broadband forum

MARKET UPDATE

Access Agnostic CPE Management

MU-478

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Introduction

In the early days of Broadband, most service providers used a single technology, with Telcos focused on ADSL and Cable Operators focused on early generations of DOCSIS. With the evolution towards higher speeds, the "Gigabit era" has seen both Telcos and Cable Operators push fiber deeper into Access networks. This has resulted in many service providers using multiple types of broadband access technology. For example, some Telcos deploy both DSL and FTTH and some Cable Operators now deploy both DOCSIS and FTTH.

From an operations and service management perspective, it is desirable to abstract the service management from the access technology type so that a common approach can be used for all customers, irrespective of the type of broadband connectivity that they use. For example, a service provider may wish to use the same approach to optimize Wi-Fi, manage applications, or provision security capabilities such as parental controls in the same manner for all of their broadband customers, independent of whether they are connected via DSL, Cable, or FTTH. A level of abstraction above the physical "modem" layer reduces time and integration effort for development of new services. This makes it easier to maintain and evolve such services as well as reducing time to market for new national broadband home services which may span multiple broadband access technologies. Indeed, for some operators that span multiple countries, this approach can even expedite a multi-national or global launch of a new product capability.

This document illustrates how the move towards the User Service Platform [1] (USP as defined in TR-369; see MU-461 [7] for more details on USP and its use cases) and convergence on a common device data model (TR-181) [2] can also be used as an opportunity to further harmonize the device management approach across multiple access technologies, specifically FTTH and DOCSIS.

Context

As Telcos began deploying GPON FTTH in addition to their existing DSL broadband, many initial GPON deployments used a 2-box approach whereby the GPON ONT (effectively the FTTH "modem") was separate from the Residential Gateway (the Broadband router). This enabled Telcos to use GPON's native management protocol, OMCI, for provisioning the ONT (both the GPON physical layer and Ethernet VLANs at layer 2) but they could also use the TR-069 [3] protocol to provision the Residential Gateway (IP at layer 3 and above). This was useful since TR-069 was already being used to provision services on DSL routers, hence a common approach was feasible.

As GPON FTTH deployments increased, the deployment model evolved to include the option of an integrated ONT and Residential Gateway, sometimes called a Layer 3 ONT. Hence from both the customer and service provider's perspective it offered a 1-box solution. The challenge was then how best to approach the management of such Customer Premises Equipment without completely re-working the approach already used for the 2-box solution.

The solution was TR-142 [4] which simply partitioned the Layer 3 ONT into two logical blocks, one was the GPON ONT and the other was the Residential Gateway. The blocks were 'connected' internally via a virtual User Network Interface (vUNI) and OMCI and TR-069 were then used in parallel to configure and manage their own respective functional elements. This minimized the impact on existing Operational Support Systems (OSS) yet facilitated a common management approach at the service layer for both DSL and GPON, independent of whether GPON was deployed using a 1-box or 2-box approach. This is illustrated below:

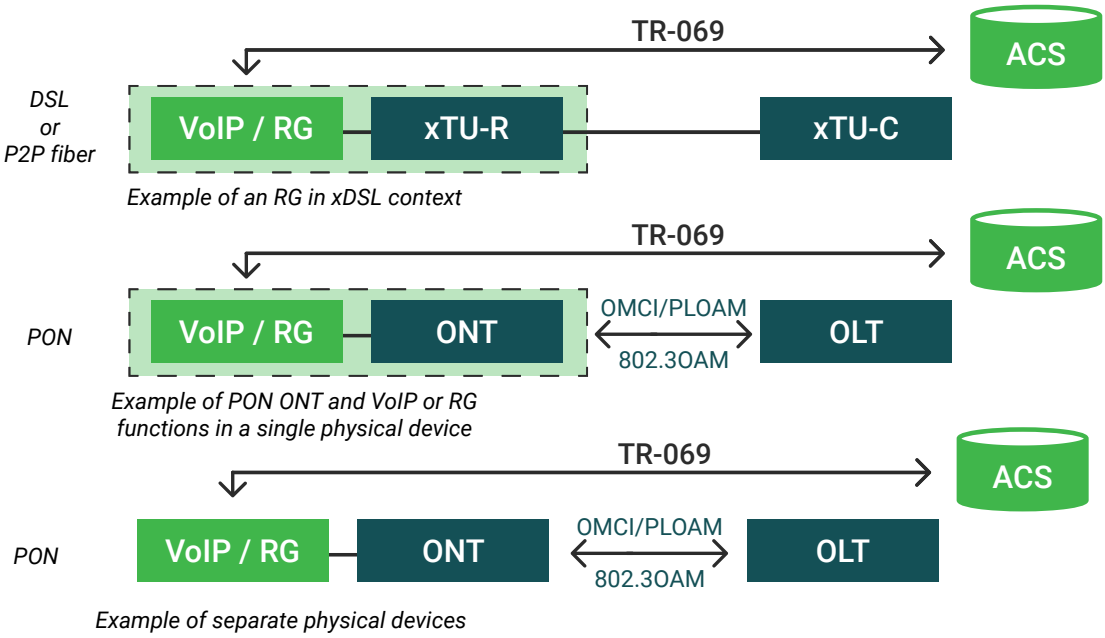

Figure 1: TR-142 Approach to Combined OMCI and TR-069 Management of GPON ONT

Similarly, Cable Operators also sought to have a common approach to the management and provisioning of CPE across both cable and fiber access networks. Some Cable Operators (mainly in the USA) began to deploy the EPON variant of FTTH. In 2012, CableLabs first published their DPoE specification (DOCSIS Provisioning over EPON) [5]. This enabled EPON equipment to be provisioned using existing DOCSIS-based provisioning systems. However, not all Cable Operators favored the EPON approach to FTTH (an IEEE standard) and many (especially in Europe) deployed FTTH based on the ITU standards track (i.e. GPON and more recently XGS-PON). Furthermore, some Cable Operators had also begun to use TR-069 as a management protocol too. Hence the CableLabs eRouter specification (first produced in 2006) [6] for the IP layer functionalities required in a DOCSIS Residential Gateway includes the use of TR-069 (in addition to older SNMP-based approaches). The CableLabs eRouter specification also references TR-181 in Annex D as the recommended device model for Residential Gateways when using TR-069 as the remote management protocol.

A New Opportunity for Further Harmonization

TR-069 has been used to manage hundreds of millions of devices across the globe including Broadband Residential Gateways, small cells (e.g. femto cells), VoIP devices, set-top boxes (STB), Network-Attached Storage (NAS), and many others. Service providers are now evaluating how to evolve their broadband device management in the era of real-time telemetry, data lakes, compute processing (including AI and ML) in the Cloud, Over The Top (OTT) service delivery, and new operating models.

The connectivity technology will vary to the premise however the need to serve an ever-increasing number of managed application services and devices behind whatever network termination device will be common across all homes and businesses.

Looking beyond TR-069, the USP (TR-369) is the next step in the evolution of remote device management. It enables more real-time telemetry for monitoring plus a multi-controller approach that will facilitate new business models, allowing multiple Services and Applications access to the CPE. It is consistent with the “as a Platform” paradigm that abstracts service management and orchestration capabilities from the underlying technologies.

For example, a Service Provider may choose to outsource their Wi-Fi optimization to a partner who has their own cloud-based Machine Learning (ML) capabilities developed specifically for that purpose. The Service Provider can control the exposure of just the key Wi-Fi parameters from their CPE to their Wi-Fi/ML partner’s USP Controller. Similarly, the Service Provider may have a separate internal team with their own USP Controller to manage Zigbee-connected IoT devices, or perhaps their Business division has their own USP Controller to manage the CPE

(including enhanced Security) of Home Workers. TR-069 has been a huge global success but TR-369 brings improved technical capabilities and increases the flexibility to securely support new commercial models in the Gigabit broadband era.

Furthermore, the TR-181 data model has evolved to encompass the latest generation of Wi-Fi data elements too (including mesh Wi-Fi environments). CableLabs, Wi-Fi Alliance (WFA), and the Broadband Forum have all aligned on TR-181 to harmonize on a single Residential Gateway data model. In addition, CableLabs has also referenced the use of USP (TR-369) as a remote management protocol that can be used in conjunction with the TR-181 data model .

These technology standards developments create the opportunity for even greater harmonization across disparate broadband access technologies. Cable, fiber and DSL Residential Gateways can all use the same TR-181 RG data model including the latest Mesh Wi-Fi and IoT capabilities. In addition, it is possible to manage GPON, XGS-PON, and DOCSIS connected RGs using the new USP (TR-369) remote management protocol. The final step is to do for DOCSIS RGs what TR-142 did for Layer 3 GPON ONTs (effectively FTTH RGs). That is to have a coherent management approach for "1-box" Cable Modems with integrated Layer 3 RG/eRouter capabilities. This is illustrated below:

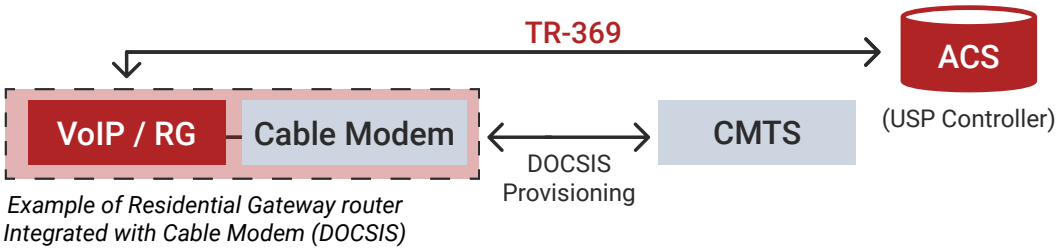

Figure 2: Use of USP TR-369 in conjunction with DOCSIS Provisioning

Figure 2 shows a "TR-142 equivalent model" for Cable-based service delivery. The device management covers two main areas: the DOCSIS provisioning systems and the RG management system. The former (i.e. DOCSIS provisioning) refers to the set of systems and platforms dedicated to the cable modem configuration file creation, management, and dispatching (including Customer Information repository and potentially DHCP and TFTP servers, etc.); this is designed to leverage the Cable Operator's existing approach to provisioning DOCSIS connectivity in order to reduce OSS impact as USP is introduced. The latter (i.e. TR-369) refers to the configuration and management of the "non-WAN modem" part of the Cable RG; in this case, TR-369 is used as a management protocol via an ACS platform.

1 As well as IoT sensors and controls plus packet capture diagnostics capabilities.
2 https://www.cablelabs.com/data-elements-and-tr-181-connect-to-the-pnm-data-you-need

Conclusion

Designed to co-exist with and easily migrate from existing Telco and Cable provisioning solutions (such as TR-069), USP (TR-369) and TR-181 represent a fully realized ecosystem for adding value to the connected home and enabling the agile rollout of new services.

The evolution of operations, device and application service management with USP mirrors the evolution of the connected home with a vast growth in the number of hardware and services behind the home gateway irrespective of the final connectivity.

Application providers, communication service providers and consumer electronics manufacturers can use USP for innumerable cases, including advanced analytics, broadband deployment, onboarding, managing Wi-Fi, security, and an interoperable IoT.

An 'Open Standard' supporting multiple independent devices, varied services and with the opportunity of diverse and redundant, separate and secure controllers across an increasing number of service divisions or partnered application providers.

The Broadband Forum offers a comprehensive set of testing options for the USP Agent that span both interoperability and a self-certification or in-lab program. Assuring interoperability and a higher level of confidence that elements will work well within a connected home ecosystem.

The evolution of CPE management to make use of the User Services Platform (TR-369) and the TR-181 RG data model (that has been agreed between CableLabs, WFA, and BBF) creates the opportunity for a harmonized approach which is aligned across DOCSIS, legacy copper, GPON, and XGS-PON access technologies.

Broadband Forum's Connected Home Council would like to recognize the following for their valued contributions to this document:

Gavin Young – Vodafone

John Blackford – CommScope

Jason Walls – QA Cafe

Terminology

References

The following references are of relevance to this Market Update. At the time of publication, the editions indicated were valid. All references are subject to revision; users of this Market Update are therefore encouraged to investigate the possibility of applying the most recent edition of the references listed below.

A list of currently valid Broadband Forum Technical Reports is published at: www.broadband-forum.org.

Document	Title	Source	Year
[1] TR-369	User Services Platform (USP)	Broadband Forum	2019
[2] TR-181	Device Data Model	Broadband Forum	2019
[3] TR-069	CPE WAN Management Protocol	Broadband Forum	2018
[4] TR-142	Framework for TR-069 enabled PON Devcies	Broadband Forum	2017
[5] DPoE-SP ARCHv2.0-I07-190213	DPoE Architecture Specification	CableLabs	2019
[6] CM-SP-eRouer- I20-190515	IPv4 and IPv6 eRouter Specification	CableLabs	2019
[7] MU-461	Realizing the Promise of the Connected Home with User Services Platform (TR-369)	Broadband Forum	2019

Abbreviations

This Market Update uses the following abbreviations:

ACS	Auto-Configuration Server
ADSL	Asymmetric Digital Subscriber Line
AI	Artificial Intelligence
BBF	Broadband Forum
CPE	Customer Premises Equipment
DOCSIS	Data Over Cable System Interface Specification
DSL	Digital Subscriber Line
EPON	Ethernet Passive Optical Network, an IEEE standard
FTTH	Fiber To The Home
GPON	Gigabit Passive Optical Network, an ITU standard
IoT	Internet of Things
MD	Marketing Draft
ML	Machine Learning
MR	Marketing Report
OLT	Optical Line Terminal
OMCI	Optical Management & Configuration Interface
ONT	Optical Network Terminal
PLOAM	Physical Layer Operations Administration & Maintenance
PON	Passive Optical Network
RG	Residential Gateway
SNMP	Simple Network Management Protocol
WA	Work Area
XGS-PON	10 Gbit/s symmetric Passive Optical Network, an ITU standard