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## Content Monitoring: A Key Component of Comprehensive Edge Resource Management



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As operators become increasingly bandwidth-constrained, bandwidth saving and optimization techniques that were traditionally used in the digital video headend, such as VBR and statmuxing, are now trickling down to the edge of the cable network. This allows for additional bandwidth saving opportunities on applications including SDV/ VOD, among others. Due to the dynamic, session-based nature of these applications, a dedicated resource manager often is required to manage different user sessions to allow applications to optimize shared resources on the same network.

A sound balance has to be maintained and managed between bandwidth (resource) allocation and service quality. That is, optimizing bandwidth and resources at the edge must not come at the cost of degrading a subscriber's viewing experience. This is especially important since subscriber sensitivity to quality degradations, such as video tiling, black/frozen screens and audio disruptions is ever-increasing as HDTV and other new interactive applications continue to proliferate into more households. And, of course, as competition among TV service providers intensifies, much of the battle for consumer loyalty will be won by providing a quality viewing experience.

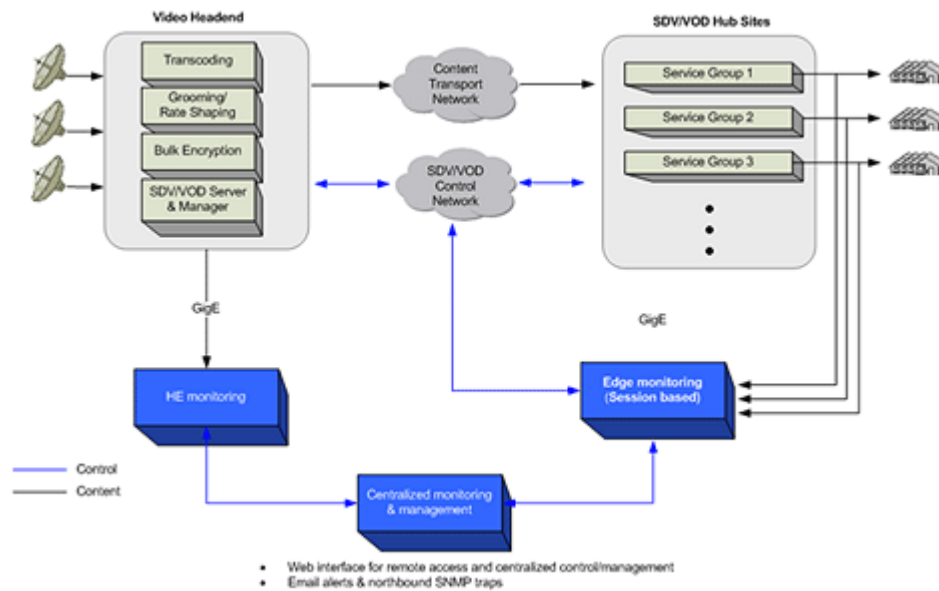
### Why Monitor at the Edge?

As hub sites at the edge of the network perform more complex and mission-critical video processing tasks in real time, the probability of errors happening at the edge increases by an order of magnitude. That's because the potential points of performance degradations or failures multiply.

First, in the case of variable bit rate SDV, the statistical multiplexing tasks that are done first in video headend will be done many times over at the hub sites. Secondly, the edge hub sites are not as well staffed and equipped (e.g., video wall) as the video headends, and many hub sites are unmanned. Finally, the hub sites usually do not have the same redundancy level as some video headends do. These highlight the importance of monitoring at the edge, and the integration required between the monitoring system and the edge resource manager to mitigate problems and increase QoS and QoE.

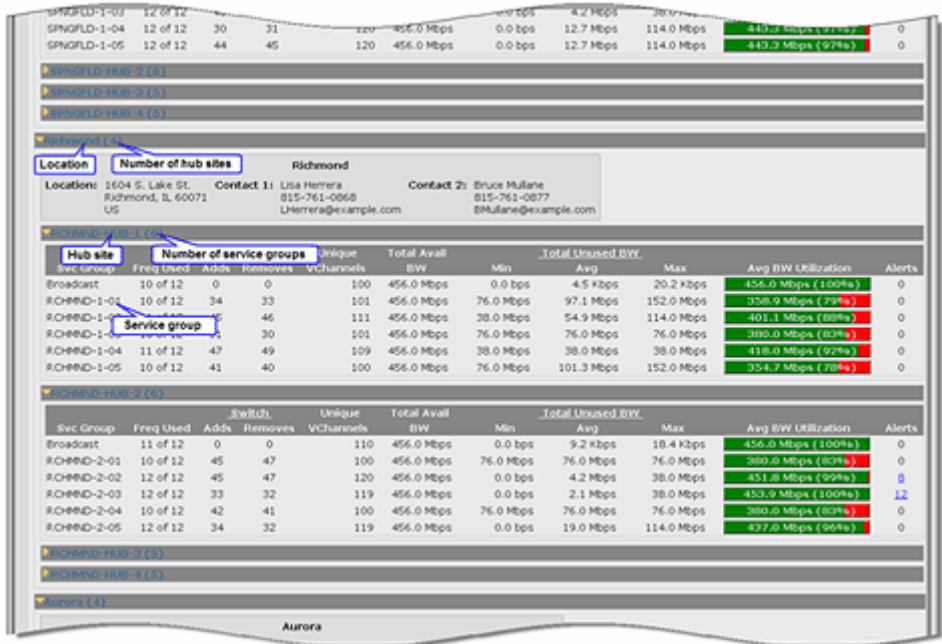
For example, in an SDV or VOD network, the monitoring system can be directed to tune into a certain QAM channel to monitor and validate the service based on the session information provided by the SDV/VOD resource manager. This monitoring strategy and deployment, as shown in the diagram below, will provide key utilization and health statistics associated with the network. More importantly, it can alert on the occasions anomalies happen, such as verifying if

the right program is turned up for the right service group, at the right QAM frequency and at the right time. The monitoring system also can alert on any RF modulation errors (MER/BER), SNR issues, and MPEG errors associated with every service monitored at the edge.



### An Overall Edge Resource Management Objective

Any monitoring system should be SDV equipment-agnostic and be able to display a holistic view of all the key statistics by service group for different hub sites at different locations. The screenshot below shows an example of locations and their respective hub sites and service groups being monitored. For the Richmond location, there are a total of four hub sites. Two of the hub sites have six service groups, and the other two have five service groups. The user can easily see all the key statistics and alert counts associated with each service group. This provides the operator with a quick assessment of the overall health on a large-scale SDV network in multiple locations, as well as individual entry points for any anomaly detected on the network through alert counts displayed on the screen.



The edge resource manager has all the knowledge related to where and when services are delivered based on user activity and bandwidth capacity. Therefore, through integration, the video service monitoring system should be able to monitor what went wrong with which service and when. The two systems work in conjunction to accomplish the overall edge resource management objective, which is not only to share resources and manage bandwidth allocation, but also to inform engineers of any opportunities to optimize the quality of experience at the edge. This creates a more resilient edge network and system.

### Conclusion

The network edge is becoming ever more complex and strategic to cable operators as they seek to deliver more localized and personalized programming and ads to their subscribers. Adding to the complexity is the addition of next-generation VOD servers, ad servers, intelligent QAM modulators and other edge devices, coupled with new SDV architectures. Ensuring that today's - and tomorrow's - services are delivered with optimal quality requires operators to closely monitor their programming and ad content as it flows through these devices. Content monitoring should be considered an indispensable component of any approach to comprehensively managing edge resources.

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