Network Quality of Service

By Rick Blum, Research Programs Manager, and Jeffrey M. Kaplan, Director, Strategic Marketing

Highlights

- Implementing quality of service (QoS) is important to the IP network strategy of 83% of survey respondents, a percentage that will increase to 95% by 2002. Nearly all end-user organizations in this timeframe will review carriers' networks' QoS capabilities when making a purchase decision.
- The major contributors driving QoS initiatives are mission-critical data applications, IP telephony, and service level agreements (SLAs).
- Managing bottlenecks in the last mile's bandwidth and end-to-end latency are equally important objectives of QoS for most respondents. Throughput and latency are the key metrics for measuring QoS, within both an enterprise network and a carrier network.
- For 47% of respondents, technology is the biggest challenge to implementing QoS. A majority of respondents need help in QoS network planning, design, and implementation.
- The current high cost of QoS products is a significant barrier to realizing QoS goals for 46% of respondents, even though most are satisfied with their products' capabilities. Another 43% of respondents cite a lack of standards as a major impediment to implementing or improving QoS.
- A majority of respondents will implement one or more of the following within 12 months: label switching, service marking, relative priority marking, differentiated services, and/or integrated services.

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Introduction

The Internet Protocol (IP) has served global networks well, providing a standardized method to transmit data among many disparate systems. But IP is designed for simplicity, and only enables a "best effort" service that can be subject to delays and loss of data. For data networks, this is an acceptable trade-off. But in the emerging world of convergence, driven by new applications such as voice over IP and multimedia, minimal latency and jitter can be critical. Simply increasing the size of the IP network "pipe" to meet those demands is not always sufficient. In this environment, vendors and standards bodies are creating technologies and techniques that enable IP to improve the quality of service (QoS) it can provide, while retaining the characteristics that has enabled it to become the dominant networking protocol.

Throughout September 2000, Lucent NPS conducted a Web-based industry survey on a broad range of network issues impacting network quality of service. This particular survey was completed by 158 network professionals. The data reported is intended to yield valuable insight into the past, current, and future strategies for implementing and improving QoS in respondents' networks. It also identifies the barriers and challenges that network professionals expect to encounter as they plan and implement these QoS technologies and techniques. These results will assist networking organizations to assess their individual progress as compared to the industry, and identify opportunities for improvement.

For the purposes of this survey, network-based quality of service (QoS) is defined as the management of available bandwidth to deliver consistent, predictable data (packets) over an IP-based network. QoS is accomplished by sorting and classifying IP packet requests into traffic classes and allocating the proper resources to direct traffic based on various criteria, such as application type, user ID, source or destination IP address, and time of day.

THE BOTTOM LINE

Achieving a higher level of QoS in IP networks is a goal that network managers will not be able to ignore. The need for maintaining service levels while implementing new bandwidth-intensive applications will continue to drive more efforts into prioritizing and managing network traffic. Simply over-provisioning the network is a strategy that has limited long-term potential. As such, network professionals should recognize the importance of understanding QoS technologies and strategies available today, and begin planning for implementation so their networks will be capable of sustaining acceptable levels of performance as network traffic grows.

Typical of an embryonic set of technologies, QoS presents many technical, organizational, and managerial challenges that will quickly take a prominent spot in network managers' lists of concerns. These managers will also have to deal with a lack of staff experienced in this arena. Most will look to outside consulting firms to help them overcome this deficiency, especially in the planning, design and implementation phases of their network QoS efforts.

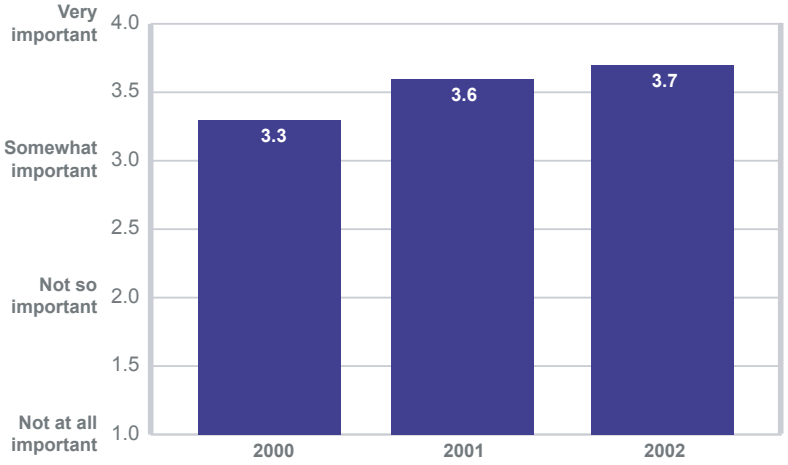
It is still too early to know which QoS strategies, technologies and techniques will be most widely adopted. Many are complementary and can be implemented in various combinations, depending on need. Keeping an open mind on all the possible QoS solutions at this stage of the game, along with thorough testing of potential products, will engender the best long-term results.

