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**Technical requirements for access network - 10 Gbit/s
symmetric passive optical networks (XGS-PON)**

接入网技术要求 10 Gbit/s对称无源光网络 (XGS-PON)

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1 Scope

The document lays down the reference model, the service requirements, the optical network requirements, the PMD layer requirements, the TC layer requirements, the functional requirements and the management and maintenance requirements of the 10 Gbit/s symmetric passive optical network system.

It applies to the design, development, production and manufacture of XGS-PON equipment in the public telecommunication network environment, and dedicated telecommunication networks may use it for reference.

2 Normative references

After the standard wording on dated and undated references, the clause lists national standards including GB/T 7611 on the electrical characteristics of digital network bit rate interfaces, GB/T 9254.1 and GB/T 9254.2 on the electromagnetic compatibility of information technology equipment, GB/T 9771.1 on non-dispersion-shifted single-mode fibre, GB/T 20185 on SDH optical interfaces and GB/T 33845-2017 on gigabit-capable passive optical networks.

It then lists industry standards of the YD/T series, among them YD/T 1054, YD/T 1082, YD/T 1420, YD/T 1619, YD/T 1954, YD/T 1996.2, YD/T 2276, YD/T 2375, YD/T 3623, YD/T

3691.2 on the physical media dependent layer of XGS-PON, YD/T 3691.3 on its transmission convergence layer and YD/T 3757 on optical line terminals supporting network slicing.

International references follow: IEC 60825-2 on the safety of optical fibre communication systems, the ITU-T recommendations G.711, G.723.1, G.729-2012, G.982-1996, G.984.5 Amd.1, G.988, Y.1291 and Y.2201, and the IEEE standards 802.1D, 802.1X, 802.3, 802.11n, 802.11ac and 802.11ax. The Chinese and English glosses of the cited titles are printed side by side.

3 Terms and definitions

3.1 10 Gbit/s symmetric passive optical networks, XGS-PON: a PON system supporting a nominal transmission rate of 10 Gbit/s in the downstream direction and a nominal transmission rate of 10 Gbit/s in the upstream direction.

3.2 optical distribution network, ODN: a point-to-multipoint optical fibre infrastructure. The note divides the ODN into the simple optical distribution network, whose fibre topology is a point-to-multipoint structure with a single root node made up of fibre, optical splitters, filters and other passive optical components, and the composite optical distribution network, which is formed by connecting two or more passive network segments through active equipment, these segments being either optical trunk lines or optical distribution segments; optical distribution networks with different root nodes may share part of the common optical line facilities.

3.3 optical distribution segment, ODS: a point-to-multipoint passive optical fibre facility with a single root node made up of optical splitters, filters and other passive optical components.

3.4 dynamic bandwidth assignment, DBA: the process by which the OLT assigns the upstream transmission capacity of the PON to the service-bearing entities in the ONU. The note states that the assignment process is based on the dynamic indication of service activity and on the pre-configured service contract.

3.5 status reporting DBA, SR-DBA: the dynamic bandwidth assignment method in which the ONU reports its buffer occupancy explicitly over the embedded OAM channel, so that the activity state of the service-bearing entities in the ONU can be inferred from it.

3.6 traffic-monitoring DBA, TM-DBA: the dynamic bandwidth assignment method in which the OLT infers the activity state of the service-bearing entities in the ONU by observing the transmission of idle XGEM frames in the upstream bursts.

4 Abbreviations

The clause glosses the abbreviations used in the document, each with its Chinese term and its English expansion. Network and equipment entities include OLT for optical line

terminal, ONU for optical network unit, ODN, ODS, OTL for optical trunk line, RE for reach extender, CO for central office, HGU for home gateway unit, IAD for integrated access device, MDU for multiple dwelling unit, MTU for multi-tenant unit, SBU for single business unit and SFU for single family unit.

