ACTIVITIES OF ITU-R STUDY GROUP 6 FOR THE FUTURE OF BROADCASTING

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ABSTRACT

For many decades, the International Telecommunication Union, Radiocommunication Sector, Study Group 6 (ITU-R SG 6) has been leading the international standardization of the end-to-end broadcasting chain from the production of programmes to their ultimate delivery to the audience. Its Recommendations and Reports are the key to the successful international exchange of programmes and the overall quality assessment methodologies for audiovisual content. A fundamental responsibility is to protect spectrum and quality of service for broadcasting.

Telecommunications and the Information Communication Technology (ICT) landscape are changing rapidly. Traditional television viewers are now “consumers” of audiovisual content delivered through a growing number of platforms and reproduced on a wide variety of user “terminals”.

SG 6 will continue to be the pioneer of the international standards for broadcasting services and audiovisual content applications in the global media landscape, studying emerging technologies to enable innovative new services and seeking to maintain the quality of experience that audiences have come to expect from broadcasters and content makers.

INTRODUCTION

Media consumption, especially broadcast media, is an integral part of our everyday lives. Broadcasters have always been expected to provide the best service based on state-of-the-art technologies of the time. This has ranged from early radio broadcasting in the 1920s, to black & white television, then colour, high definition (HDTV), and now the latest ultra-high definition television (UHDTV). Reliable radio and television broadcasting provides a “point-to-everywhere” instantaneous delivery system for essential information and safety advice to the public. International standards applied to broadcasting technologies address the need for global, harmonized solutions to improve interoperability, allowing industry to innovate and therefore guaranteeing the quality of experience that the audience expects.

The ITU is the United Nations specialized agency for information and communication technologies that celebrated its 150th anniversary in 2015. Its primary roles are to allocate global radio-frequency spectrum and satellite orbits, develop the technical standards that

ensure networks and technologies seamlessly interconnect, and strive to improve access to Information Communication Technologies (ICTs) to underserved communities worldwide. The ITU currently has 193 member countries and almost 800 private-sector entities and academic institutions. The ITU is organized into three main areas, or “Sectors” of activity: Radiocommunications, Standardization, and Development.

The ITU Radiocommunication Sector (ITU-R) aims to create the conditions for the harmonized development and efficient operation of existing and new radiocommunication systems. Its objectives are to ensure interference-free operation, and to assure the necessary performance and quality in operating such systems.

The ITU-R Study Groups develop the technical bases for decisions taken at World Radiocommunication Conferences (WRCs) and develop global standards on radiocommunication matters. Study Group 6 has responsibility for broadcasting services.

This paper reports on activities and prospects of ITU-R SG 6 that aim at the sustainable development of broadcasting for the future.

ROLE OF ITU-R STUDY GROUP 6

The International Telecommunication Union, Radiocommunication Sector, Study Group 6 (ITU-R SG 6) has been leading the international standardization of the broadcasting chain from the production of programmes to their ultimate delivery to the audience. Its Recommendations and Reports are the key to the successful international exchange of programmes between organizations and for the overall quality assessment methodologies for audiovisual content. Finally, it has a fundamental responsibility to protect broadcasting spectrum and the quality of broadcasting services. The scope of SG 6 can be found in (1).

Although SG 6’s studies of radio frequencies are limited to terrestrial networks, it has the unique remit within the ITU to investigate, discuss and recommend standards for the creation of television and radio programmes no matter what the intended delivery platform, including terrestrial, satellite, cable, and broadband networks. Never before have these activities been so critically important to support current and future broadcasting services, where viewers enjoy audiovisual content delivered through an ever growing number of delivery platforms using a rapidly increasing diversity of reproduction devices.

SG 6 also recognizes the issue of the environment and climate change and has a responsibility to improve the environmental performance of broadcasting systems.

To achieve its goals, the work of SG 6 is conducted in three Working Parties (WPs), each of which is responsible for the different technological areas in the end-to-end broadcasting chain, as summarized in Table 1.

