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SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
DIGITAL SYSTEMS AND NETWORKS

Access networks – Optical line systems for local and
access networks

**Higher speed bidirectional, single fibre,
point-to-point optical access system (HS-PtP)**

Recommendation ITU-T G.9806

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Recommendation ITU-T G.9806

Higher speed bidirectional, single fibre, point-to-point optical access system (HS-PtP)

Summary

Recommendation ITU-T G.9806 describes a higher speed bidirectional single fibre point-to-point optical access system than the data rate in existing ITU-T point-to-point access systems. It supports 10 Gbit/s and above for the optical access services including the optical distribution network (ODN) specification, the physical layer specification, services requirements and the operation, administration and maintenance (OAM) specification.

History

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Recommendation ITU-T G.9806

Higher speed bidirectional, single fibre, point-to-point optical access system (HS-PtP)

1 Scope

This Recommendation describes a higher speed bidirectional point-to-point (HS-PtP) Ethernet-based optical access system for the optical access services including the optical distribution network (ODN) specification, the physical layer specification, services requirements and the operation, administration and maintenance (OAM) specification.

For an effective use of optical fibres cited in [ITU-T G.986], this Recommendation specifies only a single fibre bidirectional transmission system, also known as duplex working as defined in [ITU-T G.982]. Dual-fibre systems are out of the scope of this Recommendation. This Recommendation also specifies systems with line rate at 10 Gbit/s. Line rates higher than 25 Gbit/s are for future study.

In addition, this Recommendation describes the case of a single domain managed optical network unit (ONU) and related optical line termination (OLT) requirements. The case of a dual domain managed ONU and related OLT requirements are for future study.

2 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.

- [ITU-T G.982] Recommendation ITU-T G.982 (1996), *Optical access networks to support services up to the ISDN primary rate or equivalent bit rates*.
- [ITU-T G.985] Recommendation ITU-T G.985 (2003), *100 Mbit/s point-to-point Ethernet based optical access system*.
- [ITU-T G.986] Recommendation ITU-T G.986 (2010), *1 Gbit/s point-to-point Ethernet-based optical access system*.
- [ITU-T G.988] Recommendation ITU-T G.988 (2017), *ONU management and control interface (OMCI) specification*.
- [ITU-T G.9807.1] Recommendation ITU-T G.9807.1 (2016), *10-Gigabit-capable symmetric passive optical network (XGS-PON)*.
- [IEEE 802] IEEE Standard 802 (2014), *IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture*.
- [IEEE 802.3] IEEE Standard 802.3 (2015), *IEEE Standard for 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*.
- [BBF TR-156] Broadband Forum Technical Report 156 (2017), *Using GPONN Access in the context of TR-101*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 optical access network (OAN) [ITU-T G.985]: The set of access links sharing the same network-side interfaces and supported by optical access transmission systems.

3.1.2 optical distribution network (ODN) [ITU-T G.985]: An ODN provides the optical transmission means from the OLT towards the users, and vice versa. It utilizes passive optical components.

3.1.3 optical line termination (OLT) [ITU-T G.985]: An OLT provides the network-side interface of the OAN, and is connected to the ODN.

3.1.4 optical network unit (ONU) [ITU-T G.982]: An ONU provides (directly or remotely) the user-side interface of the OAN, and is connected to the ODN.

3.1.5 duplex working [ITU-T G.982]: Bidirectional communication using a different wavelength for each direction of transmission over a single fibre.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ANI	Access Node Interface
BER	Bit Error Ratio
Bm	Class B- stands for B minus
CPRI	Common Public Radio Interface
CRC	Cyclic Redundancy Check
DWLCH	Downstream Wavelength Channel
EMS	Element Management System
FEC	Forward Error Correction
FER	Frame Error Rate
FCS	Frame Check Sequence
GEM	GPON Encapsulation Method
HS-PtP	Higher Speed Point to Point
ID	Identifier
LPT	Link Pass Through
LRS	Line Rate Switching
MAC	Media Access Control
MC	Media Converter
MIB	Management Information Base
OAM	Operation, Administration and Maintenance

OAN	Optical Access Network
OC	Operation Control
ODN	Optical Distribution Network
OLT	Optical Line Termination
OMCC	ONU Management and Control Channel
OMCI	ONU Management and Control Interface
OPL	Optical Path Loss
ONU	Optical Network Unit
OSS	Out Of Sync
OUI	Organizationally Unique Identifier
PLOAM	Physical Layer Operations, Administration and Maintenance
PON	Passive Optical Network
QoS	Quality of Service
RE	Reach Extender
R/S	Receive/Send reference point at the interface of the ONU to the ODN
SNI	Service Node Interface
S/R	Send/Receive reference point at the OLT side
TOL	Transmit Optical Level
UNI	User Network Interface

5 Conventions

None.

6 Configuration of an OAN

6.1 System configuration

See clause 5.1 of [ITU-T G.985].

