Navigating Interoperability Hurdles For XGS-PON Within the Cable Access Network

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1. Introduction

In recent years, there has been an uptick in the momentum to provide fiber to the premises (FTTP) solutions in the cable industry. While optical technologies have long been a part of the cable network, FTTP is being considered more for the access network. For FTTP, the premises can be a subscriber's home, a commercial location, a campus environment, a multi-dwelling unit (MDU), and other locations. Over the past couple of decades, operators have embraced the passive optical network (PON) technology for their fiber-based access network implementations. The point-to-multipoint topology of PON lends itself nicely to the current and future designs of the cable network.

Historically, in the cable industry, Ethernet passive optical network (EPON) technology was the preferred choice for most operators who provide PON as an access network solution. EPON is a standard developed by the Institute of Electrical and Electronics Engineers (IEEE) standards body. Because of this perceived preference for EPON, CableLabs, with the help of industry partners including cable operators and vendors, developed the DOCSIS® provisioning of EPON (DPoE) set of specifications that allowed cable operators to leverage their existing DOCSIS investment to provision and manage EPON deployments. In addition to this work helping to leverage existing BSS and OSS investments, another objective of the work was to support interoperability of the PON equipment. This group of specifications allowed operators to quickly and efficiently deploy EPON services while achieving their business objectives.

More recently, many cable operators have begun deploying PON technologies defined by the International Telecommunications Union Telecommunications Standardization (ITU-T). The ITU-T has developed Gigabit Passive Optical Network (GPON) [1] and the family of more recent GPON derivatives, including 10 Gigabit Symmetrical PON (XGS-PON) [2]. These same operators will likely embrace 25GS-PON [3], or the 50Gbps PON ITU-T solution, for their future deployments.

As the cable industry has begun to deploy multiple gigabit service, there's a growing current of enthusiasm and interest for the efficient deployment, management and maintenance of those access networks. Furthermore, the speed at which technology is moving is impressive and expensive. It is challenging to keep pace with these advancements, which require a matrix of expertise and decision-making support. PON is one of the technologies that keeps marching forward. CableLabs has participated in the development of PON-based standards and specifications for over a decade, and we're continuing in that vein to help operators lower barriers for deploying and operating FTTP solutions.

Common provisioning and management of PON in the cable industry typically requires support of legacy systems that have been in place for decades, e.g., DOCSIS OSS or integration with newer back-office systems. Near-term objectives for the work CableLabs is beginning include XGS-PON and 25GS-PON support, including applicability for next-gen PON flavors with special focus on vendor neutrality through device interoperability.

CableLabs has created two working groups dedicated to optimizing the integration of ITU-T PON technologies into cable network. The two working groups are the Common Provisioning and Management of PON (CPMP) and Optical Operations and Maintenance (OOM) [4]. These two working groups are complementary in their activities. Both are supporting the integration of ITU-T PON technologies into cable networks. The CPMP group is focused on supporting the back-office provisioning and management of XGS-PON as well as the interoperability of Optical Network Units (ONU) with Optical Line Terminals (OLT). The OOM working group is focused on the operations and maintenance of the underlying optical networks.

2. Hurdles in XGS-PON Interoperabilty

With any technology there is investigation and due diligence to learn and understand how that technology should be implemented. There are always tradeoffs with technology, whether that be price, timing, or things out the operator's control like product availability. However, when customer premise equipment (CPE) is required, there is always an underlying benefit to the interoperability of that device with the network that it connects to. When a cable operator is providing high-speed data (HSD) services to a subscriber, CPE is almost always required in the home.

Interoperability provides necessary competition which results in pricing benefits, innovation, and choice for operators. Having the choice of which ONU is connected to the OLT is instrumental in providing lower cost services with the ability to help foster innovation. The cost of CPE in each subscriber's home is a significant investment for the operator and having the ability to choose multiple suppliers is key. That's all well and good, but with any technology there are always hurdles to interoperability and XGS-PON is no different.

Interoperability involves several technical and logistical challenges. Addressing these hurdles typically involves a combination of adherence to standards, thorough testing, and collaboration between vendors to ensure equipment from different manufacturers can work together seamlessly.