Importance of QoS to Network Strategy

Quality of service for IP-based networks has become a more important issue for many network planners as companies push forward with applications requiring guaranteed throughput with minimal latency and jitter. ATM networks were designed with these characteristics in mind, but have made little headway in local-area and campus networks. New technologies and techniques to improve QoS in IP networks have been developed over the last few years to help network planners and designers meet these new demands.

Most respondents to this survey recognize that they will have to implement QoS over the next two to three years. Nearly half (48%) of respondents indicate that implementing or improving their IP network QoS is very important this year. That percentage will rise to approximately 80% by the year 2002. Only a scant 5% of respondents do not believe that QoS will be somewhat or very important to their IP network strategy through 2002.

Importance of Implementing/Improving QoS



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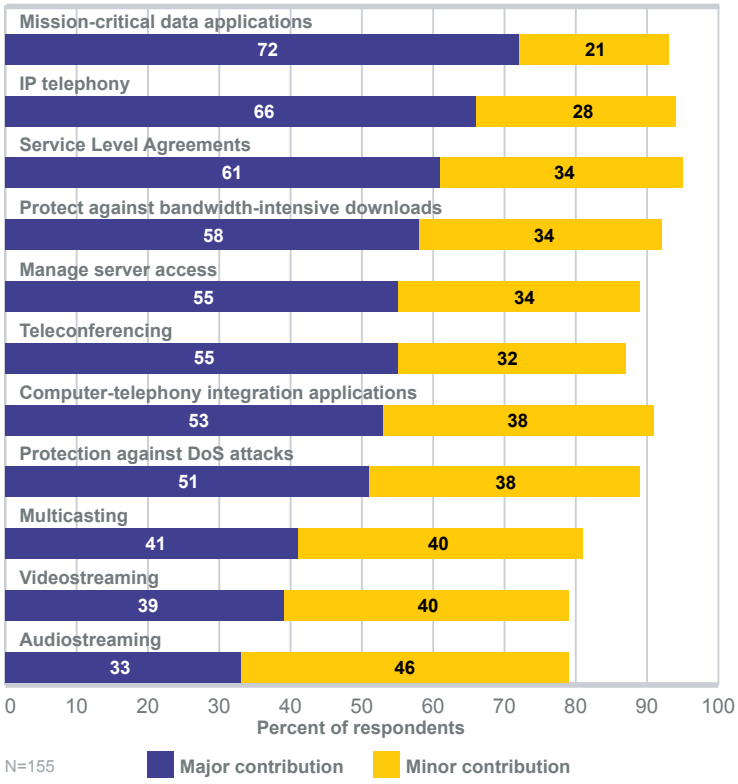
Contributing Factors to Importance of QoS



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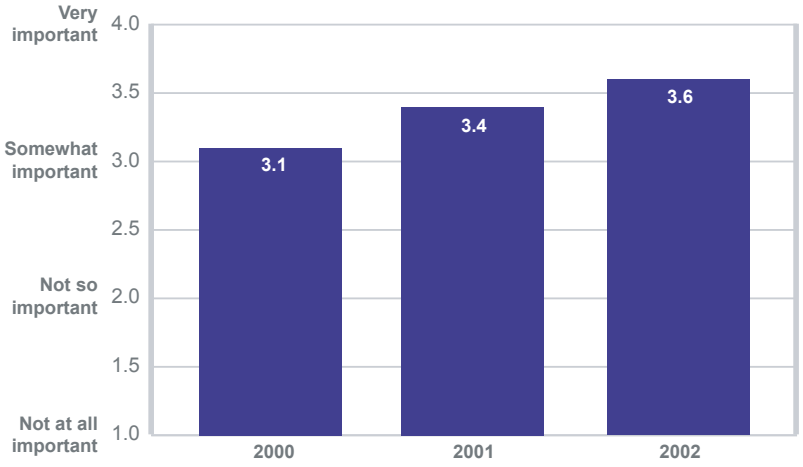
There are various factors driving the growing importance of QoS. Surprisingly, the leading factor is not a new technology, but rather an old standard—mission-critical data applications— that is most often cited as a major contributor to the importance of QoS. Hot new applications such as multicasting, videostreaming, and audiostreaming are major contributors to QoS efforts for only a minority of respondents.

The second driving factor is a new technology that is a major contributor to nearly two thirds of respondents' QoS efforts. That new technology is IP telephony. Predictions for the rapid growth of this application are apparently warranted based on the responses to this survey.

Importance of Carrier's QoS Capabilities in Purchase Decision



Note: End-user organizations only

N=76

The third major driver of QoS efforts is service level agreements. Combining both major and minor drivers, services level agreements is the most frequently mentioned of all factors that contribute to the importance of QoS in respondents' IP network strategy. Clearly, both enterprises and carriers are looking to QoS to enable meaningful and manageable service levels.

