthen their cybersecurity.

Table 2-1: Major guidelines and frameworks for cybersecurity

ORGANIZATION	OVERVIEW OF GUIDELINES/Frameworks
World Broadcasting Unions (WBU)	WBU Cybersecurity Recommendations for Media Vendors' Systems, Software and Services Developed through a collaboration of major broadcast unions (including the EBU, NABA, and ABU), these recommendations provide a set of security requirements that broadcasters should expect from their vendors. They are widely referenced as an international standard for procurement. https://worldbroadcastingunions.org/wp-content/uploads/2024/11/WBU-Cyber-Security-Recommendations-for-Media-Vendors-2018-01-22-FINAL.pdf
European Broadcasting Union (EBU)	EBU R 143: Cybersecurity Recommendation This is one of the most widely recognized recommendations in the industry. It defines minimum security requirements for media systems and services, and is regularly updated to reflect modern trends like the shift to IP-based systems and the use of cloud (SaaS) products. It covers a broad range of topics, from vulnerability management to access control. https://tech.ebu.ch/publications/r143
North American Broadcasters Association (NABA)	Essential Guide to Broadcast Cybersecurity This guide provides practical advice for North American broadcasters. It addresses specific regional concerns, offering best practices for securing the Emergency Alert System (EAS) and concrete recommendations for using cloud services (SaaS/PaaS/IaaS). https://www.nab.org/cybersecurity/broadcasterResources.asp
ICT-ISAC Japan	ICT-ISAC Broadcast Equipment Cybersecurity Guidelines ICT-ISAC Japan has developed specialized cybersecurity guidelines for broadcast equipment through its Broadcast Equipment Cyberattack Countermeasure Working Group (WG). These guidelines, first published in 2018, address the unique challenges of securing broadcasting systems, which prioritize high availability and often operate on legacy or isolated infrastructure. The framework emphasizes practical, incremental security measures tailored to broadcasting environments, such as secure network segmentation, endpoint protection, and vulnerability management for systems running general-purpose OS like Windows and Linux. https://www.soumu.go.jp/main_content/000859328.pdf
ISO/IEC	ISO/IEC 27001, ISO/IEC 27002 The ISO/IEC 27001 standard provides companies of any size and from all sectors of activity with guidance for establishing, implementing, maintaining and continually improving an information security management system. https://www.iso.org/standard/27001

ISO/IEC 27002 provides best practices to implement the management system defined by ISO/IEC 27001 focused on cybersecurity.
<https://www.iso.org/standard/75652.html>

National Institute of Standards and Technology (NIST)

NIST Cybersecurity Framework (CSF)

While not specific to broadcasting, the NIST CSF is the foundational framework for cybersecurity risk management across critical infrastructure sectors worldwide. It provides a common language and a systematic approach by organizing activities into five core functions: Identify, Protect, Detect, Respond, and Recover. Many broadcasters use the CSF as the basis for building and evaluating their own security programs.
<https://www.nist.gov/cyberframework>

Center for Internet Security (CIS)

CIS Controls

The CIS Controls are a set of practical, prioritized guidelines published by the non-profit organization, the Center for Internet Security (CIS). They provide a list of concrete actions that are most effective against cyberattacks, which has the advantage of making it clear where to start. The controls are also designed to be implemented in phases, allowing organizations to tackle them incrementally according to their size and maturity level.
<https://www.cisecurity.org/controls>

2.4.2 Recent Incidents at Media Organizations

In late July 2025, the South African Broadcasting Corporation (SABC) and major media house eMedia were targeted in a business email compromise (BEC) phishing attack. The incident originated from a compromised SABC email account belonging to a manager responsible for stakeholder relationships and partnerships.

Phishing emails containing a PDF attachment were sent to various contacts, including a senior executive at eNCA, a subsidiary of eMedia. The email urged recipients to open the PDF, which displayed a blurry image resembling a bank statement along with a link to access the full document. This link redirected users to a malicious website designed to steal email credentials. Once compromised, these credentials were used to further spread the phishing email to contacts in the victim's address book.

eMedia confirmed that one of its senior executives at eNCA was affected, but stated that the situation was swiftly contained. The company reported that the initial malicious email was sent from the compromised SABC account after an eNCA employee interacted with it. Both organizations promptly implemented measures to secure their IT environments and strengthen cybersecurity protocols.

As of this writing, no disruption to broadcasting services has been reported. This incident reflects a growing trend of BEC attacks targeting South African businesses.

Sources:

<https://mybroadband.co.za/news/broadcasting/605080-two-south-african-broadcasters-hit-by-cyberattack.html>

<https://news.broadcastmediaafrica.com/2025/08/04/south-africa-sabc-and-emedi-experience-massive-cyber-attack/>

2.4.3 Global Cybersecurity Outlook in 2025 (the World Economic Forum's Report)

The Global Cybersecurity Outlook 2025 highlights a rapidly evolving and increasingly complex cyber landscape. Key drivers include geopolitical tensions, sophisticated cybercrime, fragmented regulations, and the accelerated adoption of emerging technologies like AI and quantum computing. These factors are deepening cyber inequity, especially for small organizations and developing regions, which often lack the resources to build resilience.

AI is both a risk and an opportunity: while 66% of organizations expect AI to significantly impact cybersecurity, only 37% have safeguards in place for secure deployment. GenAI is enabling more advanced phishing and fraud, lowering barriers for cybercriminals. Supply chain vulnerabilities and third-party risks are also major concerns, with 54% of large organizations citing them as top challenges.

The cyber skills gap continues to widen, with only 14% of organizations confident in their talent pool. Regulatory fragmentation adds further complexity, making compliance difficult across jurisdictions. To address these challenges, the report calls for stronger public-private collaboration, investment in cyber resilience, and leadership engagement. Cybersecurity must be treated as a strategic priority, with economic incentives and inclusive solutions to protect the entire digital ecosystem.

Source:

<https://www.weforum.org/publications/global-cybersecurity-outlook-2025/>

SATELLITE BROADCASTING (D/SB)

Project Manager: **Mr Masashi KAMEI** (NHK, Japan)

This annex describes technologies on the latest satellite systems for UHDTV broadcasting and specifications of the latest satellite broadcasting systems. It also describes the latest topics on advanced satellite broadcasting technologies.

3.1 ITU-R Documents Related to Satellite Broadcasting Systems

3.1.1 Radio Regulations

ARTICLE 23 Section 2 "Broadcasting-satellite services"

APPENDIX 30 "Provisions for all services and associated Plans and List for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5GHz (in Region 1) and 12.2-12.7 GHz (in Region 2)

APPENDIX 30A "Provisions and associated Plans and List for feeder links for the broadcasting-satellite service (11.7-12.5GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2

RESOLUTION 506 "Use by space stations in the broadcasting-satellite service operating in the 12 GHz frequency bands allocated to the broadcasting-satellite service of the geostationary-satellite orbit and no other"

RESOLUTION 507 "Establishment of agreements and associated plans for the broadcasting-satellite service"

RESOLUTION 528 "Introduction of the broadcasting-satellite service (sound) systems and complementary terrestrial broadcasting in the frequency bands allocated to these services within the range 1-3 GHz."

RESOLUTION 536 "Operation of broadcasting satellites serving other countries."

RESOLUTION 548 "Application of the grouping concept in Appendices 30 and 30A in Regions 1 and 3"

RESOLUTION 552 "Long-term access to and development in the frequency band 21.4-22 GHz in Regions 1 and 3"

RESOLUTION 553 "Additional regulatory measures for broadcasting-satellite networks in the frequency band and 21.4-22 GHz in Regions 1 and 3 for the enhancement of equitable access to this frequency band"

RESOLUTION 554 "Application of pfd masks to coordination under No. 9.7 for broadcasting-satellite service networks in the band 21.4-22 GHz in Regions 1 and 3"

RESOLUTION 555 "Additional regulatory provisions for broadcasting-satellite service networks in the frequency band 21.4-22 GHz in Regions 1 and 3 for the enhancement of equitable access to this frequency band"

RESOLUTION 557 "Consideration of possible revision of Annex 7 to Appendix 30 of the Radio Regulations"

3.1.2 Recommendations

(<https://www.itu.int/rec/R-REC-BO/en>)

BO.1213 "Reference receiving Earth station antenna pattern for the broadcasting-satellite service in the 11.7-12.75 GHz band"

BO.1408 "Transmission system for advanced multimedia

services provided by integrated services digital broadcasting in a broadcasting-satellite channel"

BO.1443 "Reference BSS earth station antenna patterns for use in interference assessment involving non-GSO satellites in frequency bands covered by RR Appendix 30"

BO.1516 "Digital multiprogramme television systems for use by satellites operating in the 11/12 GHz frequency range"

BO.1659 "Mitigation techniques for rain attenuation for broadcasting-satellite service systems in frequency bands between 17.3 GHz and 42.5 GHz"

BO.1696 "Methodologies for determining the availability performance for digital multi-programme BSS systems, and their associated feeder links operating in the planned bands"

BO.1724 "Interactive satellite broadcasting systems (television, sound and data)"

BO.1774 "Use of satellite and terrestrial broadcast infrastructures for public warning, disaster mitigation and relief"

BO.1784 "Digital satellite broadcasting system with flexible configuration (television, sound and data)"

BO.1900 "Reference receive earth station antenna pattern for the broadcasting-satellite service in the band 21.4-22 GHz in Regions 1 and 3"

BO.2063 "Alternative BSS earth station antenna radiation pattern for 12 GHz BSS bands with effective apertures in the range 55-75 cm"

BO.2098 "Transmission system for UHDTV satellite broadcasting"

3.1.3 Reports (<https://www.itu.int/pub/R-REP-BO/en>)

BO.2007 "Considerations for the introduction of broadcasting-satellite service of high-definition television and ultra-high-definition television systems in the band 21.4-22 GHz"

BO.2071 "Broadcasting-satellite service system parameters between 17.3 GHz and 42.5 GHz and associated feeder links"

BO.2101 "Digital satellite broadcasting system (television, sound and data) with flexible configuration"

BO.2102 "Multiple-feed BSS receiving antennas"

BO.2397 "Satellite transmission for UHDTV satellite broadcasting"

BO.2497 "Characteristics and effectiveness of frequency sharing criteria for the broad-casting-satellite service in Regions 1 and 3 subject to RR Appendix 30"

3.2 Latest Topics on Satellite Broadcasting in Japan

3.2.1 Development of Layered Division Multiplex Transmission for Satellite Broadcasting

NHK STRL is developing a satellite broadcasting system

with layered division multiplex (LDM) that multiplexes multiple modulation signals in the same channel with different power levels with the aim of providing services with flexibility in accordance with changes in the receiving environment due to rain attenuation, etc. as a next-generation satellite broadcasting system. The LDM transmission consists of an upper layer (UL) with high power and a lower layer (LL) with low power, and it enables signals to be transmitted with different bitrates and robustness in the same channel. It is useful for broadcasters to maintain broadcasting services provided by UL signal with a robust transmission parameter during heavy rainfall.

Advanced satellite broadcasting system for 8K program with LDM transmission and multi-layer coding of VVC

NHK STRL has developed an LDM-based modulator and demodulator for satellite broadcasting in the 21-GHz band. The 21-GHz-band satellite broadcasting allocated to the frequency band of 21.4-22.0 GHz in ITU-R Regions 1 and 3 is expected to be utilized as transmission channels for new broadcasting services with large capacity. Then, two 300-MHz-class wideband transponders are assumed in the 21-GHz band and a wideband LDM-based modulator and demodulator with the nominal symbol rate of 250 Mbaud were developed shown in **Figure 3-1**.



Figure 3-1: Wideband LDM-based modulator and demodulator

Versatile Video Coding (VVC), the latest standard in video coding technology, enables multi-layer coding for efficiently encoding multiple videos. It can encode low-resolution and high-resolution videos together, with the former as a base layer (BL) and the latter as an enhancement layer (EL). This enables spatial scalability, i.e., low-resolution image decoding by partial reception and high-resolution video decoding by full reception. Using this function to decode the required part of the bitstream makes it possible to display at a resolution suitable for each receiver. When considering 8K resolution video coding, it can obtain the BL that includes information for 4K resolution and the EL that includes information for 8K resolution based on the prediction with BL.

An advanced satellite broadcasting system in which the BL with 4K resolution and EL with 8K resolution in multi-layer coding of VVC are assigned to the UL and LL of the LDM transmission, is effective as a countermeasure for degradation of receiving condition due to rainfall as explained in **Figure 3-2**. Programs with 8K resolution are normally shown by receiving both the UL and LL correctly, while programs with 4K resolutions can be shown during heavy rainfall by correctly receiving only the UL.

NHK STRL examined its indoor demonstration at NHK STRL Open House 2024 shown in **Figure 3-3**. The modulation scheme of the UL and LL signals were set to QPSK and 8PSK, respectively.

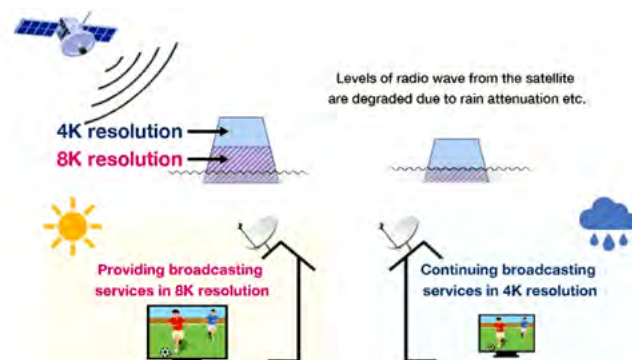


Figure 3-2: Image of advanced satellite broadcasting system for 8K program with LDM transmission and multi-layer coding of VVC

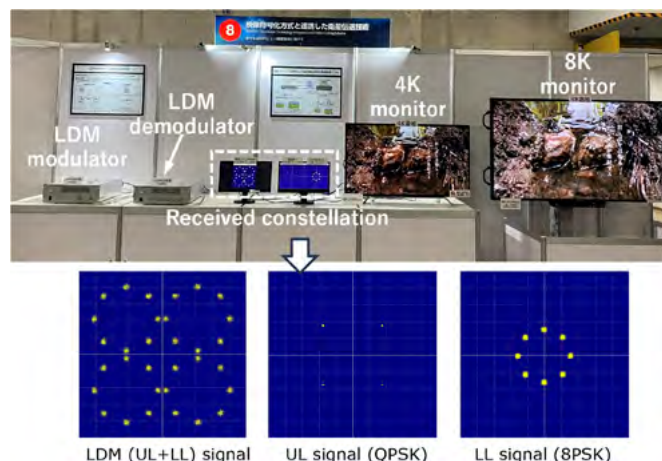


Figure 3-3: Indoor demonstration at NHK STRL Open House 2024

Improvement of LDM transmission performance by phase rotation of the LL signal

The parameters of the UL and LL signals in LDM transmission can be configured individually and flexibly. The constellations of the LDM signals can be shifted in accordance with the amounts of the rotation of the LL signal. Fig. 3-4 shows its case when QPSK modulation is used for both the UL and LL signals with the 2-dB power difference.

