Monitoring Utilization and Subscriber Metrics of DOCSIS 3.0 network from an OSS perspective

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Summary

Today's pressure to remain competitive in the broadband marketplace is stronger than ever. The performance-enhancing potential now available with DOCSIS 3.0 is providing cable operators with the data rates and flexibility needed to compete head-to-head with fiber-based products and come out on top. But delivering high speed access services is only one step in gaining a competitive advantage, cable operators must also focus on quality of service and customer experience to best utilize the DOCSIS 3.0 capabilities.

High-end services are linked to customer demands for quality and reliability. Lack of visibility into service quality and customer experience can eventually lead to customer dissatisfaction and churn. The increased flexibility of DOCSIS® 3.0 increases the complexity of managing the network for superior customer experience and service quality. Correlating subscriber experience metrics and expert recommendations as organized display of information, including historical data and trend analysis rather than raw DOCSIS® data facilitates MSO's with keeping up with increased volume of DOCSIS® 3.0 data. High Resolution data for detecting and triaging intermittent problems along with a roll-up and break-down of bonding group related capacity and quality information is invaluable for troubleshooting issues and saving truck rolls.

Introduction

A multitude of options for the consumers today is driving MSOs to provide an unmatched level of quality of service to keep consumers from shifting loyalties to the Telco markets. MSOs and OSS vendors are constantly challenged to keep up the existing solutions to effectively manage and monitor emerging technologies.

DOCSIS 3.0 has features that help MSOs compete with Telcos with the ability to provide services that are bandwidth intensive. As MSOs are rolling out DOSCIS 3.0 services into markets, it has become increasingly critical to gain visibility into the performance of these deployments to make sure the consumers are getting appropriate tier of service. From the MSO Network Operations Centre perspective it is important to gain insight to the performance of the DOCSIS 3.0 networks to justify deployment and capital expenditure and make sure that the infrastructure is configured, tuned and utilized efficiently, thus achieving maximum ROI benefits. There is also a strong need to troubleshoot DOCSIS 3.0 configuration and performance issues from a CMTS perspective and also from the CM perspective that are not directly accessible via standard CL options and MIB structure. Bonded channels in the downstream and upstream, while providing increased data throughput, also increase the probability of impairments with ingress, group delay, micro-reflections and other linear distortions and hence plant maintenance and monitoring has never been so critical. In addition the variety in vendors providing equipment for deploying DOCSIS 3.0 solutions demands a need for normalizing data from different vendors to provide a consistent data view to the operator.

This paper will discuss approaches to roll-up and aggregate and normalize DOCSIS 3.0 specific parameters to better equip MSOs in proactively monitoring the deployments.

Increased flexibility in DOCSIS 3.0 increases the complexity of deployment and Management as the MSOs can roll out the deployment with multiple combinations as shown in the figure1 below.