Not only will enterprise IT organizations strive to improve their QoS in the years ahead, they will expect their carriers to do the same. Currently, 43% of respondents say that their carrier's QoS capabilities are very important, but by 2002 that percentage will rise to 63%. Undoubtedly, carriers will have to keep their networks QoS capabilities in sync with that of enterprises.

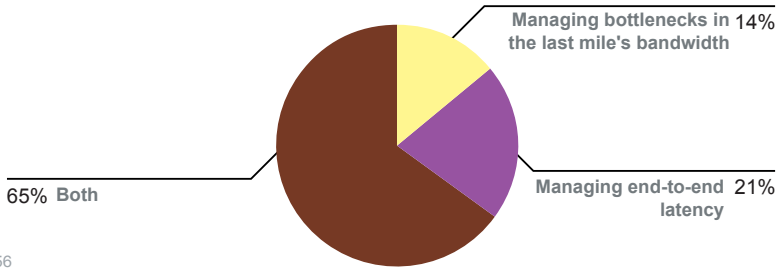
Clearly, both enterprises and carriers are looking to QoS to enable meaningful and manageable service levels.

QoS Drivers and Benefits

Typically, two issues drive efforts to improve network QoS: bottlenecks in the last mile's bandwidth and end-to-end latency. While some respondents view one or the other of these issues as the primary driver of their QoS efforts, the large majority (65%) place equal emphasis on mitigating each of these potential problems.

Simply meeting corporate user demand for new applications is the most frequent benefit of implementing mechanisms to improve network QoS, as cited by 75% of respondents. But, improving the performance of existing mission-critical applications is a potential benefit for two-thirds of respondents.

Primary Driver of QoS Efforts



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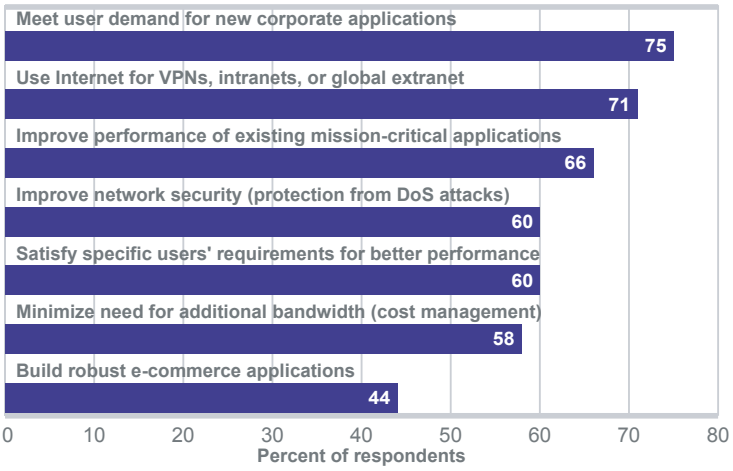
Benefits of QoS Mechanisms



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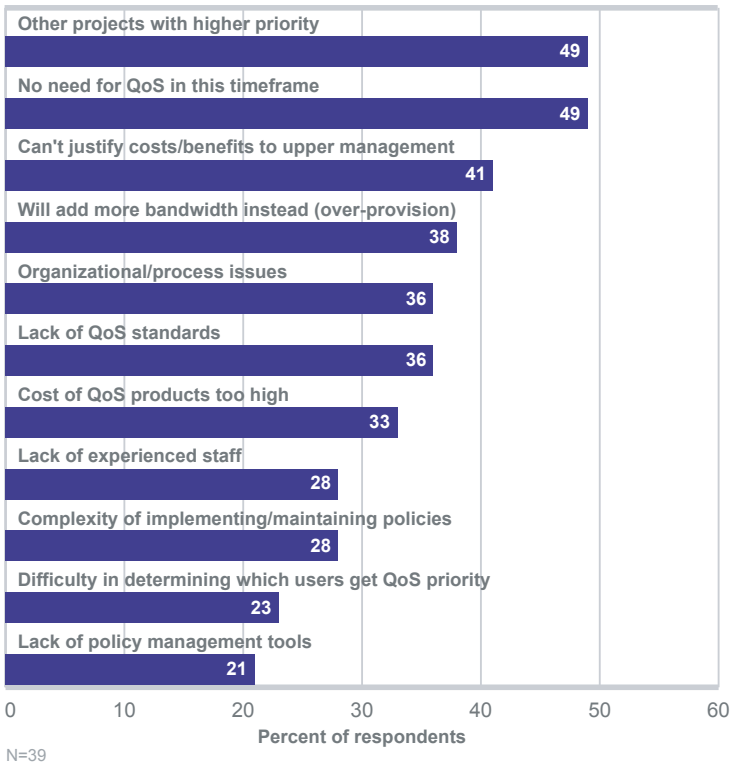
Seven out of ten respondents are implementing QoS in order to use the Internet for virtual private networks (VPNs), intranets, or global extranets.