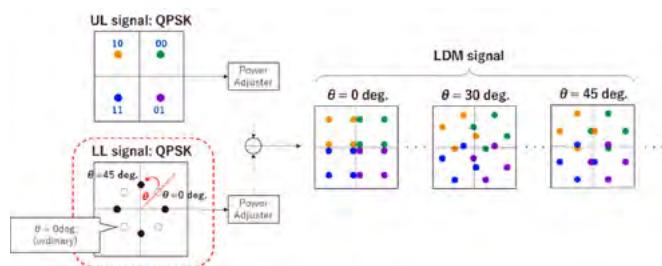


Figure 3-4: Constellation shift of LDM signal by phase rotation of LL signal

The simulation results of the transmission performance of the UL signal are shown in Fig. 3-5 when LDPC code rate of 1/2 is applied. It shows that the performance of the UL signal is changed according to the phase rotation of the LL signal and the C/N to obtain the BER of 1×10^{-11} can be decreased to 7.9 dB for 45-degrees rotation compared to 9.3 dB for ordinary in this transmission parameters.

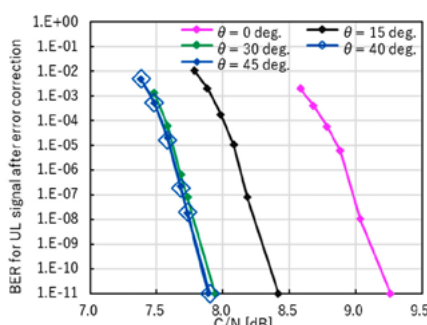


Figure 3-5: Improvement of transmission performance of UL signal by phase rotation of LL signal

DIGITAL SOUND BROADCASTING SYSTEMS (D/DSBS)

Project Manager (tentative): **Dr Hirokazu KAMODA** (NHK, Japan)

This Annex reports the current standards for digital sound broadcasting systems, latest developments in the standardization, and trends.

4.1 Digital Sound Broadcasting Systems within Frequency Range 30-3000 MHz

The Recommendation ITU-R BS.1114-12 describes several systems for terrestrial digital sound broadcasting (DSB) to vehicular, portable, and fixed receivers within the frequency range 30-3000 MHz. It details the main features of these systems, including source coding, channel coding, modulation, transmission structure, and quality of service thresholds. The Radiocommunication Sector aims to ensure rational, equitable, efficient, and economical use of the radio-frequency spectrum for radiocommunication services.

Table 4-1: Overview of global systems

System	Region	Standard	Key Features
A (DAB)	Europe, Australia	ETSI EN 300 401	COFDM, DQPSK, up to 64 services, robust in multipath
F (ISDB-T SB)	Japan	ISDB-T SB	BST-OFDM, hierarchical transmission, MPEG-2 AAC
C (IBOC)	USA	NRSC-5	Hybrid/all-digital, OFDM, HD Codec, FM band reuse
G (DRM)	Europe	ETSI ES 201 980	DRM+, VHF support, AAC, advanced data services
H (CDR)	China	GY/T 268.1-2013	Simulcast/all-digital, DRA+, LDPC, SFN-ready
I (RAVIS)	Russia	GOST R 54309-2011	Digital-only, immersive audio/video/data

The ITU Radiocommunication Assembly recognizes a growing global interest in terrestrial DSB for local, regional, and national coverage within the 30-3000 MHz frequency range. It highlights prior Recommendations ITU-R BS.774 and BO.789 for DSB system requirements, noting the benefits of complementary terrestrial and satellite systems and advocating for common receivers to enable mass production and lower costs. The Recommendation ultimately suggests that Digital Systems A, F, C, G, H, and/or I should be used for terrestrial DSB services and encourages administrations to evaluate their merits. It also invites radio-receiver manufacturers to develop economical, portable, multiband, and multi-standard receivers that can adapt to different systems and allow for software upgrades.

4.1.1 Technical Highlights

Audio Quality & Codecs

- Bitrates: 8-800 kbit/s
- Codecs: MPEG-2 Layer II, MPEG-4 HE-AAC v2, DRA+,

HD Codec

- Multichannel Support: Most systems support 5.1 surround sound

Spectrum Efficiency

- All systems outperform FM in spectral use
- Modulation schemes: OFDM, COFDM, QAM
- Support for single frequency networks (SFNs)

Robustness

- Designed for multipath and shadowing environments
- Use of time/frequency interleaving, on-channel repeaters

Receiver Flexibility

- Dynamic multiplex reconfiguration
- OSI model compliance
- PAD (Programme Associated Data), EPG, traffic info
- Emphasis on low-cost, multiband, multi-standard receivers

4.1.2 System-Specific Insights

4.1.2.1 Digital System A (DAB) – Eureka 147

- Purpose & Features: Designed for satellite and terrestrial broadcasting with a focus on low-cost, multi-service digital radio. It supports vehicular, portable, and fixed reception, with strong performance in urban multipath environments using on-channel repeaters. Offers high-quality audio, data services, and conditional access. Efficient in spectrum and power usage via OFDM and error correction.
- Standardization: ETSI EN 300 401.
- Audio Coding: Initially MPEG Layer II, now DAB+ with MPEG-4 HE-AACv2 (8–384 kbit/s).
- Modulation & Channel Coding: DQPSK OFDM with convolutional coding; UEP for MPEG-2, uniform for MPEG-4.
- Interleaving: Time (16 frames) and frequency interleaving.
- Program Associated Data: 0.33-64 kbit/s for dynamic labels, HTML, JPEG.

4.1.2.2 Digital System F (ISDB-TSB)

- Purpose & Features: Japanese system for robust, flexible multimedia broadcasting over terrestrial networks. Uses BST-OFDM, 2D interleaving, and concatenated error correction. Shares physical layer with ISDB-T and

transport layer with MPEG-2 systems. Supports TMCC for receiver control and low-power portable devices.

- Standardization: Japan.
- Audio Coding: MPEG-2 Layer II, AC-3, MPEG-2 AAC (CD quality at 144 kbit/s).
- Modulation & Channel Coding: OFDM with DQPSK, QPSK, 16-QAM, 64-QAM; RS (204,188) + punctured convolutional codes.
- Interleaving: Byte, bit, symbol-wise time, and frequency interleaving.

4.1.2.3 Digital System C (IBOC)

- Purpose & Features: Enables analogue-digital simulcasting in FM band for smooth transition. Offers improved multipath performance and CD-quality audio. Supports data-casting and flexible bit allocation. Operates in Hybrid (analogue + digital) or All Digital modes. Uses Diversity Delay for seamless analogue-digital switching and supports SFN with GPS sync.
- Standardization: NRSC-5 (USA).
- Audio Coding: HD Codec (HDC), supports multichannel.
- Modulation & Channel Coding: OFDM with convolutional codes (2/9 to 4/5).
- Interleaving: Time and frequency interleaving tailored to channel use.
- Program Associated Data: Opportunistic, no audio quality loss.

4.1.2.4 Digital System G (DRM)

- Purpose & Features: Digital-only system for all analogue sound broadcasting bands. Supports smooth analogue-digital transition and defines DRM+ for VHF. Offers CD-quality audio, data services, and dynamic multiplexing. Uses FAC, SDC, and MSC for service management and seamless frequency switching.
- Standardization: ETSI ES 201 980.
- Audio Coding: MPEG-4 AAC with SBR, PS, MPS.
- Modulation & Channel Coding: Punctured convolutional codes with 4-QAM/16-QAM; supports EEP and UEP.
- Interleaving: Cell interleaving for time-frequency robustness.
- Program Associated Data: Text messages, packet delivery with FEC.

4.1.2.5 Digital System H (CDR)

- Purpose & Features: Chinese system for FM band digital transition. Supports simulcast and post-analogue switch-off modes. Offers CD/5.1 audio, data services, and SFN. Flexible spectrum modes (100/200 kHz) and supports spectrum sharing with FM.
- Standardization: GY/T 268.1-2013 (China).
- Audio Coding: DRA+, HE-AAC, AVS audio.
- Modulation & Channel Coding: OFDM with LDPC for MSD; convolutional for SDI/SI. Supports QPSK, 16QAM,

64QAM.

- Interleaving: 2D frequency-time, block bit, and sub-carrier interleaving.
- Program Associated Data: Dynamic labels, EPG, advanced text services.

4.1.2.6 Digital System I (RAVIS)

- Purpose & Features: Russian system for high-quality sound and multimedia in VHF bands. Digital-only, supports video, images, EPG, and localized SFN broadcasting. Designed for mobile reception up to 200 km/h and offers short delay and high-quality AV services.
- Standardization: GOST R 54309-2011 (Russia).
- Audio/Video Coding: HE-AAC (SBR, PS, MPS); H.264/AVC, H.265/HEVC.
- Modulation & Channel Coding: OFDM; MSC uses QPSK/16QAM/64QAM; Low Bitrate Channel uses QPSK; Reliable Data Channel uses BPSK. BCH + LDPC coding.
- Interleaving: Bit, cell, block, and frequency interleaving.
- Program Associated Data: Video, audio, images, traffic, EPG.

4.1.3 Deployment Considerations

System Selection:

Based on regional needs, spectrum availability, and receiver market

Transition Strategy:

Hybrid modes (System C, H) support gradual migration

Interoperability:

Systems like F and G align with TV broadcasting standards

Receiver Design:

Multi-standard, upgradable, low-cost devices encouraged

4.2 Digital Sound Broadcasting Systems below 30 MHz

Recommendation ITU-R BS.1514-3 defines the technical basis for terrestrial digital sound broadcasting (DSB) systems operating below 30 MHz, aiming to support the transition from analogue AM broadcasting to digital systems. It evaluates system performance, spectrum efficiency, compatibility, and robustness under various propagation conditions.

Two systems are recognized:

- **DRM:** Designed for global use in long-wave (LF), medium-wave (MF), and short-wave (HF) bands.
- **IBOC DSB:** Primarily developed for use in North America, especially in the MF band.

4.2.1 Digital Radio Mondiale (DRM) System

Digital Radio Mondiale (DRM) is a fully digital

broadcasting system designed for operation below 30 MHz, including LF, MF, and HF. It uses steep spectral shoulders to confine its signal within a 9 or 10 kHz channel, enabling efficient spectrum use and minimizing adjacent channel interference. The system supports multiple modes, making it adaptable for different frequency bands and propagation conditions. DRM employs advanced audio coding (xHE-AAC and AAC+SBR) to deliver high-quality sound even under challenging conditions. It uses OFDM and QAM modulation combined with forward error correction and time interleaving to ensure robust transmission. The system is modular and scalable, allowing for wider bandwidths and flexible allocation between audio and data services. DRM also includes Emergency Warning Functionality (EWF), which supports alarm signaling, automatic frequency switching, and text-based alerts via Journaline.

4.2.2 IBOC DSB System

IBOC DSB is designed to operate in the MF band and supports both hybrid and all-digital modes. In hybrid mode, it allows simultaneous transmission of analogue and digital signals within the same channel, facilitating a smooth transition from analogue to digital broadcasting. The system uses AAC with SBR for audio coding, offering FM-like stereo quality. Its layered codec structure enables graceful degradation and extended coverage through a blend function that switches seamlessly to analogue or backup digital signals when needed. IBOC DSB employs OFDM and QAM modulation with advanced error protection and interleaving. It supports data broadcasting at rates between 4 and 16 kbit/s, with flexible trade-offs between audio and data quality. The system is compatible with existing AM transmitters and does not require new spectrum allocations, making it highly efficient and practical for gradual deployment.

4.3 Recent Standardization Activities and Trends

4.3.1 ITU-R

At the ITU-R Working Party 6A and Study Group 6 meetings in March 2025, the revision of recommendation ITU-R BS.1114 was discussed and approved. The latest HD Radio (IBOC DSB) system definitions for advanced service modes with increased service capacity have been incorporated. These advanced service modes offer higher capacity than standard service modes by employing higher-order modulation schemes and modifying channel encoding and interleaving techniques.

4.3.2 Thailand's Frequency Planning for DAB+

Thailand's DAB+ digital radio implementation plan initially considered allocating frequencies based on its 77 provinces, but for higher spectrum efficiency, the country reorganized this into 10 regions and 34 allocation areas. Each allocation area consists of one to six provinces, and

the frequency range is set at 174–230 MHz. The system adopted is DAB+ (MPEG-4 HE AAC v2), with each area allocated 5–6 frequency blocks. The first two blocks are adjacent and reserved for national or wide-area networks. Infrastructure sharing is mandatory, with measures in place for interference mitigation.

The recommended transmission power is up to 10 kW in metropolitan areas, up to 4 kW in other regions, and up to 1 kW in border zones and gap fillers. Interference assessment follows Recommendation ITU-R BS.1660-9. In terms of capacity planning, the DAB+ ensemble net bitrate is 1152 kbps, with a recommended bitrate of 64 kbps per channel, supporting up to 18 channels. According to NBTC (National Broadcasting and Telecommunications Commission) regulations, the bitrate is not fixed, allowing broadcasters to select higher quality (e.g., 128 kbps) or lower rates (e.g., 32–48 kbps) depending on their service requirements.

Regulations categorize broadcasting services into national, regional, and local tiers, and the frequency plan supports all of these. NBTC has already published technical standards for transmitters and receivers, with licensing expected to begin between late 2025 and 2026.

Source:

S. Suansook, "Frequency planning for digital radio network in Thailand," [ABU Technical Review, issue 301](#), 2025.

4.3.3 DRM Adopted as a Chinese Industry Standard

According to the release from the Digital Radio Mondiale Consortium, on August 1, 2025, China's National Radio and Television Administration (NRTA) publicly announced the release of the official industry standard GY/T 423-2025, titled "Technical Specifications for Medium and Short-Wave Digital Sound Broadcasting", which had been officially issued on July 29, 2025.

Sources:

<https://www.drm.org/drm-standard-adopted-for-domestic-short-and-medium-wave-radio-broadcasting-as-a-national-chinese-industry-standard/>

<https://std.samr.gov.cn/hb/search/stdHBDetailed?id=3BAE9D1ABE9A1E81E06397BE0A0A8E76>

REPORT OF TOPIC CHAIRMAN

TOPIC AREA: PRODUCTION

By **Kazim PEKTAS (TRT-Türkiye)**

A total of four projects are under the Production Topic Area, as below:

1. **Ultra High Definition TV and Advanced Immersive Sensory Media Systems P/UHDAISM**
2. **Systems for people with special needs P/SN**
3. **IT -based Production System and file-based workflows P/ITPS**
4. **Big Data, Personalisation and Artificial Intelligence P/BDAI**

For this reporting period I have received five contributions from NHK Japan:

Project Topic: **Ultra High Definition TV and Advanced Immersive Sensory Media Systems (P/UHDAISM)**

Project Manager: **Mr Kimihiro Tomiyama** (NHK, Japan)

- **Harmonized Operation between Audio and Video Renderers for Presentation of Immersive Content**
- **Content-Driven AR Communication in the Coming Future**
- **3D Display Using Light Source Array Toward realizing 3D/2D switchable display**

Project topic: **Systems for people with special needs (P/SN)**

Project Manager: **Ms Reiko Takou** (NHK, Japan)

- **Audio-Description Production Technology for Live TV Sports Programs**

Project topic: **Big Data, Personalisation and Artificial Intelligence (P/BDAI)**

Co Project Manager: **Mr Taro Miyazaki** (NHK, Japan)

- **News Metadata Generation System**

HARMONIZED OPERATION BETWEEN AUDIO AND VIDEO RENDERERS FOR PRESENTATION OF IMMERSIVE CONTENT

1. Toward live-action immersive content where users can move freely looking around and listening

NHK has developed the technology for the harmonized operation between audio and video renderers, which enables users to watch videos and listen to audio from their preferred locations and orientations within a virtual space on a variety of devices. **Figure 1** depicts the overview of the developed system. In the system,

video data of immersive content is composed of scene description and video objects. Audio data of immersive content is composed of audio metadata and audio signals. A video renderer and an audio renderer process video data and audio data according to user's location and orientation, respectively. Then, the video and audio corresponding to user's location and orientation are produced. Additionally, by rendering video according to the display capabilities of each device, such as a head-mounted display (HMD) or tablet, users can enjoy immersive content on their preferred devices.

