

Interface Specification

for the
passive **N**etwork **T**ermination **P**oint
in the **P**assive **O**ptical **N**etwork of
PÝUR – Tele Columbus Group

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3 Conventions

Throughout this document, the key words "**MUST**", "**MUST NOT**", "**SHALL**", "**SHOULD**", "**SHOULD NOT**", and "**MAY**" in this document are to be interpreted as described in [RFC2119]:

"MUST, SHALL"	This word means that the item is an absolute requirement of this specification.
"MUST NOT"	This phrase means that the item is an absolute prohibition of this specification.
"SHOULD"	This word 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 behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
"MAY"	This word 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.

4 Applicability and Contact

This document applies to Tele Columbus Group. Affiliates and/or subsidiaries as listed below:

- Tele Columbus Berlin-Brandenburg GmbH & Co. KG
- Tele Columbus Cottbus GmbH
- Tele Columbus Kabel Service GmbH
- Tele Columbus Multimedia GmbH
- Tele Columbus Netze Berlin GmbH
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- PrimaCom Berlin GmbH
- KSP-Kabelservice Prenzlau GmbH
- Martens Deutsche Telekabel GmbH
- pepcom GmbH
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- HL komm Telekommunikations GmbH
- Kabelcom Rheinhessen GmbH
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- KKG Kabelkommunikation Güstrow GmbH
- MEDIACOM Kabelservice GmbH
- Mediaport GmbH
- NEFtv GmbH
- REKA Regionalservice GmbH
- Tele-System Harz GmbH
- TKN Telekabel-Nord GmbH
- WTC Wohnen & TeleCommunication GmbH & Co. KG

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5 Scope

This document describes the basic requirements to be met by CPE equipment for using data and voice services at the passive network termination point (pNTP) of the Operator cable network according to Sec. 5 FTEG (German Act on Radio Equipment and Terminal Equipment).

The first part of this document (Part A) covers the basic physical as well as GPON and XGS-PON protocol requirements for using Internet protocol (IP) services over the Operator network. The second part (Part B) focuses on the Internet access service whereas the third part (Part C) lists the requirements for using Operator's telephony services.

The characteristics given in this interface specification are intended to be used to derive and specify requirements for equipment such as cables and ONTs to connect them to the dedicated optical passive network termination point. The values in this interface specification take precedence over requirements in equipment product standards and in installation standards. The given characteristics are not intended to be used as electromagnetic compatibility levels or user emission limits in the operator network.

This interface specification may be changed at any time to reflect changes made to the network as required by Sec. 5 para. 1 FTEG. Anyone using this specification is encouraged to regularly check for the newest version available from the Operator web site. This interface specification may be superseded in total or in part by the terms of a contract between an individual user of this specification and the Operator.

6 References

In the case of a conflict between specific requirements in this document with requirements in any of the directly or indirectly referenced documents, the specific requirements of this document take precedence.

6.1 Normative References

In order to claim compliance with this specification, it is necessary to conform to the following standards and other works as indicated, in addition to the other requirements of this specification. Notwithstanding, intellectual property rights may be required to use or implement such normative references.

All references are subject to revision, and parties to agreements based on this specification or other users of this specification are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

[ANGA NTP]	ANGA, "Specification for the passive Network Termination Point in DOCSIS 3.0 Environment Network and Provisioning requirements, Version 1.01", ANGA 100 001 v1.01 (2016-07), July 2016.
[BBF TR-069]	TR-069: CPE WAN Management Protocol, Amendment 6 Corrigendum 1, June 2020, Broadband Forum.
[BBF TR-104]	TR-104: Provisioning Parameters for VoIP CPE, Issue 2, March 2014, Broadband Forum.
[BBF TR-156]	TR-156: Using GPON Access in the context of TR-101, Issue 4, November 2017, Broadband Forum.
[BBF TP-247]	TP-247: Abstract Test Plan for GPON ONU Conformance, Issue: 4, April 2020, Broadband Forum.
[DIN EN 50117]	Coaxial cables - Part 2-1: Sectional specification for cables used in cabled distribution networks - Indoor drop cables for systems operating at 5 MHz - 1000 MHz, DIN EN 50117-2-1:2008-08, 2008, DIN.
[DIN EN 60825]	Safety of laser products - Part 1: Equipment classification and requirements, DIN EN 60825-1 VDE 0837-1:2022-07, Part 2:

