

International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Series J
Supplement 6
(09/2016)

SERIES J: CABLE NETWORKS AND TRANSMISSION
OF TELEVISION, SOUND PROGRAMME AND OTHER
MULTIMEDIA SIGNALS

**Transmission of ultra high definition television
over cable with functions defined in
Recommendations ITU-T J.183, ITU-T J.288 and
ITU-T J.94**

ITU-T J-series Recommendations – Supplement 6

ITU-T



Supplement 6 to ITU-T J-series Recommendations

Transmission of ultra high definition television over cable with functions defined in Recommendations ITU-T J.183, ITU-T J.288 and ITU-T J.94

Summary

Supplement 6 to ITU-T J-series Recommendations describes a combination example of functions defined in Recommendations ITU-T J.183, ITU-T J.288 and ITU-T J.94 in order to achieve high speed transmission by channel bonding technology for 4K/8K ultra high definition television (UHDTV) distribution over an existing transmission system compliant with Annex C to Recommendation ITU-T J.83.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T J Suppl. 6	2016-09-02	9	11.1002/1000/13241

Keywords

Cable TV, channel bonding technology, ultra high definition television (UHDTV).

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

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Supplement 6 to ITU-T J-series Recommendations

Transmission of ultra high definition television over cable with functions defined in Recommendations ITU-T J.183, ITU-T J.288 and ITU-T J.94

1 Scope

This supplement provides UHDTV cable transmission with functions defined in [ITU-T J.183], [ITU-T J.288] and [ITU-T J.94].

2 References

- [ITU-T J.94] Recommendation ITU-T J.94 (2016), *Service information for digital broadcasting in cable television systems.*
- [ITU-T J.183] Recommendation ITU-T J.183 (2016), *Time-division multiplexing of multiple MPEG-2 transport streams and generic formats of transport streams over cable television systems.*
- [ITU-T J.288] Recommendation ITU-T J.288 (2016), *Encapsulation of type length value (TLV) packet for cable transmission systems.*

3 Definitions

None.

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Supplement

None.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

CNR	Carrier-to-Noise Ratio
HFC	Hybrid Fibre and Coaxial
NIT	Network Information Table
QAM	Quadrature Amplitude Modulation
TLV	Type-Length-Value
TS	Transport Stream
TSMF	Transport Streams Multiplexing Frame
UHDTV	Ultra High Definition Television

5 Conventions

None.

6 System concept

The system concept of UHDTV transmission with functions defined in [ITU-T J.183], [ITU-T J.288] and [ITU-T J.94] is shown in Figure 1.

At the cable TV headend, an MPEG-2 transport stream (TS) and/or type-length-value (TLV) is input into a transmitter. The network information table (NIT) specified in [ITU-T J.94] is inserted into the input MPEG-2 TS while the TLV-NIT specified in [ITU-T J.94] is inserted into the input TLV stream. After that, TLV packets are fragmented and encapsulated into a fixed-length packet called a fragmented TLV packet, in accordance with [ITU-T J.288]. The fragmented TLV packets and/or MPEG-2 TS are multiplexed into the transport streams multiplexing frame (TSMF) specified in [ITU-T J.183]. Multiple QAM carriers transmission system, based on Annex C of [b-ITU-T J.83], are used for transmitting them.

At the home receiver, each carrier is demodulated. After that, the fragmented TLV packets and/or MPEG-2 TS are de-multiplexed from TSMF. Then, the fragmented TLV packets are restored to the original TLV packets in accordance with [ITU-T J.288].