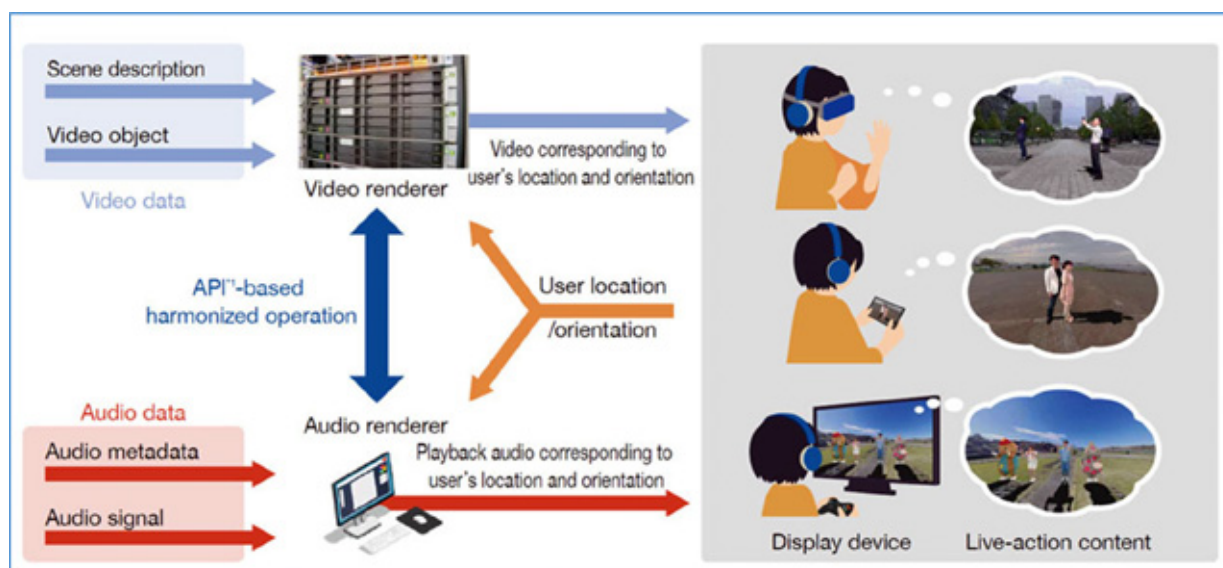


Figure 1: Overview of developed system

The utilized technologies in the system comply with the latest MPEG standards, including the scene description (ISO/IEC 23090-14, MPEG-I Part 14) to arrange video objects in a time-series space and the audio rendering method for Virtual Reality (VR) content (ISO/IEC 23090-4, MPEG-I Part 4). Furthermore, some features and functionalities have been independently expanded.

2. Developed technology for the harmonized operation between audio and video renderers

They have developed a mechanism to harmonize a video renderer and an audio renderer by having them share the user's position information to enable the presentation of the video and audio in a synchronized manner. **Figure 2** shows the protocol among the audio renderer, video renderer, and user's device.

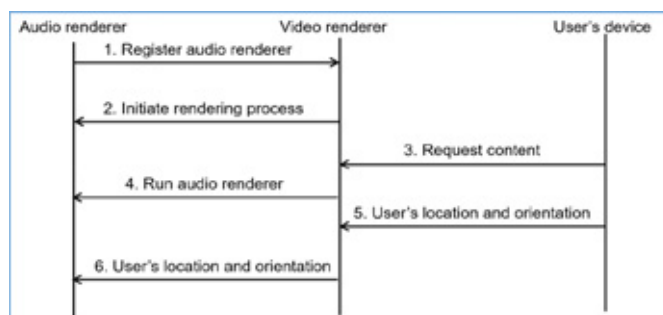


Figure 2: Protocol among audio renderer, video renderer, and user's device

1. The audio renderer registers itself to the video renderer. This allows the video renderer to identify the audio renderer with which it should be paired.
2. In response to the registration, the video renderer notifies the audio renderer that the rendering process to be initiated.
3. The user's device requests the content user want to enjoy to the video renderer. On the basis of the request, the video renderer initiates rendering the video data.
4. The video renderer runs the audio renderer while it starts playing.
5. The user's device continuously informs the video renderer of the user's viewing location and orientation.
6. The video renderer shares the user's location and orientation with the audio renderer.

Owing to this mechanism, the video and audio corresponding to the user's location and orientation are output from video renderer and audio renderer and they are presented at the user's device in synchronization with each other. Our implemented user's devices are shown in **Figure 3**.



Figure 3: Implemented user's devices

CONTENT-DRIVEN AR COMMUNICATION IN THE COMING FUTURE

As a concept for future content, NHK STRL is introducing the image of content that expands spatially through AR glasses. You can experience how to operate the content, react to each scene, and communicate while watching the content.



Figure 4: AR communication in the near future to enjoy content together

- **Sharing of the viewing experience beyond space**
You will be able to communicate beyond space while viewing the same content. Sharing each other's view will create conversations and discoveries, triggered by the content.
- **Enhancement in the operability and convenience of video content**
New functions, such as gesture recognition, will make basic operations, such as playing back the scene you want to watch again and inputting your reactions, simpler while you enjoy content.
- **Display of scene-linked information**
You will be able to see other viewers' reactions to the scene you are watching by displaying them around the content.

3D DISPLAY USING LIGHT SOURCE ARRAY TOWARD REALIZING 3D/2D SWITCHABLE DISPLAY

NHK STRL is researching technology to display natural three-dimensional (3D) images according to the viewer's eye position. By using an electrically switchable light source array^{*1}, a display that allows users to select and view 3D or two-dimensional (2D) images according to user preference has been developed.

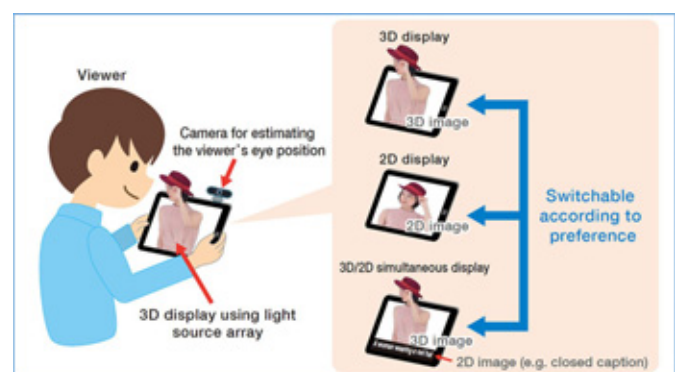


Figure 5: 3D/2D switchable eye-tracking three-dimensional display

3D images can be displayed through the reconstruction of light rays in various directions by displaying light source array images on an LCD panel for light-ray control. When a white image is displayed on the LCD panel and functions as a plane light source, 2D images can be displayed, enabling 3D/2D switching or 3D/2D simultaneous display according to user preference.

By estimating the viewer's eye position using a camera and generating elemental image array^{*2} in real time according to the eye position, a 3D image display with a wide viewing zone^{*3} has been developed.

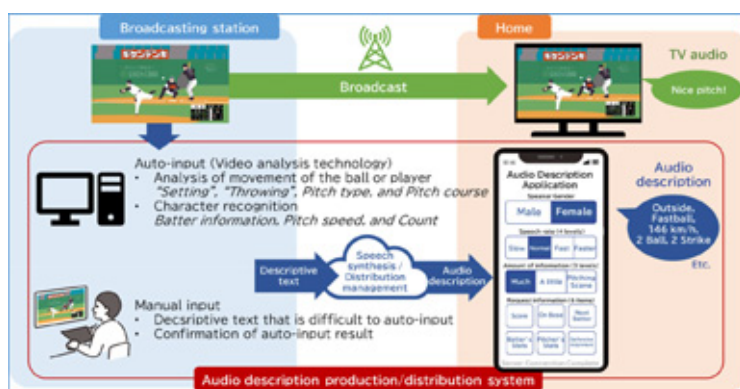
*1: Light source array: A number of light sources arranged at equal intervals for reconstruction of 3D images.

*2: Elemental image array: An image generated to reproduce light rays emitted from an object in various directions.

*3: Viewing zone: The range in which 3D images can be viewed.

AUDIO-DESCRIPTION PRODUCTION TECHNOLOGY FOR LIVE TV SPORTS PROGRAMS

NHK is developing a system to produce and deliver audio descriptions for live sports broadcasting programs to help more people, including those with visual impairments, fully understand such programs.



Overview of audio description production and distribution system

Features:

- This system generates descriptive texts about plays and game conditions, converts them into audio descriptions, and delivers them to the audio description app before the broadcast video is displayed on the home's television. The audio descriptions are then played in time to match the TV program at home.
- The descriptive texts are either generated by the video/image analysis technology they developed or manually entered by the operator using their input tool.
- Their current focus is live baseball broadcasts. The video analysis technology identifies player's movements ("setting" and "throwing"), pitch types ("breaking ball," "fastball"), and pitch course (e.g., "high inside," "low outside"). The image analysis technology recognizes batter information (such as player name, uniform number, right/left-handed hitter), pitch speed, and count from visual information overlaid on the video.
- The audio description app allows users to adjust the speech rate or amount of information. Users can also listen to information such as score, on-base data, and next batter, which are extracted from external data by the system, at any time they like.

In future work, they will focus on the practical application of an audio description production and distribution system for baseball, while also expanding its scope to other sports and advancing R&D on technologies for efficient audio description production.

NEWS METADATA GENERATION SYSTEM

NHK Science and Technology Research Laboratories (NHK-STRL) is conducting research on natural language processing technologies to enhance the efficiency of news content production. This article introduces a system designed to generate expressive content with minimal manual effort by automatically producing metadata for news manuscripts and visualizing the results.

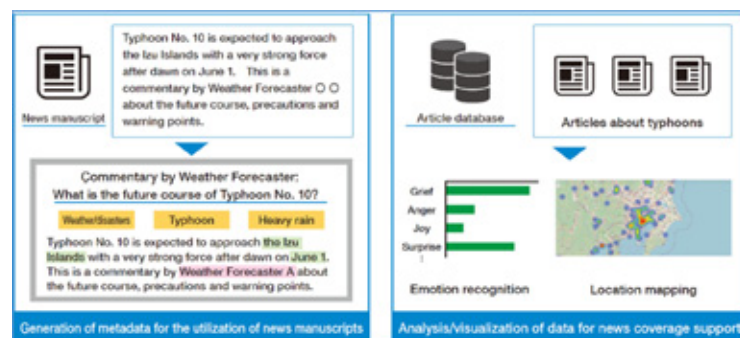
Metadata Generation Using AI for News Manuscript Utilization

When publishing news manuscripts online, NHK assigns multiple labels that succinctly represent the content of each article. Given the existence of thousands of label types, manually selecting the appropriate ones is a highly time-consuming task. To address this, the system employs AI technology to automatically assign suitable labels to news articles.

NHK-STRL has also developed a system that automates various processes essential to news production, including title generation, keyword extraction, and article anonymization. By combining human oversight with system-generated outputs, the overall efficiency of content production can be significantly improved.

Data Analysis and Visualization to Support News Coverage

In the event of a large-scale disaster or similar situation, the system visualizes the regions begin covered, allowing users to quickly understand the coverage status and plan strategic reporting accordingly. Furthermore, the system visualizes the emotional polarity (positive or negative) of news articles related to each region using emotion recognition technology, thereby contributing to the identification of local issues.



Future Outlook

NHK-STRL aims to deploy these systems in production environments by 2026. By around 2028, the goal is to establish technologies capable of simultaneously processing not only natural language but also other types of information, such as image data. ■

ABU DIGITAL BROADCASTING SYMPOSIUM

The ABU Digital Broadcasting Symposium (DBS) 2026 will bring together industry leaders, innovators, and professionals from around the world. Over four days, the event will feature conferences, exhibitions, and workshops, reinforcing its reputation as a leading regional broadcasting event.

Theme: "The Rising Synthetic Era"

Building on this theme, DBS 2026 will spotlight the rise of synthetic intelligence and creative technologies transforming broadcasting. As these tools evolve from assistants to collaborators, the symposium will explore how broadcasters can elevate content, streamline delivery, and deepen engagement amid a shifting media landscape.

Key Takeaways and Innovations

AI-Driven Content: Experts will demonstrate how intelligent technologies will reshape creative workflows, enabling hyper-personalised and adaptive content experiences.

Immersive and Interactive Experiences: The symposium will showcase emerging tools and formats that will deepen audience engagement through immersive storytelling and interactive media.

Future-Ready Infrastructure: Discussions will focus on cloud-to-edge workflows, scalable broadcast networks, and secure, sustainable operations. These advances will translate directly into significant cost savings, reduced latency, and enhanced agility for talented teams, preparing broadcasters for the next era of distribution and delivery.

Focused Topic Workshops: Participants will engage in in-depth discussions on specialized topics, led by industry experts driving digital transformation.

A Platform for Growth and Collaboration

Since 2005, DBS will have supported broadcasters through ongoing digital change. DBS 2026 will advance this mission by addressing the impact of synthetic intelligence and intelligent systems, offering timely insights and practical strategies for organisations to adapt and thrive in an AI-driven media future. Participants will network with broadcast and digital transformation experts while exploring emerging solutions and alternative tools that will redefine the industry landscape. This strategic advantage will encourage early commitment, ensuring attendees will leave not just with inspiration but with actionable plans and a competitive edge in the rapidly evolving media landscape.

Looking Ahead

DBS 2026 will reaffirm its role as a premier knowledge-sharing and networking hub, driving meaningful discussions and innovation. As the industry evolves, the symposium will remain dedicated to empowering broadcasters with essential tools and insights.

Stay tuned for the next issue for details on future DBS events and the full DBS 2026 report. ■

ABU DBS 2026

DIGITAL BROADCASTING SYMPOSIUM

THE RISING SYNTHETIC ERA



30 MARCH - 2 APRIL 2026
BERJAYA TIMES SQUARE HOTEL,
KUALA LUMPUR
www.abu.org.my/dbsymposium

ABU-IPPTAR TECHNICAL WORKSHOP - RADIO PRODUCTION TECHNOLOGIES



The ABU Technology Department and the Institut Penyiaran dan Penerangan Tun Abdul Razak (IPPTAR) jointly organised the Workshop on Radio Production Technologies. It was held from 28 to 30 October 2025 at Dewan Dinamik, IPPTAR, Kuala Lumpur. The workshop attracted more than 35 participants from ABU member organisations. Its objective was to help revolutionise radio production by leveraging transformative tools such as artificial intelligence and cloud-based workflows to drive innovation and reshape industry practices. These technologies are vital for audio quality, streamlined workflows, and increased operational efficiency. The event showcased innovations and case studies, encouraging participants to adopt new approaches to content creation and broadcast management.