2.1. Standardized Technology

XGS-PON is a specific flavor of ITU-T PON with a library of standards that define the technology and provide information on how this solution should be implemented and managed. A major objective of any standards development organization (SDO) is interoperability. However, it is never a simple practice. Different vendors may interpret or implement the XGS-PON standards in slightly varied ways, which can lead to compatibility issues. Ensuring that equipment from different manufacturers adheres strictly to the standards is crucial for interoperability.

In the context of XGS-PON, there is the ONU Management and Configuration Interface (OMCI). This OMCI information is defined in the ITU-T G.988 [5] standard. This is the accepted way to configure and manage ONU equipment via the OLT. The OMCI standard defines managed entities (ME) that are the basic configuration and management data unit in the OMCI. Each ME is unique and is the fundamental building block to configure an ONU as well as provide fault reporting, performance monitoring, and security. Simply put, the ME list is extremely comprehensive and as such, it is very difficult to provide simple and extensible way to support interoperability.

Successful configuration of varied services over the FTTP network requires a significant amount or organization and coordination between the operator requirements and what is available in the ME library. For example, telco operators have had to create their own "OpenOMCI" taxonomy for their specific implementations. This allows the operator to build services to support their specific requirements using vendor equipment created to support the G.988 standard. However, these OpenOMCI requirements are specific to each telco operator and are not applicable in deployments outside of their own.

In a similar manner, the cable industry has organized a working group to develop the "Cable OpenOMCI" specification. This work is to support the entire global cable industry, not just specific network operators. Additional information for this Cable OpenOMCI is provided in this document.

2.2. Vendor-Specific Implmentations

Vendors might support proprietary features or extensions in their XGS-PON equipment. While these can offer enhanced performance, additional functionality, and vendor differentiation they can also create interoperability issues if these features are not supported universally across different vendor equipment.

While it is always a good idea for equipment suppliers to have product differentiation there are ways in which this can be handled to support interoperability. A framework of requirements must be developed to support these vendor-specific implementations for interoperability to succeed.

2.3. Operator Requirements

Another hurdle for interoperability is the considerable variety of operator requirements. Each operator is different, and each operator requires a specific implementation to support their business objectives. While certain configuration parameters, fault reporting, and performance monitoring is common among different implementations there are always differences and this requires different configurations for network components and CPE.

By defining commonalities between various cable operators, with the help of those operators and vendors, CableLabs will be able to define requirements that can be supported by the equipment manufacturers and implemented for all operators that wish to leverage the specifications.

2.4. Network Configuration, Service Activation, and Management

XGS-PON networks require precise network management and configuration to ensure proper operation. Differences in management systems or configuration approaches between vendors can create integration challenges.

This is a significant hurdle to wide adoption of interoperable devices. Every operator has a different back-office support system and as such, the configuration and management processes are different. The coordination effort and the development of a common set of processes to support interoperability is a heavy lift across an entire industry, but well worth the effort.

Additionally, different vendors might have different approaches to service activation and provisioning. Ensuring these processes are compatible across various equipment is essential for a smooth customer experience.

2.5. Testing and Certification

Comprehensive interoperability testing is required to ensure that equipment from different vendors works together as expected. Certification processes and testing environments need to be robust and standardized to verify interoperability. Many operators don’t have the infrastructure to support such testing, which becomes a barrier when choosing equipment suppliers. The development of test plans and interoperability events is key for an industry to support interoperability and avoid vendor lock-in. A significant input in time-to-market is testing. Testing and validation of requirements is a significant cost and effort. When the entirety of an industry supports such work, time-to-market can be reduced, as well as costs.

2.6. Time

Another hurdle to interoperability is time. It takes a significant amount of effort to develop the capability for interoperability. When individual operators take it upon themselves to develop the necessary infrastructure to support interoperability it takes a substantial investment in time and money.

However, when and industry gets together to create common requirements between the operators, the time and money is spread across everyone and benefits the industry and the technology in totality.

3. Objectives for Deploying XGS-PON in a Cable Access Network

While PON deployments lend themselves nicely to the topology of the HFC network, considerable planning is required on how the technology will be implemented in the access network. As mentioned in the introduction, EPON was the original technology decision for many cable operators when deploying PON. However, some operators have embraced ITU-T's GPON technology and more recently XGS-PON.