	Safety of optical fibre communication systems (OFCS), DIN EN 60825-2 VDE 0837-2:2019-05, 2022, DIN.
[DIN EN 61754]	Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces – Part 4: Type SC connector family, DIN EN IEC 61754-4:2023-09, Part 20: Type LC connector family, DIN EN IEC 61754-20:2023-08, 2023, DIN.
[G.652]	Recommendation ITU-T G.652, Characteristics of a single-mode optical fibre and cable, 2016-11-13, ITU.
[G.657]	Recommendation ITU-T G.657, Characteristics of a bending-loss insensitive single-mode optical fibre and cable, 2016-11-13, ITU.
[G.983.3]	Recommendation ITU-T G.983.3, A broadband optical access system with increased service capability by wavelength allocation, 2005-07-14, ITU.
[G.984.1]	Recommendation ITU-T G.984.1, Gigabit-capable passive optical networks (GPON): General characteristics, 2008-03-29, ITU.
[G.984.2]	Recommendation ITU-T G.984.2, Gigabit-capable Passive Optical Networks (G-PON): Physical Media Dependent (PMD) layer specification, 2019-08-29, ITU.
[G.984.3]	Recommendation ITU-T G.984.3, Gigabit-capable passive optical networks (G-PON): Transmission convergence layer specification, 2014-01-13, ITU.
[G.984.5]	Recommendation ITU-T G.984.5, Gigabit-capable passive optical networks (G-PON): Enhancement band, 2022-02-13, ITU.

[G.987.1]	Recommendation ITU-T G.987.1, 10-Gigabit-capable passive optical networks (XG-PON): General requirements, 2020-03-15, ITU.
[G.987.2]	Recommendation ITU-T G.987.2, 10-Gigabit-capable passive optical networks (XG-PON): Physical media dependent (PMD) layer specification, 2023-06-13, ITU.
[G.987.3]	Recommendation ITU-T G.987.3, 10-Gigabit-capable passive optical networks (XG-PON): Transmission convergence (TC) layer specification, 2021-05-29, ITU.
[G.9807.1]	Recommendation ITU-T G.9807.1, 10-Gigabit-capable symmetric passive optical network (XGS-PON), 2023-02-22, ITU.
[G.988]	Recommendation ITU-T G.988, ONU management and control interface (OMCI) specification, 2022-11-13, ITU.
[IEEE 802.1Q]	IEEE Standard for Local and Metropolitan Area Networks Virtual Bridged Local Area Networks, IEEE 802.1Q-2022, 2020-06-03, IEEE
[RFC1918]	Rekhter, Y. et al., „Address Allocation for Private Internets“, BCP 5, RFC 1918, February 1996.
[RFC2119]	Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
[RFC2131]	Droms, R., "Dynamic Host Configuration Protocol", RFC 2131, March 1997.
[RFC2132]	Alexander, S., and Droms, R., "DHCP Options and BOOTP Vendor Extensions", RFC 2132, March 1997.
[RFC2460]	Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", RFC 2460, December 1998.

[RFC3315]	Droms, R., Bound, J., Volz, B., et al., "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)", RFC 3315, July 2003
[RFC3633]	Troan, O. and R. Droms, "IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6", RFC 3633, December 2003.
[RFC3646]	Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C., and M. Carney, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)", RFC 3315, July 2003.
[RFC6598]	Weil, J., Kuarsingh, V., Donley, C., Liljenstolpe, C., and M. Azinger, "IANA-Reserved IPv4 Prefix for Shared Address Space", BCP 153, RFC 6598, April 2012.
[RFC3261]	Rosenberg, J., Schulzrinne, H., „SIP: Session Initiation Protocol“, RFC3261, June 2002
[TC SIP]	Tele Columbus Group, "Interface Specification for the Telephony Service in the Cable Network of PŸUR – Tele Columbus Group", March 2020