Respondents who have not implemented QoS, nor plan to do so within 12 months, cite a variety of reasons to hold off. For nearly half of these respondents, there is no need for QoS in this timeframe. An equal number may recognize a need, but cite other projects having higher priority as their reason for not implementing any QoS strategies in the year to come. Both of these reasons can contribute to the high percentage (41%) of respondents who are unable to justify QoS costs versus benefits to their management.

Thirty-eight percent of respondents plan to add more bandwidth to their network (over-provision) in place of QoS. This can be a successful strategy in some environments, but may not be sufficient for many new applications, such as IP telephony.

Top Reasons for Not Implementing QoS



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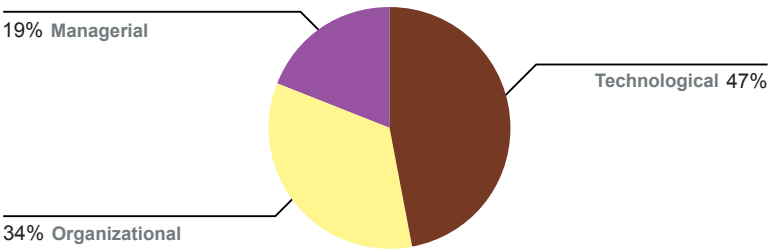
Challenges and Barriers to Implementing QoS

Nearly half of respondents find technological issues to be the biggest challenge they have in implementing their QoS strategy. Organizational issues are the biggest challenge for one-third of respondents. As a still maturing set of technologies, QoS will remain a technological challenge for many network managers. But as the market develops and network professionals get more experience with QoS technologies, we expect to see the pendulum swing more toward organizational issues as the most frequent challenge.

Biggest Challenge to Implementing QoS



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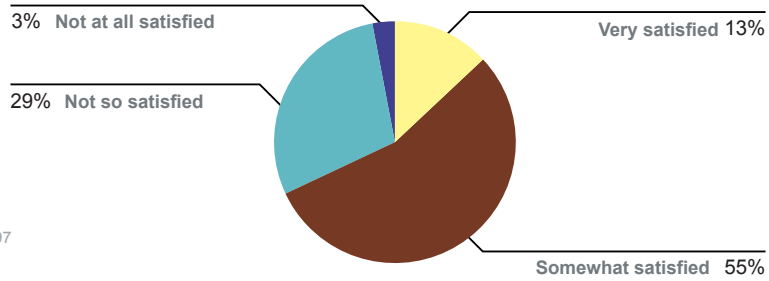
Satisfaction with QoS Products



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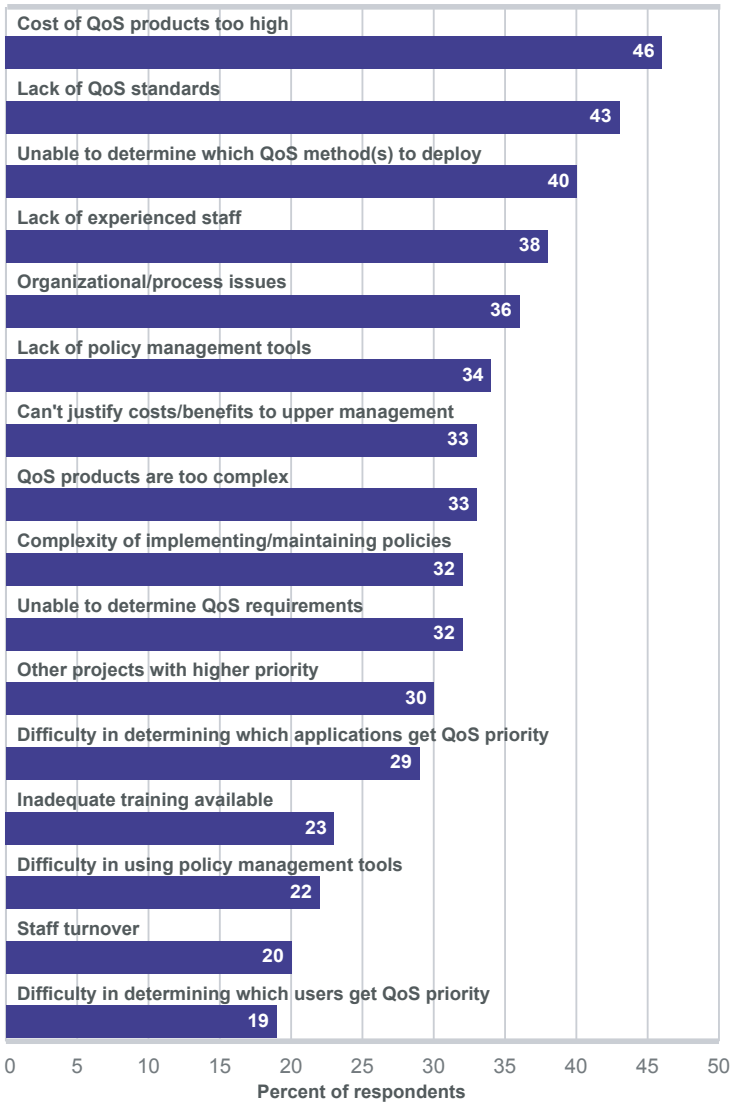
Significant Barriers to Implementing QoS