While every technology has its own requirements to support a particular deployment, there are common objectives for all operators. This paper will describe how the cable industry will remove some of those barriers for operators to efficiently deploy XGS-PON. First, we'll explore some of the common objectives operators maintain to deploy XGS-PON to support their business needs.

3.1. Device Interoperability

Vendor neutrality through device interoperability is the key objective for deploying XGS-PON in a cable operator's network. As described above, there are several hurdles for true interoperability. Developing a standard methodology to provide interoperability will require several unique solutions for XGS-PON.

Developing requirements and accompanying activities to support interoperability takes a significant effort by all involved. While there are an exhaustive number of things that must come together to support true interoperability, fundamentally it requires three steps.

1. Define common processes and requirements
2. Update device software to support requirements
3. Interoperability testing

Defining a set of common requirements and processes typically requires a set of documents that equipment suppliers can leverage to support the second piece of interoperability, updating software. The solutions to remove interoperability hurdles described in this document will be based on a set of two documents: a CPMP technical report and a Cable OpenOMCI specification. These documents will allow suppliers to integrate the processes and requirements into their products to support interoperability.

Testing the requirements and equipment is done through interoperability events. This is a testing opportunity where several vendors work together to connect their products to each other and validate their implementation. This single activity is extremely important to the industry as it proves the requirements are valid.

This activity has a two-fold benefit. First, it allows the vendors to validate the implementation to support interoperability. Second, if the testing turns up interpretation issues in the documentation, this information can then be updated in the specifications. This symbiotic relationship between the documents and the testing is key to complete solution and viability of the work.

3.2. Leverage DOCSIS Back-office

Some operators will require their existing investment in the DOCSIS back-office to support PON deployments. This was true when CableLabs developed DOCSIS Provisioning of EPON (DPoE) [6] and it is still true today for XGS-PON. However, instead of generating a library of detailed specifications, a technical report with recommended solutions will be created. The idea now is to develop a process that can be quickly implemented, tested, and deployed.

A key function of this work is a DOCSIS adaptation layer that will convert DOCSIS configuration to XGS-PON configuration. The equipment suppliers that already have a DOCSIS adaptation function in their product portfolio will be able to translate DOCSIS configuration parameters into an XGS-PON configuration via OMCI MEs. Therefore, the technical report doesn't need to develop requirements to support this translation, merely describe the process that vendors can implement given their existing products.

3.3. Cable OpenOMCI

Another key objective for the success of XGS-PON deployments in a cable network is the creation of a Cable OpenOMCI specification. Cable operators have traditionally deployed ITU-T PON systems where both the OLT and ONUs are supplied by the same vendor. This has often been necessitated due to a lack of cross-vendor interoperability, where the ONU of one vendor is not fully compatible with the OLT of another vendor.

The CableLabs Cable OpenOMCI specification addresses those shortcomings and supports network operator deployment of ITU-T OMCI-managed G.9807 XGS-PON, via industry-wide best-practice standardization for consistent interoperability between OLTs and ONUs of any vendor.

The Cable OpenOMCI specification focuses on common cable operator service configurations and incorporates ideas like those of telco operator OpenOMCI documents, that were created with the intent to promote interoperability. These telco operator documents include the AT&T OpenOMCI and Verizon OpenOMCI specifications.

CableLabs is creating the Cable OpenOMCI specification so that manufacturers of OLT and ONU equipment can develop product firmware versions that better meet the needs of CableLabs member operators. The specification heavily references the ITU-T G.988 specification and provides guidance to the manufacturers to clarify areas where there may have been ambiguity in G.988 standards.

3.3.1. Service configuration via Cable OpenOMCI specification

The Cable OpenOMCI specification organizes referenced G.988 MEs into specific functional sets. The largest of the functional sets cover the MEs that are commonly used by cable operators to configure residential HSD/Internet and managed IP-Video services over PON. Another of the configuration-centric functional sets covers the configuration of a SIP agent embedded in the ONU to provide landline voice services. While another large functional set is dedicated to performance monitoring MEs that an operator can use to periodically read the value of various status monitoring management objects on the ONU.

