Pioneering the Future of PONs: Why Conformance and Interoperability Testing are Key

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Capacity and speed are the keys to an entirely new generation of consumer broadband services, including multi-screen HD in-home video, interactive and conferencing services, and home monitoring/automation. Greater capacity, faster speeds and lower latencies will also allow service providers to offer growing businesses a broader array of services, moving beyond where traditional broadband access technologies, such as T1-lines, ISDN, and DSL, left off.

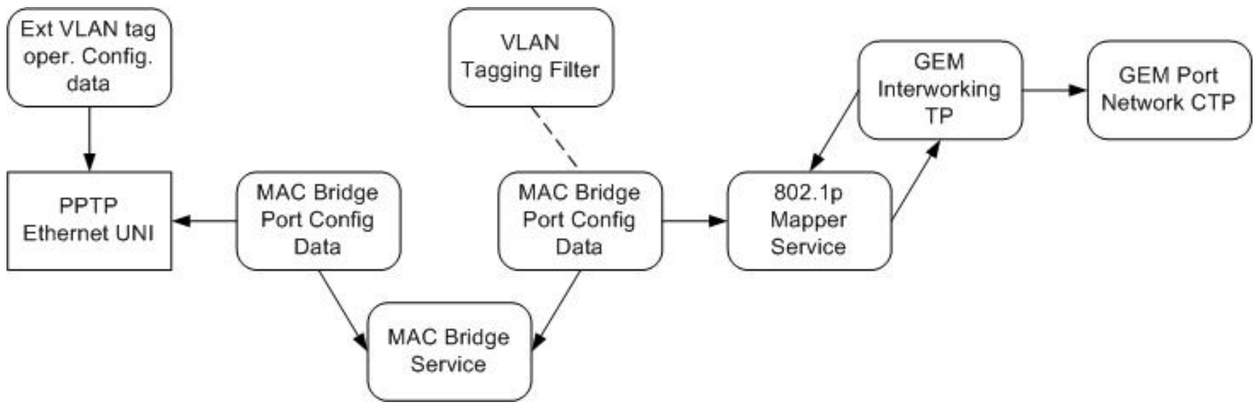
Power of PONs

Passive Optical Networks, or PONs, are proving to be valuable assets in the progression towards new service offerings and technologies. With increasing competition for video services from other providers and pressure from governments on their national broadband plans, PONs give providers the ability to meet challenges head-on in a way that is future proof and cost effective.

There are several different standards for PONs, defined by the Institute of Electrical and Electronics Engineers (IEEE), and the International Telecommunications Union – Telecom Division (ITU-T). GPON (or Gigabit PON), specified by the ITU-T, is one type of PON that is being deployed in the Americas and Europe today, and is the first of the family of PON technologies being tested by the University of New Hampshire InterOperability Laboratory (UNH-IOL).

Today's GPON testing focuses primarily on the OMCI protocol. OMCI, or ONT Management Control Interface, is a key component to the interoperability lifecycle of GPON. OMCI allows a service provider to provision a diverse number of applications and services utilizing the PON, including voice, video, and data. But the real strength within OMCI comes from its inherent flexibility. OMCI was one of the first specifications to document a standardized provisioning mechanism for the end-to-end layer 2 data-path. This makes the protocol very powerful and very complex. Most deployed services are configured in a way that is specific to the provider, where each deployment represents a subset of what OMCI is capable of configuring. OMCI as a whole was defined as a superset of all possible configurations. Figure 1 shows a typical OMCI configuration for a single service, based on the Broadband Forum TR-156 requirements.

Figure 1: OMCI configuration for a single service offering



A PON consists of a single Optical Line Termination (OLT) and multiple Optical Network Terminations (ONTs) communicating over an Optical Distribution Network (ODN). The PON operates as a point-to-multipoint link in the downstream direction and a point-to-point link in the upstream. This topology means downstream applications, such as broadcast video, can leverage the multicast nature of the PON, but on the flip side means there are increased complexities for upstream applications requiring dedicated bandwidth. The Broadband Forum's TR-156 specification, along with an implementer's guide published by the ITU-T, has helped to clarify some of the required configuration approaches.

Within OMCI, the OLT is the configuration master, and may approach the configuration of an ONT as it sees fit. This has lead to a massive gap between ONT devices produced by different manufacturers. Given the many-to-few relationship of possible ONTs to OLTs in the market, companies can triage with conformance testing of basic functions on the ONT. Conformance testing ensures that the ONT is, at the very least, correctly implementing the standard as worded. This is an effective method to prove the ONT accepts the OMCI messages from the OLT and that the ONT operates on those messages, thus supporting basic configuration topologies. While this allows providers to weed out the broken implementations from those that are functional, it is hardly exhaustive, and may not reflect the specific needs of the provider or show how their OLT vendor has chosen to implement an approach to the configuration problem.

Given its power and complexity, the real meat of testing OMCI is through the interoperability of a given OLT and a given ONT, exercising multiple deployment scenarios, such as different network architectures or services. The UNH InterOperability Lab has already found different OLT implementations that configure a layer 2 data path that, while functionally identical at the edges, took two very different configuration routes within the OMCI layer. This is not a problem with the standards – it is well within the power and purpose of OMCI and allows OLT vendors to meet different provider and market demands – but it means that different ONTs must be ready and able to accept both configurations to realize a fully interoperable deployment.

Power to the People

As the premier independent proving ground for data communications, we at the UNH-IOL are usually the first to beat the drum for interoperability in a given technology. Interoperable, heterogeneous networks drive down costs and promote real innovation. The UNH-IOL is pioneering the interoperability of PONs, starting with GPON. Partnering with industry leading system vendors and optical chipset providers, the UNH-IOL has the only publicly available heterogeneous test bed of GPON OLTs and ONTs. Additionally, the UNH-IOL OLT Emulator is the industry's first available ONT conformance test tool, and allows different OMCI configuration flows to be tested in a standardized and repeatable fashion. This type of conformance testing decreases product time to market, reduces quality assurance costs, and provides a trusted means to verify products and ensure customers feel confident that deployments will work, and work well.