

Call for Proposal

For collaborative development of GPON/EPON ONT SoC

1. Introduction

Gigabit-capable Passive Optical Network (GPON) systems are characterized, in general, by an optical line termination (OLT) system and an optical network unit (ONU) or optical network termination (ONT) with a passive optical distribution network (ODN) interconnecting them. There is one-to-many relationship between the OLT and the ONU/ONTs, respectively. It offers downstream data rate of 2.488Gbps and upstream data rate of 1.244Gbps. Downstream and upstream wavelengths used are 1490 nm and 1310 nm. RF video is transmitted on 1550nm wavelength.

Ethernet PON Passive Optical Network (EPON) system deployment is similar to GPON, though EPON offers symmetric data rate of 1.25Gbps in both downstream and upstream. Downstream and upstream wavelengths used are 1490 nm and 1310 nm, same as GPON.

The GPON/EPON ONTs mostly act as home gateway unit (HGU), where ONT acts as residential gateway and packet forwarding occurs at layer 3. However, in some applications, ONTs act as single-family unit (SFU) and forward data at layer 2.

C-DOT invites participation from the Indian start-ups/ organizations/ research and academic Institutions in a collaborative project for development of a GPON/EPON ONT System-on-Chip (SoC). It should support relevant standards including ITU-T G.984.x (GPON) and IEEE 802.3ah (EPON). ONT SoC must be interoperable with any third party GPON/EPON OLT.

The potential participants should have demonstrable expertise in high end chip designing/ FPGA designing preferably in optical communication related technologies. Participants must declare in advance if they are planning to use any third-party IP in the designing of SoC.

The final outcome i.e. GPON/EPON ONT SoC shall be used in designing a field deployable GPON/EPON ONT solution in conjunction with other relevant devices such as Optical diplexer/BOSA, memories, Wi-Fi chip/module supporting various WLAN standards/protocols, SLIC etc. Suitable entity for mass production and marketing of the developed SoC shall be selected by the partner(s) in consultation with C-DOT.

CDOT will design an ONT using this SoC, any functional issues or interoperability issues needs to be addressed by the collaborative partner(s).

Through a process of rigorous technical evaluation, C-DOT shall select participants holding the most promise of delivering commercial grade outcomes as its development partners (“Partner”) in the project.

2. Project Description

GPON is compliant to ITU-T Rec. G.984.x. The general characteristics and architecture of GPON are as per ITU-T Rec. G.984.1. Physical Media Dependent (PMD) layer specifications are as per ITU-T Rec. G.984.2. The physical layer (PHY) and the transmission convergence (TC) layer specifications for GPON are as per ITU-T Rec. G.984.3. The ONT management and control interface (OMCI) and other management requirements are as per ITU-T Rec. G.984.4. Recommendation ITU-T G.984.5 defines wavelength ranges reserved for additional service signals to be overlaid via wavelength division multiplexing (WDM) in future passive optical networks (PON) for maximizing the value of optical distribution networks (ODNs).

Ethernet PON Passive Optical Network is defined in IEEE 802.3ah.

C-DOT in consultation with collaborative partners will decide important features of ONT SoC from user perspective like chip form factor, chip package, power consumption, input voltage, operating temperature, etc.

During participation in the project, the partners may use their respective pre-existing design or undertake fresh development or both.

3. Indicative list of features supported by ONT SoC–

- Integrated GPON ITU-T G.984 MAC
- Integrated EPON IEEE 802.3ah MAC
- Internal Serdes for glueless interface to MSA optical transceivers
- Integrated GBE PHYs to support Four IEEE 802.310/100/1000Base-T ports
- Two PCIe ports for interfacing IEEE 802.11ax Wi-Fi chip/module (Backward compatible to 802.11 a/b/g/n/ac device)
- Support for Wi-Fi data path acceleration
- VOIP sub-system: Integrated VoIP processor, PCM/ISI or ZSI interface for direct interfacing to single/dual channel SLIC
- Integrated USB Host controller and PHY to support two USB 2.0 / USB3.0 ports.
- Flexible Flash Interface (SPI NAND, parallel NAND interface)
- Integrated DDR4 SDRAM
- Two I2C master interfaces
- Two UART interfaces (Debug feature via UART—115.2Kbps)
- 5-signal P1149.1 compliant EJTAG support for CPU testing and software development
- 1588v2 timing synchronization integration with PON ToD and 1PPS
- Single input power operation (3.3V input)
- Single 25MHz crystal clock input for system PLL
- 40 GPIO pins with Interrupt feature(8 Interrupt controllers)
- Energy Efficient Ethernet support (IEEE 802.3az)
- Per-port configurable auto-crossover function
- Power down mode / low power mode for SoC
- Dying gasp interrupt