3.3.2. Performance monitoring via Cable OpenOMCI specification

G.988 defines the MEs that are used to configure an ITU-T PON system for various services as well as MEs that can be used for status monitoring. In situations where there are MEs or attributes of those MEs that have been defined as optional in G.988 but have been determined by CableLabs member operator as being required, those MEs or attributes are specified as mandatory in the Cable OpenOMCI specification.

3.3.3. *Event messaging via Cable OpenOMCI specification*

An additional focus area of the Cable OpenOMCI specification is on notifications from the ONU. An ONU can send asynchronous events to the OLT which can provide these to an operator's network management system. The ONU can transmit three different types of asynchronous event messages.

The first type of event message is an alarm. Examples of alarm events include the ONU sensing a component failure or the ONU failing a specific self-test. The second type of event message is an attribute value change. Examples of this type are when the logical ONU ID changes or when the active firmware image changes. The third type of event message is a threshold crossing alert. Examples of this type of event include those transmitted when codeword error or frame error counters exceed a pre-defined threshold.

Receiving and processing asynchronous event messages in an operator network management system can be thought of as a reactive type of network management. When an operator has millions of ONUs deployed, it's easy to see that the volume of event messages from the ONUs could be overwhelming. So, it is incumbent on the operator to configure the ONU, OLT and their network management systems to focus on the most critical, service impacting types of events. Of course, an alternative to this type of reactive network management practice is a proactive one, whereby the operator's network management system periodically polls the value of important management objects from each of the ONUs on the network. In this manner, a proactive system may be able to find a small issue with a given ONU before the issue grows to become service impacting.

4. Implementing XGS-PON in a Cable Access Network

There are several methods at an operator's disposal to deploy XGS-PON to meet their service objectives. While this section will focus on leveraging the DOCSIS back-office and a specific Cable OpenOMCI configuration, there are some fundamental PON topologies that any of these objectives must support.

Any defined implementation must support PON topology options like a centralized versus distributed architecture. While a centralized PON network includes a more traditional "big iron" OLT located at the headend or hub, a newer distributed PON architecture is gaining momentum. Like cable's distributed access architecture concepts, PON also has a distributed Remote OLT (R-OLT) technique.

4.1. Leveraging the DOCSIS Back-office

Any fiscal objectives by operators include leveraging past spend to support existing and new services, if possible. CableLabs and the industry have been able to leverage the DOCSIS back-office time and time again, including with PON deployments. See the DPOE specifications. This trend continues with the request by some to now support their impending XGS-PON deployments with the DOCSIS operational support systems (OSS).

At a high-level, the idea is to use the CM configuration file and the associated processes to support the provisioning and management of the ONU. There are several steps to take advantage of this concept. Figure 1 below shows the reference architecture that will be the basis for describing and defining this method.

CableLabs has created the Common Provisioning and Management of PON working group to define this method. The group consists of cable operators that want to leverage their DOCSIS back-office, and vendors that plan to implement the solution. This work is expected to be used for XGS-PON and other related PON technologies like 25GS-PON and others.