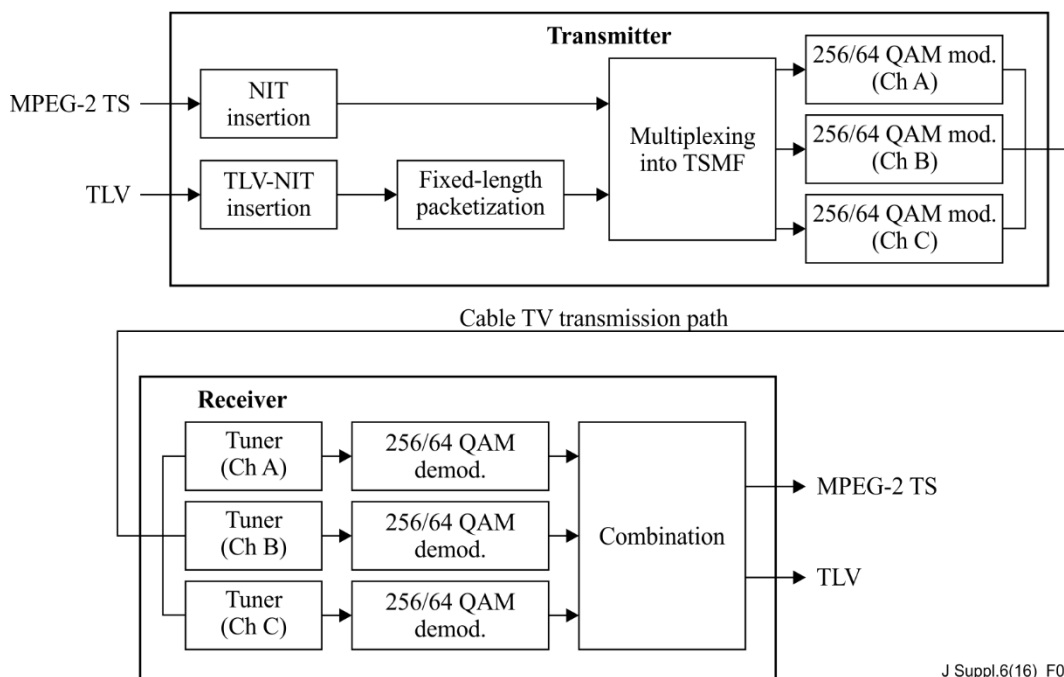


Figure 1 – System concept

7 Trial for 8K UHDTV cable TV distribution

8K UHDTV cable TV distribution was demonstrated and stably played on an 85-inch 8K LCD display through a commercial large-scale cable network in Tokyo in May 2016.

The trial was conducted in the hybrid fibre and coaxial (HFC) network shown in Figure 2. Table 1 lists the parameters applied to the transmitted signal of 8K UHDTV. In total, 95 channels, including three channels carrying the 8K UHDTV signal, were frequency division multiplexed and transmitted from the headend.

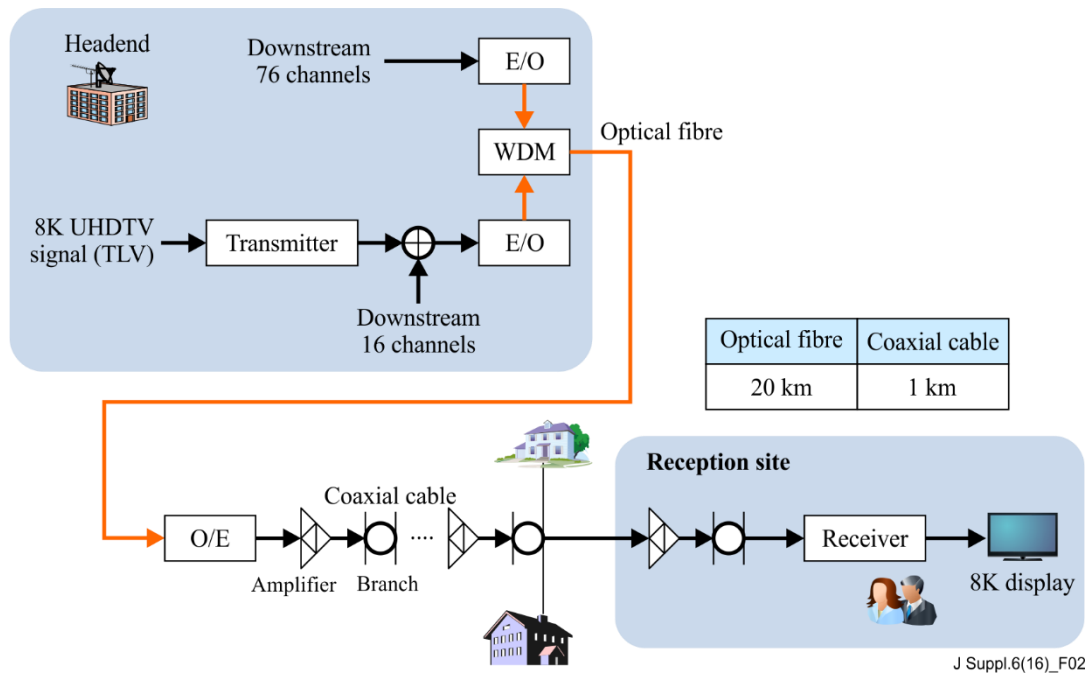


Figure 2 – Experimental set-up

Table 1 – Parameters for transmitted signal

TLV stream rate	100 Mbit/s
Video coding	HEVC / H.265
Audio coding	MPEG-4 AAC
Bandwidth per channel	6 MHz
Symbol rate	5.274 Mbaud
Bit rate per channel w/o parity bits for FEC	256 QAM: 38.88 Mbps 64 QAM: 29.16 Mbps
No. of channels	Two channels with 256 QAM and one channel with 64 QAM
Freq. of multiple QAM channels (Centre frequency (MHz))	256 QAM: 273 MHz, 447 MHz 64 QAM: 635 MHz