The workshop commenced with a welcome address by **Ms Nur Shahira**, Broadcast Engineer at IPPTAR, followed by opening remarks from **Dr Veyssel Binbay**, Director of Innovation and Technology at the ABU.

Following the opening remarks, the workshop transitioned to its first session, titled "Future Radio: Hypermedia Production for Next-Generation Audience Capture", which examined recent trends in radio and podcasting. **Ms Alia Zainal**, Head of Sales at IPSB Technology, discussed the global surge in podcast consumption, particularly in news and political genres. She noted that podcasting offers opportunities for smaller programs to reach larger audiences as the medium expands worldwide.

Continuing the discussion on new media trends, **Mr Alex**



Poon from Media Prima Audio highlighted the growing importance of artificial intelligence in media production, emphasizing its necessity for contemporary broadcasters. He also addressed the emergence of short-form content platforms, such as YouTube, which are reshaping audience engagement and adapting to the preferences of the TikTok generation.

Throughout the event, participants engaged in interactive sessions and hands-on demonstrations, gaining practical skills and actionable insights to navigate the rapidly evolving media landscape. As the event progressed, each

day featured sessions focused on advanced technologies and real-world applications.

On the second day, the agenda shifted. Distinguished speakers from Stagetec, Meinberg, and BCI gave in-depth presentations. These sessions explored infrastructure choices such as Zenon Media Remote Production/ Combined Network, the role of precise timing in broadcast environments, and strategies for audio networking redundancy. These foundational decisions form the backbone of future-ready radio operations, ensuring broadcasters can meet the evolving industry demands in





live and broadcast scenarios.

Opening the technical presentations, **Mr Yap Wei Keong** from Stagetec Asia highlighted Stagetec's expertise in radio production technologies and its collaborations with Stage Tec Germany and Zenon Media. He introduced advanced workflow solutions, including AoIP (Dante/AES67) infrastructures, broadcast automation, cloud-ready systems, and centralised management platforms designed to support modern radio operations.

Mr Ben Cosstick, Head of Meinberg Asia, then spoke about why it's important for broadcasts to have very accurate clocks, especially when switching to using computer networks. He explained that keeping audio and video perfectly in sync is essential for a good viewer experience. He described a case in which poor timing caused audio and video to go out of sync, frustrating listeners during a live event. He ended by showing tools that help keep timing reliable, easy to manage, and long-term supported.

To close the day, **Mr Brian Ong** and **Mr Cheong** from BCI delivered the final session, discussing essential considerations and redundancy strategies for audio

networking in live and broadcast environments. Their session explored best practices for designing resilient audio-over-IP infrastructures, emphasising network reliability, failover mechanisms, and system robustness to ensure uninterrupted audio delivery during live productions and broadcast operations.

The third day commenced with an online session titled "Audiocodec in Cloud", presented by **Mr Antonio Perez** from AeQ. AeQ specialises in audio and video solutions for broadcasting. Mr Perez introduced SmartTalk, a cloud-based platform for high-quality, low-latency audio connections between mobile devices and radio stations. He also demonstrated real-time remote connections. After the session, participants visited RTM, where they were briefed on the broadcast system handover process and programme management within RTM's production chain. Rounding out the workshop's content, the event concluded with a session on "AI in Radio Production", presented by **Mr Suhaimi Sulaiman**, Radio Music Supervisor at RTM. This final session brought the event full circle by highlighting radio's enduring impact and its distinct ability to engage audiences in the digital era.

The workshop concluded with closing remarks from **Dr Veyssel Binbay**, who expressed his confidence that the insights gained would empower attendees to advance their efforts. After the closing ceremony, participants toured RTM's production studios. They also participated in an informative and engaging visit to Voices. My's in-house facilities. This further enhanced their understanding of operational excellence in broadcasting.

At the end of the workshop, participants reported a greatly improved understanding of new technologies. They expressed confidence in enhancing operational efficiency, improving sound quality, and delivering more engaging content to audiences across multiple platforms. ■



INSIDE THE VOV-ABU TECHNOLOGY WORKSHOP: SHAPING THE FUTURE OF BROADCASTING WITH AI



VOV–Vietnam is setting a new industry standard by forging the future of broadcasting with artificial intelligence. In partnership with the Asia-Pacific Broadcasting Union (ABU) Technology, VOV hosted a two-day workshop in Hanoi (November 25–26, 2025) with an immersive podcast session in Ho Chi Minh City. This initiative showcased practical, hands-on implementation of AI in media and underscored VOV's commitment to leading digital transformation.

With about 25 top engineers, technicians, and content creators, the workshop highlighted two main goals: driving practical AI adoption and inspiring readiness for change.

International experts introduced the latest trends, emerging regulations, and live AI tools. Participants left equipped to transform Vietnamese broadcasting through AI.

International experts shared their experience in AI-driven media and broadcasting. Speakers included **Mr Hangyong Jung** (Engineer, KBS–South Korea), **Mr Andrew Davies** (Head of Radio, ABU Secretariat), and **Dr Veysel Binbay** (Director, Technology & Innovation, ABU). They presented on several key technical topics:

- AI tools for radio and audio production: Presenters gave a hands-on overview of advanced tools, such as available applications/services that generate or improve audio





content automatically. They showed how VOV's teams could integrate these technologies into daily workflows.

- Expanding AI applications: The workshop explored AI's reach into social media, addressing the growing importance of podcasts and multimedia to boost audience engagement.

Dr Veyssel Binbay explained how AI is changing radio and broadcasting. He discussed AI-enabled personalized content, multilingual AI presenters, and real-time disaster alerts. He reviewed AI tools for voice generation, audio enhancement, transcription, and workflow automation. Dr Binbay emphasized responsible AI use. Key points included human oversight, transparent labelling of AI-generated content, strong data privacy, and monitoring for bias. He also grouped recommendations into critical, high-priority, and strategic categories. These help broadcasters use AI safely, maintaining trust and editorial standards.



On the second day, KBS engineer **Mr Hangyong Jung** informed participants about KBS's adoption of AI in broadcasting. He called 2025 a milestone for AI-driven production. KBS is building a large AI dataset and has introduced new AI guidelines on ethics, transparency, rights, and accountability. AI now powers generative animation, AI announcers and DJs, and improved disaster broadcasting. In radio, AI handles news reading, language processing, script generation, and speech-to-text conversion. KBS also uses AI Robocam for automated camera switching and an AI Reporter system. These tools drive efficiency and modernize radio production.

ABU experts and VOV teams, building on the workshop's momentum, set clear priorities for using AI as a foundation for digital transformation, reinforcing VOV's leadership in digital broadcasting. ■



WEBINAR SERIES ON MEMBERS' INNOVATION: CELLULAR COMMUNICATION NETWORK CAPACITIES FOR BROADCAST CENTERS



Webinar series on
**MEMBER
INNOVATIONS**



Dr. Mohieddin Moradi
Director of Research and Development,
IRIB-Iran

Cellular Communication Network Capacities for Broadcast Centers

4th December 2025 | 15:30-16:30 KUL Time | Online (TEAMS Meeting)

On 4 December 2025, the Asia-Pacific Broadcasting Union (ABU) hosted its latest Members' Innovation Webinar, focusing on "*Cellular Communication Network Capacities for Broadcast Centers*". **Dr Mohieddin Moradi**, Director of Research and Development at IRIB-Iran. The event brought together a dynamic mix of digital strategists, broadcast engineers, project leaders, editors, and innovation leaders, all interested in how new cellular technology could change broadcast operations and audience engagement.

Dr Moradi's presentation had two main parts: first, a brief overview of how cellular networks have evolved, and second, a closer look at real-world 5G uses in broadcasting. This approach gave both technical and strategic attendees useful information.

The presentation showed how 4G has progressed to 5G, highlighting major improvements like latency under 1 millisecond, monthly network capacity increasing from 7.2 to 50 exabytes, and peak data rates rising from 1 Gbps to 20 Gbps. With spectrum access up to 30 GHz and support for a million devices per square kilometer, 5G sets a new standard for broadcast innovation.

The focus then shifted to new 5G broadcast applications. Dr. Moradi pointed out key milestones in the 3GPP standards, like Release 17 allowing 6–8 MHz broadcast channels and Release 18 expanding into the UHF band, which brings 5G into terrestrial broadcasting. Ongoing pilots worldwide suggest that broad adoption is coming soon.

He also explained the benefits of LTE-based 5G broadcast systems. These systems use dedicated frequencies for free-to-air, receive-only services, so no SIM card is needed. This setup allows universal access. The high-power, high-tower design provides almost complete coverage, much better than regular mobile networks.

Satellite-enabled 5G was another highlight, with SpaceMobile's 2023 breakthrough of direct 5G calls and data between regular smartphones and LEO satellites at 14 Mbps marking a new era of universal connectivity. Regulatory efforts like WRC-23's focus on direct-to-cell spectrum and linking LEO satellites are expected to help connect remote and underserved communities.



The session ended with a look at 5G Multicast-Broadcast Services (5G MBS), which could change how mass content is delivered. By combining multicast, unicast, and point-to-multipoint transmissions, 5G MBS allows broadcasters to reach large audiences for live events and emergency alerts, without the usual bandwidth limits of traditional OTT services.

This webinar highlighted how important 5G and cellular network innovations are for the future of broadcasting. As more trials and deployments happen, broadcasters will gain more flexibility, reach, and efficiency. The ABU remains committed to these discussions, helping members stay connected to the latest trends in media. ■

An overview of different generations of cellular communication networks

Different generations of cellular communications

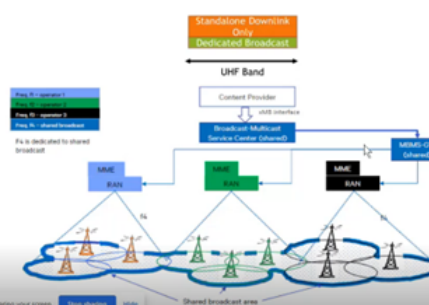
Technology	1G	2G	3G	4G	5G
Year	1979	1991	2001	2009	2019
Use Cases	Analog System, Dropped Calls, Giant Cell Phones	Texting (SMS), MMS, Conference Calls, Long Distance Call Tracking	Cheap data transmission, GPS, Web Browsing, SD Video Streaming	HD Video Streaming, Wearable Devices, High Speed Applications	Internet of Things, Cloud Storage, Remote Surgical Robots
Frequency	30 KHz	1.8 GHz	1.6-2 GHz	2-8 GHz	3-30 GHz
Bandwidth	2 kbps	364 kbps	3 Mbps	100 Mbps	10 Gbps
Avg Speeds	2 kbps	40 kbps	300 kbps	25 Mbps	150 Mbps
Range	N/A	50 mi	35 miles	10 miles	1,000 ft

Issue	4G	5G	6G
Per device peak data rate	1 Gbps	10 Gbps	1 Tbps
End-to-end (E2E) latency	100 ms	10 ms	1 ms
Maximum spectral efficiency	15 bps/Hz	30 bps/Hz	100 bps/Hz
Mobility support	Up to 350 km/hr	Up to 500 km/hr	Up to 1000 km/hr
Satellite integration	No	No	Fully
AI	No	Partial	Fully
Autonomous vehicle	No	Partial	Fully
XR	No	Partial	Fully
Haptic Communication	No	Partial	Fully
THz communication	No	Very limited	Widely
Service level	Video	VR, AR	Tactile
Architecture	MIMO	Massive MIMO	Intelligent surface
Maximum frequency	6 GHz	90 GHz	10 THz

The potential of 5th generation telecommunications network (5G) in the media industry

LTE-Based 5G Broadcast Features

- In this example, we have 3 different cellular operators, and the F4 frequency is allocated to shared broadcasting.
- Broadcast shared channel (F4 carrier frequency): 100 % radio frame
- Shared broadcasting area
 - Without the need for a SIM card
- Receive only mode
 - Receive Free-To-Air (FIA) capability
 - Downlink only mode without the need for Uplink



How to contribute to the Technical Review

Would you like to contribute an article to the ABU Technical Review?

We welcome submissions from everyone. This is an excellent opportunity to showcase your organisation's work and gain significant exposure.

We are open to a variety of articles, including research papers, details on new technical developments, or any content that will interest TR readers. The Technical Review, our quarterly publication, is distributed to all ABU members, industry partners, and technical staff, as well as international organisations such as the ITU, other broadcasting associations, and universities.

While it primarily targets engineers, it also features general interest news stories. It contains articles on new technologies, developments in broadcasting, member innovations, and other materials of interest to engineers.

Your article can be of any length and written in any style. Should you include photos, please ensure they are high resolution (at least 2 megapixels). Although we cannot offer payment, we do provide a free half-page advertisement for select articles, especially those covering technical research. This advertisement will be placed immediately after your article, giving your organisation extra publicity.

Additionally, articles by ABU members on Case Studies, Research, and Practical Implementations are eligible for the annual ABU Technical Review Prizes, which include a cash prize and a certificate.

You can view previous issues of the Technical Review on the ABU website's main page or directly at: <https://www.abu.org.my/technical-review/>

We look forward to considering your submission.



The ABU Technical Committee Meets in Ulaanbaatar



If you need more information, please contact: balqis@abu.org.my

News from The ABU Region

MAJOR MEDIA COMPANIES COLLABORATE TO REDEFINE SINGAPORE'S MEDIA AND ENTERTAINMENT SCENE

StarHub and Mediacorp have formed a strategic partnership to enhance entertainment experiences for audiences in Singapore by leveraging their strengths and innovations. Through this collaboration, Mediacorp, the nation's largest content creator and media network, will feature StarHub TV+ content packages on its digital streaming platform, mewatch. This integration offers viewers a streamlined experience with greater variety and convenience.

For the first time, users will have access to StarHub's extensive array of premium content directly within mewatch. This includes popular offerings such as the English Premier League, over 7,000 hours of live sports across various disciplines, and a well-curated selection of beloved Asian dramas and TV shows.

In an era of fragmented viewing options, the partnership between StarHub and Mediacorp aims to establish a more cohesive content destination. By combining global blockbusters, live sports, and local storytelling, they offer flexible micro-packages and free subscription options, enhancing accessibility to premium content for households across Singapore.

Nikhil Eapen, Chief Executive of StarHub, stated that the partnership aims to provide audiences with the most diverse and exciting content portfolio. He emphasized that this collaboration will not only make popular programming easier to access but also create new advertising opportunities based on data-driven insights, allowing brands to connect more effectively with viewers.

This alliance also offers advertisers enhanced media efficiency. By leveraging Mediacorp's extensive reach and content ecosystem alongside StarHub's robust video platforms and first-party data, the partnership enables precisely targeted live TV ad placements. This capability allows for better targeting, more relevant engagement, and measurable results, all crucial in a fragmented media landscape.

