



Voice Over IP (VoIP) Implementation Guide for Network Performance Management

Introduction

The long-hyped convergence of voice and data onto a single network is finally becoming reality. Major industry magazines and analysts are now discussing the explosion of VoIP deployments, and corporate rollouts have commenced in order to take advantage of the operational efficiencies and competitive advantages that are facilitated through VoIP's advanced communication services.

However, when convergence occurs on your network, will the infrastructure be ready to handle this added burden? Almost universally, industry analysts talk about incomplete and delayed VoIP implementations caused by poor pre-deployment analysis, planning and lack of well-integrated management tools that address both networked voice and data applications. The risks are not only the investments made in the VoIP equipment and upgraded infrastructure, but also in the potential impact on organizational productivity when a voice initiative has a negative effect on existing networked business services. The reputation of the IT organization can hinge on the success or failure of a VoIP implementation.

The solution to mitigate these risks is a lifecycle approach to VoIP deployment: assessment, planning, impact analysis, and ongoing management. Although completing each of these steps may seem, at times, overwhelming and complex, engaging a network and application performance management solution, especially one that will view VoIP in context with all other application traffic on the network, will increase the potential for a successful project.

This white paper describes how the *nGenius*[®] Performance Management System can help in completing a comprehensive analysis, developing a thorough plan, and assessing the impact of your VoIP implementation. A thorough investigation of each step of the lifecycle process increases the probability of a successful rollout, and ultimately achieves optimized performance of both business and voice applications across the enterprise network.



The VoIP Challenge

The success or failure of a VoIP project depends on the acceptance of the organization's end-users. VoIP must offer the same high-quality service that end-users have come to expect - Plain Old Telephone Service (POTS) "five nines" (99.999%) reliability. Because of these high expectations, there is concern about relying on a delay-tolerant data infrastructure to carry delay-sensitive voice services.

Even before adding voice, data networks themselves have become quite complicated. They are burdened with new applications, a multitude of technologies, and a variety of systems and servers that, combined, are a formidable challenge to manage. Now add VoIP to the mix – convergence exponentially increases the complexity of managing the performance of all the business services and applications transported over a common infrastructure. Existing networks were designed and built for delay-tolerant applications – packet loss in data applications is compensated for with retransmissions, for instance. However, telephone conversations take place in real time, which was not a problem on a dedicated analog network, but once coexisting on a shared IP network with the multitude of other business applications, voice becomes subject to the highs and lows of a constantly changing data network environment.

Voice Quality Indicators

| Characteristic | Definition | Recommendation | Source |
|----------------|---|------------------------|--|
| Latency/Delay | The time it takes for data to get from Point A to Point B on the network. VoIP is sensitive to delay because human conversations occur in real time. | Below 150 ms (one way) | ITU-T G.114 |
| Jitter | Jitter is the variance in delay. When some voice packets arrive with little delay followed by additional voice packets with greater delay, parts of the conversation on the receiving end will become uneven. | < 40ms | National Institute of Standards and Technology |
| Packet loss | Dropped packets. Voice typically uses the RTP protocol running over UDP, which doesn't retransmit lost packets; meaning portions of the conversation can be lost. | Below 1% and 3% | National Institute of Standards and Technology |

The quality of a telephone conversation depends on low latency, jitter and packet loss (see "Voice Quality Indicators"). In a network without enough bandwidth or with other hidden performance problems, voice calls can quickly become corrupted. The challenge is to ensure that voice and data services function efficiently and harmoniously in the same network, and ultimately, deliver a quality of service that will delight the end user. So how can you accomplish this and make your VoIP deployment a success?

The Need to Manage the Converged Environment

"CIOs need a more thorough approach to managing VoIP in enterprise environments now that VoIP is rapidly evolving from an emerging technology to a mainstream business need."

The Yankee Group

Enterprises need a well-designed process to help minimize the delay, jitter, and packet loss that will degrade voice call quality - after all, *voice will only be as reliable as the network supporting it*. This requires a robust network and application performance management solution to track these conditions. The steps to include in this process are:

- (1) Pre-deployment **Assessment** to baseline application performance and network usage, and discover latent network issues that would be magnified upon voice implementation;
- (2) Project **Planning** to ensure network readiness and a well-thought-out process which will stack the odds in favor of a smooth deployment;
- (3) Post-deployment **Impact Analysis** of both data and voice applications to confirm well-running network services; and
- (4) **On-going Management** of the converged network to keep performance optimized over the long-term.