WP 6A’s remit is terrestrial broadcasting system characteristics including channel coding/decoding and modulation/demodulation, frequency planning and sharing for sound, video, multimedia and interactivity, characteristics of transmitting and receiving antennas, evaluation methods of service areas, transmitter and receiver reference performance requirements, and requirements for source coding for terrestrial emission.

WP 6B’s remit covers the areas that bridge programme production and broadcasting emission. These include the interfaces required in the production chain to the various

delivery media (terrestrial, satellite, cable, internet, etc.) together with source coding and multiplexing of content, metadata, middleware, service information, and access control. This is applicable to all broadcasting services, including multimedia/interactive and converged services, for both fixed and mobile terminals. WP 6B is also responsible for determining broadcaster requirements for Electronic News Gathering (ENG) as well as requirements for the delivery of broadcast content to end-users whatever the method of distribution.

WP 6C's unique remit is the "presentation layer" for radio and television broadcasting. This includes signal formats for production and exchange of sound and television programmes, methods to evaluate sound and picture quality, and guidance on the use of new technologies for the end-to-end "presentation layer". WP 6C is the home of the well-known seminal Recommendation for assessing image quality, namely ITU-R BT.500. Several Recommendations and Reports have been developed for standardized methodologies for evaluating sound and picture quality which are used throughout the world's media community for all forms of media presentation. WP 6C has undertaken a programme of work to introduce new requirements based on the growing types of reproduction devices and environments where audiovisual content is consumed.

In response to the UN Convention on the Rights of Persons with Disabilities and ITU Resolution 175 (Guadalajara, 2010), SG 6 is actively working on improving accessibility to audiovisual media services for persons with hearing, sight or age-related disabilities, in collaboration with ITU-T.

ITU-R SG 6 is responsible for a number of ITU-R documents that directly relate to the broadcasting service, including the Recommendations, Reports and Handbooks (2-6). It also continually develops new documents and revises existing texts as needed, making SG 6 one of the most productive Study Groups in ITU-R.

WP 6A	WP 6B	WP 6C
Terrestrial broadcasting delivery	Broadcast service assembly and access	Programme production and quality assessment
- Terrestrial broadcast delivery systems (channel coding and modulation) - Spectrum utilization and sharing - Antennas - Reference transmitter and receiver - Protection of the broadcasting service from interference	- Signal interfaces - File formats - Metadata - Source coding - Multiplexing and transport - Access control - Multimedia and interactivity - Requirements for delivery and distribution - Integrated broadcast-broadband	- Acquisition of video and sound - Signal representation - Recording and archiving - Quality evaluation methods for video and sound - International programme exchange

Table 1 – Major areas of responsibilities of Working Parties in ITU-R SG 6

PROSPECTS FOR THE FUTURE OF BROADCASTING

The environment for telecommunications and Information Communication Technology (including broadcasting) is changing ever more rapidly. New technologies and devices are being introduced continuously and viewers enjoy audiovisual content delivered through various means which are then reproduced on a growing number of user devices. It is important that ITU-R SG 6 continues to protect spectrum allocated for broadcasting services, ensuring that it is used efficiently and economically to enable innovative new services to be launched. By continuing to study emerging technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), and Virtual Reality (VR), SG 6 can expect to maintain and enhance its prominent position in the global media landscape.

Transition to Digital Broadcasting and to Next Generation Broadcasting

ITU-R SG 6 and its predecessors have produced Recommendations on digital terrestrial broadcasting systems for television, sound radio and multimedia services. Six international digital terrestrial television broadcasting systems (DTTB Systems), ATSC, DVB-T, ISDB-T, DTMB, DTMB-A, and DVB-T2 are specified in ITU-R Recommendations (BT.1306, BT.1877). Multiple ITU-R broadcasting systems have been standardized and adopted by the world's different regions and countries, primarily due to the different requirements and the different timing of development in each region. And now a new DTTB system, ATSC 3.0, has been standardized in the North America.