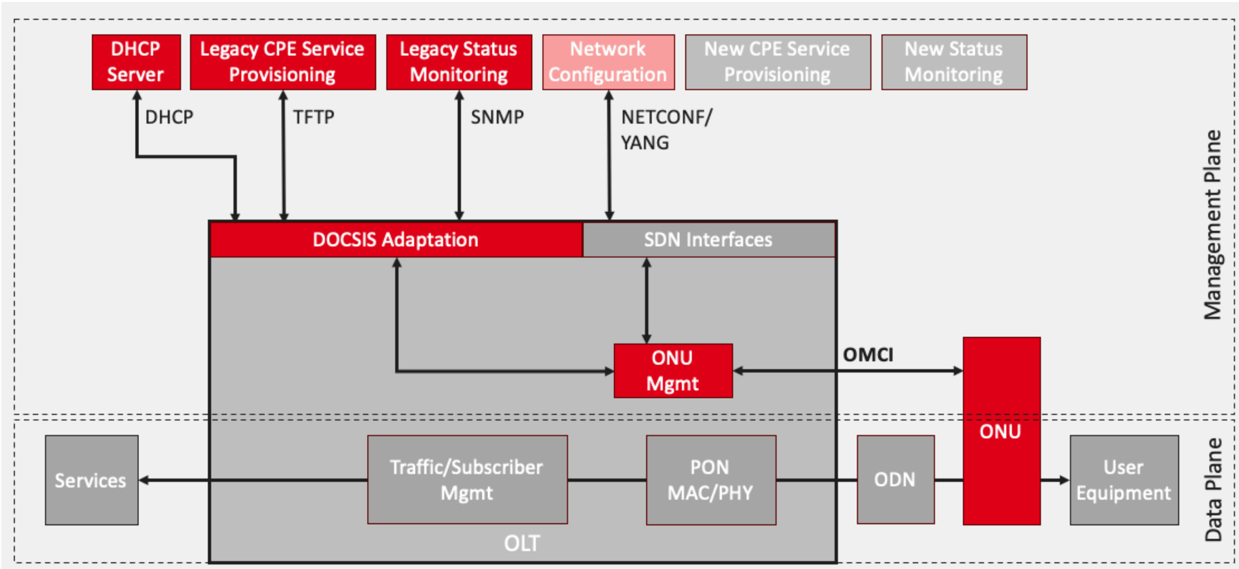

Figure 1 – Provisioning and Management of ITU-T PON via DOCSIS Adaptation

This CPMP working group has defined specific steps to define this solution. The process consists of:

1. Develop a set of common use cases
2. Generate DOCSIS cable modem configuration files based on the use cases
3. Run the CM configuration files through a DOCSIS adaption layer
4. Send the PON configuration to the ONU

4.2. Residential Use Cases

Defining a set of use cases that will support the services required is a common denominator as a first step to this method. These use cases are based on the services cable operators offer today and may include in future offerings. The hardware needed to support the uses cases are a key part of the puzzle that also must be defined and supported.

For example, high-speed data (HSD) services will require an ONU. For an HSD and voice product, the hardware would include the ONU and an embedded or external digital voice adapter (DVA). The HSD and voice service must define both options for operators to meet their business objectives. Table 1 below lists some example residential use cases.

Table 1 – Use Case Examples

Use Case	CPE	Provisioning Method	Notes
HSD-only	1-box: ONU	cfg-file	L2 CPE device – may include multiple Ethernet UNIs
HSD + embedded Over-the-top-configured Voice	1-box: ONU only	cfg-file + ACS/TR-104	Voice endpoint embedded in ONU
HSD + embedded OMCI-configured Voice	1-box: ONU only	cfg-file + MTA cfg-file	Voice endpoint embedded in ONU

HSD + external Voice	2-box: ONU + DVA/ATA	cfg-file + ACS/TR-104	Standalone Voice endpoint (DVA/ATA), OTT IP Voice configuration
HSD + IP Video	3-box: ONU + RG + IP-STB	cfg-file + ACS/TR-181	Unicast IP Video handled via external RG and external IP-STB
HSD + external Voice + IP Video (Triple-Play)	3-box: ONU + RG + IP-STB	cfg-file + ACS/TR-104/TR-181	Voice endpoint (eDVA) embedded in external RG, OTT IP Voice & RG configuration
HSD-only, ONU w/embedded RG	1-box: ONU	cfg-file + ACS/TR-181	GW with multiple LAN ports
HSD + embedded Voice, ONU w/ embedded RG	1-box: ONU/RG/eDVA	cfg-file + ACS/TR-104	Voice endpoint embedded in ONU
Hotspot/Community WiFi / Mobile WiFi offload	2-box: ONU + RG	cfg-file + ACS/TR-181	Handled via WiFi AP in external RG

Throughout the remainder of this section, we will use the double-play use case of HSD and managed IP Video as an example of how this can be implemented. The term managed IP Video is used in this context to mean a primary-screen cable TV service, akin to what was previously delivered via QAM signals over a Hybrid-Fiber Coax (HFC) cable plant. In the U.S. this type of managed IP Video service is sometimes referred to as a Title VI service. This service is most commonly delivered to an IP-STB provided by the operator to the subscriber. Figure 2 below shows a graphical representation of this use case from the access network point of view.