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Even though technology is the biggest challenge to nearly half of respondents, two-thirds are very or somewhat satisfied with the QoS products currently available on the market. While this is an encouraging number, especially for an evolving set of technologies, a significant minority of respondents are not satisfied with the QoS products on the market today. In addition, of those who indicate some level of satisfaction, only 13% are very satisfied. For vendors of these products, the message is that many improvements are still required until QoS technologies are widely adopted and implemented.

Even though technology is the biggest challenge to nearly half of respondents, two-thirds are very or somewhat satisfied with the QoS products currently available on the market.

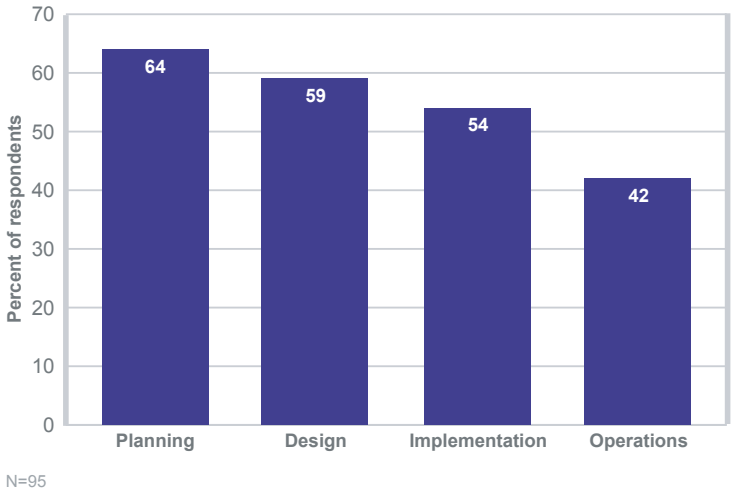
Not only is there considerable room for QoS product improvement, the cost of these products is a significant barrier to implementing QoS for nearly half of respondents. This combination is likely to retard the adoption of QoS for the immediate future.

Product cost is only part of the story. For 43% of respondents, lack of QoS standards is a significant barrier to successfully implementing QoS in their network environments. And for another 40%, simply determining which QoS methods to deploy is a significant barrier.

In total, the typical respondent identified five significant barriers to implementing QoS.

Given this number, it is clear that many network organizations do, and will need help in implementing and/or improving their QoS. A majority need assistance in the first three stages of the network lifecycle: planning, design, and implementation. Only 42% of respondents need help in network QoS operations. However, as more network organizations actually integrate QoS products into their networks, we expect this percentage to rise to a majority of respondents.

Areas Where Help is Required to Implement/Improve QoS



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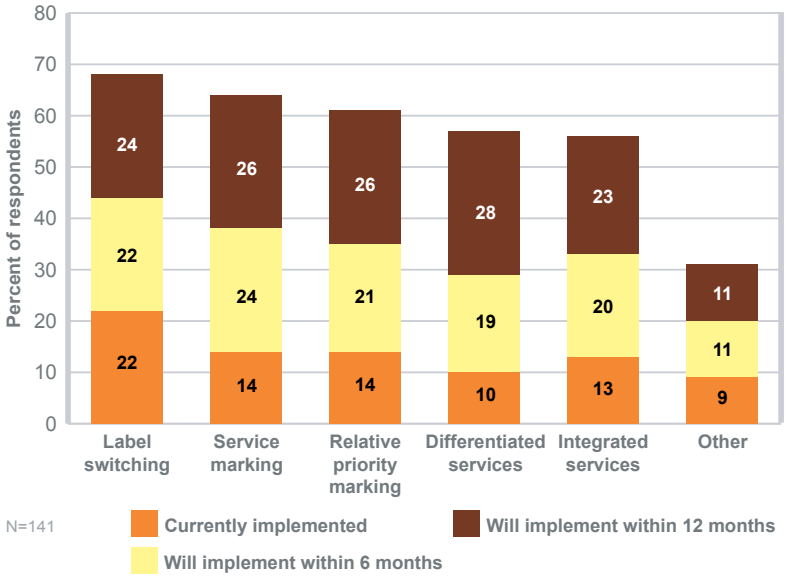
QoS Implementation Status and Plans

Among five leading QoS strategies, label switching is currently most frequently implemented (by 22% of respondents), followed by service marking (14%) and relative priority marking (14%). This order of implementation will remain constant over the next 12 months, although percentages will rise dramatically to more than 60% of respondents for all three strategies.

