

Keys to Success for Network QoS

An ENTERPRISE MANAGEMENT ASSOCIATES® (EMA™) White Paper
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Executive Summary

Network Quality of Service (QoS) has become an imperative element of responsible network architecture and design. Proper use of network QoS allows the peaceful co-existence of high-value, latency-sensitive traffic such as VoIP and IP videoconferencing with bandwidth-hungry, but less time-sensitive traffic. But while networking pros understand the need for network QoS, accurate deployment and ongoing enforcement of consistent QoS policies is difficult, particularly in large, distributed environments, and thus management technologies and practices must be optimized to assure success. This ENTERPRISE MANAGEMENT ASSOCIATES® (EMA™) whitepaper examines the detailed reasons for using network QoS, best practices for implementing and ongoing management of network QoS, and the LiveAction solution for QoS management offered by ActionPacked! Networks.

The Case for QoS

Today's business and governmental organizations rely on a few key assumptions about what IT provides for them. One of those assumptions is that mission-critical applications will be assigned every resource and technique possible across the integrated IT infrastructure in order to assure both high availability and high performance. This assumption translates into requirements for the data center, in terms of server architecture and storage technologies and practices, as well as for the ubiquitous delivery infrastructure commonly known as the network. And while there are a number of different choices for how to improve performance and optimize application delivery within the network, one of the most universal is the use of QoS definitions and policies. But while the concept of network QoS is well understood and not technologically complex, it is often not deployed successfully, or at all, because of the challenge of "getting it right."

Network operators have long recognized that there are a wide range of application types and flows transiting their networks. There are Web-based applications, file transfers, collaboration tools, messaging applications, voice, video, and enabling network services present concurrently on virtually every link. Further, this mix of traffic is present both within campus LAN settings as well as on wide-area (WAN) links. The various flows have very different characteristics, as well as different relative business values. Good network design requires an understanding and expectation of precisely what mix of application types (including each type's usage and flow rates) are likely to exist and must thus be supported in terms of network volume (bandwidth) and network speed. "Successful" network delivery is commonly determined objectively by the use of delivery metrics, such as latency (the time it takes for packets to get from point a to point b), jitter (how badly out-of-order the packets arrive at their destination), and packet loss (how many packets didn't make it and had to be sent again). End users and consumers of IT tend to have a more subjective view of success, typically termed as "end user experience" which is only partly a network issue.

Some applications require special handling within the network – the most common example being Voice over IP (VoIP). IP-based voice traffic requires end-to-end latency of less than 200 milliseconds, jitter of less than 50 milliseconds, and a total packet loss budget of less than 2%. When any of these metrics is exceeded, voice quality begins to degrade below the point where effective human communications are possible. Fortunately, VoIP calls require a mere 64 kbps of bandwidth – a relatively small percent of the average network links in enterprises today. Unfortunately, congestion and contention with other

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applications can result in high latency and packet drops (loss) due to overfull forwarding queues. As a real-time application, VoIP does not handle these situations well and can do nothing but degrade in quality. On the other hand, non-real-time applications, such as file transfers, simply take longer to complete, and any packets that are not delivered successfully can simply be retransmitted.

Networking pros have historically focused on bandwidth utilization as the first indicator of problems, and subsequently as a planning objective for assuring application delivery quality. “Throwing bandwidth at the problem” has been a common approach over the years, despite the fact that most practitioners recognize that this is a temporary measure at best. And further, bandwidth in the WAN is expensive, so any amount of increased bandwidth is likely to come only at a significant cost. A better approach is to design a set of network delivery priorities by which important applications are given preference for delivery across the network versus those that are relatively less important.

So what else can be done, if simply increasing bandwidth is not a viable option? One option is to optimize the application traffic, using compression and intelligent caching to reduce the volume of traffic, particularly around Web-based apps as well as file transfers. This approach requires purchasing and deploying load balancers and delivery controllers, typically within the data center. Another approach is to shape or groom the traffic that is traversing WAN links, using technologies known as WAN optimization. Again, this approach requires purchasing WAN Optimization Controllers (WOCs),

which provide prioritization, compression, and caching based on what traffic arrives for transport at WAN end points. One of the common techniques used in WAN optimization is QoS, whereby defined application types are given priority delivery rights by the WAN optimization controller.

But QoS can also be implemented directly on network devices and equipment, with no requirement for deploying additional controllers. Network-based QoS can be, for many, a highly cost-effective approach to proactively manage traffic and assure application

delivery. Network QoS is predominantly implemented by the use of packet tags, which are defined and assigned to classes of applications by means of policy parameters within configuration settings on network devices such as switches and routers. Traffic is tagged wherever it first enters the network, and all the other network devices along the delivery path prioritize that flow based on the observed tag. For example, latency-sensitive traffic such as VoIP will be assigned a high priority, so that it will be given better treatment for timely delivery, thus minimizing latency, jitter, and loss and thereby assuring adequate quality. By the same example, streaming Web video would be assigned a low priority, often known as “best effort,” and awarded only whatever transmission capacity is available at the time it is crossing the network.