On the other hand, in the domain of mobile telecommunication services, audiovisual applications are becoming dominant. The 3rd Generation Partnership Project (3GPP) and ITU have been developing standards for mobile telecommunication systems known as International Mobile Telecommunication (IMT). Its latest version for the Long Term Evolution (LTE) or '4G' system specification includes a broadcast mode that enables broadcasting-like audiovisual services and network structure. They are also developing a next generation system, IMT-2020 or '5G', with the aim of adding advanced features and enhancements including low latency and large capacity.

Although it is uncertain now whether the mobile telecommunication standard will be adopted for broadcasting service, it is important for broadcasters to study different mobile delivery options to ascertain how best broadcasters can benefit in the future of terrestrial broadcasting. SG 6 will continue to study new transmission systems with advanced performance, efficiencies and ecological benefits for use worldwide in the future.

Protection of Spectrum for Broadcasting

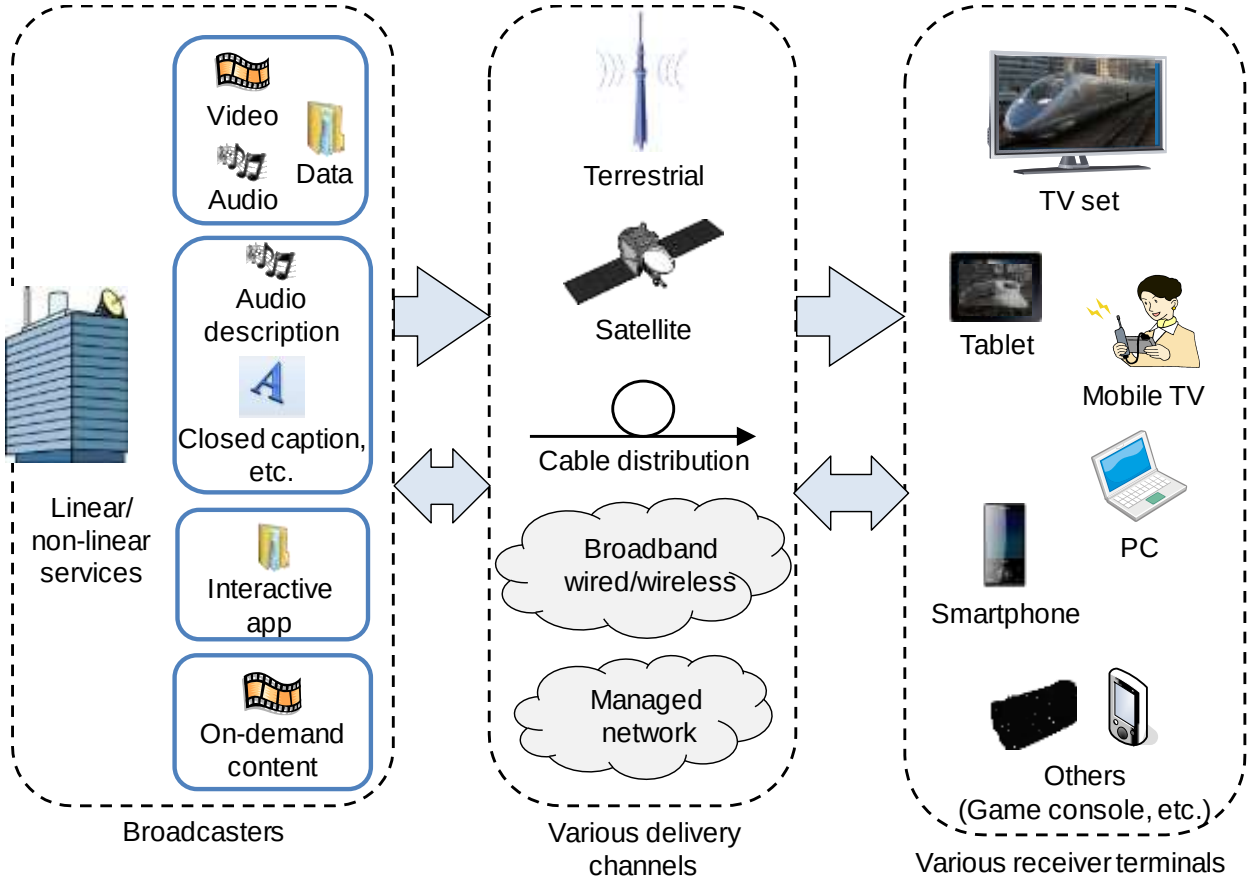
The UHDTV system is one of the major applications of next-generation broadcasting. Some countries have already launched UHDTV services via satellite or terrestrial broadcasting and several countries have carried out field experiments. It is not certain that the spectrum currently allocated to broadcasting services is sufficient for the introduction of new broadcasting applications and services including UHDTV, 3DTV without glasses and new VR content. These new services will demand greater transmission capacity and it would be to the detriment of many Administrations if broadcasters could not introduce new applications and services due to insufficient spectrum. It may therefore be worth considering a new paradigm of networks and spectrum usage for broadcasting.