Tham Loke Kheng, Chief Executive of Mediacorp, commented that integrating StarHub and Mediacorp's platforms delivers greater value to audiences and advertisers. With their combined strengths, they aim

to enrich the entertainment experience for viewers and provide advertisers with a comprehensive suite of solutions across television, digital, and data-driven platforms to optimize campaign effectiveness. [\[APB News\]](#)

THE EUROPEAN BROADCASTING UNION ACCELERATES ROUND-THE-CLOCK LIVE NEWS WITH THE LIVEU ECOSYSTEM

The EBU has launched an initiative to provide continuous live news coverage through its Eurovision News Exchange, enabling members to access and share real-time news worldwide via IP-based contributions and hybrid distribution.

The mission-critical News Exchange, previously operated on a satellite-only system, will use LiveU Matrix to deliver members' live signals throughout Europe and beyond. The project connects over 60 public service newsrooms in Europe and globally using the LiveU Reliable Transport protocol, which incorporates Secure Reliable Transport (SRT) capabilities.

Additionally, 15 Eurovision News Exchange members are participating in a phased rollout of LiveU Ingest, enabling cloud recording and shared content workflows across primary and backup channels.

According to Emilio San Pedro, Head of Eurovision News Exchange at the EBU, this project represents a significant advancement for the broadcasting industry, positioning public service media organisations to leverage cloud-based IP workflows that deliver live news faster, more sustainably, and cost-effectively than conventional systems. He also noted that LiveU's Matrix platform enhances connectivity among Europe's leading broadcasters and ensures seamless, future-proof live news delivery for audiences worldwide, unlike previous fragmented systems. The LiveU Matrix platform enables live news sharing among members and other sources, central to this initiative.

The system integrates 125 LiveU transceivers at member locations, using Dual Active (active/active) redundancy to ensure uninterrupted service through parallel cloud and transceiver streaming. This reliability enhances Matrix's function as a primary distribution system alongside backup satellite distribution.

Deployment began earlier this year, with LiveU Matrix

supporting major news events, including the Papal Conclave. The EBU aims to complete the transition to hybrid and IP-based distribution by January 2026, gradually phasing out the satellite workflow. [\[APB News\]](#)

PRASAR BHARATI LAUNCHES PILOT TO ONBOARD POPULAR REGIONAL CHANNELS ON DD FREE DISH

Prasar Bharati has launched a pilot to add more regional language channels to DD Free Dish. Licensed channels in Schedule 8 languages (excluding Hindi and Urdu) permitted and licensed by the Ministry of Information and Broadcasting can apply for slots on upgraded MPEG-4 streams, strengthening regional language presence on national broadcasting.

Regional channels broadcasting in Kannada, Tamil, Telugu, Malayalam, Bangla, Assamese, and Odiya will be prioritised, as these languages are underrepresented on DD Free Dish. Preference will also go to regional news channels over non-news channels. Selected broadcasters will receive free slots for the duration of the pilot, which runs until 31 March 2026. The pilot aims to broaden visibility for regional content and support communities with limited access to programming in their native languages.

Currently, DD Free Dish carries 482 television channels –including 320 DD co-branded educational channels such as PM eVidya and Swayam Prabha – and 48 radio channels. In addition to Doordarshan channels, the platform features a diverse array of private TV channels spanning general entertainment, news, devotional programming, movies, and sports.

As India's largest free-to-air DTH platform, DD Free Dish reaches about 65 million households, according to Chrome Data. The platform plays a key public service role in delivering free information, education, and entertainment to remote and marginalised areas. Broadcasters wishing to expand their reach and better serve diverse communities should apply now to join the platform and advance this public service mission. [\[ABU News\]](#)

MALAYSIA ADVANCES TO NEXT STAGE IN 5G BROADCAST DEVELOPMENT

Malaysia has moved into the next phase of 5G broadcasting, following 2 years of initial research and industry engagement to determine the technology's future. The current stage aims to assess whether one-way broadcasting over a 5G network can be practically implemented.

While the technology remains in the testing stage and the device ecosystem and transmitters are not yet fully prepared, initial trials indicate strong potential for future deployment.

The main challenges are system readiness, transmitter capability, device chipset support, and connection stability. In theory, the technology is functional and can be implemented.

5G Broadcast technology represents the latest advancement in telecommunications, enabling content to be delivered directly to mobile devices without reliance on traditional internet connections. Unlike conventional mobile networks, which operate on two-way communication, 5G Broadcast facilitates simultaneous one-to-many transmissions with high quality and broader coverage by utilizing the Ultra High Frequency (UHF) spectrum, typically reserved for terrestrial television.

Technical limitations have been observed during trials with several commercially available devices, including the Xiaomi 12 and OnePlus 10 Pro, resulting in inconsistent results. Issues such as broadcast delays, freezing, and unstable connections are key concerns. Some device chips are believed to support 5G Broadcast, but manufacturers have not provided official confirmation. Test performance has varied, with some stable operation and other instances of instability.

The government has initiated efforts to explore the potential of 5G Broadcast as a complement to existing national broadcasting delivery methods.

The 5G Broadcasting Conference is a key platform to showcase simulations, findings, and technology demonstrations from test-bed sessions. The event also offers opportunities for industry collaboration, technical knowledge sharing, and strategic discussions among MCMC, broadcasters, industry players, and stakeholders to assess market readiness and explore 5G Broadcast applications at national and ASEAN levels.

The initiative is set to benefit industry stakeholders and guide the proof-of-concept for 5G broadcast, reinforcing Malaysia's leading role in ASEAN. [\[Bernama\]](#)

TM PARTICIPATES IN CANDLE SUBMARINE CABLE CONSORTIUM TO LINK MALAYSIA AND ASEAN NATIONS WITH JAPAN

TM, Meta, SoftBank Corp., IPS Inc., PT XLSmart Telecom Sejahtera Tbk, and NEC Corporation are collaborating to develop the Candle submarine cable system.

The Candle project is a 24-fiber pair, 8,000-kilometer submarine cable system connecting Japan, Taiwan, the Philippines, Indonesia, Malaysia, and Singapore. Launching in 2028, the system aims to expand infrastructure and provide secure, redundant routes to meet rising demand for data communications driven by 5G and advances in artificial intelligence.

The Candle cable system will be among the first in the Asia-Pacific region to use a 24-fiber-pair architecture, enabling substantial capacity to support growing communications demands.

The Candle submarine cable is a strategic step to strengthen the region's digital infrastructure. As demand for robust, high-speed connectivity increases, Candle is expected to deliver greater network diversity and resilience along a key corridor using state-of-the-art

technology. The project also exemplifies collaboration among international partners and shows a collective commitment to advancing digital inclusion and economic opportunity for over half a billion people in the Asia-Pacific region.

Representatives from each participating organization have highlighted the significance of the Candle system in supporting the region's digital transformation.

TM's involvement in the Candle submarine cable system aims to build resilient digital infrastructure to meet growing demand for digital services and cloud-based, AI-driven innovation across Asia. The project is expected to enhance TM's capacity to support hyperscalers, enterprises, and global service providers expanding in ASEAN, and further establish Malaysia as a digital hub. The initiative also aligns with TM's long-term ambition to become a Digital Powerhouse by 2030, strengthening connections between Malaysia and the global digital economy.

Meta has expressed a vision for widespread access to artificial intelligence and emerging technologies, reinforcing the company's commitment to connecting individuals globally and supporting seamless communication.

SoftBank Corp. has highlighted the importance of the 24-fiber-pair architecture in the Candle system, describing it as a foundation for next-generation social infrastructure. Integration with other submarine cables is expected to enhance the diversity and redundancy of global communications networks originating from Japan, further strengthening the nation's role as a digital gateway for Asia.

IPS Inc. has reaffirmed its commitment to advancing digital infrastructure development in the Asia-Pacific region, emphasizing the strategic role of its subsidiary, InfiniVAN, in supporting the Philippines' emergence as a regional connectivity hub.

PT XLSmart Telecom Sejahtera Tbk has expressed full support for the Candle project and anticipates benefits for all consortium members and for Indonesia.

NEC Corporation, with decades of experience in the submarine cable industry and multiple projects across the Asia-Pacific region, will act as system integrator for the Candle project. The company will oversee manufacturing, route design, installation, and testing, helping create a reliable communication environment that supports the regional digital economy.

The Candle initiative marks a significant milestone in regional collaboration, aiming to strengthen connectivity, ensure secure and reliable international data transmission, and foster digital growth across ASEAN communities and businesses. [\[TM News\]](#)

MALAYSIA AND RUSSIA EXPAND MEDIA TIES WITH MOU BETWEEN RTM AND RTTV

Radio Televisyen Malaysia (RTM) and Russia Today TV (RTTV) have formalized a Memorandum of Understanding (MoU) to advance mutual understanding and professional collaboration in the fields of information and broadcasting. The agreement aims to promote the exchange of expertise and further cooperation between Malaysia and Russia in the media sector.

The signing ceremony featured Director-General of the Department of Broadcasting Malaysia, Datuk Suhaimi bin Sulaiman, and Deputy Executive Director for International Cooperation and Distribution at RTTV, Ms Karina Melikyan.

According to both organizations, the MoU is considered a milestone for strengthening media cooperation between Malaysia and the Russian Federation, focusing on balanced information exchange, journalistic development, and mutual respect in broadcasting.

The agreement outlines plan for collaboration in news and information exchange, programme co-production, content sharing, and professional training. Future initiatives may include cooperation on digital and AI-driven content development and the sharing of technical expertise and best practices in broadcasting.

RTM and RTTV anticipate that this partnership will contribute to a more dynamic and interconnected media landscape, further supporting cooperation between Malaysia and the Russian Federation. [\[RTM\]](#)

EBU HONOURED WITH 2025 EMMY® AWARD FOR ST 2110'S ROLE IN ADVANCING DIGITAL MEDIA PRODUCTION

The European Broadcasting Union (EBU) has received the 2025 Engineering, Science & Technology Emmy® Award from the Academy of Television Arts & Sciences (ATAS). This recognition acknowledges the collaborative efforts of the EBU, the Society of Motion Picture and Television Engineers (SMPTE), and the Video Services Forum (VSF) in jointly developing the ST 2110 suite of standards.

During the awards ceremony in North Hollywood, California, key contributors to the ST 2110 initiative, including Félix Poulin, Hans Hoffmann, Willem Vermost, Ievgen Kostiukevych, and Pavlo Kondratenko, were present to accept the award.

This recognition highlights years of collaboration within the media technology community that have shaped the creation, transmission, and delivery of professional content. The ST 2110 suite of standards, which outlines how uncompressed video, audio, and data can be sent over Internet Protocol (IP) networks in professional settings, is at the center of this progress. By replacing traditional Serial Digital Interface (SDI) systems – older systems that carried video signals over physical cables – ST 2110 has become a crucial backbone for modern

broadcast and production infrastructures, offering greater flexibility, scalability, and interoperability.

With the ongoing shift toward fully digital, software-defined production, ST 2110 serves as a key enabler of this transformation. The standard establishes a foundation for future developments, such as the Digital Media Facility (DMF), which aims to make media workflows more flexible, and the Media eXchange Layer (MXL), which focuses on easier and more seamless media exchanges. These initiatives are expected to further streamline, virtualise, and interconnect professional media workflows throughout the industry ecosystem.

The award highlights the effective collaboration of the EBU, SMPTE, and VSF, each contributing expertise and resources to advance the industry standard.

ST 2110's open standard has empowered companies to innovate, interoperate, and scale efficiently, streamlining operations and reducing complexity.

The industry is transitioning from hardware-based to software-defined workflows. This marks a major milestone, building on the SMPTE 2110 standard, which has shaped media technology. [\[EBU News\]](#)

RRI MALANG SUPPORTS RADIO DIGITALISATION BY DISTRIBUTING DIGITAL RADIOS

The central government tasked LPP RRI Malang with distributing 110 DAB+ radio units to local institutions. This effort is part of a broader initiative by the Central LPP RRI Directorate of Technology and New Media (TMB), which includes distributing 360 DAB+ and 181 Digital Radio Mondiale (DRM) units.

RRI Malang is one of five RRI stations in Indonesia recognized by the central government for advancing radio broadcast digitization.

The other recognized stations are RRI Semarang, RRI Yogyakarta, RRI Gunung Sitoli, and RRI Bengkulu. RRI Malang distributed the 110 DAB+ radio units in phases over several weeks to regional government executives, district and city offices, legislative members (DPRD), public broadcasting partners, private radio stations, and regular RRI listeners. Recipients included five sub-districts in Malang City: Lowokwaru, Blimbing, Klojen, Sukun, and Kedungkandang.

For example, during the handover in Blimbing District, Anandia Novirika from RRI Malang Public Relations presented a DAB+ radio to the Head of Blimbing District, I. K. Widi Eika Wirawan SSos MM.

Widi expressed appreciation for the initiative and hoped that radio digitization in Blimbing would benefit the local community.

The delivery of DAB+ radios in the other four sub-districts and several villages was also well received. More broadly,

radio digitalization supports integrated administrative services.

The importance of transitioning to digital radio was highlighted at a previous RRI Central LPP TMB Directorate event. Muhammad Sujai, Director of TMB RRI, noted advantages such as the ability to host up to 16 radio programs on a single frequency and improved audio clarity.

DAB+ and DRM radios are also used for disaster broadcasting as part of an early warning system (EWS). This system temporarily interrupts regular programming to deliver critical information, such as weather forecasts, to a wider audience. These features are essential given the region's geography. Greater Malang is in valleys and highlands surrounded by the Bromo Tengger Semeru, Arjuno-Welirang, and Kawi Mountains, making it prone to disasters. The southern coast of East Java, from Banyuwangi to Pacitan, is also vulnerable due to its proximity to the Indian Ocean. Robust disaster preparedness in these areas is essential to protect communities and support resilient regional development.

[\[RadiInfo Asia\]](#)

ABC TO SUPPORT LOCAL MEDIA DURING EMERGENCIES

The ABC will share digital news with local outlets in regional, rural, and remote Australia during significant events to improve community access to essential news and support local journalism. With 68 sites nationwide, including 58 in regional areas, the ABC offers broad newsgathering resources. Participating outlets can access ABC coverage of weather events, service disruptions, and public health crises, strengthening local information networks.

The proposal continues ABC's history of collaborating with media for audiences' benefit, including projects with South Pacific, Indigenous, and community broadcasters. ABC Managing Director Hugh Marks emphasized the ABC's trusted role during major events. He said sharing content ensures Australians in affected communities have reliable, timely information.

Marks also noted that the plan will help local journalism, as newsroom cutbacks have challenged providers and created coverage gaps.

ABC News Director Justin Stevens said ABC can provide reliable, high-quality news to regional communities and important context for national audiences through its news network.

Stevens added that many local producers lack resources for full reporting and stressed the importance of reaching wide audiences.

The initiative draws on findings from the Australian Local News Resilience Project, which identified emergency news coverage as a key area for collaboration between regional

producers and the ABC.

Since 2019, more than 200 regional Australian newspapers have cut services or closed, reducing the number of journalists, weakening media diversity, decreasing local reporting, and leaving communities more vulnerable to misinformation.

