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**Access, Terminals, Transmission and Multiplexing (ATTM);**
**Plastic Optical Fibre System Specifications**
**for 100 Mbit/s and 1 Gbit/s**

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# Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

# Introduction

Polymer Optical Fibres (POF) based on Poly-Methyl-Metha-Acrilate (PMMA) with step-index 1mm core diameter (referred to in the rest of the present document as POF) have gained interest in the recent years for their interesting properties compared to the better known glass optical fibre (GOF). The main advantages of POF when compared to GOF are:

- POF large core diameter (1mm) allows do-it-yourself installation and termination with common cutter and electrician-like low cost tools.
- POF high diameter and numerical aperture makes bending loss sensitivity much low.
- POF mechanical resilience and elasticity makes it possible to step on it and even tie it. Dust and water harm POF to a much smaller extent than GOF.
- The optical sources for POF are in the visible range, and the optical launch is usually non-collimated. POF optical sources are thus intrinsically eye-safe and easy to troubleshoot, as the signal can be seen by the naked eye.

For all these reasons, POF is potentially very interesting in several applications (industrial automation, automotive, home networking) where it shows key advantages to the more traditional copper cabling:

- Complete immunity to electromagnetic interference (EMI).
- Being POF an electrical insulator (like GOF), it can be laid down in power ducts. This apparently minor issue is seen as a key element by several European Telcos for in-house installation in brown-field areas.
- Lower weight (a fundamental issue in the automotive sector).

These native properties have to be balanced by some drawbacks: PMMA exhibits a strong attenuation (see Figure 1), minimum for visible light (0,15 dB/m to 0,20 dB/m at 650 nm, to be compared to 0,25 dB/km at 1 550 nm for silica single mode fibre), which limits the reach of the links to about hundred meters without bends.

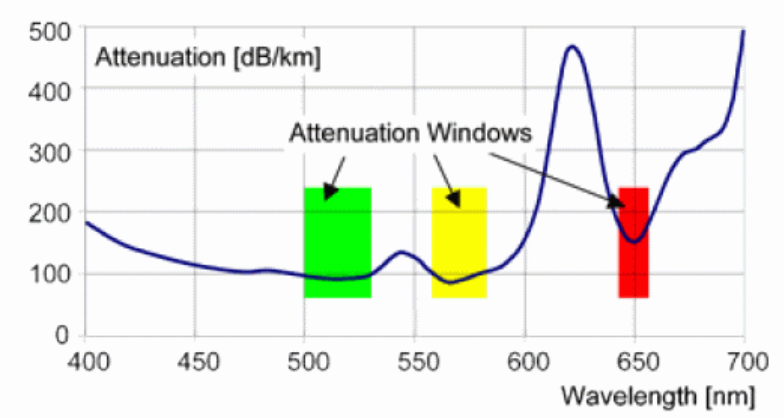


**Figure 1: POF Attenuation**

Besides, as next step in the evolution of Access Networks (see Figure 2), it is foreseen that higher bandwidth services will be delivered, either with active network elements built closer to the end-user (e.g. VDSL2 or Point-to-Point FTTH technology), or at the opposite end with active elements more distant from the end-user (e.g. GPON FTTH technology). The target for bandwidth delivered in home could be up to 1 Gbit/s in case of FTTH or up to 120 Mbit/s downstream and up to 50 Mbit/s upstream in case of VDSL2 technology.