The protection of the spectrum allocated to broadcasting services has never been of such paramount importance. During the WRC in 2015, the UHF band was under threat from agenda items on additional spectrum allocation for IMT and mobile services. The broadcasting community tackled this challenge to protect the broadcasting service in the UHF band by conducting and distributing the results of studies on frequency sharing and compatibility with other services.

One of the preliminary agenda items of the World Radiocommunication Conference in 2023 (WRC-23) calls for the review of spectrum use and the study of spectrum needs for existing services within the frequency band 470-960 MHz in Region 1. This embraces the spectrum requirements of the broadcasting and mobile services, except for aeronautical mobile. The result of this agenda item may influence significantly the future of terrestrial broadcasting. The broadcasting community must therefore be well prepared for these discussions in order to protect the future development of broadcast media.

Global Platform for Broadcasting

One of the objectives of ITU-R SG 6 is to study harmonized systems for delivering programmes to audiences using combined terrestrial, satellite and internet platforms. In



Source: Report ITU-R BT.2400-0

Figure 1 – Global platform for broadcasting

the current media environment, broadcast content can be delivered through conventional over-the-air broadcasting channels and through broadband networks including IP networks and IMT for consumption on many types of “terminals” including smartphones and tablets.

As traditional broadcasting and Internet services continue to merge, broadcasting services can be further enhanced by combining media content, data and applications using broadband networks, an approach known as Integrated broadcast-broadband (IBB). This includes the HbbTV, Hybridcast, TOPSmedia and Ginga systems. Specific examples of IBB enhancements are Access Services for people with special needs (Enhanced Closed Captions, Closed Signing and Audio (Video) Description).

It is expected that applications in the area of Internet of Things (IoT) will find their way into the daily practice of the Broadcasting service. Communication between a television receiver, a smartphone or tablet and IoT devices allows more attractive presentation of broadcast content, thereby bridging broadcast content and a wider range of daily life activities.

To meet the need for a more holistic approach to broadcasting and content delivery, SG 6 has been studying what is currently known as “The Global Platform” (Figure 1). This is a delivery platform which can utilize any number of distribution platforms to provide broadcast content to end-users who may choose to use any receiving or reproduction device via any reception platform they have access to, using both broadcasting and non-broadcasting technologies. An initial Report has been published to address usage scenarios, requirements and technical elements for the global platform.

It has become clear that SG 6 needs to accelerate studies on the full integration of the internet into a future broadcasting ecosystem such that the consumer may remain unaware and unconcerned as to how the content is received.

Evolution of Audiovisual Systems

In the evolution of television image and sound systems, new parameters and paradigms are continually being developed to better serve the audience. The ability to easily exchange programme material through common file and signal formats is vitally important for the successful production, international exchange and long-term archiving of culturally important content.

Image systems

Television image systems have evolved from the early analogue television (NTSC, PAL and SECAM), through digital Standard Definition Television (SDTV) with Standard Dynamic Range (SDR) to HDTV and UHDTV, and then UHDTV with High Dynamic Range (HDR). The most recent two-dimensional image system specified in Recommendation ITU-R BT.2100 integrates the wide colour gamut (WCG) and higher frame rates (HFR) and adds HDR (Figure 2). The highest level of UHDTV provides ultra high-definition images with a high sense of being there and sense of realness, fully exploiting the extended features of UHD, HFR, WCG and HDR. These features will give producers the potential to engage and heighten the audience’s experience of their programs. It is worth remembering that psychophysical studies form the foundation of those image parameter values.