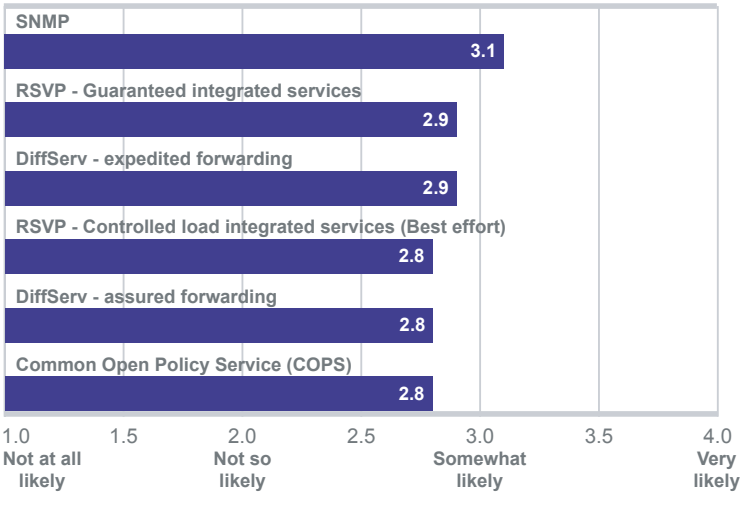
Led by Simple Network Management Protocol (SNMP), Resource Reservation Protocol (RSVP) guaranteed integrated services, and Differentiated Services (DiffServ) expedited forwarding, respondents are likely to implement a wide range of QoS technologies in the next 12 months. But the lack of significant rating differences among the six technologies (SNMP will likely be implemented by 80% of respondents, and COPS by 67%) shows the inter-relatedness of these technologies, which can be used individually or in a complementary fashion.

The likelihood of using each of the four QoS techniques shows the same pattern as the QoS technologies.

QoS Implementation Status



Likelihood of Deploying QoS Technologies Within 12 Months



That is, there are only small differences in likely implementation plans. Transmission Control Protocol (TCP) rate control/shaping is likely to be implemented by the highest percentage of respondents (84%), while class-based queuing will likely be implemented by 68% of respondents.

Traffic prioritization, which is the classification of services to enable network prioritization, can be achieved based on a number of criteria. Respondents are most likely to prioritize network traffic based on application type (91%), such as giving ERP traffic priority over email traffic. But a wide range of characteristics are being seriously considered, with destination IP address (82%) and source IP address (81%) being the leading characteristics.

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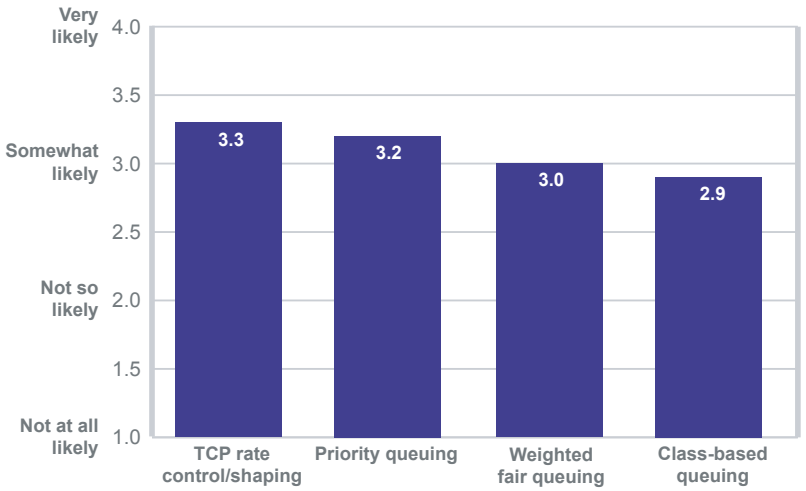
Likelihood of Using QoS Techniques Within 12 Months



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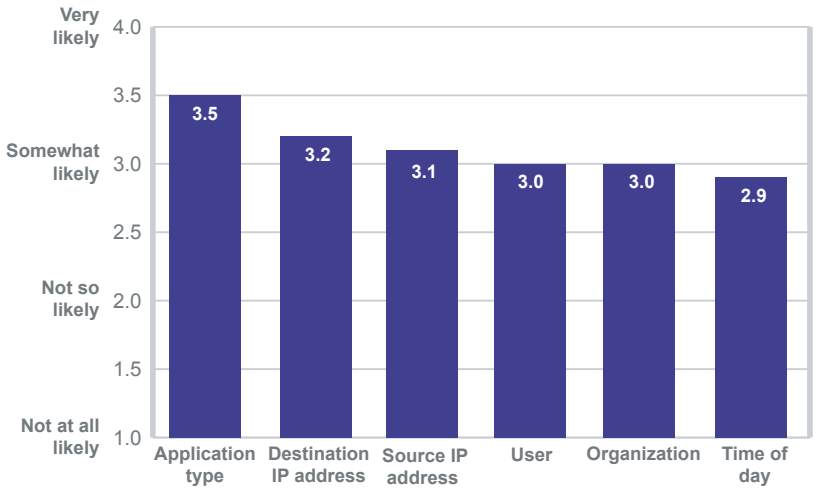
Likelihood of Using Traffic Prioritization to Improve QoS