Professor Kristy Hess of Deakin University said sharing emergency content can help small local news producers with limited resources and may improve coverage quality as local journalists balance emergency and other reporting. To join the scheme, outlets must provide reputable public news, have a complaints system, and be members of a media association. The ABC aims to launch the scheme with regional providers in 2026. [\[C+T\]](#)

MEASAT, GUODIAN GAOKE, AND STARWIN FORM STRATEGIC ALLIANCE TO ADVANCE SARAWAK'S DIGITAL FUTURE

MEASAT Global Berhad (MEASAT) has announced a strategic alliance with China's Guodian Gaoke and StarWin to introduce next-generation satellite-based Internet of Things (IoT) services in Malaysia. The partnership, formalized during the International Digital Economy Conference Sarawak (IDECS) 2025 in Kuching, supports Sarawak's goals of 96% high-speed internet coverage, 20% GDP contribution from the digital economy, and full online government services by 2030. Under the agreement, MEASAT will be the authorized service provider for the Tianqi Low Earth Orbit (LEO) Constellation, while Guodian Gaoke will supply the satellites, and StarWin will provide certified ground terminals.

The alliance is expected to strengthen Sarawak's digital infrastructure, especially in rural and remote areas. Advanced LEO satellite technology enables reliable data transmission, even in challenging environments such as dense forest canopies. This makes the solution well-suited for smart agriculture, flood monitoring, renewable energy, and telemedicine. Sarawak's Minister of Utility and Telecommunication, Dato Sri Haji Julaihi Haji Narawi, noted that IoT adoption has already increased agricultural productivity and income, and emphasized that broader implementation could further improve efficiency and sustainability in the state.

MEASAT's Chief Operating Officer, Yau Chyong Lim, described the partnership as a significant development for Malaysia's digital transformation and efforts to address connectivity gaps. The collaboration is highlighted as a contributor to Sarawak's development objectives and as an example of the potential for satellite IoT to drive inclusive growth. Information about the Tianqi LEO Satellite IoT solutions is available at MEASAT's booth during IDECS 2025 at the Borneo Convention Centre Kuching. [\[ABU News\]](#)

KBS AND CMG SIGN MOU ON MEDIA PARTNERSHIP, SIGNALING POTENTIAL RETURN OF HALLYU TO CHINA

KBS announced a strategic partnership with China Media Group (CMG) during APEC 2025 Korea, aiming to enhance media cooperation and potentially ease China's Hallyu ban (限韩令).

On November 1, 2025, in vibrant Gyeongju – the dynamic host city of APEC 2025 Korea – President and CEO Park Jang-beom of KBS and President Shen Haixiong of CMG signed a landmark Memorandum of Understanding (MOU). This historic agreement sparks new opportunities for media exchange, strengthens bilateral relations, and shapes the future of the global media landscape.

The MOU sets out plans for cooperation across media formats, including news and sports, and encourages collaboration on broadcasting technology, equipment, and digital media development. It also establishes personnel exchanges and broader industry cooperation, including mutual participation in major international events each organisation hosts.

KBS is set to energise this partnership through a dynamic lineup of international events in 2026 and beyond, beginning with the APEC 2026 Summit in China. Among the proposed cultural exchange initiatives are the much-anticipated return of the Korea-China Song Festival, paused since 2016; an inspiring KBS Symphony Orchestra performance in Beijing; and an exciting expansion of the Music Bank World Tour to China.

KBS President and CEO Park shared his excitement: "This MOU goes beyond collaboration between media organisations; it signifies the return of the Korean Wave (Hallyu) - spanning K-pop, K-dramas, and other cultural content - to the Chinese audience".

CMG, established in 2018 through the merger of CCTV (China Central Television), CNR (China National Radio), and CRI (China Radio International), is China's largest media group. The organisation operates 51 television channels, 22 radio channels, and multiple digital platforms. [\[KBS\]](#) ■

DIGITAL BROADCASTING *Updates*

UPDATE ON ATSC STANDARDS: RELEASE OF REVISED A/300 SUITE

The latest annual update of A/300, “ATSC 3.0 System,” was approved by ATSC members on 17 July. As part of the ballot, members instructed ATSC staff to revise references and schemas across the ATSC 3.0 Standards and Recommended Practices suite. This work is now complete. All 23 Standards and 10 Recommended Practices have been updated and are available on the ATSC website.

The 2025 revision of A/300 introduces a new Annex B, titled “ATSC 3.0 Operating Configurations.” It also features a refreshed cover design that matches ATSC’s updated branding. All public technical documents will now use this new visual identity.

Work is underway to integrate changes from A/322:2024-09 Amendment No. 1, “ATSC 3.0 Errata,” approved on 28 July. This amendment addresses errata related to MIMO, Channel Bonding, LDM configurations, and Subframe and Frame terminology. It clarifies the LDM Core Layer ≤ Enhanced Layer SNR description. Resolving these issues is expected to improve system accuracy and operational clarity. The amendment is published and will be incorporated into the base standard.

Further progress came with the approval of an amendment to A/331 on 10 September. The document,

A/331:2025-06 Amendment No. 1, “Time” aims to eliminate confusion around references to “GPS”, clarify distinctions between time and location data, and refine the description of time within the standard. Publication of this amendment is expected soon.

Several additional membership ballots are currently active or forthcoming, including proposals for:

- A/331:2025-06 Amendment No. 2 – User Agent String
- A/337:2024-04 Amendment No. 1 – Application Event Delivery
- A/339:2024-04 Amendment No. 1 – Audio Watermark Modification and Erasure
- A/331:2025-06 Amendment No. 3 – Signaling, Delivery, Synchronization, and Error Protection

These updates show ATSC’s commitment to a robust, clear, and interoperable standard as ATSC 3.0 expands globally. [\[ATSC\]](#)

CURVED IMAGE SENSORS ENHANCE WIDE-ANGLE IMAGING

STRL is developing thin, flexible, curved image sensors to create compact, high-quality cameras with wide fields of view.

An image sensor converts light from a lens into electrical signals. Traditional flat sensors face a challenge: the imaging plane and focusing plane*1 do not align perfectly. This misalignment causes peripheral blur that becomes more pronounced as the field of view increases.

To correct image distortions (aberrations), conventional cameras use multiple lenses to bend and refocus light, but adding more lenses increases the camera’s size. To overcome this, STRL developed technology that curves the image sensor to match the focusing surface, also called the focusing plane. This reduces the need for multiple lenses, allowing cameras to be smaller and lighter while still delivering high-quality, wide-angle images (**Figure 1**).

Prototype and operational demonstration of a curved image sensor

Conventional image sensors cannot be bent because the

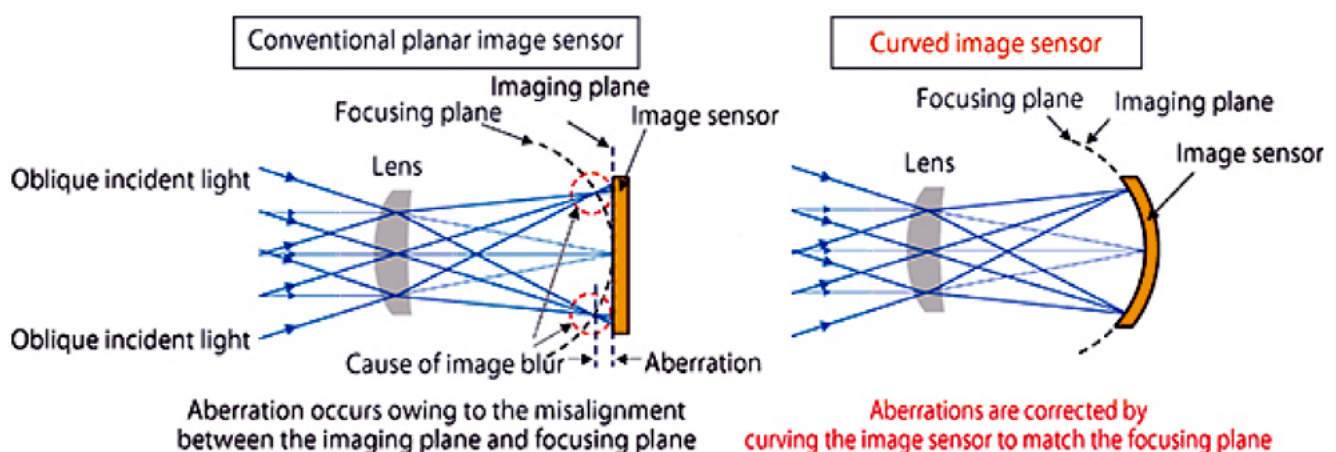


Figure 1: Principle of aberration correction using a curved image sensor

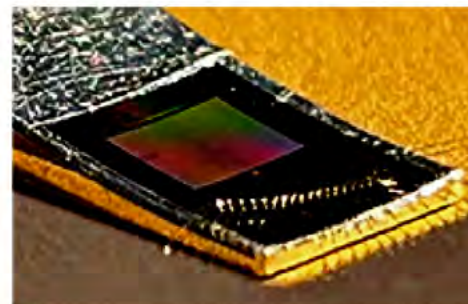
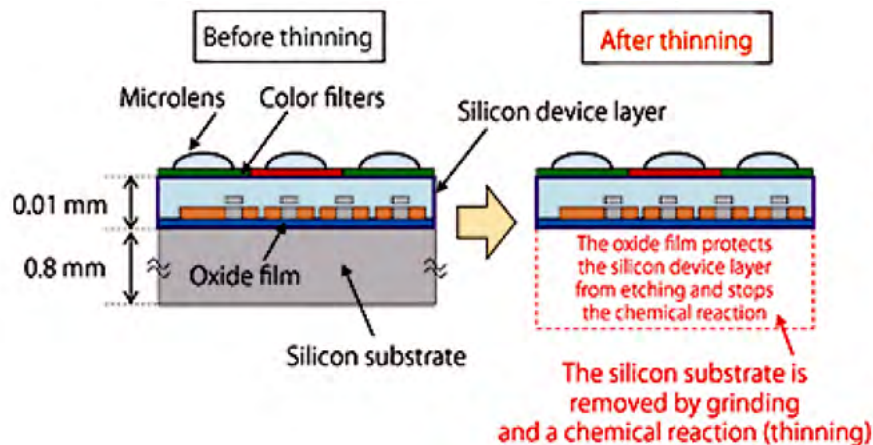


Figure 2: Structure of the image sensor (left) and the developed curved image sensor (right)



Figure 3: Output images from the developed image sensors

Left: Image from the planar image sensor (before curving)
Right: Image from the concave curved image sensor (radius of curvature: 25 mm)

imaging circuitry is built on a thick, rigid silicon substrate. STRL overcame this by developing a chemical thinning process that reduces the silicon substrate thickness. This process uses a thin oxide layer between the silicon substrate and the device layer as a barrier to prevent the chemical reaction from occurring at the right point. Using this method, STRL produced an ultrathin image sensor (320 × 240 pixels) with a thickness of just 0.01 mm*2 (Figure 2).

Figure 3 shows images of the same scene, captured with a concave curved sensor (radius of curvature: 25 mm) and a conventional flat sensor. Both tests use a single achromatic lens*3, designed to reduce color distortion by bringing two wavelengths of light into focus on the same plane. Both sensors produce sharp focus at the center, but the flat sensor shows noticeable blurring around the edges. The curved sensor greatly reduces peripheral blur and effectively corrects aberrations (Figure 3).

STRL aims to expand the field of view by designing sensors with curved surfaces of a smaller radius. This progress will help develop compact, high-quality cameras capable of capturing wider-angle images. [\[NHK STRL\]](#)

DVB PUBLISHES TEST STREAMS TO SUPPORT AVMSD SERVICE PROMINENCE VERIFICATION

The DVB Project has released a set of test streams to help manufacturers and service providers validate their implementations of service-prominence signalling. The streams cover various configurations for different implementation approaches and are available for free download from the Verification and Validation section of the DVB website.

Under the EU's Audiovisual Media Services Directive (AVMSD), television, streaming platforms, and video-sharing services must follow common rules to protect users, promote European content, and safeguard fundamental rights. Article 7 requires that services of general interest be easily discoverable. In response, DVB has worked to ensure this requirement is consistently supported within DVB-based systems.

The DVB Service Information (DVB-SI) specification enables receivers to identify available services. It also provides access to "now and next" programme information through data in transport stream tables. To meet AVMSD obligations, the Service Prominence

Descriptor was added to the specification.

The newly published test streams were developed from a Request for Proposals issued in November 2023. They enable implementers to verify signalling scenarios such as service prioritisation and regionalisation. [\[DVB News\]](#)

MEDIACONNECT ROUTER INTRODUCES FLEXIBLE VIDEO ROUTING WITHIN AWS NETWORKS

AWS has announced the general availability of AWS Elemental MediaConnect Router, a new capability that allows broadcasters and content providers to dynamically route live video between sources and destinations across the AWS network.

According to AWS, this feature makes managing complex live video workflows in the cloud more efficient by eliminating the need to reconfigure infrastructure as routing needs change. Key benefits of MediaConnect Router include simplifying the switching between primary and backup feeds, allowing distinct regional variants to be routed separately, and supporting simultaneous management of multiple parallel feeds for comprehensive coverage.

The router enhances content delivery within the AWS network, providing users with lower transport latency, improved packet delivery reliability, and simplified operations compared to standard methods. As a fully managed service, it reduces operational burden and capacity costs by supporting routing between inputs and outputs across all supported regions and endpoints.

MediaConnect Router can be launched via the MediaConnect console, the MediaConnect API, or the AWS Cloud Development Kit (CDK). It can operate as a standalone component, integrate with existing MediaConnect flows, or serve as part of a broader video workflow within AWS Elemental's suite of media services for processing, monetising, and delivering high-quality video at scale. [\[APB+ News\]](#)

VIETTEL ACCELERATES NEXT-GENERATION STREAMING SERVICES WITH THE DEPLOYMENT OF ATEME'S ADVANCED END-TO-END VIDEO DELIVERY PLATFORM

Viettel has completed the rollout of Ateme's comprehensive end-to-end video delivery solution, marking a major enhancement to its next-generation TV and over-the-top (OTT) services across Southeast Asia.

As part of its strategy to support rapid growth in its television and OTT business, the Vietnamese telecommunications group selected Ateme to deliver a comprehensive set of video technologies, covering encoding, cloud DVR, low-latency streaming, and scalable content delivery. The platform integrates networking and security components to ensure robust, reliable service.

Designed for more than 7 Tbps of peak throughput and capable of handling almost four million concurrent

sessions, the platform stands as one of the largest and most powerful video delivery infrastructures in Southeast Asia. According to Ateme, the system has already demonstrated peak live traffic of over 5 Tbps in production, reinforcing its ability to perform at scale under real-world conditions.

Ngo Xuan Truong, Broadband & TV Manager at Viettel, emphasized the deployment's importance: "Viettel's mission is to deliver advanced digital experiences to every household. Ateme's flexible, reliable platform allows us to provide premium streaming at scale while retaining control and efficiency."

Viettel chose Ateme's solution for its flexibility and proven reliability, meeting the rigorous standards of Vietnam's state telecom leader. Its intuitive interface lets operations teams manage services independently, while features like per-household session control enable detailed optimization and a better user experience.

Duc Long Nguyen, Regional Sales Manager APAC at Ateme, said, "We're proud to help Viettel build one of the region's most powerful video delivery infrastructures. This collaboration shows how Ateme's technology meets top standards for reliability, scalability, and user experience".