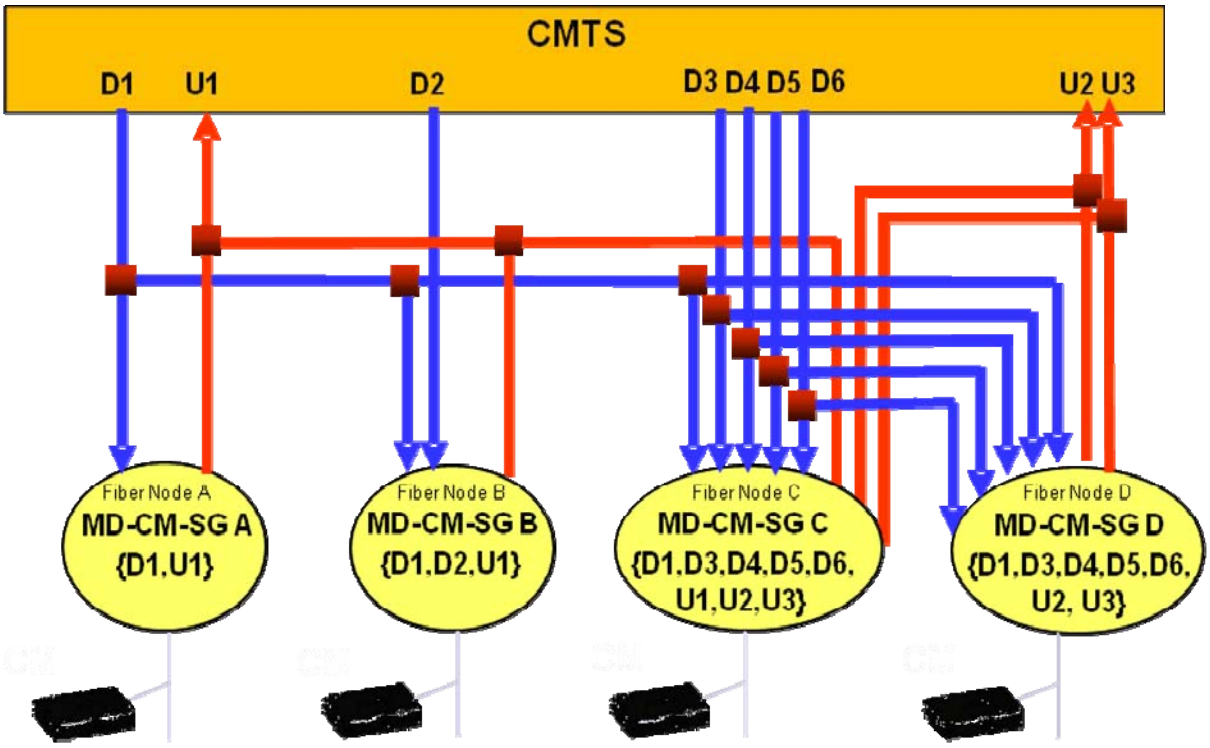

Figure 1 DOCSIS 3.0 Flexibility and Complexity

With the flexibility of creating CM Serving Groups with a combination of Upstream and Downstream interfaces, the means to utilize available capacity to the maximum extent is greatly increased. From the sample configuration in the figure above it becomes clear that it not only is required to measure the characteristics of individual interface but also the characteristics of interfaces(s) from a bonding group perspective of a serving group.

Organized Display of Data from CMTS Perspective

Obtaining the configuration of the available Bonding Group associations in a CMTS is the first step toward understanding the utilization of the CMTS. A visual representation of the available bonding groups with their association to the individual interfaces provides a powerful mechanism for operators to make sure that the actual CMTS configuration is in line with the expected configuration. Figures 2 and 3 represent the presentation of Downstream and Upstream bonding groups in a CMTS. Aggregating the utilization of the data to the respective bonding group provides a good picture of the overall capacity of the bonding group and this is very valuable information in determining if the plant has reached its capacity and if a node split is required to accommodate more CPEs. The aggregation to average and maximum utilization of a bonding group and the breakdown of the same for the individual interfaces provides insight

into the subscriber experience indicating if there is any service level degradation due to the high average utilization.