Just as there are benefits in combining all applications on the same network, there are also benefits in uniting performance management in a single application. Where the goal is to deliver high quality voice and data services over a converged network, it is essential that the performance management solution is also "converged," supporting both data and VoIP applications,

VoIP Protocols

There are multiple VoIP products offered today, typically built to conform to one or more of the following standards:

H.323: The International Telecommunications Union, or ITU, designed H.323 to define how multimedia, such as video, audio, travel over a packet-switched network.

MGCP: Media Gateway Control Protocol runs in conjunction with other IP protocols such as H.323 or SIP to bridge circuit switched and packet networks. It enables "dumb" IP endpoints, such as analog phones, to connect to an IP backbone and function with the same feature set as its IP phone counterpart.

RTP/RTCP: The Real-Time Transport Protocol, Real-Time Control Protocol, provides end-to-end delivery services for data with real-time characteristics, such as audio, voice or simulation data.

SCCP: The Skinny Client Control Protocol, "Skinny," for short, is a Cisco proprietary protocol, allowing Cisco-compatible devices to operate in a client-server mode with IP endpoints issuing proxies for services from the Cisco Call Manager.

SIP: Session Initiation Protocol defined in RFC 3261. Like Skinny, SIP is a low overhead protocol. It performs basic call setup functions such as establishment of user location (i.e. translating from a user's name to their current network address), feature negotiation, call management, and changing features of a session while in progress.

as voice traffic will mingle every day with storage, videoconferences, ERP, CRM, e-commerce, and other business critical applications. To be successful in this converged environment, network managers need to see all application traffic regardless of type in order to fully analyze and efficiently control the traffic flow.



With a unified solution, the diverse infrastructure and dynamic mix of application traffic can be viewed and managed holistically. With the ability to see the entire system, the finger pointing that may be inescapable with separate monitoring applications is avoided. Additionally, a fully integrated product can lower the total cost of ownership (TCO) by reducing “tool clutter” associated with a separate performance management products for each different application, data source, and technology.

nGenius Can Help! Moving Through The Voice over IP Lifecycle

“To support VoIP and other demanding applications successfully, IT organizations need to change their approach to network management. IT organizations must develop an approach that is less fragmented. One characteristic of this new approach is that it allows for the use of management data from multiple sources. A second characteristic of the new approach is that it consists of fewer, more tightly integrated tools.”

Ashton, Metzler & Associates

NetScout offers a solution for these issues with the nGenius® Performance Management System. Comprised of the nGenius® Performance Manager software and nGenius® Probes, the nGenius Solution is purpose-built for monitoring and reporting on voice and data applications in converged environments. It identifies and tracks key business applications, such as Citrix and Lotus Notes, and displays them along side VoIP-related protocols, such as RTP voice and call set up protocols such as SIP or MGCP, helping IT organizations optimize the quality of voice implementations while simultaneously protecting against degradations in business application responsiveness. Further, it is vendor independent, capable of supporting both standards-based voice and data infrastructure as well as industry-leading proprietary implementations from companies such as Cisco and Avaya.

The nGenius System is uniquely suited to deliver crucial support in each step of the VoIP Lifecycle from Assessment, Planning, Impact Analysis, and Ongoing Management.

Assessment: Is your network ready for Voice over IP?

“A network audit/assessment is imperative; without it, the probability of failure is greater than 50 percent.”

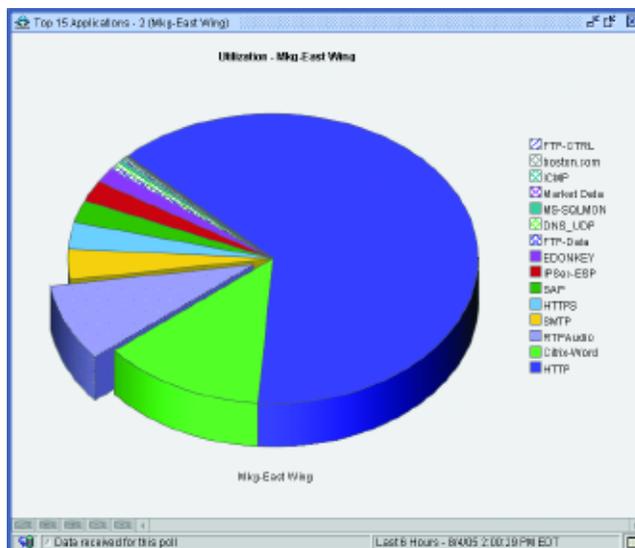
Gartner

During the assessment phase of a VoIP project, a substantial amount of information is gathered in order to understand VoIP feature requirements, update the voice and network infrastructure, create Quality of Service and security plans, and figure out the impact of VoIP on the IT organization.