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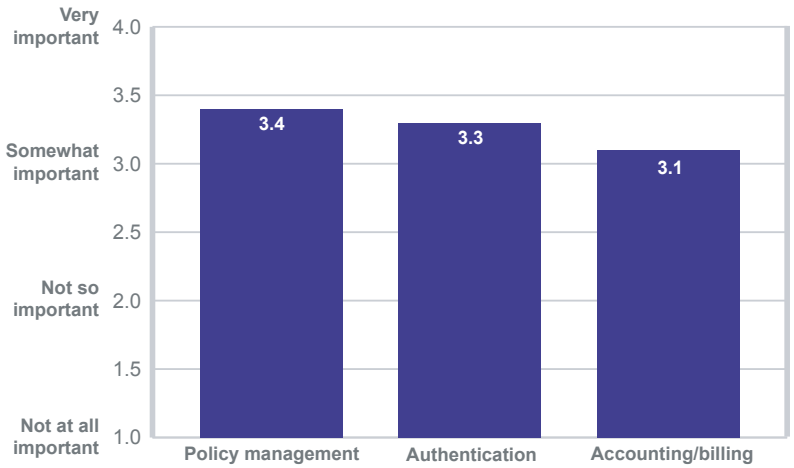
Importance of Support Services to Implement QoS



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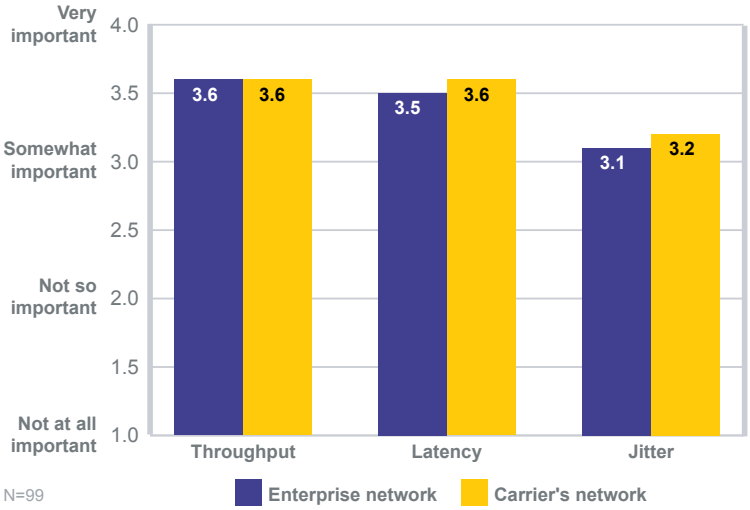
Importance of Metrics for Measuring QoS



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Along with QoS strategies, technologies, and techniques, network managers have to consider various support services in their QoS implementation plans. Policy management is the most important of these, followed by authentication and accounting/billing. As we saw previously, there are only small differences in the importance of these choices, indicating that achieving QoS is a complex task.

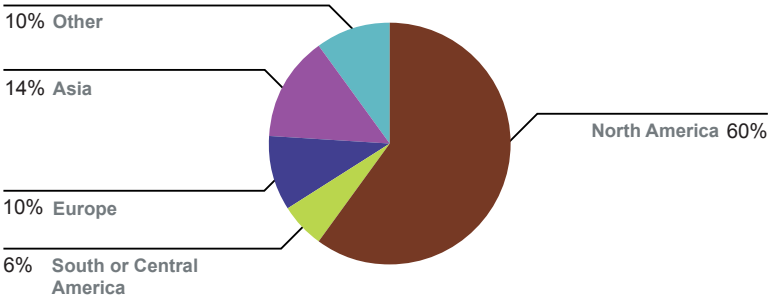
Savvy network managers in both enterprise and service provider organizations know the importance of baselining network performance in order to intelligently set goals and measure the impact of changes to the network. When implementing QoS, network throughput and latency are considered to be almost universally important metrics for measuring QoS. Jitter is somewhat often less important as its impact is more application-specific. Still, more than eight out of ten respondents consider this an important measurement of network QoS.

Respondent Profile

Qualified survey respondents were primarily from North America (60%), with Europe (10%), Asia (14%), and South and Central America (6%) also represented. Other locations represented in the results include Australia, South Africa and Turkey.

Survey respondents represent a cross-section of industries led by telecommunications and computer services providers. This industry category accounted for one-third of all respondents. Technology equipment vendors (13%), government/education/non-profit organizations (11%), and financial services/insurance/legal firms (9%) were also well represented.

