Video Quality Assurance Across IP Networks: Challenges, Requirements & Winning Strategies

New Technologies Permit Operators to Proactively Manage, Identify, and Solve Problems to Control Operational Costs and Boost Efficiency

Abstract

As customers demand increasing flexibility to receive video services anywhere and anytime with the best possible quality of service, cable operators of all types have deployed IP next-generation networks, which provide new levels of scalability, flexibility and fault resilience, while acting as a platform for the rapid deployment of new video services.

Operators will be challenged with monitoring and troubleshooting the growing number of video flows across these dynamic IP networks. A single lost IP packet can create visible artifacts on a large number of television screens, promoting the need for a new approach to video quality monitoring.

A new set of technologies can be used to ensure high-quality transmission of video across an IP network, using network-centric and service-centric views. This new, integrated solution – bridging the gap between “IP engineers” and “video engineers” – enables cable operators to precisely isolate and rapidly resolve video issues, while providing a common reference for diverse operational groups that will reduce the duration of impairments and consequently reduce subscriber support calls.

Introduction

The world of entertainment video is changing to support alternative methods for viewing content (e.g., on-demand) and additional devices for displaying video programs (e.g., PCs, game systems and handheld mobile devices). The industry is relatively young, but viewers still expect a flawless experience. Testimony arises from anyone who has endured a widespread video outage during a major Pay-Per-View event, Final Four tournament game or major football game. But poor quality of experience triggers more than inconvenience.

For instance, a major boxing event transmitted by a medium-size Multisystem Operator (MSO) region can generate more than $1 million in revenue. Unhappy customers will cancel subscriptions if confronted by a major outage. Further, cable television represents a lifeline service during local or national emergencies. Cable networks disseminate urgent news and critical public information, warning the public of severe weather or other impending dangers.

Service providers require a comprehensive service assurance solution in order to achieve the expectations of continuous high-quality viewing experiences. Such a solution enables service providers to proactively identify quality issues before they impact customers and leads to more efficient troubleshooting and resolution.

Challenges for Providing Consistently Good Quality of Experience

The cable community understands the complexity of troubleshooting IP networks. Adding newer video services adds to the complexity, straining network operational resources. Isolating video anomalies to a specific problem domain and allocating proper operational resources is critical to supporting high-quality video over an IP network and controlling costs.

Video relies on the network to provide customers with a high quality of experience. An effective video fault management system allows providers to detect and resolve quality issues before customers complain. Limiting help desk calls is preferred. Service calls reduce profit and increase customer churn. The average cost of a single customer case equals or exceeds the profitability of that consumer for an entire year, according to some cable providers.

In the broadcast television industry, success depends on consistently providing excellent video quality. When broadcast video services are delivered over an IP network, quality of experience is affected directly by packet loss and jitter. One IP video packet contains approximately 1,400 bytes of information, and each IP packet contains multiple MPEG encapsulated video packets. The loss of even one IP packet can lead to video impairments lasting half second or more. A single dropped packet also may cause “tiling.” Many dropped packets can lead to video freezes or loss of signal at the customer’s location.

Lengthy content delivery chains further complicate video networks. The delivery chain includes the broadcaster's head-end, the transport network consisting of multiple network elements, video manipulations such as multiplexing, ad insertions and finally through to the customer's home network and set-top box.

A video assurance solution must account for the various technologies transporting the video services and reduce the operational complexity for those charged with maintaining the quality of those services.

Video Assurance Management Solution Requirements

To assure excellent quality, service providers delivering broadcast television services over IP networks need powerful end-to-end, fault-management systems for continuous monitoring and correlation of service and network performances. These systems must meet several requirements:

- Identify faults in real-time and determine the impact to the specific video services.
- Support visibility into several operational domains (such as head-end, core, aggregation or access) for fault isolation.
- Integrate with the network infrastructure and operations support systems (OSS).
- Share common information pools and automation scripts for fault isolation, identification and resolution.
- Promote communication among personnel from different operational domains (head-end, core, aggregation, access).
- Present information in language familiar to both network operations and video operations personnel.
- Provide an architecture that supports devices from multiple vendors.
- Provide operational dashboards with intuitive drill-down navigation to detailed quality statistics per domain, per program and per stream.
- Extensible architecture to include components supporting future services.