This deployment further establishes Viettel as a leading provider of high-quality, large-scale digital and streaming services throughout the region. [\[APB+ News\]](#)

CASTANET 5G, FORSWAY, AND PARTNERS UNVEIL HYBRID VODOS SOLUTION AIMING TO REVOLUTIONIZE VIDEO-ON-DEMAND

Castanet 5G and Forsway, together with Mainstream Data, Apogee Networks, and Vodomedia, are introducing a hybrid VoDoS (Video-on-Demand-over-Satellite) solution to revolutionize the delivery of streaming video. The core benefit is a unique combination of one-to-all 5G Broadcast distribution and edge caching, enabling content providers to reduce costs, improve video quality, and scale efficiently while directly addressing issues of cost, reach, and last-mile reliability. This technology will be demonstrated at the NAB Show East in New York City, October 22-23.

This hybrid VoDoS system leverages national satellite distribution and edge-caching to deliver a B2B2C wholesale satellite service tailored for ISPs and content providers. It replaces regional data centers and middle-mile infrastructure, allowing seamless, cost-efficient delivery straight to consumers. "The VoDoS satellite CDN provides ISPs a complete end-to-end wholesale service for direct content delivery", said Vern Fotheringham, Executive Chairman of Castanet 5G.

Forsway's advanced equipment enables direct-to-consumer access while integrating with Vodomedia's robust digital rights management (DRM), a system that controls how users access and use digital media both

online and offline), ensuring secure and flexible content delivery. Tobias Forsell, CEO of Forsway, explained, “Our hybrid VoDoS consortium delivers a one-stop solution for internet service providers (ISPs), allowing them to easily launch video-on-demand (VoD) and live streaming services to a variety of users, with lower delivery costs, improved connectivity, and greater scalability for emerging business models”.

The offering brings together Forsway’s hybrid IP satellite user devices, Mainstream Data’s network management, Vodomedia’s studio content and DRM, and program management and broadcast expertise from Apogee Networks and Castanet 5G. [\[Satellite Evolution\]](#)

ITU JOURNAL SHOWCASES ADVANCES IN SECURING GENERATIVE AI

Privacy and security now play a critical role in the era of rapid AI advancements. The latest issue of the ITU Journal on Future and Evolving Technologies (Volume 6, Issue 3) examines how researchers protect generative AI systems from threats such as unauthorized access to data, model parameters, and sensitive information.

This edition highlights security and privacy at many levels. It covers algorithm design, cryptography, system architecture, deployment, hardware, and governance.

The featured papers span three interrelated domains:

- * Algorithms, architectures, and applications
- * Deployment, standardization, and development
- * Information and signal processing

The ITU Journal is free for readers and contributors. It provides comprehensive coverage of communications and networking research. Submissions are accepted year-round on topics relevant to the International Telecommunication Union (ITU). [\[ITU\]](#)

IAB TECH LAB LAUNCHES DEALS API 1.0 TO IMPROVE TRANSPARENCY AND TRUST IN PROGRAMMATIC ADVERTISING

In a significant advancement for deal-based programmatic advertising, the IAB Tech Lab has released version 1.0 of its Deals API for public comment. The new specification aims to standardize how supply-side platforms (SSPs) and demand-side platforms (DSPs) synchronize deals, eliminating manual data entry errors and increasing transparency among sellers, packagers, and curators.

Designed to address long-standing issues such as deal mismatches and under-delivery, the Deals API offers clearer visibility into deal structure. It also fosters more efficient collaboration among all parties involved. As deal-based monetization becomes more central to curation and streaming, the IAB Tech Lab sees this specification as a critical step toward building a cleaner, more trusted programmatic supply chain.

“The Deals API sync capability directly addresses a key inefficiency in the programmatic supply chain for high value, curated private marketplaces”, said

Anthony Katsur, CEO of IAB Tech Lab. “The ability to prove transparency to all parties involved in packaging and selling the deal will improve accuracy and build confidence in deal-based media transactions – a vital growth area for publishers, especially in an era of declining traffic”.

The specification introduces a standardized method for transmitting programmatic deals from origin systems (typically SSPs) to receiving systems (typically DSPs). By reducing manual entry across multiple systems, the API enhances operational efficiency and minimizes the risk of errors. The public comment period will remain open until January 31, 2026.

Despite their importance to curation and streaming, deal-based transactions have been subject to manual processes. These often cause misconfiguration, unclear ownership, and delivery gaps. According to Nick Allen, Vice President of Product Management at Magnite, “two-thirds of deals are configured with the desired supply yet deliver no or very little revenue”.

Deals API v1.0 directly addresses these challenges by increasing transparency around the business entities involved in deal packaging – including the seller, packager, and curator, where applicable. This clarity strengthens accountability and enhances trust across the transaction chain.

Anna-Maria Nalepa, Senior Technical Product Manager at Basis Technologies, noted that while the API formalizes long-standing operational needs, it also provides a foundation for future innovation in deal management. “Beyond enabling better collaboration and cleaner data as deal volumes grow, the API brings transparency to curation. It clarifies who is involved and in what capacity. It sets the stage for a more transparent, deal-driven programmatic marketplace in an ecosystem long burdened by complexity”.

Future iterations of the API will expand support for deal discoverability, enabling all participants to understand their role, inclusion, and relationship within a deal.

[\[TVTechnology\]](#) ■

Equipment Trends

WOHLER ENHANCES iVAM2-MPEG WITH SRT FRONT-PANEL MONITORING OF MPEG ANALYSIS



Wohler has updated its iVAM2-MPEG Secure Reliable Transport (SRT) monitor, adding several functional enhancements that support broadcast and production workflows. The update now supports Caller and Listener connection modes, enables monitoring of encrypted SRT streams, and allows selection of Stream-ID for operations involving multiple SRT streams on a single IP address or port.

The addition of dual Caller and Listener modes enables the device to initiate or receive SRT connections, depending on workflow requirements. The monitor now processes encrypted SRT streams, enabling operators to work with secured contribution and distribution feeds. In environments that handle multiple SRT streams, the new Stream-ID selection feature lets you monitor specific streams, simplifying management in multi-programme setups.

The update also brings the Advanced MPEG Stream Analyser to the device's front panel. Previously, only the web interface offered this feature, but users can now access parsed MPEG tables and programme information directly from the front panel and select audio, video, or subtitle PIDs for real-time decoding. [\[APB+ News\]](#)

IGOLGI ENABLES AD INSERTION INTO ANY LIVE VIDEO SIGNAL



Igolgi has added iLux Live SSAI to its lineup, offering a server-side ad insertion system for ad placement on existing live signals. The solution incorporates a full workflow that includes ad database management, quality control, traffic scheduling, frame-accurate ad insertion using SCTE-35 markers or audio cue tones, and analytics and reporting.

Unlike traditional ad inserters that work solely in the compressed domain and often require ads to be stored in multiple formats, iLux Live SSAI addresses common

incompatibility and timestamp issues by transcoding ads to match the characteristics of the incoming signal. As a result, users avoid the hassle of managing ads in multiple formats and achieve reliable, seamless ad playback. The system aligns the ad content with the live feed's bandwidth, resolution, framerate, timestamps, PIDs, and codecs, ensuring consistent delivery to downstream receivers for uninterrupted viewer experiences.

The platform also supports advanced on-screen graphics and visual ad formats. This includes options for overlay ads, L-Bar presentations, and logo insertion. iLux Live SSAI can merge ad content with the source stream and adjust scaling to produce the required layout or format. [\[OTTNews\]](#)

DIGITAL ALERT SYSTEMS NOW OFFERS DC POWER OPTION FOR DASDEC-III



Digital Alert Systems has released the DAS3-DC-PS, a DC power supply for the DASDEC-III emergency alert system, compatible with -48VDC power used in telecom and broadcast facilities.

With the release of the DAS3-DC-PS, the company now offers both AC and DC power configurations for its EAS hardware. Key advantages of the DC supply include eliminating the need for external AC-to-DC converters, reducing heat output, improving power efficiency, and streamlining battery-backup integration.

The DAS3-DC-PS replaces the standard AC supply and connects through a two-lug terminal strip. Operating at 48V DC – below the commonly regulated 50V threshold – the unit reduces the risk of electrical shock and allows installers to use lower-voltage cabling. This can make installation and routine maintenance easier in facilities that have adopted DC power schemes.

Take advantage of these benefits by considering DC operation for your power systems: lower corrosion on copper cables and battery terminals, full compatibility with telecom power standards, and straightforward support for 12V lead-acid batteries as a 48V backup

source. This ensures continued operation during outages without inverters or extra conversion equipment – a key operational advantage. [\[TVTechnology\]](#)

SONY UNVEILS ALPHA 7 V FULL-FRAME MIRRORLESS CAMERA

Sony has officially taken the wraps off the highly anticipated **Alpha 7 V** (α7 V), the fifth generation of its popular full-frame mirrorless camera line. Positioned as a powerful and versatile hybrid camera, the A7 V introduces a host of cutting-edge features inherited from Sony's high-end professional models, making it a compelling option for a wide range of content creators.



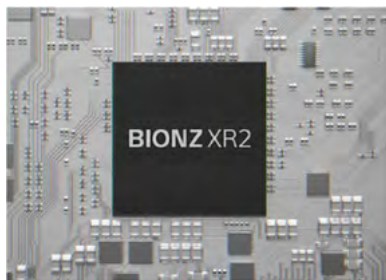
Available for pre-order now and expected to ship in late December 2025, this new iteration builds significantly upon the success of its predecessor, the A7 IV, offering upgrades in sensor technology, processing power, and autofocus performance.

At the Core: New Sensor and AI Power

The A7 V is driven by a newly developed **33MP full-frame partially stacked Exmor RS CMOS sensor**, a first for this camera line. This stacked design dramatically increases readout speeds, enabling faster performance across both stills and video.

Partnering with this sensor is the latest-generation **BIONZ XR2 image processing engine**, which incorporates a dedicated **AI processing unit**.

This integration is a game-changer for autofocus. The AI unit refines subject recognition, enabling the camera to track human subjects with improved pose estimation and reliably identify animals, birds, insects, cars, trains, and airplanes with unprecedented accuracy. The AF system uses 759 phase-detection points that cover 94% of the image area.



Blazing Speed and Advanced Video Capabilities

The speed enhancements are immediately apparent. The A7 V is capable of blackout-free continuous shooting at up to 30 frames per second (fps) with full AF/AE tracking, a substantial leap from previous models. It also introduces a "Pre-Capture" mode that buffers up to a second of images before the shutter is fully depressed – perfect for capturing fleeting moments in sports or wildlife photography.

For videographers, the A7 V doesn't disappoint. It offers 7K oversampled 4K recording at 60p in full-frame mode

and 4K at 120p in a Super 35mm (APS-C) crop. Sony has also addressed overheating concerns with an improved heat-management system, enabling extended recording times.

Design, Stabilization, and Connectivity

Sony has refined the physical design, incorporating a robust, weather-sealed magnesium alloy chassis and a redesigned, more comfortable grip. The 5-axis in-body image stabilization (IBIS) system has been upgraded to offer up to an impressive 7.5 stops of correction. A new "Dynamic Active Mode" further enhances stability for smooth, handheld video recording.



A new 4-axis touchscreen offers a 3.2-inch view. Dual USB-C ports and Wi-Fi 6E provide modern connectivity. [\[Sony\]](#)

ATOMOS LAUNCHES HDMI MONITOR-RECORDER NINJA TX GO



Atomos is elevating filmmaking workflows with the launch of the Ninja TX GO, a versatile HDMI-based monitor-recorder designed to broaden the reach of the Ninja TX series among filmmakers and content creators. The device is now available through Atomos resellers and the company's web store. Camera control functionality will be added soon as a free over-the-air update for both the Ninja TX GO and Ninja TX models.

The Ninja TX GO integrates monitoring, professional recording, camera control, and cloud connectivity in a compact form factor intended for mirrorless and DSLR workflows. It features a 5-inch, 1500-nit HDR touchscreen that delivers a brighter, more precise viewing experience than standard in-camera displays. Monitoring tools include EL Zone, waveform, vectorscope, and focus peaking, providing detailed control over exposure, framing, and colour management.

The device supports direct recording to CFexpress Type B or USB-C SSDs in formats such as Apple ProRes, ProRes RAW, Avid DNx, and H.265/H.264. Using compatible RAW-capable HDMI inputs, the Ninja TX GO can capture

up to 6Kp30 RAW footage.

A key capability of the Ninja TX GO is integrated camera control. Users can adjust settings – including aperture, shutter speed, and ISO – directly from the touchscreen. This applies to supported cameras from Canon, Fujifilm, Nikon, Panasonic, Sony, and Z CAM.

In addition to monitoring and recording, the Ninja TX GO's built-in Wi-Fi enables efficient camera-to-cloud workflows and provides users with 20GB of free ATOMOSphere cloud storage. Seamless integration with Frame.io and Dropbox, and support for NDI 6/HX3, enhances live streaming capabilities, underscoring the device's versatility for modern productions.



For productions that demand SDI connectivity or more advanced recording, the existing Ninja TX offers SDI I/O, AirGlu wireless timecode, and 8Kp30 RAW recording, distinguishing it for higher-end use cases. Both the Ninja TX GO and TX utilize the new AtomOS platform, engineered for improved performance, usability, and streamlined updates. Additionally, a locking cable mechanism ensures secure connections during critical on-set applications. [\[BroadcastPro ME\]](#)

LEADER OFFERS CINEMATIC LOOK FOR LIVE BROADCAST OUTPUT



Leader Electronics has introduced the v8.2 software update for its ZEN and ZEN-W Series waveform monitors and rasterisers, adding advanced cinematic camera setup and analysis capabilities to live broadcast operations. The update extends support for ARRI LogC3/C4, RED, and Sony S-Log false-colour monitoring across the ZEN Series (LV5600, LV7600, LV5350, LV7300) and the ZEN-W Series (LV5600W, LV7600W).

As more live sports, music, and entertainment productions adopt large-sensor cinematic cameras to achieve shallow depth of field and a more dramatic visual style, vision engineers face greater complexity when matching exposure and colour across mixed-camera systems. Version 8.2 addresses this challenge by bringing

Leader's cinematography-oriented monitoring expertise into live production environments.

The enhanced false colour presets and Log-based exposure tools – already familiar on film sets – provide real-time, intuitive support for achieving consistent exposure across cinematic and traditional broadcast cameras. Engineers can easily switch between camera types while maintaining a unified monitoring workflow from the studio to the OB truck.

This update builds on earlier features from the LV5350. It now brings these capabilities to all ZEN and ZEN-W models. This ensures accuracy, continuity, and efficiency across diverse production setups.

Koichi Fukagawa, Manager of the Sales Planning Unit at Leader Electronics, noted that live production is rapidly adopting cinematic aesthetics. He emphasised that v8.2 empowers engineers to uphold creative intent reliably from capture through live broadcast output by using trusted monitoring tools rooted in Leader's cinematography expertise. [\[APB+ News\]](#)

DCA901 - BROADCAST MICROPHONE ARRAY



The DCA901 introduces a new level of flexibility for audio capture in broadcast and media production. This compact digital broadcast microphone array provides eight channels of high-quality audio over a single network connection. Its steerable pickup zones focus on desired sound sources while reducing ambient noise. With integrated DSP, minimal cabling, and rapid deployment, the DCA901 replaces traditional, bulky analogue setups and supports contemporary, story-driven production workflows.