- Integrated Power-on-reset circuit
- Programmable Watchdog timer and hardware timers
- Control Processor such as MIPS/ARM etc.
- Software SDK should be provided for SoC with following features:
 - Residential gateway, NAT, DNS, Firewall, Multicast support (IGMPv2 and IGMPv3), IPv4/IPv6, Multiple VLANs on a Single UNI Port through UNI PHY, PPPoE, DHCP, STATIC IP on WAN Interfaces
- Layer 2, 3 and 4 based parsing, filtering, classification, QoS and header modification at wirespeed.
- Flexible classification, filtering and deep packet inspection.
- The data path forwarding requirements are as per BBF-TR156.
- QoS, traffic scheduling, shaping and policing
- OMCI MIBs as per standard ITU-T G.984.4
- 9 Min No of T-CONTS should be supported by SoC
- 32 Min No of GEM Ports should be supported by SoC
- Performance counters required for GEM and Ethernet Data for all PHY Ports
- BBF-TR069 based Auto configuration
- Single VLAN /Double VLAN (QinQ and IEEE 802.1ad)
- VOIP SIP stack with support of all VOIP CODECS- G.711, G.729a, G.729ab, G.7231 and SIP signalling
- Compliance with all relevant latest standards including:
 - Compliant with GPON ITU G.984.x
 - Compliant with IEEE 802.3ah EPON standard
 - Compliant with IEEE 802.1p, IEEE 802.1q, and IEEE 802.1ad
 - Complaint with BBF-TR069 and BBF-TR156
 - Compliant with TEC/GR/FA/PON-002/02/NOV-18

This is not an exhaustive list; some other features may be added after discussion with collaborative partners

4. Optional list of features which may be considered for inclusion in GPON/EPON ONT SoC:

- XGS-PON as per ITU-T G.9807 standard
- OMCI MIBs as per standard ITU-T G.988
- 10GEPON(Symmetric) as per IEEE 802.3av standard
- Direct interface to BOSA (in addition to supporting optical diplexer)
- Integrated Flash memory
- Integrated audio CODEC and HVG controller
- Support for encryption with keys supplied from outside
- Integrated IEEE802.11ax compliant MAC/PHY/Radio chip with internal PAs (Power amplifiers) (Backward compatible to 802.11 a/b/g/n/ac)
- Enhanced security capabilities feature which is defined in amendment 3 of ITU-T standard, G.984.3. (G.984.3 (2008) Amd. 3 (04/2012)

The collaborative partner(s) may also suggest additional features for inclusion in the SoC

5. ACRONYMS AND ABBREVIATIONS

BOSA	:	Bi-Directional Optical Sub Assembly
CCRP	:	C-DOT Collaborative Research Program
DDR	:	Double Data Rate
EPON	:	Ethernet PON Passive Optical Network
GPON	:	Gigabit Capable Passive Optical Network
IEEE	:	Institute of Electrical and Electronics Engineers
ITU-T	:	International Telecommunications Union – Telecommunications Standardisation Sector
MAC	:	Media Access Control
ODN	:	Optical Distribution Network
OLT	:	Optical Line Termination
ONT	:	Optical Network Termination
ONU	:	Optical Network Unit
PHY	:	Physical Layer Device
SDRAM	:	Synchronous Dynamic Random-Access Memory
SoC	:	System-On-Chip
USB	:	Universal Serial Bus
XGS-PON	:	10 Gigabit Symmetrical Passive Optical Network