This example uses a single ONU with an embedded residential gateway (RG), and the provisioning method takes advantage of a DOCSIS configuration file and an Auto-Configuration Server (ACS) along with the TR-181 [7] data model for the over-the-top RG configuration. The ACS is often used to configure aspects of residential gateways including IP routing and WiFi Access Point functions. TR-181 is the Broadband Forum (BBF) technical report that defines the provisioning and management parameters for an RG.

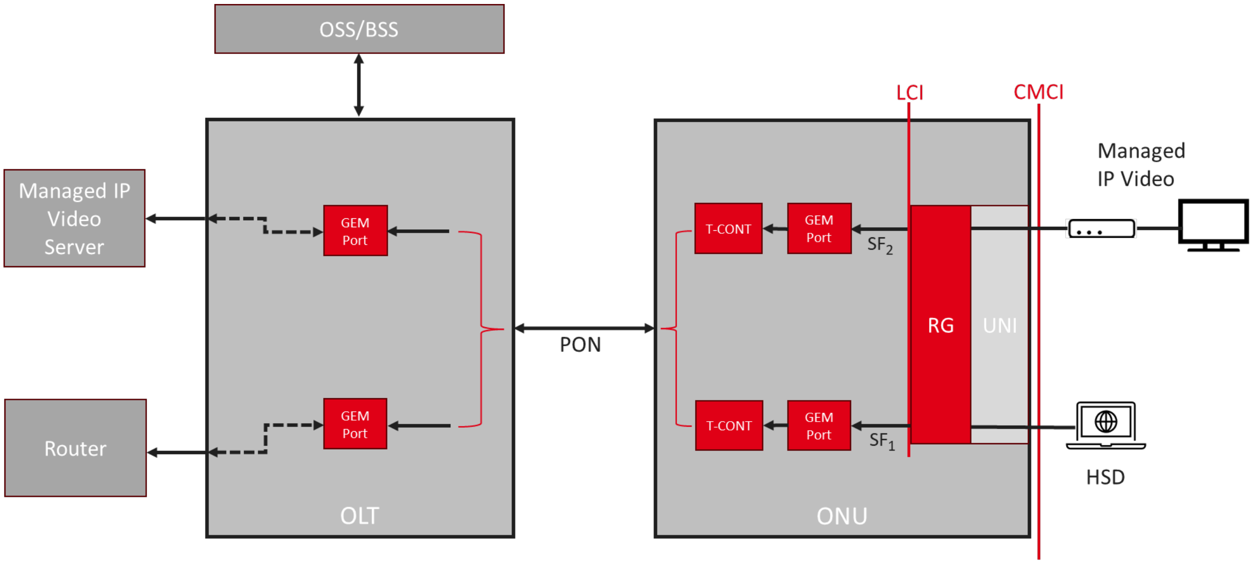

Figure 2 – HSD + Managed IP Video

The implementation of managed IP video services often supports the concept of an upstream and downstream service flow pair, distinct from the HSD service flows, to carry that video traffic. It is common for operators to define distinct service flows for managed IP video traffic so they can provide any desired QoS treatment to that traffic and so they can distinguish the managed IP video traffic consumed by the subscriber from the subscriber's HSD traffic. In this manner, if the operator chooses to implement monthly byte caps or usage-based billing, they can choose to exempt or "zero-rate" the managed IP video traffic by simply ignoring the bytes consumed over the managed IP video service flow pair. In Figure 2, service flow one (SF_1) is configured to support the HSD service, and service flow two (SF_2) supports the managed IP video service.