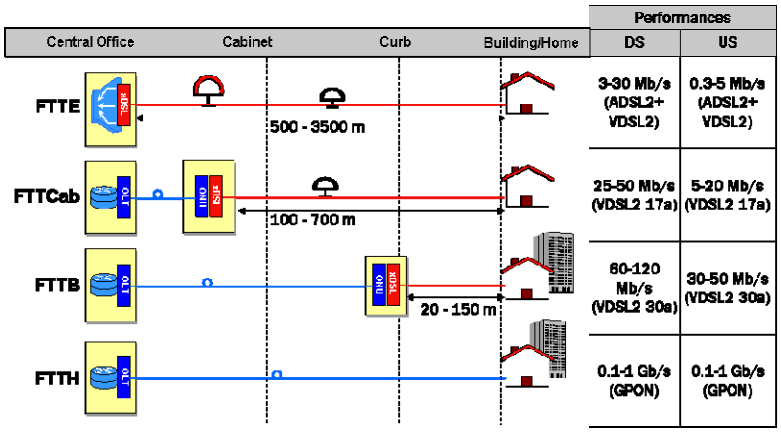


**Figure 2: Evolution of Access Networks**

The home network must not represent a bottleneck for the expected evolution for services such as the introduction of High Definition quality IPTV, multi-room/multi-vision configuration, using different channels seen in different rooms with up to 3 Set Top Boxes (STBs) and high quality video communication via the TV set. More in general, with the "Connected Home", several devices will be connected together: the home network can be used, for example, to share multimedia contents not necessarily delivered in real time by access network, but with the paradigm of "download and play" this content can be stored in a device inside the house and use it afterwards. Besides, this residential network must be easy, fast and cheap to deploy.

# 1 Scope and Purpose

## 1.1 Scope

The present document specifies the POF cabling system 100 Mbit/s and 1 Gbit/s for interoperability among different suppliers. The system comprises the active optical elements, the cables, connectors and wall plugs. A future step could be to achieve integration of POF interfaces into end user equipment.

## 1.2 Requirements Notation

If the present document is implemented, the key words "MUST" and "SHALL" as well as "REQUIRED" are to be interpreted as indicating a mandatory aspect of the present document. The keywords indicating a certain level of significance of a particular requirement that are used throughout the present document are summarized below.

**MUST:** This word or the adjective "REQUIRED" means that the item is an absolute requirement of the present document.

**MUST NOT:** This phrase means that the item is an absolute prohibition of the present document.

**SHOULD:** This word or the adjective "RECOMMENDED" means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.

**SHOULD NOT:** This phrase means that there may exist valid reasons in particular circumstances when the listed behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.

**MAY:** This word or the adjective "OPTIONAL" means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

# 2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

## 2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

[2] IEEE 802.3: "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 Amendment: Physical Layer Specifications and Management Parameters for 10Gb/s Passive Optical Networks".

[3] IEC 60825 series: "Safety of laser products".

[4] DSL Forum Technical Report TR-126 (December 2006): "Triple-Play Services, Quality of Experience (QoE) Requirements".

[5] DSL Forum Technical Report TR-069: "CPE WAN Management Protocol".

[6] IEC 60793-1-47: "Optical fibres - Part 1-47: Measurement methods and test procedures - Macrobending loss".

[7] IEC 60793-2-40: "Optical fibres - Part 2-40: Product specifications - Sectional specification for category A4 multimode fibres".

[8] IEC 60794-2-40: "Optical fibre cables - Part 2-40: Indoor optical fibre cables - Family specification for A4 fibre cables".

[9] IEC 60794-2-41 (Edition 1.0): "Optical fibre cables - Part 2-41: Indoor cables - Product specification for simplex and duplex buffered A4 fibres".

[10] IEC 61754-21: "Fibre optic connector interfaces - Part 21: Type SMI connector family for plastic optical fibre".

[11] IEC 61754-22: "Fibre optic connector interfaces - Part 22: Type F-SMA connector family".

[12] IEC 61754-24: "Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces - Part 24: Type SC-RJ connector family".

[13] IEC 60332: "Tests on electric and optical fibre cables under fire conditions".

[14] European Commission (18 November 2008) Version 3: "Code of Conduct on Energy Consumption of Broad Band Equipment".

[15] IEC 60884-1: "Plugs and socket-outlets for household and similar purposes - Part 1: General requirements".

[16] ISO/IEC 8802-3: "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".

[17] CENELEC EN 60950-1: "Information technology equipment - Safety - Part 1: General requirements".

[18] ITU-T Recommendation K.21: "Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents".

[19] IEC 60068-2-27: "Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock".

[20] ETSI EN 300 019-2-3: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-3: Specification of environmental tests; Stationary use at weatherprotected locations".

[21] IEC 60068-2-6: "Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)".

[22] IEC 60068-2-64: "Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance".

[23] CENELEC EN 55022: "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement".

[24] CENELEC EN 55024: "Information technology equipment - Immunity characteristics - Limits and methods of measurement".

[25] IEC 61034-1/2: "Measurement of smoke density of cables burning under defined conditions (all parts)".

[26] IEC 60754-1/2: "Test on gases evolved during combustion of electric cables (all parts)".

[27] IEC 61754-4: "Fibre optic connector interfaces - Part 4-1: Type SC connector family - Simplified receptacle SC-PC connector interfaces".

[28] IEC 61754-20: "Fibre optic connector interfaces - Part 20: Type LC connector family".