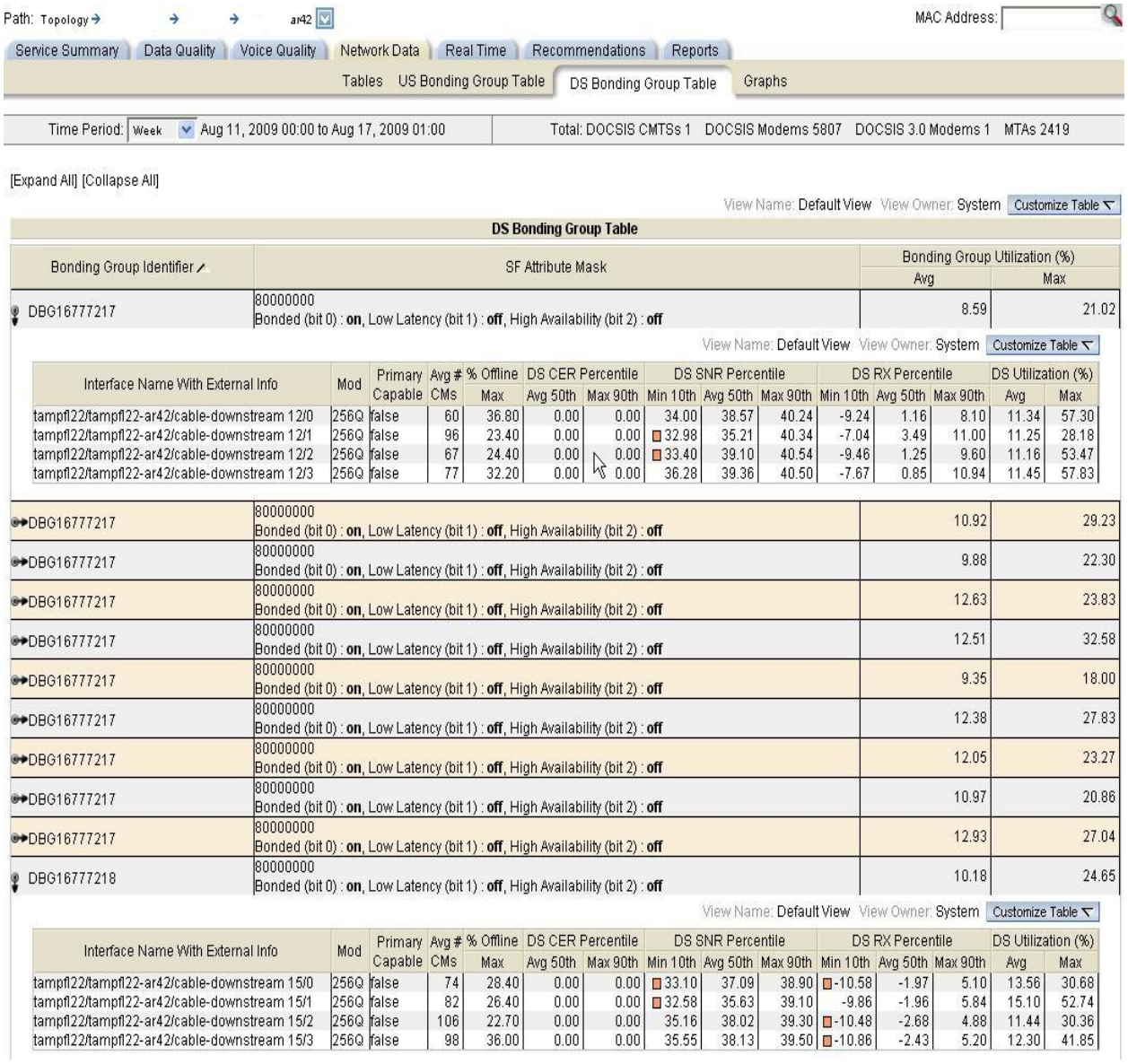

Figure 2 CMTS DS bonding group perspective

CER/MER in conjunction with channel modulation is a good measure of the channel quality. Consolidated view of this data for individual channels in a bonding group provides a quick troubleshooting means for finding interface that have specific issues. In addition to the CER/MER, attributes like SNR, Tx power provide valuable information on the channel performance. From the CMTS perspective this information is very critical for isolating configuration issues. The Node Status feature in DOCSIS 3.0 providing the DS-SG and US-SG association within a MAC domain to the Fiber Nodes reached by the MD-CM-SG can be leveraged to associate the bonding group statistics directly to the fiber node to get a HFC perspective.