6.2 Reference Acquisition

ANGA specifications	https://www.anga.de http://www.anga.de/available/ , available from https://www.pyur.com/schnittstellenbeschreibung
Broadband Forum (BBF)	https://wiki.broadband-forum.org/display/RESOURCES/
IEEE Standards Association (IEEE SA)	https://standards.ieee.org/
Internet Engineering Task Force (IETF) RFCs	http://www.ietf.org
International Telecommunication Union (ITU)	https://www.itu.int/ITU-T/recommendations
DIN German Institute for Standardization	http://www.din.de

7 Definitions and Abbreviations

7.1 Definitions

The definitions in [ANGA NTP], subclause 3.1 apply.

7.2 Abbreviations

The abbreviations in [ANGA NTP], subclause 3.2 apply.

AOR	Address of Record
BBF	Broadband Forum
C/(N+I)	Carrier (C) to Noise (N) and Intermodulation (I) ratio
CoS	Class of Service
DBA	Dynamic Bandwidth Allocation
DHCP	Dynamic Host Configuration Protocol
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DS	Downstream
DSCP	Differentiated Services Code Point
ETSI	European Telecommunications Standards Institute
FEC	Forward Error Correction
GEM	Gigabit-capable passive optical network Encapsulation Method
GPON, G-PON	Gigabit-capable Passive Optical Network
IA	Internet Address

ID	Identification
IEEE	Institute of Electrical and Electronics Engineers
IF	Interface
IGMP	Internet Group Management Protocol
IP	Internet Protocol
ITU-T	International Telecommunication Union Telecommunication Standardization Sector
LC/APC	Lucent (or Little) Connector/Angled Physical Contact
MLD	Multicast Listener Discovery
MPM	Multi PON Mode
NTP	Network Termination Point
OLT	Optical Line Termination
OMCI	ONU Management and Control Interface
ONT	Optical Network Termination
ONU	Optical Network Unit
PD	Prefix Delegation
pNTP	passive Network Termination Point
PON	Passive Optical Network
QoS	Quality of Service

RF	Radio Frequency
Rx	Receive
SC/APC	Square (or Standard) Connector/Angled Physical Contact
SIP	Session Initiation Protocol
T-CONT	Transmission Container
Tx	Transmit
UA	User Agent
US	Upstream
VEIP	Virtual Ethernet Interface Point
VLAN	Virtual Local Area Network
VSC	Vertical Service Code
WDM	Wavelength Division Multiplexing
XGEM	10-Gigabit-capable-PON Encapsulation Method
XGS-PON	10-Gigabit-capable Symmetric PON