Interfaces and transport terms include SNI for service node interface, UNI for user network interface, the interface labels for the G-PON, XG-PON and XGS-PON interfaces, T-CONT for transmission container, XGEM for the XG-PON encapsulation method, XGTC and XGS-PON TC for the transmission convergence layers, AF for adaptation function, FEC for forward error correction, PMD for physical media dependent, PON for passive optical networks, WDM for wavelength division multiplex and WBF for wavelength blocking filter.

Access and service terms include FTTB for fibre to the building, FTTH for fibre to the home, GE and 10 GE for gigabit and 10 gigabit Ethernet, EVC for Ethernet virtual connection, VLAN and VBES for the business Ethernet service VLAN, VDSL2, MoCA, WLAN, IP, L2 and L3, POTS, VoIP, RF, QoS, PIR for peak information rate, MOS for mean opinion score, PSQM for perceptual speech quality measurement, USB, Tx, Rx and ID.

5 Overview of the 10 Gbit/s symmetric passive optical network system

5.1 Reference configuration of the 10 Gbit/s symmetric passive optical network: the reference configuration of the XGS-PON system is shown in Figure 1. The system is made up of the OLT, the ONU and the ODN, and normally uses a point-to-multipoint network structure. The ODN is a point-to-multipoint optical fibre infrastructure made up of single-mode fibre, optical splitters, optical connectors and other passive optical components, and provides the transmission medium for the physical connection between the OLT and the ONU. Figure 1 places the UNI, or T, reference point on the user side and the SNI, or V, reference point towards the service node function, with the R/S and S/R reference points on either side of the ODN and an access network management block spanning the whole.

5.1 continued: Figure 2 gives a network reference architecture commonly used for an XGS-PON system, comprising the three parts OLT, ONU and ODN. The ODN is divided into the simple ODN and the composite ODN. A composite ODN may include one or more optical distribution segments, and where several such segments are present they are joined in between by an active reach extender. Where XGS-PON services and radio-frequency video services are deployed overlaid on the same ODN, the ODN may use WDM devices or an optical coupler and splitter to mix the XGS-PON and radio-frequency video signals; the reference configurations for that arrangement are given in Figures 3 and 4.

5.2 ODN structure in a coexistence environment: several different ODN structures allow XGS-PON, XG-PON or G-PON and radio-frequency video signals to coexist in the same

ODN; they are shown in Figures 3, 4 and 5. In Figures 3 and 5 a wavelength blocking filter is needed and the ONUs of XG-PON and XGS-PON are adapted onto the XGS-PON port of the OLT through a TDM and TDMA mechanism, while in Figure 4 the ONUs of G-PON and XGS-PON are adapted onto the built-in WDM port of the OLT through a TDM and TDMA mechanism.

5.2 continued: the names and functions of the wavelength filtering devices appearing in Figures 3, 4 and 5 are then listed: Tx is the transmitter and Rx the receiver; V-Tx is the video signal transmitter and V-Rx the video signal receiver; WBF is the wavelength blocking filter used to isolate the signals that interfere with Rx and WBF-V the one used to isolate the signals that interfere with V-Rx; WDM-X and WDM-X-prime are the WDM filters in the XGS-PON and XG-PON ONU used to multiplex and demultiplex the upstream and downstream wavelengths, the second of them isolating the video signal as well; WDM-G and WDM-G-prime play the same roles in the G-PON ONU; WDM-X-L and WDM-G-L are the WDM filters in the XGS-PON, XG-PON and G-PON OLT; WDM1r is a WDM filter that may be placed at the central office end to multiplex and demultiplex the XGS-PON, XG-PON and G-PON signals and may also multiplex the video signal; and the built-in WDM is a WDM filter that may be placed at the central office end to multiplex and demultiplex the wavelengths used upstream and downstream by XGS-PON, XG-PON and G-PON, namely 1 575 nm to 1 580 nm, 1 260 nm to 1 280 nm, 1 480 nm to 1 500 nm and 1 290 nm to 1 330 nm, in accordance with the relevant provisions of ITU-T G.984.5 Amd.1.