[29] IS 11801: "Information techonlogy - Generic cabling for customers premises".

## 2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] IEEE 802.3u: "Local and Metropolitan Area Networks-Supplement - Media Access Control (MAC) Parameters, Physical Layer, Medium Attachment Units and Repeater for 100Mb/s Operation, Type 100BASE-T (Clauses 21-30)".

[i.2] IEEE 802.3z: "Media Access Control Parameters, Physical Layers, Repeater and Management Parameters for 1,000 Mb/s Operation, Supplement to Information Technology - Local and Metropolitan Area Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications".

[i.3] IEEE 802.3x: "IEEE Standards for Local and Metropolitan Area Networks: Specification for 802.3 Full Duplex Operation".

[i.4] IEEE 802.1Q: "IEEE Standard for Local and Metropolitan Area Networks - Virtual Bridged Local Area Networks".

[i.5] IEEE 802.1p: "IEEE Standard for Local and Metropolitan Area Networks - Supplement to Media Access Control (MAC) Bridges: Traffic Class Expediting and Dynamic Multicast Filtering".

[i.6] IEEE 802.1D: "IEEE Standard for Local and metropolitan area networks: Media Access Control (MAC) Bridges".

# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**triple play services:** scenario in which voice, video and data are all provided in a single access subscription

## 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

| | |
|---|---|
| ACS | Auto Configuration Server |
| CPE | Customer Premises Equipment |
| EMI | ElectroMagnetic Interference |
| FTTH | Fiber To The Home |
| GOF | Glass Optical Fibre |
| GPON | Gigabit Passive Optical Network |
| HG | Home Gateway |
| IPTV | Internet Protocol Television |
| MTBF | Mean Time Between Failures |
| PMMA | Poly-Methyl-Metha-Acrilate |
| POF | Polymer Optical Fibres |
| PVC | PolyVinyl Chloride |
| QoE | Quality of Experience |
| QoS | Quality of Service |

| | |
|---|---|
| RoHS | Restriction of the Use of Certain Hazardous Substances |
| SC/RJ | Small Form Factor Connector/Registered Jack |
| SMI | Small Multimedia Interface |
| STB | Set Top Box |
| UTP5 | Unshielded Twisted Pair (Category 5) |
| VAC | Volts Alternating Current |
| VDSL2 | Very high bit-rate Digital Subscriber Line |
| VLAN | Virtual Local Area Network |

# 4 Requirements for 100 Mbit/s System (Fast Ethernet)

## 4.1 Performances

Today on the market several suppliers offer IEC 60793-2-40 [7] PMMA POF media converter solutions at 100 Mbit/s. With such performance PMMA fibre may be used in the home to interconnect all devices usually communicating through Fast Ethernet interfaces for example the link between the home gateway and the STB. Below the requirement for 100 Mbit/s Systems.

**R1** The max Physical-Layer Data Rate MUST be 125 Mbit/s, compliant with IEEE 802.3u [i.1].

**R2** The system SHOULD be able to transmit over a distance up to 100 m. Figure 3 shows the maximum reachable distance vs. POF bends number.

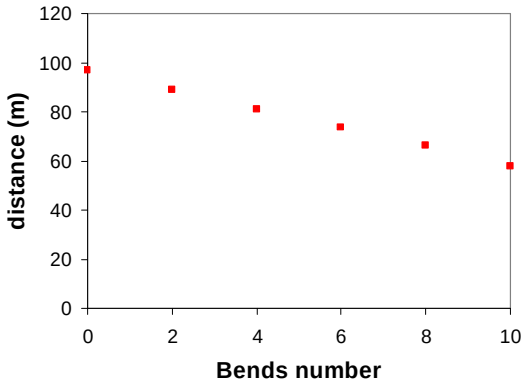


**Figure 3: Maximum reachable distance vs. POF bends number**

**R3** Macrobend radius shall be ≥ 25 mm.

**R4** Macrobending loss shall be measured according to IEC 60793-1-47 [6], method B.

**R5** The Bit Error Rate SHOULD be $< 10^{-12}$

**R6** The system MUST work in Full Duplex. Today media converters are based on duplex services which are achieved by using duplex POF. However the availability of a duplex service over simplex POF systems needs to be investigated as ultimately they may provide practical advantages to end users.