Part A

Fiber Network

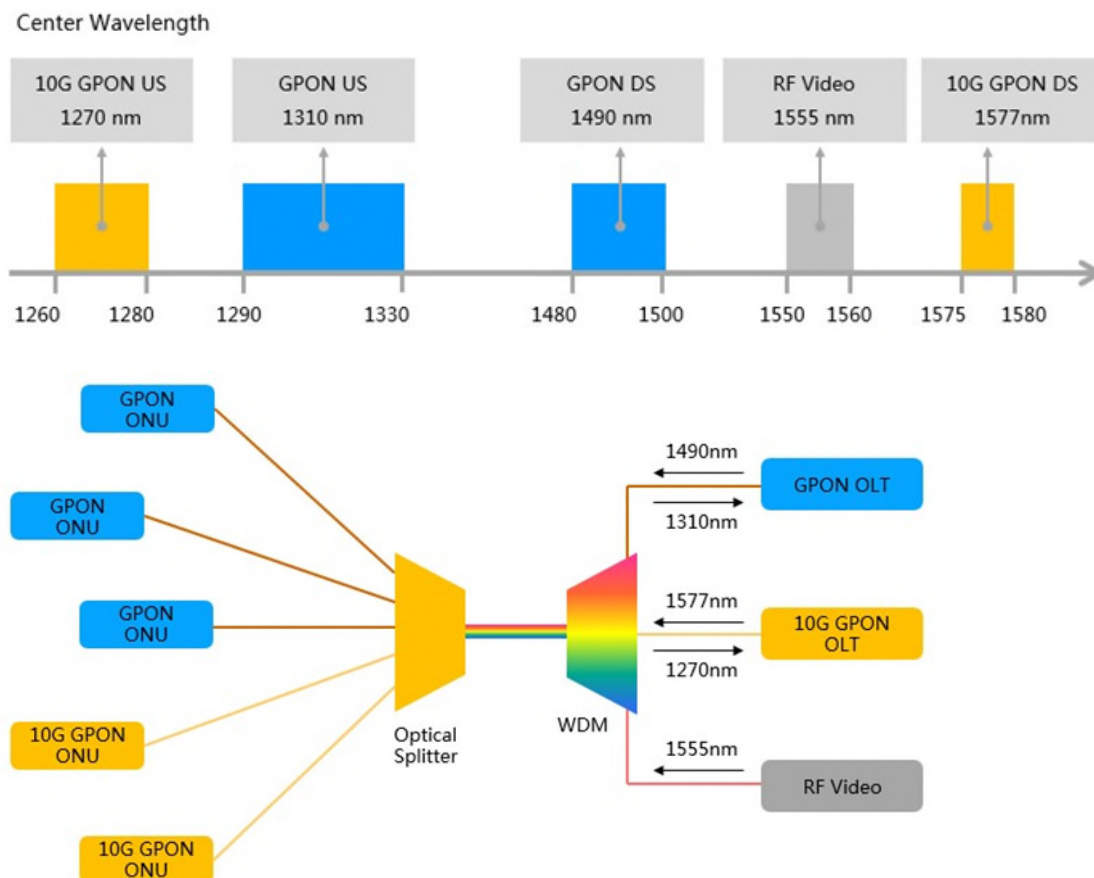
8 Optical Interface connector

The mechanics of optical interface connector and the connection requirements at the customer's pNTP in [G.652], [G.657], [DIN EN 60825] and [DIN EN 61754] apply. The connector **SHOULD** be the type of LC/APC.

9 Network optical characteristics

9.1 Multiplexing in the fiber

TC provides on the optical pNTP GPON DS/US or XGS-PON DS/US or both together as MPM for internet services and optionally RF overlay for DVB-C video services according to [G.984.5]. The availability of the signal components is depending on the local realization and are subject to change.



9.2 GPON

The optical interface of the ONT at the pNTP **MUST** comply with [G.984.2].

Parameter	Nominal values	Absolute minimum and maximum ratings and characteristics
Downstream Rx wavelength	1490 nm	1480 – 1500 nm
Downstream Rx ONU receiver power level	-23 – -3 dBm	
Downstream bitrate	2.488 Gb/s	
Upstream Tx wavelength	1310 nm	1290 – 1330 nm
Upstream Tx ONU transmitter power level	-	+0,5 - +5dBm
Upstream bitrate	1,244 Gb/s	

Table: GPON Characteristics at the optical pNTP

9.3 XGS-PON

The optical interface of the ONT at the pNTP **MUST** comply with [G.987.2] and [G.9807.1].

Parameter	Nominal values	Absolute minimum and maximum ratings and characteristics
Downstream Rx wavelength	1577 nm	1575 – 1580 nm
Downstream RX ONU receiver power level	-28 – -9 dBm	
Downstream bitrate	9.953 Gb/s	
Upstream Tx wavelength	1270 nm	1260 – 1280 nm
Upstream Tx ONU power level	4 – 9 dBm	
Upstream bitrate	9.953 Gb/s	

Table: XGS-PON Characteristics at the optical pNTP

9.4 RF-Overlay for DVB-C

The optical interface of the ONT at the pNTP **MUST** comply with [G.983.3]. The RF signal corresponds to [ANGA NTP] section 5.1 Downstream RF characteristics.

