

# INVENTION DISCLOSURE

## 1. **Invention Title.**

### **DOCSIS Service Flow provisioning via OpenFlow**

## 2. **Invention Summary.**

This invention provides a model to simplify DOCSIS QOS provisioning by leveraging the OpenFlow infrastructure.

## 3. **Invention Description.**

### **a. Describe the invention in detail.**

Market considerations:

The DOCSIS platform relies on PCMM for dynamic QOS provisioning. This architecture has proven been highly taxed by the current market offers that seems to limit the potentials to expand the usage of the DOCSIS infrastructure into new services.

Business customers, Wi-Fi hot spot users, gamers, financial market traders, and other professionals relaying on reliable high speed data infrastructure are likely to pay premium for guarantee bandwidth on demand. Thus, avoiding the high taxation of PCMM can extend the usage of Dynamic QOS beyond VoIP services at an attractive operational cost.

Technical considerations:

Leverage of OpenFlow for the specifics of DOCSIS brings cheap technology to the particular needs of a globally smaller platform like DOCSIS. Moreover, as DPoE systems are deployed the spectrum of users increases with natural extensions for PON architectures where DOCSIS provisioning is not used.

This disclosure only defines the aspects of OpenFlow Controller-Switch (e.g., controller command messages) to communicate DOCSIS QOS specifics to the CMTS to achieve expecting a similar functional aspects of the PacketCable COPS interface, not necessarily to replicate the COPS interface and transaction model.

Claims:

1. Defines new OpenFlow messages to create and delete DOCSIS Service Flows with their corresponding Classifiers. DOCSIS specific messages are defined as extensions of OpenFlow under a CableLabs identifier (similar to manufacturers OUIs).

2. Defines a simplified Service Flow push setup taking as a baseline the PacketCable COPs requirements. More specifically, this model only defines the rules for creating Service Flows in 'active' state and the correspondent deletion of them. This effectively calls for not supporting the 'committed' and 'provisioned' states of service flows. This is more in line with the OpenFlow model simplicity. However, further extensions might target this other states as sufficient evidence of usage and operational experience deemed them important.

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## Description of Claims

### Claim1:

Figure 1 shows the OpenFlow schema. The OpenFlow switch corresponds to the CMTS. For this proposal it is assumed the CMTS switch/router will support OpenFlow in its own (Independent of the DOCSIS extensions). At that point the entry barrier for openFlow extensions are minimal and likely to be implemented both technically and operationally. The OpenFlow Control will act as the PCMM Policy Server [2]. In a section below are defined the constraints and differences of both PCMM Policy Server and the role of the OpenFlow Controller.

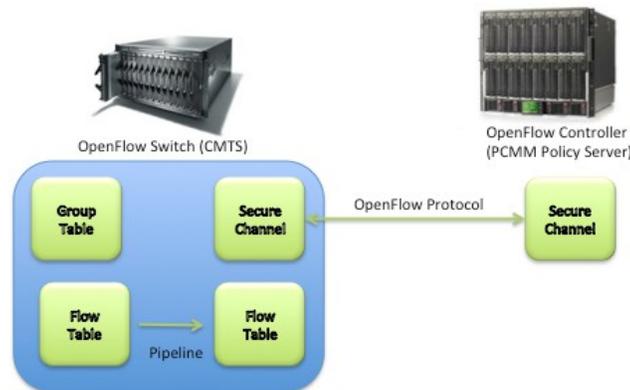


Figure 1 Openflow Components

Figure 2 shows the DOCSIS extensions. The DOCSIS QOS extensions are not related to the OpenFlow packet processing via its pipeline, see [1]. They only act as policies for the DOCSIS MAC to setup DOCSIS QOS service flows.

### Differences on requirements:

The OpenFlow Controller acting as a PCMM Policy Server defines only the PUSH Policy Model to send PCMM Gates (unidirectional QOS policy that represents a DOCSIS service Flow) to the CMTS.

Legacy PacketCable 1.5 POLL Policy of PCMM architecture is not defined in this invention but possible<sup>1</sup>.

All other aspects of the PCMM Policy Server are either maintained of subject to review in the future.

<sup>1</sup> Extending OpenFlow usage with rules to process DOCSIS messages arriving to the CMTS from the CM. For example, forwarding DSA-Request (Dynamic Service Addition Request) to the OpenFlow Controller for proper decision.

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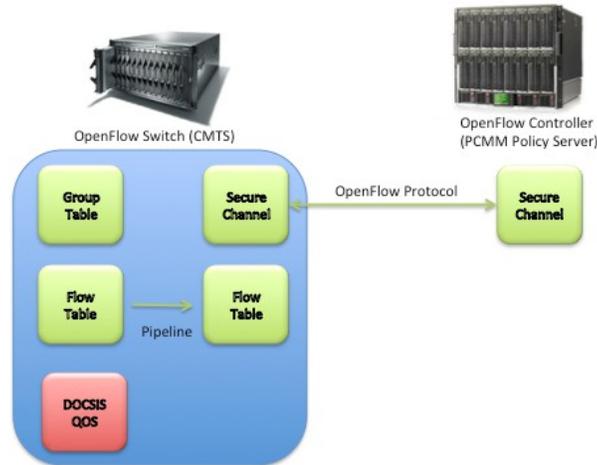


Figure 2 OpenFlow with DOCSIS QOS extensions

### Claim2:

The detail protocol mapping of a PCMM Flow Spec with a Flow Table Rules is outlined:

A PCMM Flow consists of classifiers and QOS parameters for the flow spec.

The DOCSIS Classifiers in the spec flow are similar to the FlowTable entries in openFlow. The DOCSIS QOS Param then are equivalent to a policy.

This model greatly simplify the dynamic service flow configuration, by relaxing the stringent requirements of PacketCable.

It let distribute the platform and use OpenFlow patterns to guarantee the QOS requirement to be meet without maintaining a complex gate id on a transaction.

Many HSD, just need to react to QOS, and committed resources are not as critical as in PCMM goals. Delayed reaction is a virtue of SDN (Software Defined Networks), by resolving one problem at the time.

Even for VoIP services, QOS assignment can be delayed within the call setup dialog to offer extensibility. Services like Vonage have proved that QOS for Internet telephony is already a reality without a connection path. Nonetheless a QOS profile greatly improves the customer perception of the service

**b. Why was the invention developed? What problem(s) does the invention solve? How is it better?**

PCMM policy Server model is expensive operationally, MSOS are reluctant to extend the usage of PCMM beyond VoIP due the per transaction cost involved with PCMM business models. Although the business models may change and new competitors might introduce alternatives, this solution is future prove as policies are not only on the HFC path but now integral to the data path.

Applications that could benefit with this model are:

Security: DOCSIS now has a model for Upstream Drop classifiers (packet Filters, like firewall rules at the CM. Today only via config file those policies are configured.

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With this model upstream and downstream policies can be inserted in a generalized model, using the SDN (software defined Network) capabilities of OpenFlow.

Harmonization of Business Service Policies across the entire data path using a SDN model.

**c. Briefly outline the potential commercial value and customers of the invention.**

CableLabs could license this model for other access technologies (EPON, GPON) in addition of the usage in DOCSIS and DPoE.

**4. HOW is this invention different from existing products, processes, systems?**

There are no models I am aware of that use SDN as part of the DOCSIS architecture