Portable Wireless System for Digital Video Transmission

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Abstract

A portable wireless system that enables digital video transmission in a simple fashion has been developed at NTT Access Network Service Systems Laboratories to provide a temporary TV terminal link between a TV terminal station operated by NTT Communications Corporation and a TV station. This system enables stable digital video transmission even under severe interference conditions. For easier portability, its volume and weight have been decreased compared with portable wireless systems for analog video transmission that NTT developed in the past.

1. Introduction

With the start of terrestrial digital broadcasting approaching, analog equipment for broadcasting is being replaced by digital equipment. Demand is growing for HDTV (high-definition television) class high-quality video delivery based on high-speed Internet access via optical fiber, and we also expect an increase in demand for a delivery method for contents gathering systems.

So far we have developed portable wireless systems only for analog video transmission. Recently, we have developed a portable wireless system for transmitting digital video that can be set up anywhere in a simple manner.

2. System overview

2.1 Application

This system will be applied to digital TV relay services that NTT Communications intends to provide to broadcasting stations. Figure 1 illustrates the application of this system. The network for digital TV relay service comprises relay links interconnecting TV terminal stations and terminal links connecting TV terminal stations with the broadcasting stations. Our system is designed for the TV terminal links. It can be used as a substitute link connecting the TV terminal station and the TV station when optical fiber TV terminal links are disconnected by a disaster, for example. It can also provide temporary TV terminal links connecting the site of a topical event to a TV terminal station according to the transmission needs.

2.2 System configuration and development concept

This portable wireless system uses the 11- or 15-GHz band to transmit digital video in one direction. The transmitter is composed of four units: i) a transmission control unit that processes and modulates an input signal; ii) a transmitting radio unit that performs frequency up-conversion, amplification, and transmission of the signal as a radio wave; iii) an antenna; and iv) a tripod that supports the transmitting radio unit. The receiver is also composed of four units: i) a receiving radio unit that receives and amplifies the radio wave sent from the transmitter; ii) an antenna; iii) a reception control unit that performs signal processing such as demodulation; and iv) a tripod that supports the receiving radio unit. The system configuration is shown in Fig. 2. We focused on the following development points.

- High-quality video transmission such as HDTV
- Quick setup for transmission
- Portability (compact and lightweight)
- Operation under various propagation conditions
- Multi-purpose design

The main specifications of the prototype and com-

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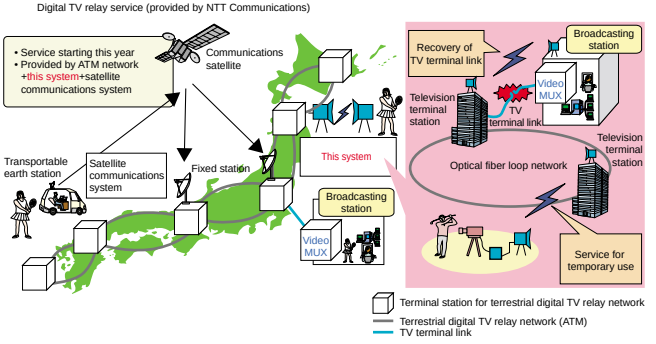

Fig. 1. Application of portable wireless system for digital video transmission.

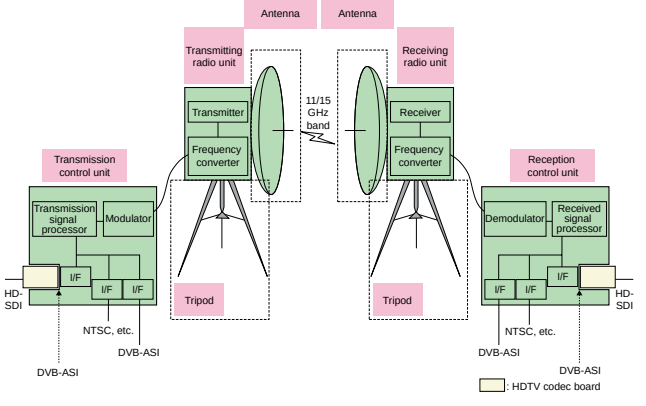

Fig. 2. Configuration of portable wireless system for digital video transmission.

Table 1. Main specifications.

	Prototype	Commercial equipment
Frequency band	11-GHz band	11/15-GHz band
Transmission radio channel	48 channels	10 channels (11-GHz band), 6 channels (15-GHz band)
User interfaces	DVB-ASI, NTSC*1, HD-SDI (when HDTV codec boards are implemented)	
Modulation	Digital transmission: 64QAM (trellis 5/6), 32QAM (trellis 4/5), 16QAM (trellis 3/4), QPSK (no convolutional code) Analog transmission: FM	
Error correction	RS(204,188)	
Data rate (TS+RS)*2	66/60/53/45/40/30/25 Mbit/s*3	
Symbol rate	13.35403 Mbit/s	
Permissible spurious emission	50 μW	
Permissible occupied bandwidth	Digital transmission: 15.5 MHz Analog transmission: 17.0 MHz	
Maximum frequency deviation (FM)	8 MHzp-p	
Transmission power	Digital transmission: 0.5 W/1.0 W/1.5 W Analog transmission: 0.5 W	Digital transmission: 0.5 W/1.0 W Analog transmission: 0.5 W
Antenna gain	33 dBi (ϕ0.6 m)	11 GHz: 33 dBi (ϕ0.6 m), 36 dBi (ϕ0.9 m) 15 GHz: 35 dBi (ϕ0.6 m), 38 dBi (ϕ0.9 m)
Volume, weight*4	28 liters, 30 kg	

*1 NTSC: Composite analog video signal standard for studio application, developed by the US National Television Systems Committee.
*2 TS: Transport Stream, RS: Reed Solomon
*3 Data rate is converted from/into DVB-ASI rate (270 Mbit/s) by de-stuffing/stuffing.
*4 Total for transmission control unit, transmitting radio unit, reception control unit, and receiving radio unit

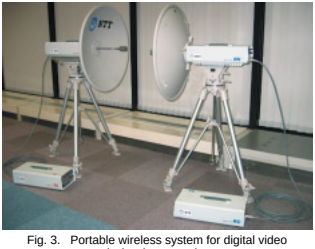

Fig. 3. Portable wireless system for digital video transmission (prototype).

mercialized version are given in Table 1. To conform to the revised Radio Law Related Investigative Standards, we reduced the number of transmission channels and decreased the transmission power of the commercialized version compared with the prototype. The appearance of the prototype system we developed is shown in Fig. 3.