Key capabilities include:

- Deliver up to 8 discrete audio channels from a single broadcast-grade array microphone.
- Steerable lobes allow virtual pickup zone adjustment, reducing the number of microphones needed and eliminating manual repositioning.
- Audio, power, and control run over a single Dante or AES67 connection, simplifying routing and reducing failure points.
- Built-in DSP handles EQ, compression, delay, and automixing so engineers can focus on creative sound.
- Supports REMI workflows and alternate feeds with flexible routing and remote lobe control.

Preset configurations ensure quick deployment and consistent setups for repeated productions.

- Seamlessly captures 5.1 immersive audio with stereo downmixing for compatibility across formats.
- Low-profile design fits stadiums, studios, and mobile use, blending into camera-facing spaces. [\[Shure\]](#) ■

WORLD BROADCASTING UNIONS TECHNICAL COMMITTEE MEETING OF OCTOBER 20, 2025



The World Broadcasting Unions Technical Committee (WBU-TC) meeting on October 20, 2025, highlighted how the global broadcasting industry is navigating technological disruption and regulatory pressure.

The main takeaways focus on four interconnected themes: the strategic imperative of Artificial Intelligence (AI), the growing priority of cybersecurity, the defence of broadcast spectrum, and the collaborative development of next-generation infrastructure for cloud, 5G, and content verification.

- **Artificial Intelligence (AI):** Broadcasters are implementing AI for practical applications and considering its strategic implications. Key concerns include establishing ethical principles to guide rapid development and ensuring accuracy in generative AI models. The meeting emphasises the importance of public broadcasters maintaining audience trust. In this context, ABU has introduced the “ABU AI Principles” document and recently launched the “ABU AI Hub” to WBU-TC.
- **Cybersecurity:** Cybersecurity has shifted from an IT issue to a core operational and strategic risk. The WBU has reinstated its Cybersecurity Subcommittee to foster a unified front. Unions are responding to new regulations (EBU’s work on NIS2 and the CRA), developing best practices for IP-based systems (EBU’s ST 2110 threat model), and addressing

supply-chain and field personnel vulnerabilities.

- **Spectrum defence:** Broadcasters face coordinated pressure on their spectrum resources, mainly from mobile industry interests. Immediate threats include the auction of the Upper C-band in the U.S., raising concerns for broadcasters in North and South America. The WBU-TC is urgently formulating unified positions for the upcoming WRC-27 and planning for WRC-31, where the critical UHF band is already on the agenda for possible reallocation in Region 1.
- **Collaborative Technology Development:** There is a strong emphasis on inter-union collaboration to shape future media infrastructure. Key projects include the DMF/ MXL initiative to create an interoperable, multi-cloud environment for production flexibility and security, though participation from some regions is lagging. The adoption of C2PA standards for content provenance is being promoted to combat disinformation and piracy. At the same time, significant progress is being made in 5G broadcasting, especially in direct-to-device delivery and robust emergency alerting systems, which are important for manufacturer adoption.

The WBU represents all the world’s major regional broadcasting unions. The ABU was represented at the meeting by Dr Veyssel Binbay, the ABU’s Director of Technology. ■



Personalities & Posts

ABU TECHNICAL BUREAU NEW VICE CHAIRPERSONS



Dr Mohieddin Moradi is a leading expert in broadcast engineering and media technology. He is Assistant Professor at Iran Broadcasting University's ICT Department, Director General of IRIB R&D, and Vice Chair of the Asia-Pacific Broadcasting Union (ABU) Technical Bureau. Since joining IRIB (Iran) in 2000 as a Broadcast Engineer, he has held key leadership roles, including Video Department Manager, Vice President of Audio and Video, and ICT Department Manager at IRIB University.

As Director General of IRIB R&D, he leads strategic research, technology localisation, prototyping, monitoring emerging technologies, and piloting projects that shape broadcasting in Iran. He oversees specialised committees and technical standards, supporting IRIB's mission of innovation.

Dr Moradi has authored over 20 scientific papers, delivered 30+ major conference presentations, and trained broadcast specialists. He has led projects to enhance audio/video quality, launch virtual studios and election channels, and integrate AI into media workflows. Internationally awarded, he continues to advance broadcast technology, research, and education, with significant national and international impact. ■



Mr Tue Nguyen Duc currently serves as Vice Chairman of the Technical Bureau of the Asia-Pacific Broadcasting Union (ABU), with nearly three decades of experience in broadcast technology and operations. He joined Vietnam Television (VTV) as an IT engineer and rose to Deputy Director of the Technical and Artistic Center.

Mr Tue specializes in implementing and integrating IT systems for television production. Since 2011, he has contributed to ABU's technical activities, attending General Assemblies and speaking at major technical conferences.

From 2013 to 2018, he led VTV's technology transformation, migrating SD to HD and transitioning analog to file-based production. He deployed newsroom systems, MAM platforms, and playout automation across all channels.

In his current role, Mr Tue coordinates technical operations, system design, and integration for all VTV programs, ensuring innovation and excellence in broadcast technology. ■



Mr Zhang Wei is a professional with over ten years of experience in his field. He holds a degree from a reputable university and has developed his career by taking on a variety of roles, building skills in leadership, project management, and problem-solving. Mr. Zhang has contributed to a range of projects and has worked effectively in both individual and team settings.

Throughout his career, Mr Zhang has remained committed to ongoing learning and professional growth. He has participated in industry workshops and training sessions to stay up to date on the latest developments relevant to his work. Colleagues describe him as reliable and thorough, and he is known for his methodical approach to tasks and attention to detail.

In addition to his professional responsibilities, Mr Zhang has been involved in community activities, occasionally volunteering his time and sharing his knowledge with others. He values clear communication and strives to maintain constructive working relationships. Mr Zhang Wei continues to build his expertise and contribute steadily to his field, aiming to support organizational goals and adapt to evolving industry trends. ■

NEW TECHNICAL LIAISON OFFICER



As Senior System Engineer (Assistant Executive Director) and Executive Committee member at Sun Siyam Media, **Mr Abdulla Azman** brings over 18 years of experience in broadcast engineering and IT. He joined Sun Siyam Media two years ago as a System Engineer, having spent 16 years at Public Service Media, advancing through key technical and leadership roles.

Mr Abdulla drives operational excellence at Sun Siyam Media by designing, implementing, and maintaining broadcast and IT systems that reduce downtime, accelerate media workflows, and improve live production reliability. His leadership in technical troubleshooting and custom software development directly elevates newsroom efficiency and strengthens technical processes.

He modernises the organisation's infrastructure through in-house software, real-time control systems, engineering upgrades, and automated workflows, boosting efficiency and reliability. He also leads digital transformation initiatives that enhance content delivery and system resilience.

Mr Abdulla's achievements include Employee of the Year (2024), promotion to Senior System Engineer (Assistant Executive Director), and appointment to the Executive Committee. He holds a Bachelor of Information Technology from Cyryx College and professional certifications, including CCNA and JICA training in Digital Terrestrial Broadcasting. ■



Mr Pattana Ustasiri is the Director of the Engineering and Technical Division at the National Broadcasting Services of Thailand (NBT Thailand). Mr Ustasiri began as a local telecommunication technician, advanced to senior electrical engineer, and now leads the Engineering and Technical Division, demonstrating steady technical and leadership growth at NBT Thailand. In his current role, he streamlines workflows to maximize productivity, leads transformative initiatives, implements advanced broadcasting technologies, and sets ambitious technical and engineering targets. He also directs budget strategies to ensure effective outcome evaluation.

His achievements include serving as a key member of the committee developing the nationwide emergency warning system (EWS), which will broadcast public threat alerts on digital television channels and is scheduled for implementation in 2025. He also drove broadcasting and television operations forward from 2020 to 2023. He participated in the working group that secured a regional NBT television station license from the National Broadcasting and Telecommunication Commission Board (2019-2021). He also led the transformation from analog to digital television systems (2014-2018). In 2025, Mr Ustasiri was nominated and appointed to the ABU Technical Bureau (TB) as a member, representing NBT Thailand.

He completed factory training in 2017 on the DTU-L10 DBD-T2 Digital TV Transmitter System (a digital television signal transmission device) at NEC Corporation and earned a 2012 ITU NBTC Training Workshop Certificate for using telecommunications and information and communication technologies (ICTs) for disaster management, awarded by the International Telecommunication Union in collaboration with the National Broadcasting and Telecommunications Commission. ■



Mr Stephen Chow is the Assistant Controller of the Engineering Division at TVB, responsible for overseeing the Technical Services Department and leading the support and development of core systems that underpin Production, Post-Production, Media Networks, and Software Development. He first joined TVB in 1999, served until 2005, and rejoined the organisation in 2012.

In his role, Mr Stephen Chow contributes to the execution of engineering initiatives and the continuous enhancement of technical operations across the division. His work includes infrastructure design, workflow optimisation, and the integration of emerging technologies to strengthen production efficiency and system reliability.

Key achievements include implementing structured cabling and fibre to increase division bandwidth, developing a web-based cue sheet app that streamlined playout automation and VOD metadata management, and driving the successful tapeless migration with a central transcoding farm. These contributions delivered significant cost savings and enhanced division technology upgrades.

He has led projects such as web applications with face recognition for drama production, AI-driven video quality enhancement for legacy content, and the exploration of LTO alternatives for archiving.

Stephen has received multiple recognitions, including Outstanding Employee Awards in 2014 and 2016, the Grand Award in 2016, and five promotions from Assistant Executive Engineer to Assistant Controller. ■

2025

20 October Tunisia
WBU Technical Committee

28 - 30 October Kuala Lumpur, Malaysia
Technical Workshop
(Collaboration with IPPTAR)

19 - 21 November Japan
Inter BEE 2025

25 - 27 November Vietnam
VOV Technical and Content Workshop

4 December Online
Members Innovation Webinar

2026

January Online
Engineering Fundamentals Level-1

19 - 23 January Kuala Lumpur, Malaysia
HFCC A26 Conference

February Online
Member Innovation Webinar

30 March - 2 April Kuala Lumpur, Malaysia
ABU Digital Broadcasting Symposium
2026

April TBC
ABU Technical Bureau Mid-Year
Meeting

20 - 22 May Singapore
BroadcastAsia Workshop

May Online
Member Innovation Webinar

June Online
ABU-DRM Webinar

June Online
Engineering Fundamentals Level-2

July Online
World-DAB-ASBU-ABU Workshop

August Kuala Lumpur, Malaysia
IPPTAR Workshop

September Online
Member Innovation Webinar

September Online
Industry Webinar on OTT Platforms

September Online
Technical Bureau Annual Meeting

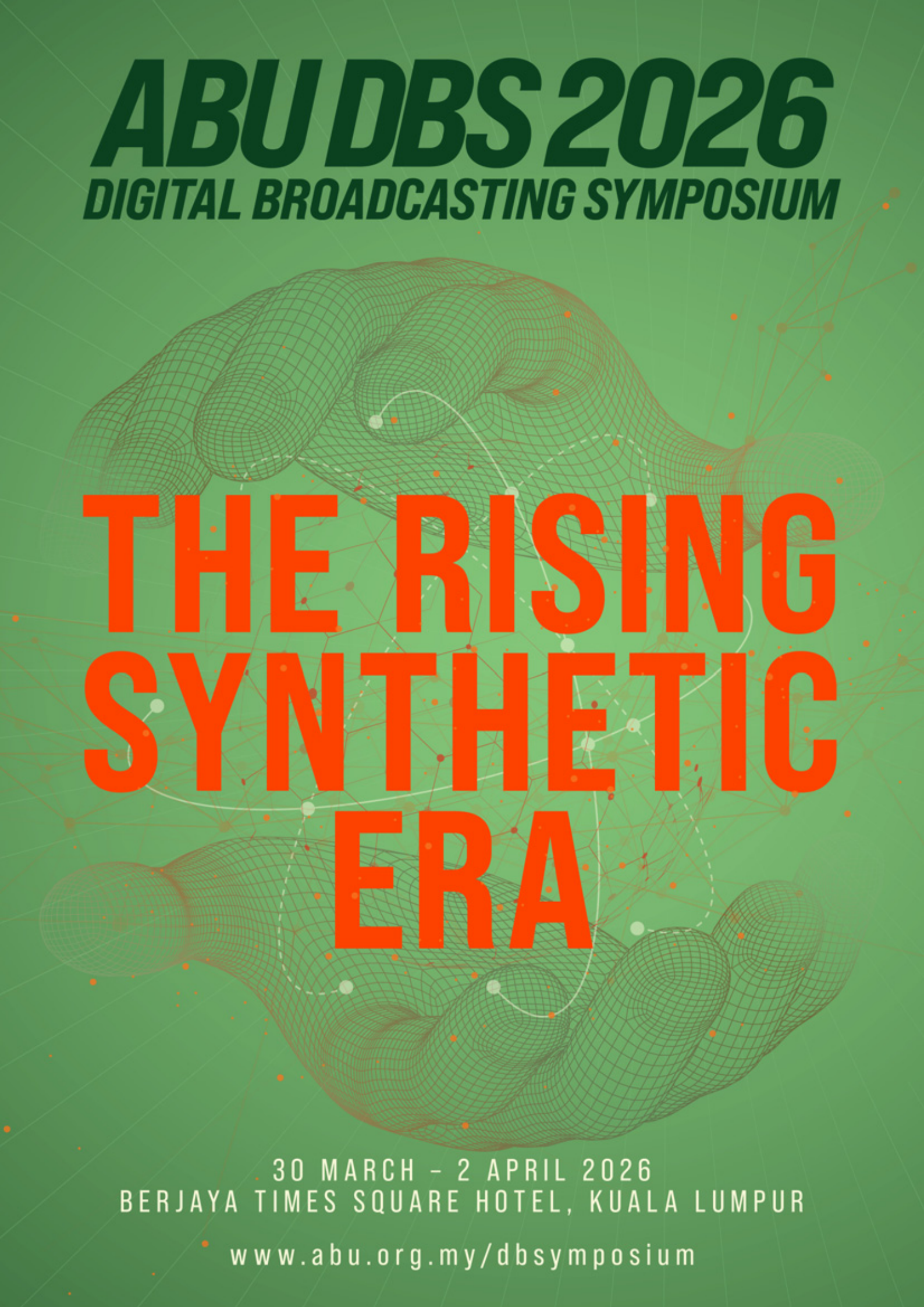
30-31 October Colombo, Sri Lanka
Technical Committee Meeting

November Tokyo, Japan
C2PA Event

December Online
Member Innovation Webinar

ABU DBS 2026

DIGITAL BROADCASTING SYMPOSIUM

The background of the poster features a green wireframe illustration of two hands cupping a globe. A network of orange and white dots connected by thin lines is overlaid on the hands and globe, symbolizing digital connectivity. The main title is centered over this graphic.

THE RISING SYNTHETIC ERA

30 MARCH – 2 APRIL 2026
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www.abu.org.my/dbsymposium