**R7** The System MUST present a Latency < 5 ms in either direction. Services such as Gaming & VoIP require low latency. Note that adaptive data rates will require traffic management and will increase latency. For industrial automation Latency < 1ms SHOULD be required.

**R8** The system MUST operate in a temperature range of 0 ºC to +60 ºC and humidity in the range of 5 % to 95 %.

**R9** The system MUST operate in Class 1 for Eye Safety [3].

## 4.2 Higher Level System Features

**R10** The system SHOULD be conform to QoS specifications per channel as outlined in DSL Forum Technical Report TR-126 [4].

**R11** The system MUST interoperate among multiple vendors systems to stimulate competition and ensure security features are common throughout vendors and SHOULD be interoperable at the specified data rate.

**R12** Bridges SHOULD be able to support both IPv4 & IPv6.

**R13** Devices SHOULD be 'Plug & Play', such that the user is able to install them very easily.

**R14** It SHOULD be possible to add/remove additional nodes without service interruption to existing nodes.

**R15** Devices SHOULD be transparent to either ACS or via a TR-069 [5] proxy on the HG (or other equipment) thus supporting the remote management of CPE such as switches and STBs that are linked by POF.

# 5 Requirements for 1 Gbit/s System

## 5.1 Performances

**R16** The max Physical-Layer Data Rate MUST be 1,25 Gbit/s, compliant with IEEE 802.3z [i.2].

**R17** The link MAY have an adaptive data rate depending upon link length and number of bends. An indicative performance is shown in table 1.

**Table 1**

| Link Length (m) | Number of 90° Bends of 12 mm Radius | Physical-Layer Data Rate (Gbit/s) |
|---|---|---|
| 50 | 0 | 1,25 |
| 50 | 10 | 0,85 |
| 75 | 0 | 0,87 |
| 75 | 10 | 0,45 |
| 100 | 0 | 0,5 |
| 100 | 10 | 0,08 |

**R18** The Bit Error Rate MUST be $<10^{-12}$, in agreement with IEEE 802.3z [i.2] standard at physical layer 1 (1000Base-SX interface). For this system, it will also be compliant with ITU-T IPTV Focus Group Proceedings 2008 and DSL Forum Technical Report TR-126 [4] where the Packet Error Rate must be $< 10^{-6}$.

**R19** The System MUST work in Full Duplex, using duplex POF. However the availability of Duplex service over simplex POF MAY be of interest.

**R20** The System MUST present a Latency < 5 ms in either direction. Services such as Gaming & VoIP require low latency. Note that adaptive data rates will require traffic management and will increase latency. For industrial automation Latency < 1ms SHOULD be required.

**R21** The system MUST operate in a temperature range of 0 ºC to +60 ºC and humidity in the range of 5 % to 95 %.

**R22** The system MUST operate in Class 1 or Class 1M for Eye Safety [3].

## 5.2 Higher Level System Features

**R23** The system SHOULD be conform to QoS specifications per channel as outlined in DSL Forum Technical Report TR-126 [4].

**R24** The system MUST interoperate among multiple vendors systems to stimulate competition and ensure security features are common throughout vendors and SHOULD be interoperable at the specified data rate.

**R25** Bridges SHOULD be able to support both IPv4 & IPv6.

**R26** Devices SHOULD be 'Plug & Play', such that the user is able to install them very easily.

**R27** It SHOULD be possible to add/remove additional nodes without service interruption to existing nodes.

**R28** Devices SHOULD be transparent to either ACS or via a TR-069 [5] proxy on the HG (or other equipment) thus supporting the remote management of CPE such as switches and STBs that are linked by POF.

# 6 Cabling solutions

## 6.1 Cable and fibre

**R29** The cable SHALL be manufactured according to IEC 60794-2-41 [9].

**R30** The cable MUST include 1 or 2 PMMA POF fibres. In the latter case one for the downstream and the other one for the upstream.

**R31** The PMMA [8] fibre MUST be compliant with the categories A4.a2, defined in the IEC 60793-2-40 [7] international standard regarding the POF fibres.

**R32** The fibre dimension (with the external coating) MUST be fitted according to the transceivers available on the market today (e.g. 1,5 mm or 2,2 mm).

**R33** The cable design MUST allow an easy access to the fibres. With this cable the termination of the cable with connector must be fast and easy.

