CHAPTER 2

DOCSIS 3.0 Support for Remote Cable MSO Links Solution

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Introduction

The *Cisco Service Control for Managing Remote Cable MSO Links Solution* is enhanced with new features that are consistent with DOCSIS 3.0 specifications and includes support for downstream bonding of multiple channels—multiple channels are bonded to a single, virtual interface to provide higher bandwidth to the cable modems.

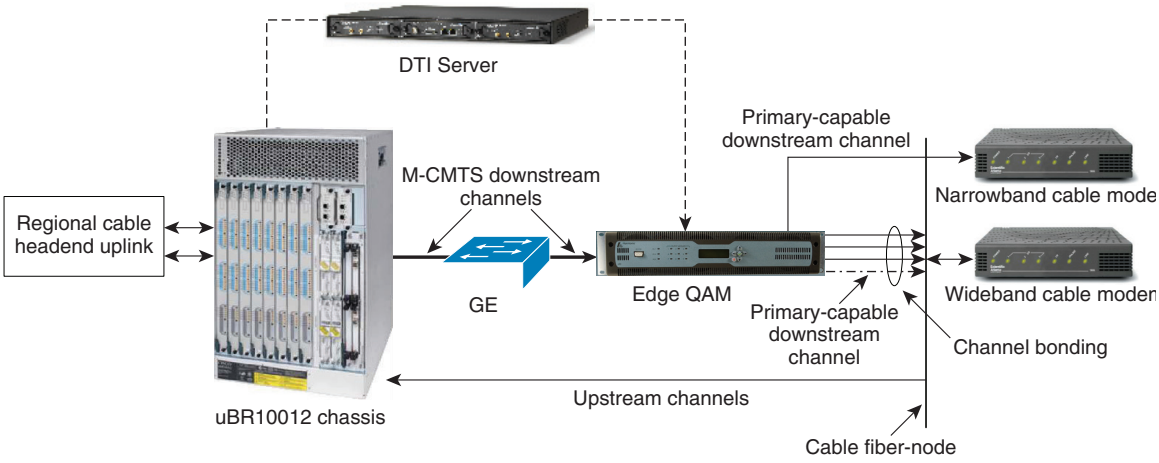
Feature Overview

The DOCSIS 3.0 Downstream bonding enables high-speed broadband access and helps cable operators offer more bandwidth-intensive services by adding one or more additional downstream Quadrature Amplitude Modulation (QAM) channels to the standard broadband DOCSIS system. This new set of downstream (DS) channels is grouped into one larger channel, known as a *bonded channel*.

With wideband data services, multiple DS channels are aggregated into a single logical wideband channel (bonding group) that delivers higher bandwidth to the wideband cable modem when compared to DOCSIS 2.0 technology. This aggregation of the DS channels is referred to as *channel bonding*. Data rates in this virtual channel range from hundreds of megabits to potentially gigabits per second creating more available bandwidth in the network.

Figure 2-1 presents a simplified view of the Cisco DOCSIS 3.0 Downstream Solution.

Figure 2-1 DOCSIS 3.0 Downstream Solution



The DS channels are used either as primary channels (used for both broadband and narrowband channels), or secondary channels (used only for wideband channels), or both. The solution provides narrowband data services to support DOCSIS 1.x or 2.0 modems and wideband data services to support DOCSIS 3.0 modems over existing Hybrid Fiber Coaxial (HFC) networks and allows DOCSIS 1.x or 2.0 and DOCSIS 3.0 modems to share the same DS channel.

The Cisco wideband CMTS uses one or more external edge quadrature amplitude modulation (EQAM) devices. The EQAM device is a network element in a separate chassis from the CMTS. The EQAM device has two or more Gigabit Ethernet input interfaces that connect to a wideband shared port adapters (SPA). For output, the EQAM device has multiple QAM modulators and RF converters that connect to a HFC network. The edge QAM device accepts Moving Pictures Expert Group (MPEG) over IP on its Gigabit Ethernet interfaces and routes the services to its QAM RF outputs.

The enhanced Cisco Service Control solution leverages the SCE bandwidth control and reporting capabilities to monitor and control the CMTS resources at the QAM level. Multiple QAMs are aggregated into a virtual group (bundle group). The bandwidth allocation for different modems are done both on the CMTS and the EQAM. The EQAM minimizes the packets waiting in queue for each channel.

The EQAM manages the queues differently for legacy and 3.0 modems:

- All traffic to the legacy modems are routed through the primary narrowband channel queue.
- Traffic for 3.0 modems are routed through the shortest possible queue.

Bandwidth Control Enhancements

The enhancements to the SCE bandwidth control include:

- Support for wideband channels—a two level virtual link hierarchy is created to support the wideband channels. The wideband channels are associated with the Aggregate Global Control (AGC) that provides a constant output signal despite variations in input signal strength. Wideband channels are associated with three AGCs in a two level hierarchy.The top level AGC is dynamic and the lower level AGCs are equivalent to the existing AGCs. At the lower level, all the 3.0 modems for wideband are aggregated into one AGC. The other AGC contains both legacy and 3.0 modems.

  The Committed Information Rate (CIR) and Peak Information Rate (PIR) parameters are derived from the CMTS and QAM configurations.

  For the example, consider a wideband channel that includes three channels. One of the three channels is a primary channel (narrowband) and contains a mix of legacy and 3.0 cable modems. If 20% bandwidth of the narrowband channel is allocated to 3.0 cable modems then the CIR and PIR values are calculated as:

  Each QAM rate - X = 30 Mb

  Percentage bandwidth allocated for 3.0 cable modems = 20%

  Table 2-1lists the CIR and PIR values of the 3.0 cable modems with 20% bandwidth of narrowband channel allocation.

Table 2-1 CIR and PIR Values

AGC Name	CIR	PIR
Wideband-Cable1/0/0:0 (top level)	0	90 Mb (3X)
Wideband-Cable1/0/0:0_P	24 Mb (0.8X)	30 Mb (X)
Wideband-Cable1/0/0:0 _W	0	90 Mb (3X)

- Subscriber fairness within virtual links—to enforce subscriber fairness within the virtual links, the bandwidth is first allocated between the subscribers based on their RP level followed by the services of each subscriber.
- Application limitation within virtual links—SCE limits specific applications within the virtual link without losing control over the traffic.
- Enabling global control with CMTS-awareness solution.

Mapping of Cable Modems Through DHCP Sniffing

The narrowband channels are updated in the IfIndex in option 82 where the IfIndex is used for both legacy and 3.0 modems. In SCE, wideband channels are associated with three AGCs in a two-level hierarchy and the mapping of the modems to appropriate AGCs depends on the following factors:

- In the VLM mapping table, the modems are mapped from the narrowband IfIndex to the wideband group.
- Modems are linked to the appropriate AGC based on their type.

Detecting 3.0 Modems

The legacy and 3.0 modems are distinguished based on the information in the bootfile. The operators use the bootfile name to identify the modem type and the service package for the subscriber. The service packages are used to map the modems to the right VLM.

The bootfile name is configured using the following options:

- Option 67 in DHCP protocol is called the *Bootfile name*, the information configured in this field is extracted and sent to the DHCP sniffer.
- DHCP header contains a field called *Bootfile name* in the DHCP header.

  DHCP LEG includes regular expression capabilities that are used to configure specific information in the Bootfile name, which is used for mapping.

The VLM extracts the DHCP sniffer query results indicating the modem type (legacy or 3.0). Based on the DHCP sniffer output, VLM maps the modems to either primary or secondary channels.