Figure 3 shows the spectrum of FDM signals measured at the reception site. Figure 4 shows a transmitter based on [ITU-T J.183], [ITU-T J.288] and [ITU-T J.94]. Table 2 lists the carrier-to-noise ratio (CNR) of three signals carrying 8K UHDTV in this trial. The required CNR is 25 dB for 64 QAM and 31.5 dB for 256 QAM before error correction (BER is around 10^{-4}) in a receiver. The received signals had enough margin of CNR to distribute more at the subscriber's site. As shown in Figures 5 and 6, UHDTV transmission was achieved successfully in a large scale cable TV network in Tokyo.

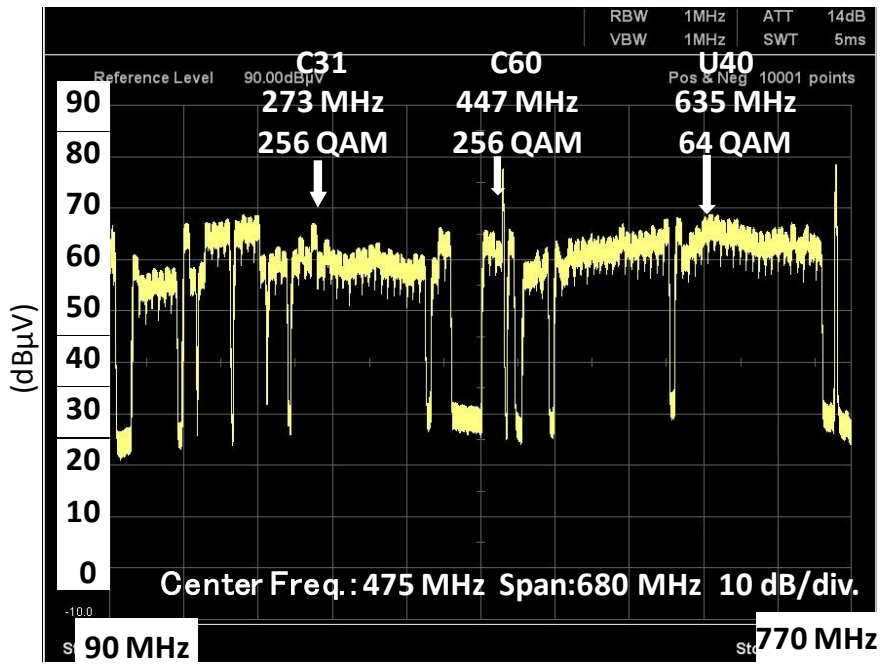


Figure 3 – FDM signals at reception site

Table 2 – CNR of three channels for transmitting 8K UHD TV signal

Center freq. (MHz)	Modulation	CNR (dB)
273	256 QAM	37.0 dB
447	256 QAM	36.0 dB
635	64 QAM	33.4 dB

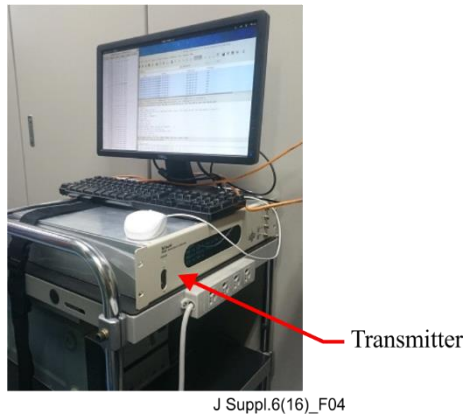
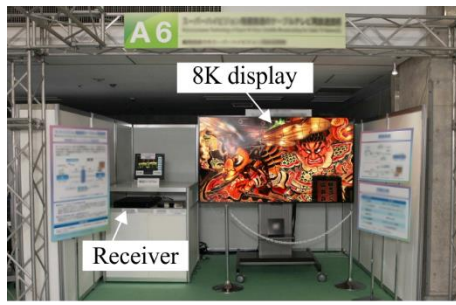


Figure 4 – Transmitter at the headend



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Figure 5 – Received UHDTV on 85-inch 8K LCD display



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Figure 6 – Demonstration

Bibliography

- [b-ITU-T J.83] Recommendation ITU-T J.83 (2007), *Digital multi-programme systems for television, sound and data services for cable distribution.*

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