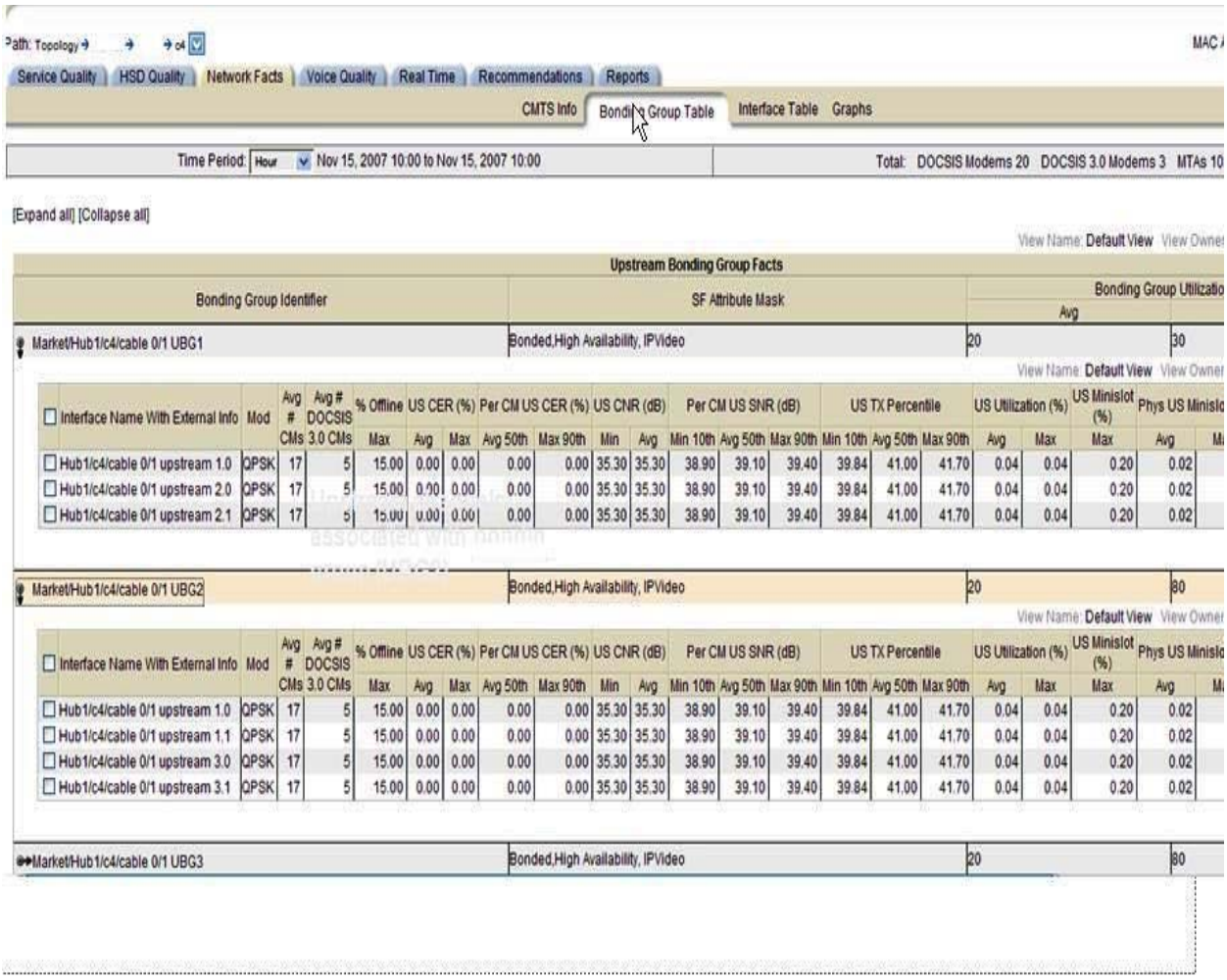

Figure 3 CMTS US bonding group perspective

Organized Display of Data from CM Perspective

From a CM perspective it is very critical to understand its capabilities and registration state to determine the QoS. A visual representation of the CM capabilities in Figure 4 provides the CM with the associated bonding groups in the upstream and downstream. Based on this information it becomes very easy to troubleshoot specific CM issues if the modem is supposed to utilize the DOCSIS 3.0 features and register to a bonded channel or to register on an unbounded channel. For a TSR this is very valuable data in determining Subscriber Experience, when a customer calls with issues regarding performance and speed. This data can be easily tied back to the consolidated data from the CMTS perspective to authoritatively cross-check that the CMTS has successfully acknowledged the DOCSIS 3.0 signature of the CM and responded with the DBC message. This association can also be useful in trouble shooting scenarios when the CMTS and CM have issues in ranging to a bonded group of channels.