**R34** Material used in the cable manufacturing MUST meet health requirements. *For specific applications as e.g. public buildings, Cable MUST be available in fire retardant version according to IEC 60332 [13] and the national standards and specifications for public buildings. For installation in public areas POF cable MUST fulfil the requirements of IEC 61034-1/2 [25] and IEC 60754-1/2 [26]. For residential installation POF cable SHOULD fulfil the requirements of IEC 61034-1/2 and IEC 60754-1 [26]/2.*

## 6.2 Connectors

**R35** Two different solutions for connectors MAY be chosen:

- The use of connectors already standardized like SMI (IEC 61754-21 [10]) or SC/RJ (IEC 61754-24 [12]) or F-SMA (IEC 61754-22 [11]) or SC (IEC 61754-4 [27]) or LC (IEC 61754-20 [28])
- The use of connectorless solution (e.g. Optolock).

# 7 Installation

The PMMA POF solution is very attractive to do a point to point architecture in an already constructed house, because the installation of the cable could be performed by the user himself. Several installation configurations can be considered: the cable can be installed in existing ducts (empty or already used by a copper/electrical cable) or installed along the wall or plinths by stapling or gluing. In the case of a visible home-cabling the constraints applied on the cable could be stricter (several corners and doors).

**R36** The cable design MUST be adapted to support small bending radii without leading to a too high bending loss. A reference value of 0,5 dB attenuation for a 25 mm bending radius measured according to IEC 60793-1-47 [6], method B can be taken into account.

# 8 Energy efficiency

Ultimately POF transceivers will be integrated in the user equipments thus reducing the number of power supplies hence the overall electrical consumption.

An alternative to this would be to power up the media converter by means of USB interface or Power over Ethernet (PoE) on the RJ45 interface. Energy efficiency targets are set out in the EU Code of Conduct on Energy Consumption of Broad Band Equipment [14].

**R37** The maximum power consumption MUST be < 0,4 W in full operation per port for 100 MbE POF transceiver; < 3,5 W (in low power mode) and <4,5 W (in full power mode) for 100 MbE and 1 GbE media converters. The target is to achieve as low power consumption as possible in the two mentioned operation modes,. Operation modes and targets present here are the 2011 targets of the EU Code of Conduct on Energy Consumption of Broad Band Equipment.

**R38** The devices SHOULD offer a standby mode and they shall enter this mode after a configurable period without any traffic.

**R39** The maximum power consumption in standby mode MUST be < 0,5 W.

**R40** The Power Mode Transition Time (the time transition from the standby mode to active mode when traffic is detected) MUST be < 1 s.

# 9 Integrated Wall Plug

The equipment described in this clause permits the usage of POF in domestic environments, especially enabling POF insertion into existing ducts used for electrical wirings. The equipment has functions of bridge between POF and Ethernet technologies. The equipment consists of POF connector(s), Optical transceiver(s), Ethernet switch with VLAN management (optional), Fast or Gigabit Ethernet interface(s), RJ45 connector(s), Integrated power supply. Annex A shows, as an example, a form factor to be suited for different countries.

**R41** Power supply: the equipment MUST be powered with AC mains supply rate voltage at 50 Hz between at least 110 VAC and 230 VAC.

**R42** The equipment in standby mode (in absence of traffic) or in the no load condition (no Ethernet interface of PCs or appliances connected) SHOULD NOT exceed 0,5 W.

**R43** The efficiency of the internal power supply stage SHOULD be not less than $[0,09 \times \ln(\text{OutputPower}) + 0,5]$.

**R44** Lifetime of the integrated wall plug should be greater than 15 years .

**R45** The operational temperature MUST be comprise between -10 °C and +60 °C in all conditions according to IS 11801 [29].

## 9.1 Interfaces - External sockets

**R46** The wall plug MUST have 1 external energy socket according to specific country standard according to IEC 60884-1 [15] for general requirements.

**R47** The wall plug MUST have 1 or 2 RJ45 ports: 10/100/[1000 optional] BaseT/TX Ethernet port.

**R48** The BaseT/TX Ethernet interface MUST be compliant to the ISO/IEC 8802-3 [16] standard.

**R49** The BaseT/TX Ethernet interface SHOULD be autosensing for rate and type of UTP5 cables (straight and crossed).

## 9.2 Interfaces - Internal sockets

**R50** The wall plug MUST have 1 or 2 or 3 POF interfaces (each interface for a couple of POFs in order to allow a bi-directional communication).

**R51** The optical interface MUST be compliant with POF diameter according to the transceivers already available on the market today (e.g. 1,5 mm or 2,2 mm).