Parameter	Nominal values	Absolute minimum and maximum ratings and characteristics
Downstream Rx wavelength	1550 nm	1547 – 1560 nm
Downstream Receive power level	-8 – 0 dBm (AGC)	-6 – -2 dBm
RF range	108 – 862 MHz	47 – 1.200 MHz
RF output level (AGC) (full channel load QAM 256 SC 108 – 862 MHz)	80 dB μ V	75 – 90 dB μ V
MER min (full channel load QAM 256 SC 108 – 862 MHz)	40 dB @ -8 dBm	35 – 50 dB @ -8 dBm

Table: RF-Overlay for DVB-C Characteristics at the passive optical NTP

10 Physical Interface Requirements

10.1 GPON

The general characteristics requirements at the customer's pNTP in [G.984.1] apply.

The physical interface requirements at the customer's pNTP in [G.984.2] and [G.984.5] apply.

10.2 XGS-PON

The general characteristics requirements at the customer's pNTP in [G.987.1] apply.

The physical interface requirements at the customer's pNTP in [G.987.2] and [G.9807.1] for XGS-PON apply.

Part B

Internet Access Service

11 ONT requirements

11.1 MAC and Upper Layer for GPON

The ONT **MUST** comply with [G.984.3].

The ONT **MUST** support all three authentication modes:

- By Serial Number (SN)
- By password also referred to as Registration ID, PLOAM password or Subscriber Location ID (SLID)
- By SN + password.

The ONT **MUST** support the provisioning of a GPON password by the customer.

11.2 MAC and Upper Layer for XGS-PON

The ONT **MUST** comply with [G.987.3].

The ONT **MUST** support all three authentication modes like on GPON.

11.3 OMCI Layer

The ONT **MUST** comply with [G.988].

The following requirements for service provisioning apply regarding [G.988] section 9.1.5 Cardholder, Table 9.1.5-1 Plug-in unit types and 9.1.6 Circuit pack:

- Cardholder: the ONT **MUST** expose a managed entity ID of two bytes, where the 2nd byte is set to value 1 indicating slot 1 is present.
- Expected plug-in unit type: the ONT **MUST** expose a type ID of one byte, which is set to value 47 or 68 indicating slot 1 is type of 10/100/1000BASE-T or Multi-Rate-10GBASE-T
- Number of ports: the ONT **MUST** expose the number of ports of one byte, which needs to be ≥ 1 , the for service provisioning used Ethernet-Port is addresses with the first port index.
- Example Nokia OLT:
`configure equipment ont slot */*/*/*/1 planned-card-type ethernet plndnumdataports 1`
`configure interface port uni:*/*/*/*/1/1 admin-up`

12 IP Addressing

12.1 IP addresses for devices connected to the ONT

The Operator provides a native IPv4/IPv6 dual-stack Internet access service to its customers. Each allowed IP capable device/interface behind the ONT will on request receive a native IPv4 address and a global IPv6 address as well as a delegated IPv6 prefix and other corresponding configuration to use for inbound/outbound IPv4 and IPv6 ([RFC2460]) traffic, respectively.

Devices/interfaces behind the ONT **MUST** support IPv4.

Devices/interfaces behind the ONT **SHOULD** request an IPv6 address and an IPv6 prefix.

The number of devices/interfaces concurrently supported behind the ONT depends on the actual tariff booked by the customer. In the most common setup there is one single IPv4 capable device/interface, e.g. a real or logical router instance, which provides Internet access to its clients by the means of network address translation (NAT) techniques. The real or logical router instance **SHOULD** also request an IPv6 address as well as an IPv6 prefix to address other clients and to provide direct routed IPv6 Internet access to these clients.

Depending on tariff and/or available IPv4 address space supported IPv4 devices/interfaces receive either a public IPv4 address out of the Operator's RIPE assigned IPv4 address space or an IPv4 address out of the [RFC1918] address space or an IPv4 address out of the [RFC6598] address space. In case of [RFC1918] or [RFC6598] addressing, IPv4 Internet access is provided centrally through Carrier Grade NAT (CGN).