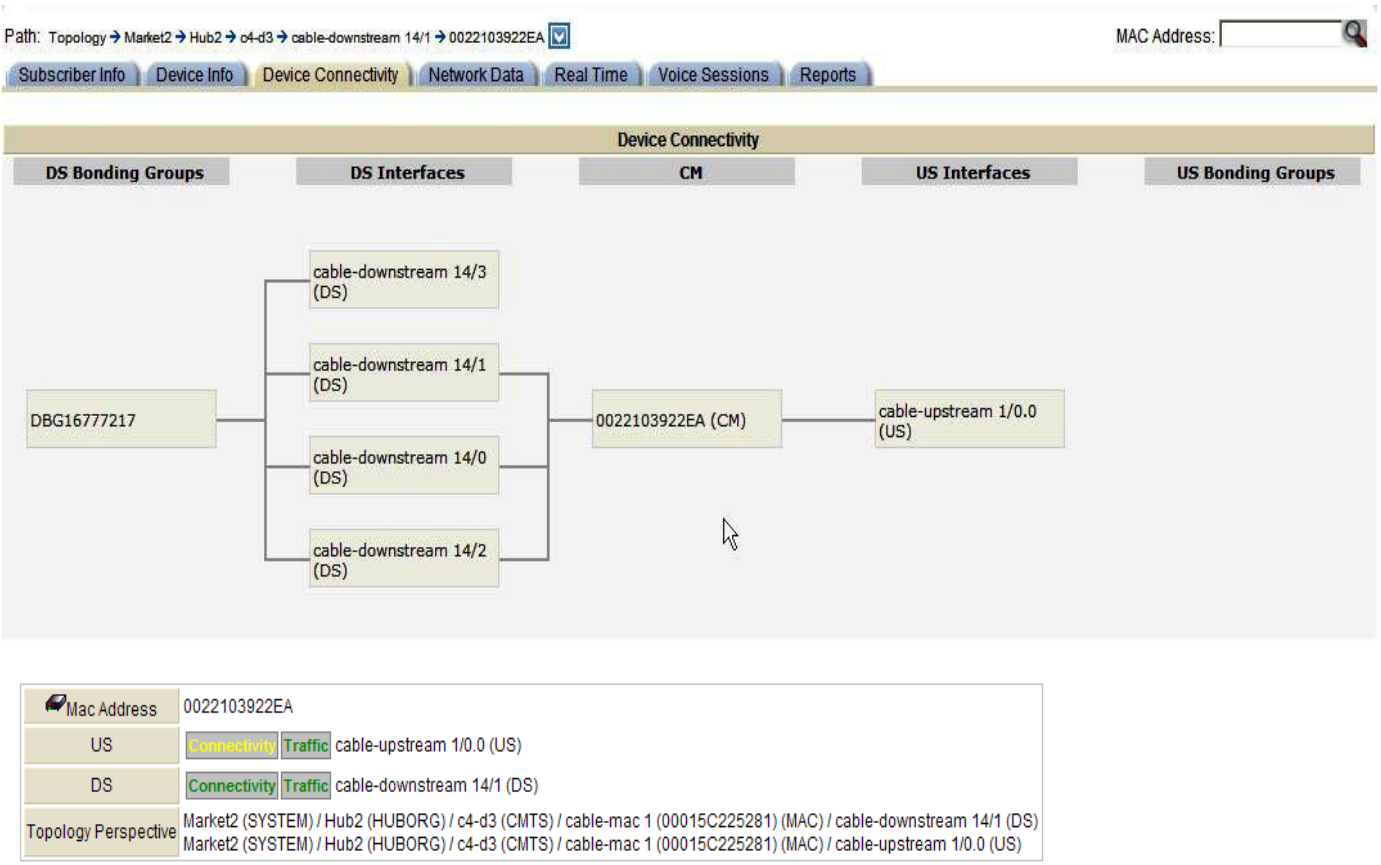

Figure 4 Topology perspective of a DOCSIS 3.0 CM

In addition to the association of basic CM connectivity to a CMTS, it is very useful to provide the individual channel metrics in the upstream and downstream associated to a CM for a DOCSIS 3.0 modem. This can help diagnose issues related to individual channel. Figure 5 provides a visual representation of a CM to its associated channels in upstream and downstream. Real-time data snapshot enables a way to troubleshoot specific interface related issues within a bonding group. Upstream and downstream utilizations from a CM perspective provide a very comprehensive measure for Subscriber Experience as perceived by the subscriber. Significant portion of Subscriber issues in a DOCSIS 3.0 deployment are related to CMTS/CM configuration issues rather than HFC plant issues and this data can be very useful in isolating such issues that can potentially save a truck roll.