**R52** The installation procedure SHOULD be "easy" in order to simplify the connection to the electrical wiring, e.g. using a single device that replaces the existing one and requires just the connection of energy and POF wirings.

**R53** Aesthetic requirements: TBD according to customer requirements.

## 9.3 Wall socket plugs versions

Four versions MUST be considered.

**R54** All versions MUST include one energy socket.

a. Version 1 (basic) with 1 RJ45 (External) and 1 POF interface (Internal).

b. Version 2 (pass-through) with 1 RJ45 (External) and 2 POF interfaces (Internal).

c. Version 3 (optical splitter) with 1 RJ45 (External) and 3 POF interfaces (Internal).

d. Version 4 (switch) with 2 RJ45 (External) 2 POF interfaces (Internal).

**R55** Other wall socket versions MAY be considered, e.g. without external energy socket.

**R56** An internal switch MUST be required for Ethernet packet management on all versions of the equipment.

**R57** The switch MUST be compliant with IEEE 802.3 [2] 10BaseT and IEEE 802.3u [i.1] 100BaseTX Ethernet specifications.

**R58** The switch MUST be compliant with IEEE 802.3x [i.3] Full duplex and Flow Control specifications.

**R59** The switch SHOULD support auto MDI/MDI-X function.

**R60** The internal switch MUST be transparent for tagged frames (e.g. TOS or VLAN tags).

**R61** An internal switch with VLAN management SHOULD be adopted for the version 2, 3 and 4 of the equipment. In addition to the previous points:

a. It MUST be compliant with IEEE 802.1Q [i.4] VLAN management specifications.

b. It MUST be compliant with IEEE 802.1p [i.5] MAC layer QoS specifications:

   i. Configuration options MUST include VLANs assignment and QoS parameters;

   ii Device configuration reset MUST be possible (and SHOULD be reasonably easy).

c. It MUST be managed via RJ45 ports or via POF ports with a layer 2 protocol:

   i. In alternative, it MUST be managed with web interface (or Telnet).

d. It SHOULD be compliant with IEEE 802.1D [i.6] Spanning Tree for complex network topologies.

**R62** The equipment MUST be compliant with EN 60950-1 [17] in order to guarantee safety requirements for RJ45 external interfaces.

**R63** The equipment MUST be compliant with ITU-T Recommendation K.21 [18].

**R64** According to the IEC 60825 series [3]the type of the customer premises is "unrestricted". As long as FTTH implementations respect hazard level 1 (IEC 60825 series [3]) at the customer premises, as well as laser class 1 or 1M (IEC 60825 series [3]) of the laser sources, no special requirements regarding marking or laser safety are necessary at the customer premises.

**R65** The equipment SHALL have an adequate mechanical robustness in order to comply with the following tests:

a. Test Ea - Shock: according to IEC 60068-2-27 [19], with parameters defined for the Class 3.2 by the standard EN 300 019-2-3 [20].

b. Test Fc - Stationary Vibration: according to IEC 60068-2-6 [21], with parameters defined for the Class 3.2 by the standard EN 300 019-2-3 [20].

c. Test Fh - Random Vibration: according to IEC 60068-2-64 [22], with parameters defined for the Class 3.2 by the standard EN 300 019-2-3 [20].

**R66** The equipment must compliant with EN 55022 [23] - class B limits.

**R67** The equipment must compliant with EN 55024 [24].

## 9.4 Sustainability requirements

**R68** The equipment MUST :

a. Minimize the number of used materials.

b. Use recycled materials.

c. Be manufactured with "lead-free" solder.

d. Avoid using hazardous materials as per the RoHS Directive [1], with specific reference to PVC for coatings.

**R69** The equipment must be compliant with Code of Conduct for Broadband Equipment for issues concerning energy consumption [14] (C.1.2 table for Home Network Infrastructure Devices).

# Annex A (informative): Integrated Wall Plug Form Factor

In this annex it is reported, as an example, the form factor that could have the wall plug integrating the POF/Ethernet bridge as presented in clause 9. Each country can fit it according to national guides.

**Figure A.1: Example of Integrated Wall Plug**

# Annex B (informative): Bibliography

CENELEC EN 60825-1: "Safety of laser products - Part 1: Equipment classification and requirements".

# History

| Document history | | |
|---|---|---|
| V1.1.1 | January 2010 | Publication |
| V2.0.0 | October 2011 | Publication |
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