6.2 Fibre type

See clause 5.2 of [ITU-T G.985].

6.3 Transmission methodology

Bidirectional transmission is accomplished by the duplex technique using two wavelength bands in each transmission direction over a single fibre.

Former point to point duplex systems defined in ITU-T make use of the 1310 nm and 1550 nm windows operating at line rates of 1 Gbit/s and below.

For duplex mode to accommodate line rates higher than 1 Gbit/s over longer distances, HS-PtP would benefit from the progress of the optical filtering and active devices technology developed for the bulk market.

Going fully O band can minimize chromatic dispersion effects and offer the capacity to benefit from the building blocks designed for larger markets. Having both upstream and downstream

channels in the same wavelength window in the low dispersion area also enables the use of the lowest cost coding.

To enable energy efficiency in low payload or idle periods, it is required that the system be line rate versatile with agility between the line rates of interest and sub-rates (e.g.,: 50 G / 40 G / 25 G / 10 G / 1 G / 100 Mbit/s) with a dynamic auto-negotiation capability.

6.4 Transmission distances

Transmission distances of 10 km, 20 km, and 40 km are within the scope of this Recommendation. Transmission distances longer than 40 km are for further study.

6.5 Wavelength allocation

To match the full range of distance and line rates, the following wavelength plan is specified.

Table 6-1 – Wavelength plan

Wavelength pair against nominal line rate	10 Gbit/s	25 Gbit/s	50 Gbit/s
Downstream direction	1330 ± 10 nm	For further study	For further study
Upstream direction	1270 ± 10 nm	For further study	For further study

Clear visual recognition of the pluggable optical modules at both the transmit and receive sides, shall be provided. Colour coding must enable quick identification of which side of the point-to-point link the optical module is intended. If different modules are necessary to cover the full extent of line rates and distances, the colour code must also enable easy identification to avoid errors in complex inventory situations.

6.6 ODN model

See clause 5.5 of [ITU-T G.985].

6.7 Line rates

Line rate at 10 Gbit/s is within the scope of this Recommendation.

Higher line rates, such as 25 Gbit/s and 50 Gbit/s, are for further study.

6.8 Classes for optical path loss

Recommended classes for optical path loss are shown in Table 6-2.

Table 6-2 – Classes for optical path loss

	Class S	Class A	Class B-	Class B
Minimum loss	0 dB	5 dB	10 dB	10 dB
Maximum loss	15 dB	20 dB	23 dB	25 dB

6.9 Reflectance in ODN

See clause 5.7 of [ITU-T G.985].

6.10 Module naming convention

The structure of an optical module naming convention is given in Table 6-3.

The names are composed of 3 letters appended to the "line rate GBase" main body. They represent:

- First letter "B" stands for single fibre bi-directional as in IEEE naming
- Second field stands for the optical budget class (S, A or Bm)
- Third letter stands for the direction (Downstream or Upstream)

Table 6-3 – Optical module naming convention

Optical budget class	Nominal line rate	Downstream	Upstream
S	10 G	10GBase-B-S-D	10GBase-B-S-U
	25 G	25GBase-B-S-D	25GBase-B-S-U
	50 G	50GBase-B-S-D	50GBase-B-S-U
A	10 G	10GBase-B-A-D	10GBase-B-A-U
	25 G	25GBase-B-A-D	25GBase-B-A-U
	50 G	50GBase-B-A-D	50GBase-B-A-U
B- (Bm)	10 G	10GBase-B-Bm-D	10GBase-B-Bm-U
	25 G	25GBase-B-Bm-D	25GBase-B-Bm-U
	50 G	50GBase-B-Bm-D	50GBase-B-Bm-U

7 Physical layer specification

The operation of the optical interface shall be full-duplex. Physical layer parameters are specified for each of the following applicable areas:

- Class S: Optical path loss 0-15 dB is intended to cover distances from 0 to 20 km.
- Class A: Optical path loss 5-20 dB.
- Class B: 10-23 dB: Introduced to relax the transceiver performances to cover distance up to 40 km.
- Class B: Optical path loss 10-25 dB is intended to cover distances from 20 to 40 km.

NOTE – The 5 dB overlap between class S and class B enables to avoid gaps due to ODN designs and wavelength choices.

All parameters are specified as follows and should be in accordance with Tables 7-1 and 7-2 for ONU and OLT for different wavelength and line rate options.

Commonalities across the OLT and ONU physical layer specifications should be maximized: transmit wavelength, receive wavelength, line code, maximum laser width, pulse mask and bit error ratio.

Specifications for 10 Gbit/s developed in Table 7-1 and 7-2 should be replicated as necessary for other line rates under consideration.

As a comparison, the methodologies in ITU-T and [IEEE 802.3] are compared in Appendix II.

Table 7-1– Physical layer specification for 10 Gbit/s ONU

Items	Unit	Specification	
ODN class		Class S	Class B-
Nominal bit rate	Gbit/s	10.3125	
Transmit wavelength	nm	1260-1280	