Deploying and Administering Network QoS

While the concept of network QoS is fairly straightforward, getting it deployed successfully can be anything but easy. Particularly in large, geographically distributed enterprise networks, where there are often hundreds or thousands of network nodes, policy enforcement for QoS definitions can quickly become a network administration nightmare. Firstly, not all network devices use the same syntax for QoS configuration, so getting the right policies in place universally will be difficult. Second, new devices coming onto the network must be brought into QoS policy compliance, lest they assign priorities to

Network QoS implemented directly on network devices can be a cost-effective alternative to deploying additional controller appliances.

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traffic incorrectly, thus interfering with proper queue management. And finally, particularly in large organizations, network device configurations are often changing, and every change brings with it an opportunity for unintended compromise of class definitions or policies. These challenges combine making it difficult to ensure that network QoS policy integrity is adequately maintained system wide.

Another challenge exists with monitoring the QoS policies that have been deployed. Traditional SNMP-based monitoring tools do not have a means for recognizing which types of traffic are present in the network and whether or not QoS policies are being complied with. Such visibility can only be established through the deployment of application-aware monitoring technologies, such as packet inspection or flow records. With ongoing monitoring through dashboards, reports, and alarms it becomes possible to recognize mis-configurations, proactively recognize and correct problems, and efficiently troubleshoot the issues that do arise.

Best Practices for Network QoS Management

In order to get the most out of network QoS, it is important for networking practitioners to pay attention to best practices in two key areas – change and configuration management and monitoring/troubleshooting. Across both of these areas, network management tools should be brought to bear to simplify the process, automate wherever possible, reduce or remove errors, and improve both efficiency and efficacy in managing and administering the network. Let's look at both of these areas in a bit more detail.

Change and Configuration Management

Within this functional area, ideal approaches will include a starting point of audit and assessment to determine precisely what applications are currently present in the network. Combining this knowledge with any expected changes will inform the definition and selection of network QoS class hierarchy. Most organizations will deploy a minimum of 3 classes, to organize high-priority (low-latency) traffic such as VoIP and separate it from business traffic as well as non-business/best effort traffic. Other organizations will go further, creating and defining as many as a dozen or more QoS classes. Helpful here is any ability to conduct “what-if” analyses, so that options for class definitions can be studied and their impacts understood before moving to production. The next step is to deploy QoS definitions across the network from end to end, consistently across all devices. While the technique of choice for many networking professionals to institute configuration changes is the Command Line Interface (CLI), scale and complexity challenges point towards higher level, policy-oriented approaches as preferable.

Best practices dictate specific steps for both the configuration and monitoring of network QoS.

Monitoring/Troubleshooting

Most important for assuring the ongoing success of a network QoS strategy is regular monitoring of network activity and QoS policy compliance. Visibility into the application traffic traveling across the network, including the QoS class tags associated with each flow, is necessary for recognizing situations where class definitions are not being followed. Monitoring dashboards and reports should be linked directly to detailed analysis and troubleshooting features, so workflows for diagnosis can be conducted and corrective actions taken as quickly as possible. Further, monitoring should readily reveal the impact of QoS (or other) changes made to the network as part of remediation efforts.

Managing Network QoS with LiveAction

ActionPacked! Networks offers a solution for monitoring and managing network QoS through its LiveAction software. LiveAction addresses the needs of network managers who seek both a better understanding of how their networks are operating and meeting application delivery expectations, as well as a facilitated set of solutions for simplifying the process of defining and applying controls. The solution has focused particularly on enabling effective management of network QoS, although it goes beyond that to also deliver broader capability for application-aware network visibility and management.

The LiveAction solution is delivered either as a set of discrete functional modules, or altogether as a single integrated solution spanning all of the individual modules' capabilities. At a high level, the LiveAction product family covers the following functionality:

- Configuring and monitoring network QoS
- Monitoring network application and service flows (based on NetFlow, sFlow, and J-Flow record collection)
- Monitoring and analyzing network routing via routing protocol analysis
- Configuring and analyzing Cisco IP SLA performance and availability tests

The LiveAction solution represents a viable approach to addressing the full spectrum of best practices for network QoS management by means of applying the functional modules outlined above – in particular LiveAction QoS Monitor and LiveAction QoS Configure. Following is an analysis of how best practice areas are addressed:

1. **QoS Change and Configuration Management:** Via the LiveAction QoS Configure module, network operators can use guided, forms-based wizards for constructing QoS policies and applying them across multiple devices. Multiple templates are provided as a starting point from which to assemble a set of QoS classes (based on Cisco best practices and training) and pre-existing QoS definitions can also be discovered and imported from fielded network devices. A CLI preview feature allows operators to check and understand exactly what commands LiveAction will issue to the devices prior to provisioning. Changes to class definitions and bandwidth allocations can even be made live, “on the fly” in response to problems as well as planned or observed changes in traffic character and behavior. Changes can be rolled back quickly and easily if they do not deliver the desired result. Audit capabilities are also provided, to ensure all devices under management maintain QoS policy integrity.
2. **QoS Monitoring/Troubleshooting:** The LiveAction QoS Monitor module provides clear, intuitive, historical and near-real-time views of QoS classes and the traffic that is traveling within them. Included are views of peak and average rates along with congestion indicators. Data can be played back to view activity and changes on a historical basis. Special alerts related to QoS class levels are generated to help operators recognize issues and problems. For Cisco-based networks, NBAR (network-based application recognition) graphs, definitions, and unknown port

LiveAction represents a viable approach to addressing the full spectrum of best practices for management of network QoS.