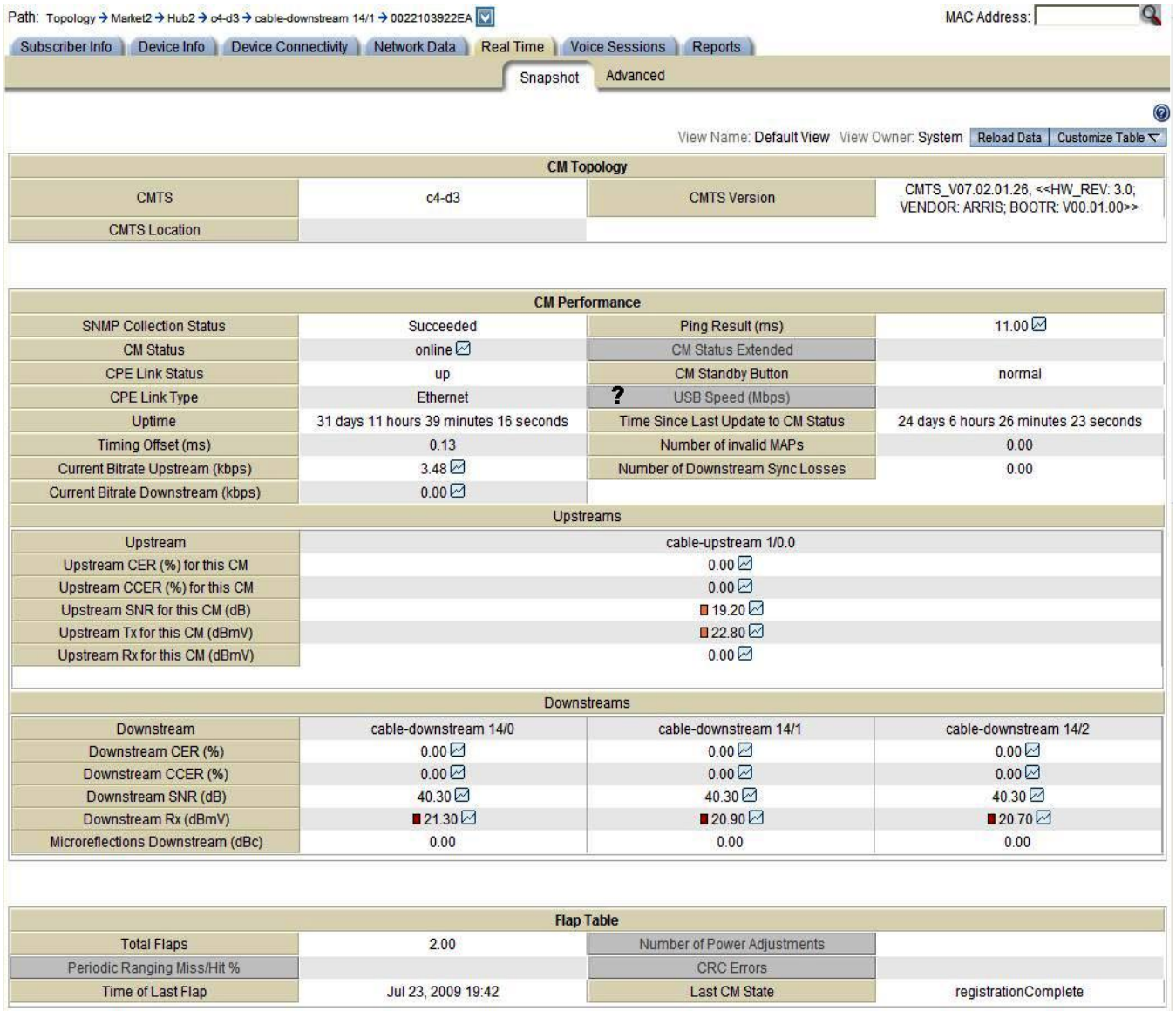

Figure 5 Real-Time snapshot of DOCSIS 3.0 CM

Historical Trending and Analysis

Real-Time snapshot data is very critical in analyzing and troubleshooting specific CM issues or specific CMTS bonding group and or interface issues. In order to perform a detailed analysis of performance and quality of the network it is very important to collect data over time and analyze it to arrive at trend calculations and behaviors. Historical data is also a very important tool in projecting capacity and planning and also to troubleshoot issues that are very hard to analyze without having insight into a bigger picture.

Historical trending is very critical for both CM and CMTS perspective. The CM perspective provides a good insight into the Subscriber Experience metrics during various periods within a

day and from the CMTS perspective it is a very powerful tool to analyze bottleneck periods and also to estimate capacity and growth.

