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OF TELEVISION, SOUND PROGRAMME AND OTHER
MULTIMEDIA SIGNALS

Digital transmission of television signals

Transmission equipment for multi-channel television signals over optical access networks by sub-carrier multiplexing (SCM)

Recommendation ITU-T J.186

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Transmission equipment for multi-channel television signals over optical access networks by sub-carrier multiplexing (SCM)

Summary

Recommendation ITU-T J.186 describes a transmission method for multi-channel television signals over optical access networks. J.186 transmission equipment is capable of transmitting multi-channel AM-VSB, and digital video signals by using sub-carrier multiplexing (SCM).

Source

Recommendation ITU-T J.186 was approved on 13 June 2008 by ITU-T Study Group 9 (2005-2008) under Recommendation ITU-T A.8 procedure.

FOREWORD

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Introduction

For an undetermined period before digital transmission fully replaces analogue transmission, it will be necessary for optical access networks to carry both formats. Digital signals should be transmitted using Frequency-Division Multiplexing (FDM) in addition to analogue signals in order to assure an effective transition from analogue to digital transmission.

Recommendation ITU-T J.186

Transmission equipment for multi-channel television signals over optical access networks by sub-carrier multiplexing (SCM)

1 Scope

This Recommendation describes a method of transmitting multi-channel television signals over optical access networks through the use of Sub-Carrier Multiplexing (SCM).

In the SCM technique, the main carrier is the optical frequency signal carrier; the sub-carriers transfer the electrically multiplexed FDM video signals in the optical sideband. The format of the signals output by the Photo Detector (PD) of the Optical Network Terminal (ONT) is the same as that of the signals input to the modulator of the optical transmitter. The SCM method is used in the trunk line of Hybrid Fibre-Coax (HFC) systems.

The system described in this Recommendation transmits FDM analogue AM-VSB and digital video signals by SCM technology. The optical modulation format is Intensity Modulation (IM).

Optical amplifiers are used to compensate the losses of the optical transmission/splitters used to create the access network. Dispersion compensation fibres (DCF) are used to compensate the chromatic dispersion of access network fibres. DCF imposes the reverse chromatic dispersion in advance in order to offset the degradation due to CSO created by the transmission of 1.55 μm optical signals over 1.3 μm zero-dispersion access fibres.

SCM technology is simple, and is based on an electrical/optical (E/O) converter and optical amplifiers in the transmitter side, and an optical/electrical (O/E) converter in the receiver side. However, the allowable optical transmission/splitter loss is smaller than that in the FM converted system. Moreover, optical reflections in the transmission lines may degrade video quality.

This system can be integrated with the G.983 series B-PON system by using G.983.3 WDM technology, with the G.984 series G-PON system by using G.984.5 WDM technology, and with the IEEE 802.3ah EPON systems. This allows the PON system to offer broadcast services and also data and voice communication services over the same optical access network. By using the bidirectional data PON system, upstream signals, e.g., control functionality and data to indicate user requirements, can be transmitted as well.

NOTE – The structure and content of this Recommendation have been organized for ease of use by those familiar with the original source material; as such, the usual style of ITU-T recommendations has not been applied.

2 References

2.1 Normative References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [1] Recommendation ITU-T J.83 (2007), *Digital multi-programme systems for television, sound and data services for cable distribution*.
- [2] Recommendation ITU-T J.87 (2001), *Use of hybrid cable television links for the secondary distribution of television into the user's premises*.
- [3] ANSI/SCTE 85-1 (2003), *HMS HE Optics Management Information Base (MIB) Part 1: SCTE-HMS-HE-OPTICAL TRANSMITTER MIB*.
- [4] ANSI/SCTE 85-2 (2003), *HMS HE Optics Management Information Base (MIB) Part 2: SCTE-HMS-HE-OPTICAL RECEIVER-MIB*.
- [5] ANSI/SCTE 85-3 (2004), *HMS HE Inside Plant Management Information Base (MIB) SCTE-HMS-HE-OPTICAL-AMPLIFIER-MIB*.
- [6] Recommendation ITU-T G.984.4 (2008), *Gigabit-capable Passive Optical Networks (G-PON): ONT management and control interface specification*.
- [7] Recommendation ITU-R BT.1306-3 (2006), *Error-correction, data framing, modulation and emission methods for digital terrestrial television broadcasting*.
- [8] Recommendation ITU-R BO.1408-1 (2002), *Transmission system for advanced multimedia services provided by integrated services digital broadcasting in a broadcasting-satellite channel*.
- [9] IEC 60728-1 (2007), *Cable networks for television signals, sound signals and interactive services-Part 1; System performance of forward paths*.

2.2 Informative References

- Recommendation ITU-T G.983.1 (2005), *Broadband optical access systems based on Passive Optical Networks (PON)*.
- Recommendation ITU-T G.983.3 (2001), *A broadband optical access system with increased service capability by wavelength allocation; Amendment 2 (2005)*.
- Recommendation ITU-T G.984.1 (2008), *Gigabit-capable Passive Optical Networks (GPON): General characteristics*.
- Recommendation ITU-T G.984.2 (2003), *Gigabit-capable Passive Optical Networks (GPON): Physical Media Dependent (PMD) layer specification; Amendment 1 (2006)*.
- Recommendation ITU-T G.984.3 (2008), *Gigabit-capable Passive Optical Networks (GPON): Transmission convergence layer specification*.
- Recommendation ITU-T G.984.5 (2007), *Gigabit-capable Passive Optical Networks (GPON): Enhancement band*.
- IEEE Standard 802.3 (2005), *Information technology – Telecommunications and Information Exchange Between Systems – Local and metropolitan area networks – Specific Requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications*.

3 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AGC	Automatic Gain Controller
ALC	Automatic Level Controller
AM-VSB	Amplitude Modulation Vestigial Sideband

AMP/BRC-U	Amplifier and Branch Unit
A-RA	Receiver Amplifier for Analogue video transmission
A-TA	Transmitter Amplifier for Analogue video transmission
CNR	Carrier-to-Noise Ratio
CSO	Composite Second Order distortion
CTB	Composite Triple Beat distortion
D/U	Desired-to-Undesired distortion ratio
DCF	Dispersion Compensation Fibre
DI	Discrete Interference
D-RA	Receiver Amplifier for Digital video transmission
D-TA	Transmitter Amplifier for Digital video transmission
E/O	Electrical to Optical
FDM	Frequency-Division Multiplexing
HE	Head End
HFC	Hybrid Fibre Coax
IM	Intensity Modulation
ISDB-T	Integrated Services Digital Broadcasting for Terrestrial
LE	Line Extender
O/E	Optical to Electrical
ONT	Optical Network Terminal
PD	Photo Detector
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase-Shift Keying
RA	Receiver Amplifier
RIN	Relative Intensity Noise
SCM	Sub-Carrier Multiplexing
SNMP	Simple Network Management Protocol
STB	Set-Top Box
TA	Transmitter Amplifier
TC8PSK	Trellis Coded 8-Phase Shift Keying
TX	Transmitter
V-OLT	Optical Line Terminal for Video signals
V-ONT	Optical Network Terminal for Video signals
VSWR	Voltage Standing Wave Ratio
WDM	Wavelength-Division Multiplexing
XM	Cross Modulation distortion