Next generation television image systems may feature further extended spatial and temporal resolutions, extended field of view, and depth information, enabling panoramic 360º images, omnidirectional multi-view images, and holographic 3D images. A common method of representation for such diversified types of 2D and 3D images may be a future target for standardization.

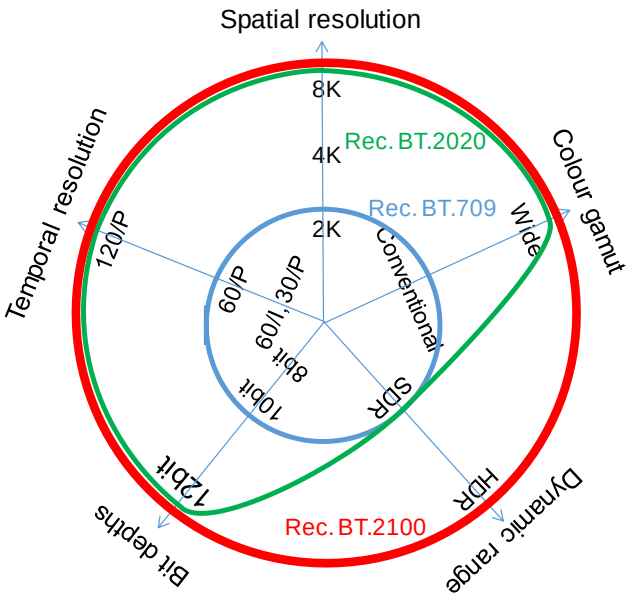


Figure 2 – Parameters of television image formats

Sound systems

Advanced sound systems that go beyond the 5.1 multichannel system have been developed and will provide audiences with significantly improved directional stability and an immersive audio experience; namely, channel-based systems utilizing up to 22.2 channels with three vertical layers and object-based systems that require a metadata set. Object-based sound systems can provide not only the immersive experience but also personalized services and access services, for instance, commentary with different language, personality and speed, depending on users' needs. The original sound scene authored by object-based audio systems is rendered for different listening environments such as headphones or multiple loudspeakers. Audio Renderers required for these advanced sound systems for content authoring and production monitoring are currently under investigation.

Virtual and augmented reality (VR/AR)

The current approach to VR is aimed mainly at offering immersive and interactive audiovisual experiences to users wearing a headset or glasses. VR/AR technologies can potentially provide users with a sense of touch and force by the use of haptic displays that can reproduce hardness, texture, shape and size of objects, as well as a 360º audiovisual sensation. Broadcasting services with tactile information will help increase the quality of experience and also serve for persons with impaired-vision or impaired-hearing to acquire additional information.

Artificial Intelligence (AI)

Data mining from social big data is becoming important for broadcasters to rapidly learn a broad range of social phenomena and to better understand the audience expectations. AI technologies have enabled this. There is potential for AI technologies to be used by broadcasters in many other areas such as simultaneous language translations, speech and image (face and object) recognition, automatic metadata generation, retrieval from programme material archives, and content recommendations to users. These technologies

and applications also have potential for automated Access Service generation with the target of 100% provision of Captioning, Signing and Audio Description services.

CONCLUSION

Broadcasting is the most effective and trusted way to deliver information, education, culture, and entertainment to large audiences. It also plays an important role in delivering emergency information and public safety advice during times of local, national and international emergency. These roles and features also contribute to the UN's Sustainable Development Goals (SDGs).

ITU-R SG 6 continues to be the pioneer of international standardization for the successful future of broadcasting services and is contributing to the advancement of the information society. SG 6 studies new audiovisual content and applications as well as new delivery systems and networks with open minded, visionary thinking. With clear and provident views, SG 6 is well placed to help strengthen the development of the broadcasting services and to reinforce its prominent role in international broadcasting standardization.

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