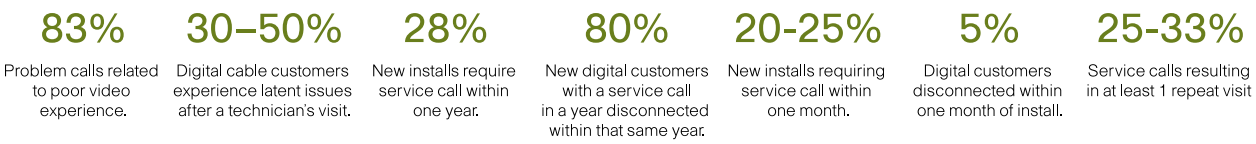
Critical Factors to Consider for Video Assurance

The critical factors a video assurance solution must consider include: operational costs, problem domain isolation and determination of services impacted. Related statistics are shown in Figure 1.

- **Operational Costs:** This inversely affects cable operator revenue. Four out of every five digital-program subscribers who placed service calls disconnected within the same year, according to studies. Up to one-third of all service calls requires at least one follow-up by a service technician. Increasing operational costs and decreasing subscriber quality of experience is an unsustainable model.

- **Problem Domain:** Successfully reducing the duration of a video delivery issue depends on locating the problem. Rolling out a truck to a customer site when the problem originates in the core transport network represents an unnecessary cost to the service provider. Similarly, dispatching network engineers to isolate and troubleshoot the IP network infrastructure would be unnecessary if the problem originated in the video head-end. An effective video assurance management solution must quickly identify the problem domain in the event of a service disruption, so providers don't incur wasted costs.
- **Service Impact:** Delivery of video services over an IP network represents the combination of two distinct technologies. A video assurance management solution must bridge this technology gap. Since video issues are likely to be reported as program issues, there must be an ability to correlate those services to the IP transport streams responsible for the delivery. Similarly, an operator should be able to assess the impact on a video service should IP transport issues be detected.

Figure 1. Video Assurance Statistics



Examples of Critical Problems Related to Video Assurance

1. What is the most important characteristic of an efficient video assurance management solution?

   Today, there are many fragmented solutions for video assurance management. Many existing video monitoring solutions are either point solutions or rely on vendors who address only a small sub-section of overall delivery. Video assurance requires an architecture that permits interoperability between monitoring and troubleshooting. Video operations dashboards should condense the amount of information presented to the operator and provide a unified service status.

   Many video impairments are transient, and service technicians often fail to properly detect and isolate the video-service disruption. Without an end-to-end video assurance management strategy, technicians lack a logical trail to follow and instead work instinctively, changing cables, connectors, STBs and other equipment, trying to solve the issue. Technicians frequently are dispatched to a reporting customer site, even though the fault actually may have been miles away at the head-end, since video has dependencies within the IP network. That saddles the service provider with increased operational costs.

   An efficient video assurance solution provides a complete end-to-end service assurance architecture for video services. The architecture must account for multiple domains including the video head-end, the providers transport and set-top boxes at home.

2. Many operations centers fail to communicate with one another.

   Productivity increases when there is an ability to measure video flow as it transfers between operational responsibilities. This occurs when an anomaly is isolated to a specific problem domain in the end-to-end path, and the appropriate operational groups receive the assignment.

   Most cable operators maintain separate video operations centers (VOC) and network operations centers (NOC). A video assurance management solution that alerts network operations personnel which part of the network requires attention (or what network event caused an anomaly) and simultaneously tells video operations personnel which specific programs were affected is critical to timely resolution. The ability for a video assurance solution to track the IP flows that contain a particular program (e.g., pre-ad-splice, post-ad-splice, pre-encrypt, post-encrypt) and all associated IP addresses used in the distribution of these services would allow service providers to determine both problem impact and the priority of the video services affected. Understanding the priority of the video service affected may mean the difference between troubleshooting a rerun vs. the Super Bowl. Through problem domain reduction and service impact assessment, operators can assign the personnel best-suited for a particular problem, reducing both resolution time and costs.

3. How can an NOC monitor a channel across multiple multicast streams and Ad Zones?

   Cable operators use IP transport addressing to route packets through their networks. For broadcast video services, multicast addresses allow a single IP stream to reach large numbers of subscribers. Advertising content is inserted to video services as the multicast flows travel through the national network and regional networks to the local hubs. The insertion of advertising at these different points in the network is commonly referred to as Ad Zones.

   The use of Ad Zones allow service providers to increase revenue by offering more specific advertising as the video service moves closer to the end subscribers. However, ad insertion presents a challenge to service providers. As the content of a video service is changed with new advertising, so must the multicast address of the IP transport. It is not unexpected that a video service may travel through several different multicast flows before reaching the subscriber. When a problem is reported on a particular video service, operators face the challenge of determining which multicast flows are responsible for the delivery of that complete service.

   A video assurance solution must be able to associate a video service with the multiple multicast flows controlling the transport of that service through the network. The video assurance solution also must be capable of determining through which points in the network these multicast flows exist. Without this capability, operators would be unable to reduce the problem domain for an issue and would be forced to examine the entire transport network.

