System Verification of Advanced ISDB-T

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Abstract—**The Advanced Integrated Services Digital Broadcasting-Terrestrial (Advanced ISDB-T) is a next generation digital terrestrial broadcasting system. From 2019, various experiments have been conducted and the fundamental performances were verified. In 2022, as for the total system verification test, the large-scale verification tests were conducted in 4 large cities in Japan. The verification test with using actual hardware including transmitter station showed the feasibility of the system.**

Index Terms—**Digital Terrestrial Broadcasting, Advanced ISDB-T,**

I. Introduction

THE first-generation digital terrestrial television broadcasting using the Integrated Services Digital Broadcasting-Terrestrial (ISDB-T) system[1] was launched in 2003 in Japan. Since then, ISDB-T system was adopted in 20 countries including Japan. More than 20 years have passed since ISDB-T system was developed, and during these years, there are various evolutions on broadcasting technologies. Ultra-high definition television (UHDTV) satellite broadcasting services using the Integrated Services Digital Broadcasting for Satellite, 3rd generation (ISDB-S3) system [2, 3] were launched in Japan in 2018, and UHDTV has become much popular recently.

II. Advanced ISDB-T SYSTEM

In order to improve the user experience and for the efficient use of terrestrial broadcasting frequency band, we are currently developing the advanced terrestrial broadcasting system for the next generation of digital terrestrial television broadcasting. For the physical layer we have developed the transmitting system Advanced Integrated Services Digital Broadcasting-Terrestrial (Advanced ISDB-T) [4, 5]. With inheriting the features of ISDB-T such as hierarchical transmission and partial reception and so on, Advanced ISDB-T has improved the transmitting performance and functions. With utilizing the latest technologies, Advanced ISDB-T improved the capacity for 1.7 times larger than ISDB-T. The main key for improving the capacity was the adoption of low-density parity-check (LDPC) codes [6] and non-uniform constellations (NUC) [7]. Availability of larger FFT size such as 16k and 32k, or higher carrier modulation such as 256QAM, 1024QAM, 4096QAM and, the expanded signal bandwidth from 5.57 MHz to 5.83 MHz have also contributed to the increasement of the capacity.

The research and development for the next generation digital terrestrial broadcasting was not only limited to the physical layer. We have also conducted the research and development of transport layer and video/audio coding. The internet protocol (IP) based transport layer was intended to realize high level harmonization between broadcast and broadband. The system enables provision of integrated broadcast and broadband services, such as multi-view video, content replacement and augmented reality (AR)/virtual reality (VR) in TV programs. To verify the integrated broadcast and broadband services, we have developed an all-IP software-based integrated master control system that outputs signals to transmission stations and broadband networks. For the video coding, the system adopted Versatile Video Coding (VVC) which is the latest video coding standard that enables high efficiency and multiple functions. For the audio cording the system utilized Moving Picture Expert Group (MPEG)-H 3D Audio (3DA).

III. Total verification tests

From 2019 to 2022, The experimental transmitter stations are constructed in 4 large cities in Japan and various transmitting experiments were conducted. To verify the system in total, we have conducted the end-to-end verification test with using actual equipment including the experimental transmitter stations in 2022. Fig.1 shows the block diagram of the verification test. Fig.2 shows the equipment of the receiving site. With using the hierarchical transmission, two UHDTV services for fixed reception and two HDTV services for mobile reception within 6-MHz bandwidth of UHF band was demonstrated. The video and audio content were encoded/decoded with VVC and MPEG-H 3DA real-time encoder/decoder. The integrated broadcast and broadband services were also verified with using a signal via a broadcast and broadband network.

IV. Conclusion

The end-to-end verification test using actual equipment of the Advanced ISDB-T was conducted in for large cities in Japan. The test was successfully done which shows the feasibility of the Advanced ISDB-T system in total.

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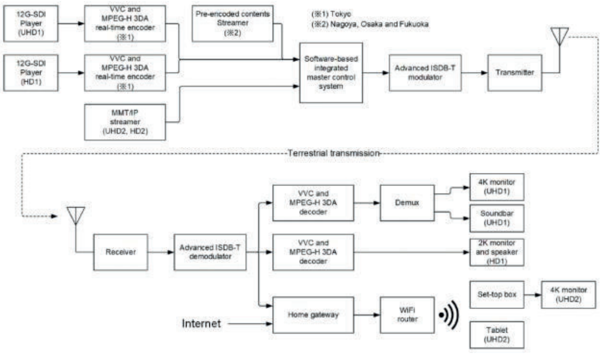

Fig. 1. Block diagram of the total verification test

Fig. 2. Equipment of the receiver site

References

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