4.3. DOCSIS Cable Modem Configuration File

For this use case example, the following is the DOCSIS configuration to support the HSD and managed IP video services. This configuration is not exhaustive of all configuration file details, merely a representation of the service flow configuration required for the example.

```
3,NetworkAccess,1,1
18,MaxCPE,1,1
24,UsServiceFlow,29
       1,ServiceFlowRef,2,1
       4,ServiceClassName,11,gig_hsd_up
       6,QosParamSetType,1,07
       8,MaxSustainedRate,4,1000
       41,DataRateUnit,1,2
25,DsServiceFlow,29
       1,ServiceFlowRef,2,2
       4,ServiceClassName,11,gig_hsd_dn
```

```
        6,QosParamSetType,1,07
        8,MaxSustainedRate,4,1000
        41,DataRateUnit,1,2
24,UsServiceFlow,27
        1,ServiceFlowRef,2,3
        4,ServiceClassName,12,ip_video_up
        6,QosParamSetType,1,07
        8,MaxSustainedRate,4,10000000
25,DsServiceFlow,27
        1,ServiceFlowRef,2,4
        4,ServiceClassName,12,ip_video_dn
        6,QosParamSetType,1,07
        8,MaxSustainedRate,4,100000000
22,UsClassifier,21
        1,ClassifierRef,1,1
        3,ServiceFlowRef,2,1
        9,Ipv4Classifier,5
                1,TosRangeAndMask,3,80 80 2F
        12,Ipv6Classifier,5
                1,TrafficClass,3,80 80 2F
23,DsClassifier,21
        1,ClassifierRef,1,2
        3,ServiceFlowRef,2,2
        9,Ipv4Classifier,5
                1,TosRangeAndMask,3,80 80 2F
        12,Ipv6Classifier,5
                1,TrafficClass,3,80 80 2F
```

In the above example DOCSIS configuration file for HSD and managed IP Video services, there is an HSD pair of service flows and an IP Video pair of service flows. Traffic is classified into the IP Video service flows via IPv4 and IPv6 classifiers. In this particular case, we make use of DiffServ Code Point (DSCP) (ToS or TrafficClass) variants of the IP classifier, and we have assumed the managed IP Video traffic bears a ToS 0x80 aka DSCP Class cs4 mark.

4.4. Upstream Traffic Classification

Think of an upstream service flow on an ITU-T PON network as being identified via a GEM port and a corresponding T-Cont. In this model, if we want to carry the two different types of traffic for this double-play (HSD + managed IP Video) service, we define a unique GEM port and T-Cont for each traffic type.

The next step in defining this service is to define the mechanism by which upstream traffic - from the subscriber's CPE to the PON - will be classified into these two distinct service flows. For those cable operators who have assigned distinct DSCP values for each service and have CPE that is able to apply a service-specific DSCP value to upstream IP packets, the IEEE 802.1p mapper service profile ME provides the needed mechanism to perform this traffic classification.

It's a multi-step process, but it's straightforward. The IEEE 802.1p mapper service profile ME includes a DSCP to P-bit mapping attribute, which allows the operator to map each of the 64 possible DSCP values to one of eight P-bit values.

The operator then maps each of the P-bit values to a specific GEM Port value. Each GEM Port value is associated with a Priority Queue, which is in turn mapped to a specific T-Cont value. Figure 3 below depicts this process.

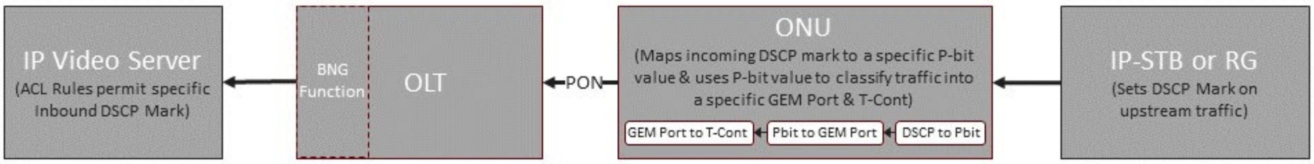

Figure 3 – Managed IP Video Upstream Traffic Classification

This traffic classification method depends on the upstream managed IP Video service traffic bearing a DSCP value that is distinct from that of the upstream HSD traffic. There are a couple of common methods to get the DSCP mark on this traffic. One method is for the IP-STB to set the DSCP mark itself on all IP packets it transmits upstream. A second method is for the RG to track all TCP sessions it is forwarding and apply a session-specific upstream DSCP mark based on the downstream DSCP mark observed by the RG. Using this second method, the operator's managed IP Video server sets the downstream mark and thereby indirectly determines the upstream mark set by the RG.