4. Monitoring the head-end network in a video assurance management solution.

   Head-ends are the heart of a video network and can impact the largest number of customers should a serious or catastrophic outage occur.

   Video content and payload quality on the ingress at the head-end is critical. Any flaws associated with the payload at this point will simply appear as poor quality on subscribers' screens. A great deal of processing takes place at the head-end that can potentially affect the video. This is where most of the video encoding, transcoding, rate shaping, program insertion, multiplexing and encryption takes place. Head-end monitoring not only guarantees the quality of the content being delivered to the subscriber, but also enables the service provider to monitor the quality of the content being supplied. The ability to identify video content errors at the acquisition source alleviates wasted truck rolls or time spent troubleshooting the IP transport, all of which reduces operational costs.

   The ability to identify video content errors at the video source assures service providers with the highest quality of service for their subscribers.

5. Monitoring the last mile is critical.

   Last mile and home network problems account for a majority of all quality issues reported to service providers and must be effectively addressed. While probes are effective monitoring tools, deployment to scale in the last mile is cost prohibitive.

   A video assurance solution must scale to the number of subscribers in the last mile, providing error correction and quality notifications as set top boxes come on and offline. Services such as rapid channel change, forward error correction and video error repair are all components affecting video quality of experience. A monitoring solution that seeks to be end-to-end must effectively address monitoring in the last mile.

6. The role of video probes in the larger video assurance management solution.

   Video probes are common tools for video monitoring. Video probes traditionally are placed at key demarcation points along the video path. Monitoring at the ingress and egress points of different domains in the transport informs the operator if the flow successfully has been transported through this domain.

   Most probes collect data about each video service by examining the MPEG transport headers carried within a multicast flow. Other probes, which are generally more expensive, are capable of examining the MPEG data contents directly for errors.

   The information gained from the probes, when combined with other video metrics, help isolate problems quickly in the delivery chain. Video probes are an important part of any video assurance solution. The key is tying these devices into the larger video monitoring architecture that accounts for the many other aspects of video assurance and video service delivery.

7. How important is the user interface in a video assurance management solution?

   Being able to monitor multiple service silos means viewing multiple screen outputs to determine where a video service may have become impaired. This is not a simple task.

   The use of a unified dashboard will prevent operators from associating diverse alerts from various screens to a common video service.

   A “single pane of glass view” is critical for network operations personnel. Complexity on how the events are collected, and from what sources, should be hidden at this level. The video service status is the critical element that should be represented and monitored. An operator should be able to quickly diagnose that an anomaly exists, the domain where an anomaly is occurring and the services that are impacted.

   For lower-level troubleshooting, specific engineering operators relevant to the problem domain where the anomaly is occurring can be dispatched for further additional diagnostics.

8. The challenge for cable operators to create unity among various vendor offerings.

   Equipment from many vendors comprises the broadcast video network, while the IP network is primarily composed of routers and switches. Head-ends and hubs have specialized equipment that captures or encodes video signals for insertion into the network and transport to the customer premises. An effective video assurance management system can view, map and communicate with every component of this network. It must offer multivendor support and be flexible to accommodate additions, changes and upgrades to the network. For example, this flexibility would recognize the addition of last mile drop points to support new subscribers; understand software upgrades in switches and routers; and accommodate new bandwidth-management schemes over time.

Summary

Consumers do not care where the problem in the network originates. They do not care whether it is in the head-end or at the set-top box or anywhere in between. The only thing that consumers care about is consistent delivery of quality video and a quality experience.

Telecom operators, broadcasters, satellite operators and cable operators are delivering more video services to end consumers today. Video is a complex, performance-sensitive service that requires a network to provide excellent quality of experience to its customers. To assure quality, cable operators who deliver video services need a powerful end-to-end video assurance solution.

We have reviewed the key drivers that can help service providers re-evaluate, redesign and build reliable, end-to-end and fault tolerant video assurance management solutions. Reduced subscriber churn and increased market share will belong to service providers who seize the opportunity to ensure customers receive the highest quality of experience through strategic and timely network management investments.

Cable operators constantly look at new service models and quality metrics that directly relate to customers' video experiences. There are myriad variables to measure and control in order to deliver an uninterrupted stream of broadcasts with a rich, clear signal and crisp sound. If service providers neglect the management aspect of this new opportunity, they may face higher costs when dealing with future operational issues. One of the determining factors in their continued success will be an overall end-to-end video assurance management solution.

For More Information

For more information on Cisco Video Assurance Management Solution visit http://www.cisco.com/go/vams.

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV
Amsterdam, The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.

Printed in USA C11-542005-00 06/09