If DHCPv4 [RFC2131] is used for configuration, the following information **MUST** be requested by the DHCP client and will then be provided by the DHCP server in accordance with [RFC2132]:

- IPv4 address
- DNS server
- Subnet mask
- Gateway address (router)

If DHCPv6 [RFC3315] is used for configuration, the following information **MUST** be requested by the DHCP client and thus will be provided by the DHCPv6 server:

- IPv6 address (IA_NA)
- DNS server

If DHCPv6 [RFC3315] is used for configuration, the following information **MAY** be requested by the DHCP client and thus will be provided by the DHCPv6 server:

- Delegated IPv6 prefix (IA_PD)

In order to avoid configuration conflict, the configuration of the device/interface (e.g. router instance) behind ONT **MUST** be done via respective DHCP. Other procedures such as static configuration **MUST NOT** be used.

12.2 IPv6 Prefix delegation

IPv6 Prefix delegation according to [RFC3633] **MUST** be supported.

Part C

Telephony Service

13 Telephony general requirements

The embedded or external telephony adapter **MUST** comply with [TC SIP].

- The Operator provides a SIP voice service based on [RFC3261] as a primary line telephony service.
- There is one SIP account per directory number (DN).
- SIP accounts **MUST** only be used at the customer's pNTP these DNs are assigned to.
- SIP accounts and other necessary data is available from PC's customer portal upon successful service activation.
- The SIP user agent (UA) **MUST** allow the user to configure at least the following parameters on a per DN basis:
 - Phone number (DN)
 - SIP domain
 - Outbound SIP proxy
 - (Authentication) username
 - (Authentication) password
- The SIP UA **MUST** support usernames matching this regexp: „[a-zA-Z0-9_]{9,20}“
- The SIP UA **MUST** support passwords matching this regexp: „[a-zA-Z0-9!\$/()=?*+#{-_.:]{8,32}“
- The SIP UA **MUST** use the same IP interface that is provisioned for Internet access service (cf. section 12)
- The SIP UA **MUST NOT** request a separate IP address and **MUST NOT** announce itself as a PacketCable device in any respect.
- The SIP UA **MUST** use IPv4
- The SIP UA **SHOULD NOT** be used behind NAT
- The SIP UA **MUST NOT** use IPv6
- The SIP UA interface to the Operator's voice service is described in [TC SIP]
- By the way of derogation from [TC SIP], subclause 17.4, Operator's SIP Signaling Entity will reply “403 - Unknown username or password” if the Registration AOR of the SIP Endpoint is not found in its database.

13.1 Provisioning

The ONT **MUST** support the provisioning of a SIP accounts by the customer.

The ONT **SHALL** support the provisioning of a SIP accounts by [BBF TR-104].

The ONT **MAY** support the provisioning of a SIP accounts by [G.988].

14 Call features / Supplementary services

Supplementary services are controlled through Vertical Service Codes (VSC), for details see the user's manuals on the Operator website.

VSCs beginning with an asterisk (*) **MUST** be escaped and sent transparently and as is by the SIP UA to the SIP server.

15 Quality of Service

Quality of Service (QoS) for voice calls (signalling and media) set up per this specification will be taken care of by the network.

16 Fax

Fax and other analogue modem transmission is sent in-band over the voice codec.

Fax relay techniques such as T.38 **MUST NOT** be used.

Part D

DVB-C Video Service

17 ONT out of scope statement for RF overlay

The operator provides the subscriber a device to uncouple the RF overlay from the optical interface connector if the DVB-C service is ordered. The device has an electrical coaxial output to provide the DVB-C service and optical interface path through for the pNTP with the GPON and XGS-PON services. An RF overlay service activation on a customer owned ONT is not supported.

Annex A: Coaxial cable assemblies

Coaxial cable assemblies to be used at the pNTP **MUST** fulfill the requirements of [DIN EN 50117] for Class A equipment.

18 Document History

Version	Date	Status
1.0	September 30, 2025	Final
0.2	February 27, 2024	Initial version for PON