Operators typically deploy a standalone Broadband Network Gateway (BNG) device in their network - north of their OLTs or deploy OLTs that integrate the BNG functionality. This functionality includes Layer 3 functions including the ability to set service-specific DSCP marks on forwarded IP packets. In our specific example, this function assures that the intended managed IP Video DSCP mark exists on all traffic destined to the IP Video Server. The IP Video Server (or a datacenter router in the path to the server) is often pre-configured with Access Control List (ACL) rules to deny inbound traffic lacking specific DCSP marks. In our example, the ACLs permit the specific IP Video DSCP mark value, and the traffic (typically a TCP SYN, HTTP Get Request, or TCP ACK) is received by the IP Video Server.

4.5. DOCSIS Adaptation Layer and Cable OpenOMCI Profile

For cable operators to leverage their existing spend on the DOCSIS back-office systems with PON services, a key function is a DOCSIS adaptation layer (DAL) that translates DOCSIS configuration parameters to PON configuration elements. This DAL allows cable operators to use their existing DOCSIS provisioning infrastructure to manage ITU-T PON networks. This means that cable operators can deploy fiber-based PON technology while still using their familiar DOCSIS tools for provisioning and managing customer services.

This cable-specific functionality was developed over a decade ago in 2011 with the release of the DOCSIS Provisioning of EPON (DPoE) specifications at CableLabs. Over the years, a few equipment suppliers have integrated the DAL functions into their product lines. As such, the objectives within the CPMP working group are to describe the process of this translation and allow the vendors to use their existing DAL functionality. This will significantly improve time-to-market and allow for vendor differentiation.

This approach requires a common set of use cases to be developed that are consistent between that of the DOCSIS and PON technologies. Leveraging this common denominator of use cases allows for the mapping between the different configuration and management protocols. In the case of DOCSIS and ITU-T PON technologies, this is the mapping of Type-Length-Value (TLV) parameters in a DOCSIS-style configuration file to ITU-T PON OMCI MEs.

The detailed mapping between DOCSIS configuration file TLVs and XGS-PON OMCI MEs is currently being developed in the CPMP working group.

5. Future Activities

There is a likelihood in the future that next generation OSS systems in the cable space will support an SDN-based implementation. This approach would integrate software-based controllers and application programming interfaces (APIs) to communicate with and manage network hardware. This contrasts with traditional networks, where network control is directly integrated into the network devices themselves. At this time, the CPMP working group is investigating this approach and will plan to support such transformations in the network to meet the needs of cable operators.

6. Conclusion

In conclusion, there is serious movement in the direction of ITU-T PON technologies, and some cable operators have already deployed XGS-PON or are investigating such implementations. There are some operators that want to leverage their previous investment in the DOCSIS back-office systems to support their future PON deployments. This paper described the concepts needed to support this implementation with a key objective of interoperability between the OLTs and ONUs as a necessity for operators. To successfully support this objective a set of common use cases will be developed, from which DOCSIS TLVs will be mapped to OMCI MEs.

Abbreviations

25GS-PON	25 gigabit symmetrical PON
50G-PON	50 gigabit PON
ACS	auto-configuration server
API	application programming interface
CM	cable modem
CPE	customer premise equipment
CPMP	common provisioning and management of PON
DAL	DOCSIS adaptation layer
DOCSIS	data over cable systems interface specification
DPoE	DOCSIS provisioning of EPON
DSCP	diffServ code point
DVA	digital voice adapter
DCA	distributed CCAP architecture
IEEE	institute of electrical and electronics engineers
EPON	Ethernet passive optical network
FTTP	fiber to the premises
GPON	gigabit passive optical network
HSD	high-speed data
ITU-T	international telecommunications union telecommunications standardization
ME	managed entities
MDU	multi-dwelling unit
OMCI	ONU Management and Configuration Interface
OOM	optical operations and maintenance
OSS	operational support system
OLT	optical line terminal
ONU	optical network unit
PON	passive optical network
R-OLT	remote OLT
RG	residential gateway
SDN	software defined network
TLV	type length value
XGS-PON	10 Gigabit Symmetrical PON as defined in [G.9807.1]

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