3. System features

The features of the system are described below in comparison with conventional portable wireless systems for analog video transmission that NTT developed in the past.

3.1 Countermeasures against incoming/outgoing interference

Several fixed wireless links, such as the mobile communications backhaul, use the same frequency band as our system, especially the 11-GHz band. Therefore, we must apply countermeasures against outgoing and incoming interference to ensure that our system does not interfere with fixed wireless links and to suppress interference from them.

To reduce outgoing interference, we implemented functions for receiving and monitoring the radio waves arriving at the transmitting radio unit. A spectrum analyzer monitors the incoming radio waves from other fixed stations, enabling us to select the most suitable radio channel that does not harm other fixed stations.

When the receiving radio unit is used in a severe interference environment, we were concerned that the low-noise amplifier might become saturated by incoming interference waves, degrading the link quality. To handle this, we applied the two countermeasures shown in Fig. 4. An automatic gain control (AGC) permits the maximum received input to be –10 dBm and a group filter reduces the interference

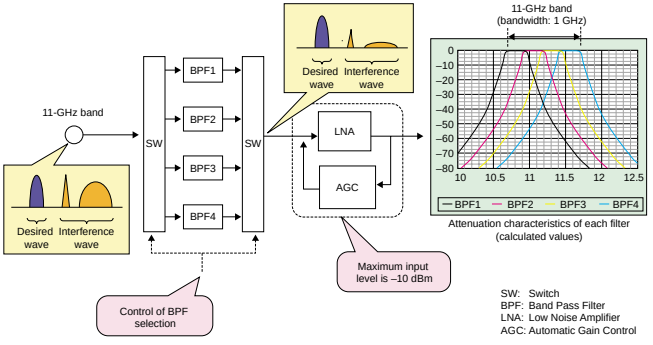

Fig. 4. Countermeasures against in-coming interference (prototype).

before it reaches the low-noise amplifier. The group filter comprises four bandpass filters and covers a total bandwidth of 1 GHz in the 11-GHz band. When the user selects the radio channel, the filter to be used is selected automatically.

As a result of these interference countermeasures, this system does not interfere with other fixed wireless links and provides stable digital TV relay service even under severe propagation conditions.

3.2 Improved portability

Compared with the existing portable wireless system for analog video transmission, both the volume and the weight have been decreased to improve portability. Previously, external codec units were necessary to transmit HDTV signals, but the new system incorporates a postcard-sized HDTV codec board (jointly developed by NHK and NTT Communications). This reduces the number of pieces of equipment to carry and shortens the system setup time, enabling us to open a link quickly. The way that the HDTV codec board is implemented in the transmission control unit is shown in Fig. 5. The parameter settings for the codec board and the alarms issued from it pass through the monitor/control bus. This system sends clock signals to set the encoding speed and power to the board.

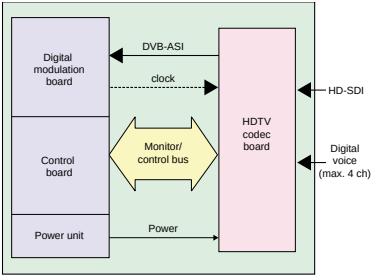

Fig. 5. Implementation of HDTV codec board (transmission control unit).

3.3 Multiple interfaces

The system has several interfaces besides DVB-ASI*1 (a general-purpose serial interface for digital

*1 DVB-ASI: *De facto* standard for the asynchronous serial interface for digital video transmission established by the European Digital Video Broadcasting project. 270 Mbit/s.

video transmission) to increase its applicability. As described in section 3.2 by implementing the HDTV codec board, the HD-SDI*2 interface can be provided. Furthermore, because the system has interfaces for analog video and analog audio (two channels), it can also transmit existing analog video. During the transition period from analog to digital broadcasting, this system can be used in place of broken links and as a temporary link for analog relay, which will expand its applicability.

3.4 Improved stability during deployment

In general, conventional portable wireless systems used a friction-based method of setting the antenna's angle of elevation on the tripod. In the new system, we added a direct angle-of-elevation fixing mechanism consisting of a rotary joint and a locking screw. This allows the antenna's direction to be adjusted finely and then fixed firmly, which improves the stability of the service. In addition, the tripod legs now have metal plates with fixing bolts to anchor the tripod or secure its feet according to the conditions where the tripod is set up.

4. Conclusion

This article presented the features of the portable wireless systems developed for digital video transmission. This system enables stable digital video transmission under severe interference conditions by implementing two interference countermeasures in the receiving radio unit: RF automatic gain control and automatic RF band pass filter selection. The volume and weight of this system have been decreased to improve portability compared with portable wireless systems for analog video transmission that NTT developed in the past.

In-house use of this system is planned for this year. In the future, we will support a smooth commercial introduction.

*2 HD-SDI: High Definition Serial Data Interface: non-compressed serial data transmission interface for HDTV video signal. Approximately 1.5 Gbit/s.

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