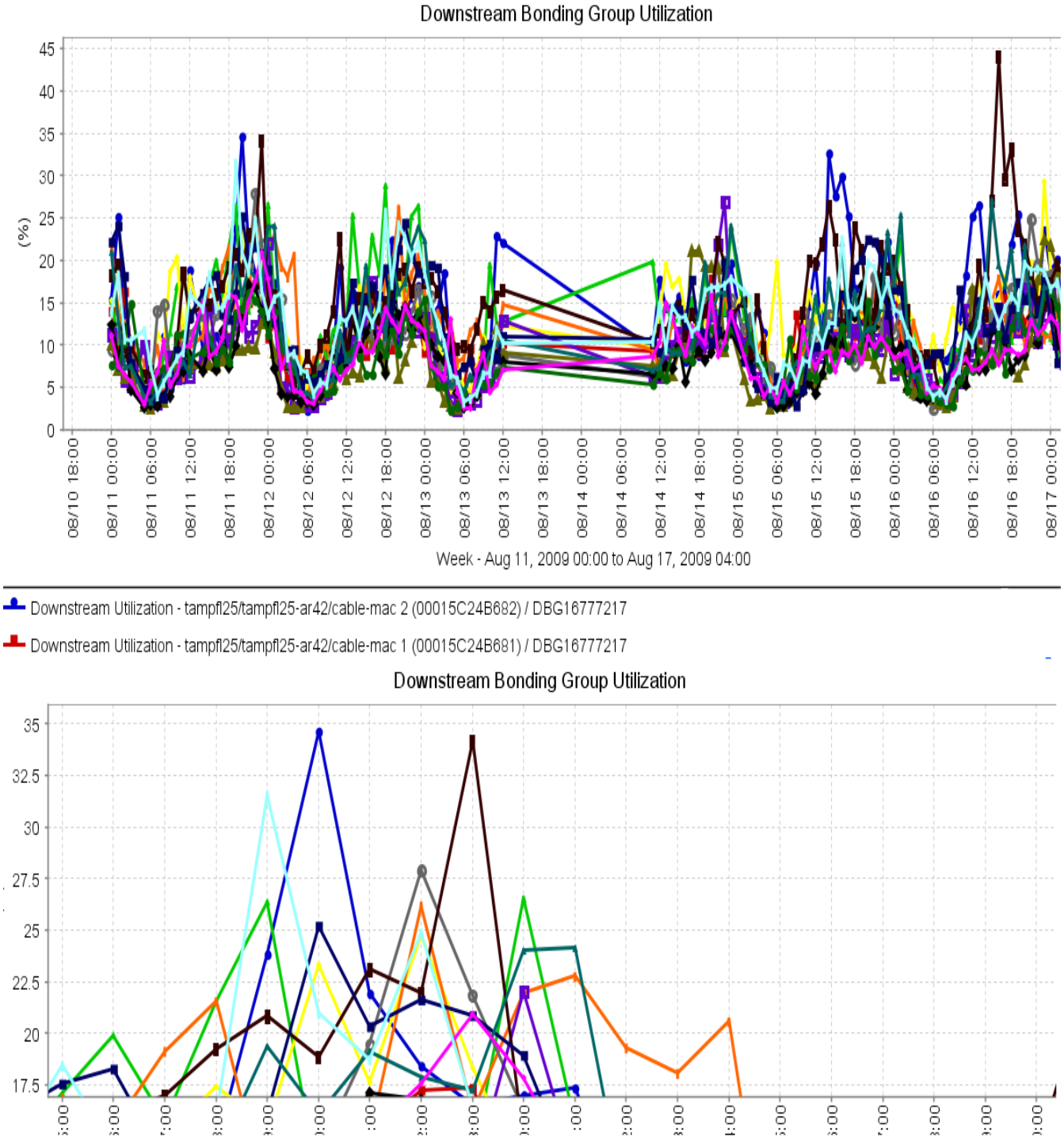

Figure 6 Historical Perspective of CMTS bonded channels

Figure 6 shows a historical perspective of individual interfaces associated to a downstream bonded group. From the visual it is apparent that over time some of the individual interfaces in the bonding group are utilized more than the others and hence a re-balancing can be performed to evenly distribute the load. Finer grain resolutions provide detailed usage patterns that can be used to study the utilization characteristics. The data for utilization can either be obtained from SNMP or from an IPDR collector.