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debugging features are provided. Also, for Cisco-based networks, CBQoS (class-based QoS) MIB views and statistics can be presented.

Additionally, the LiveAction Flow and LiveAction Routing modules provide complementary insights into the operating environment. Although these modules deliver substantial value above and beyond QoS management, their greatest value is achieved when used in conjunction with QoS management. LiveAction flow visualizations feature a patent-pending “situation awareness” design approach, which delivers complex data in the form of highly intuitive flow topology maps. By delivering visibility into traffic and activity both at the lower layers of the network as well as the upper layers, subtle issues and impacts can more easily be recognized and diagnosed.

Finally, the LiveAction IP SLA module also plays a complementary role for monitoring. Cisco’s IP SLA feature set allows proactive/synthetic testing which can help reveal potential QoS compliance issues. LiveAction IP SLA uses graphical forms for easy definition of active tests (avoiding the need to use CLI) and integrating results into reports and dashboards.

LiveAction product users have found the system to be highly intuitive and quick to use. “The visual mapping within LiveAction has made it really easy to find incorrect settings,” said a senior network engineer from an education collaborative. “And when we find them, it is a snap to get the change made and confirm we have fixed the problem.”

“(With LiveAction) we were able to find and fix a really complex QoS problem in almost no time at all.”

“We had a recurring issue with videoconferencing quality,” said a network operations manager at an international law firm. “I always suspected it was a QoS issue, but couldn’t track it down until we put LiveAction in place. The Flow module revealed the problem – a backup/replication tool was using the same protocol port as H.323, flooding our high priority class with backup traffic. It was hard-coded in the backup tool, so we had to completely rewrite our videoconferencing QoS class rules using an IP address access list. The QoS Configure tools made it possible to do this quickly and easily. We were able to find and fix a really complex QoS problem in almost no time at all!”

EMA Perspective

As IT organizations begin to realize and fully embrace the promises of network convergence, delivering all types of services and applications across a single common network, class differentiation for delivery purposes using techniques such as network QoS becomes imperative. And with this new imperative comes a new set of technical and operational challenges revolving around policy definition and policy compliance. Enterprise Management Associates advocates three key priorities for management technology to deal with this and other drivers of operational complexity. First, network management tools must provide visibility into not only the happenings within the lower layers of network delivery, but also top layers, revealing which applications and services are traversing the network infrastructure and which users/end points are driving the activity. Second, tools should facilitate the use of complex network functionality, making it simple and rapid to deploy, with a minimum of human-introduced errors. And lastly, tools must employ automation wherever and whenever possible to assist operators in recognizing issues and keeping pace with the rapid changes inherent in today’s and tomorrow’s dynamic environments.

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The truly differential value of the LiveAction approach is in its combination of visibility, control, and automation for managing network QoS.

Network management solutions such as those offered by ActionPacked! Networks represent the current best-of-breed in dealing with some of today's most pressing management challenges – particularly those having to do with successful deployment of network QoS. Based on observations, comparisons to other products in the market today, as well as direct practitioner feedback, EMA concludes that the LiveAction solution offers significant, differential value by drastically simplifying the complexity of deploying and

maintaining a robust network QoS program. By combining visibility, control, and automation into a single package, the LiveAction product is a great example of how network management technology can and should evolve to rightfully assume an indispensable status within network planning and operations.

About ActionPacked! Networks

ActionPacked! Networks is the leader in quality-of-service software for implementing VoIP, Telepresence, Unified Communications, Medianet and other mission-critical services. The company's LiveAction software increases network service quality and shortens outages by providing true understanding and precise control using rich visualizations and direct device interaction. LiveAction leverages the QoS, NetFlow, Routing and IP SLA features embedded inside Cisco devices to provide the only all-in-one solution that can support both QoS auditing and provisioning.

For more information, please contact Networks at liveaction.com

About Enterprise Management Associates, Inc.

Founded in 1996, Enterprise Management Associates (EMA) is a leading industry analyst firm that provides deep insight across the full spectrum of IT and data management technologies. EMA analysts leverage a unique combination of practical experience, insight into industry best practices, and in-depth knowledge of current and planned vendor solutions to help its clients achieve their goals. Learn more about EMA research, analysis, and consulting services for enterprise line of business users, IT professionals and IT vendors at www.enterprisemanagement.com or blogs.enterprisemanagement.com. You can also follow EMA on [Twitter](#) or [Facebook](#).

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