Respondents' Location



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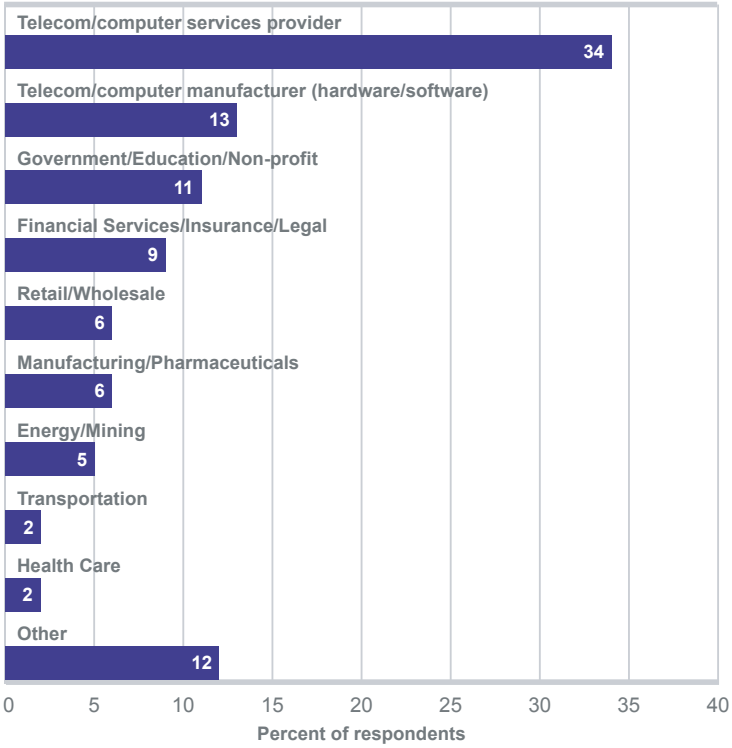
Respondents' Industry



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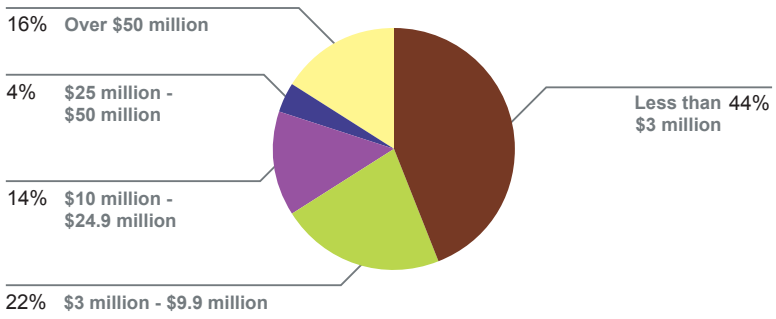
Respondents' Company's Data Networking Budget



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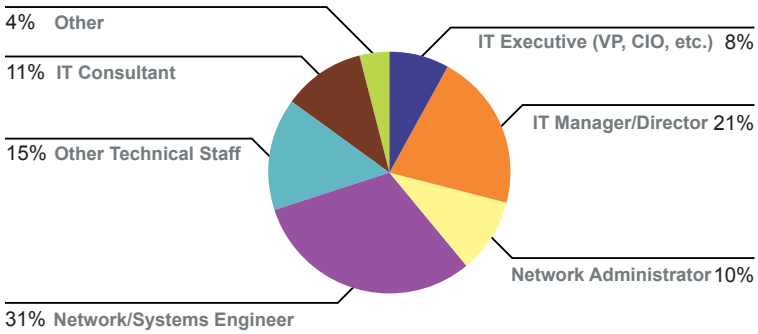
Respondents' Job Title/Function



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The size of the respondents' company's data networking budget ranges from less than $3 million to more than $50 million.

Respondent job functions are led by network/systems engineers (31%) and IT manager/directors (21%), followed by IT consultants (11%) and network administrators (10%).

Respondent Comments

- *(First, we) need more standardization on wireless IP QoS. In addition to SLAs, there (should) be a mechanism to perform inter-network settlement on charges related to metered high QoS traffic.*
- *QoS standards should be more expansive.*
- *Standards, standards, standards.*
- *QoS is primordial for aggregating customer needs to operator business viability.*
- *(QoS is) a brand new area and concept for network management*
- *In Asian region, especially in India, there is a lack of QoS. People are reluctant to pay for it as well.*
- *(We) need charting to monitor queue depths for frame relay traffic shaping.*
- *TCP degrades with latency. XTP may help.*

Methodology

This survey was conducted over the World Wide Web in conjunction with a number of network-oriented organizations. Lucent NPS would like to thank those organizations for their cooperation and support of this research project.

The survey was conducted from September 1 – October 2, 2000

http://www.lucentnps.com/surveys.

All Web survey responses were automatically collected into a survey tool. Any questions skipped or incorrectly answered by survey respondents were not included in the tabulations.

Not-applicable responses were also not included in the tabulations. Each chart includes the number of valid responses for that particular question (e.g., N=100 indicates 100 responses). Percentages shown in charts may not equal 100% due to rounding.

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