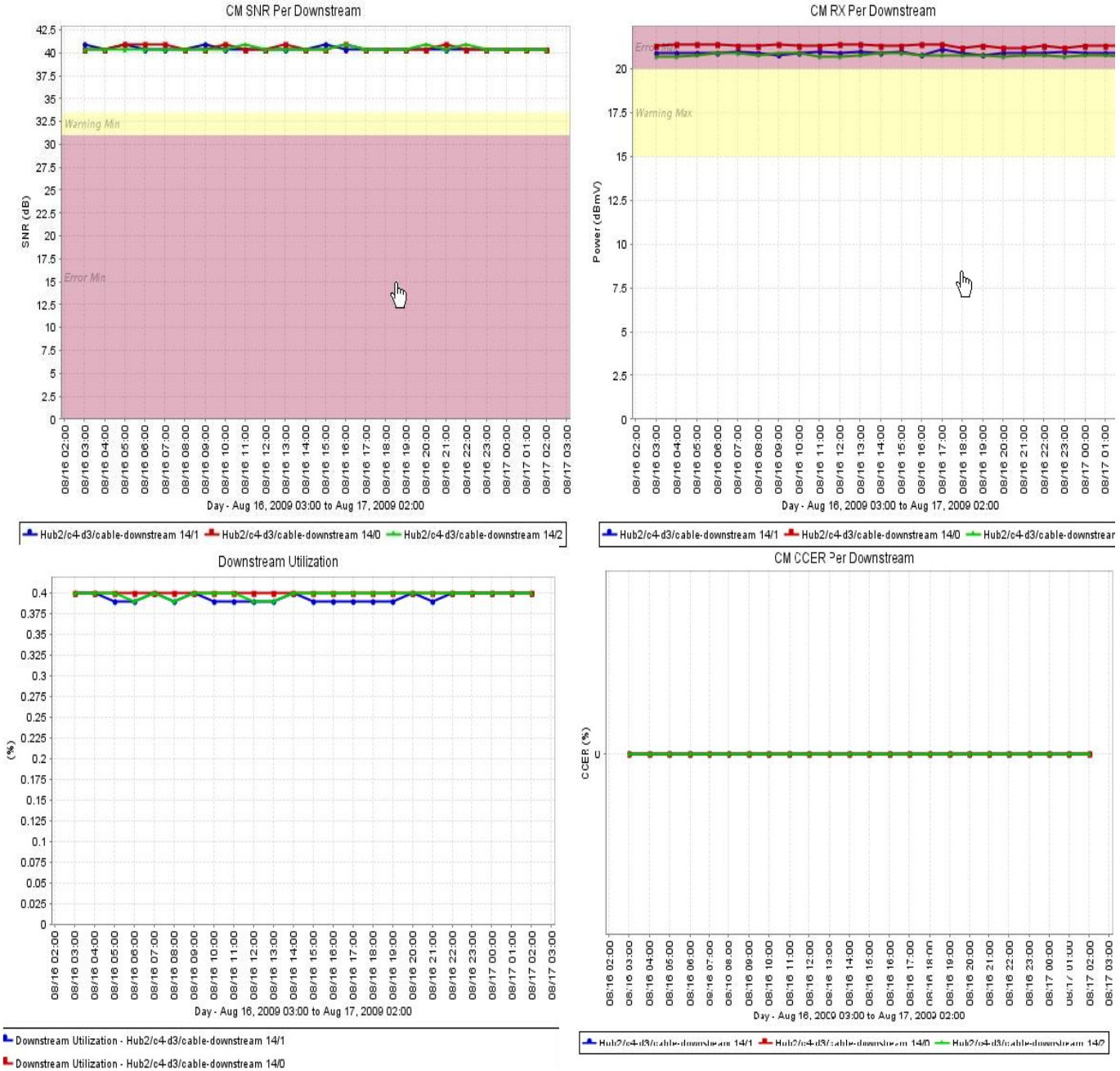

Figure 7 Historical CM Perspective of bonded channel interfaces

Figure 7 provides visual representation of the historical data from a CM perspective per individual interface of a bonded channel.

Conclusion

DOCSIS 3.0 offers tremendous data throughput increases and with this come challenges in further evolving the HFC plant to support the physical layer. Plant maintenance and monitoring must be maintained to ensure quality for HSD and VOIP subscribers and at the same time sufficient planning needs to be taken into account for capacity and growth.

Once a new service is first deployed, the infrastructure and bandwidth capacity is often over-provisioned. This extra capacity allows the service provider to stay ahead of fast growth. Once the service is deployed and better understood, it is important to maximize margins by efficient use of capital and by completely leveraging existing infrastructure. Leveraging the appropriate OSS solutions to view and analyze the data provides the MSO with a powerful tool to prepare for conversions and deployments of DOCSIS 3.0 networks

Abbreviations

SNMP – Simple Network management Protocol
IPDR – Internet Protocol Detail Record
CM – Cable Modem
CMTS – Cable Modem Termination System
CPE – Customer Premise Equipment
SNR – Signal-to-Noise Ratio
Tx – Transmit
DOCSIS – Data over Cable Service Interface Specification
CER – Codeword Error Rate
MER – Modulation Error Rate
MOS – Mean opinion Score
MSO – Multiple System Operators
OSS – Operation Support Systems
MIB – management Information Base
CL – Command Line
HFC – Hybrid Fiber Coaxial
Qos – Quality of Service
DS – Downstream
US – Upstream
MD – Media Access Control Domain
SG – Serving Group
ROI – Return on Investment
DBC – Dynamic Bonding Change
SDV – Switched Digital video
IPTV – Internet Protocol Television

References

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