As part of this information gathering process, it is important to analyze all network segments and circuits to determine volume and type of traffic in order to assess the need for upgrades and to create a snapshot of current application performance. This provides a point-in-time comparison for post-implementation impact analysis. The historical and real-time information found in the nGenius Solution makes it an ideal tool for conducting a network audit and creating a baseline which can be used post implementation to evaluate changes brought about by the voice deployment. It should be noted that plenty of time is required for pre-assessment, at least a month or more to establish proven baselines and determine if there are particular daily, weekly or monthly trends that need to be considered prior to adding voice traffic to the network. Best practices in gathering data for a network audit include:

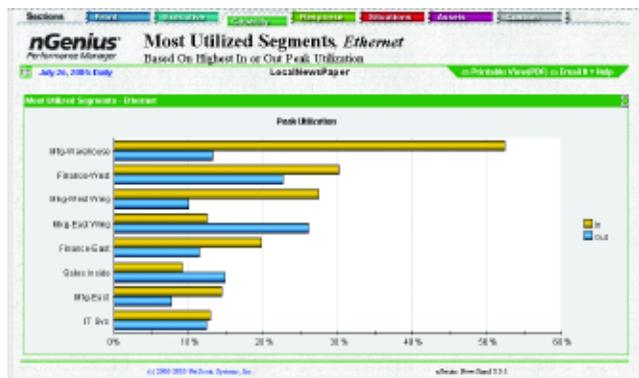
Creating an inventory of the applications running over the network.

This information is critical for optimizing the use of network resources, distinguishing business vs. recreational use, and creating QoS policies. The nGenius Solution provides the granular application-level visibility needed for a pre-deployment evaluation, as it tracks well-known, custom, complex (e.g., Exchange, SAP), and web-based (e.g., e-commerce, web-based e-mail) applications, and collects volume, utilization, host (user/server), conversation, as well as response time statistics. The nGenius Solution makes all this rich application-level data available for multiple purposes besides a snapshot baseline, including troubleshooting, capacity planning, forensic analysis, application and network monitoring.





Evaluating bandwidth to ensure capacity for VoIP services. The *nGenius* Solution provides historically-based growth forecasts and ranks most-/least-utilization information on all segments and circuits across the enterprise network. This provides valuable insight that helps ensure that adequate capacity is added to the network prior to the VoIP rollout, and that neither voice nor revenue-generating data applications will have to compete for inadequate resources post implementation. During the VoIP Planning phase the baseline and forecast reports will be used to fine-tune traffic flows across the enterprise, understand the normal traffic patterns and make informed decisions on where to invest in additional capacity.



Creating response time baselines of the organization's mission-critical applications. For validation that VoIP has not negatively impacted key business applications after deployment, it is imperative to have a baseline of application performance. Response time, a key performance metric, is delivered as an integral component of the *nGenius* Solution. It provides insight into the end user's experience with critical business applications, helping to ensure service levels, detect and prevent performance degradations, and troubleshoot application performance problems when they do occur.

Identifying subtle performance anomalies. As part of the network audit, it is essential to search for subtle network performance issues, for example, excess packet loss or application retransmissions. Anomalies that may not have a large impact on service delivery pre-VoIP deployment can often be magnified once voice is implemented, affecting quality of both voice and business applications.

Planning - Have You Made all Decisions Necessary to Ensure Effective Rollout?

“An inadequate planning and assessment phase can undermine the entire project and significantly increase the cost of the rollout.”

The Yankee Group

The next step in the lifecycle process is to use the data gathered in the Assessment phase to plan and prepare the network for readiness. This possibly may be the most critical activity in the entire project - as carpenters often say, “measure twice, cut once.” IT staff initiating a VoIP deployment will want to take a similar approach by planning, making decisions, and taking action based upon quantitative information collected. A well-tuned network and appropriate implementation plan will assure a more successful deployment and a hospitable environment for VoIP.

The following is a guideline of decisions that must be made and actions to take based upon the information collected in the Assessment phase:

Fine-tune capacity

- Look for any “surprise” traffic running on the network. If an application was retired or is not an approved use of the network, use conversation data from the *nGenius* System to pinpoint the IP source (users or servers) in order to remove this activity from the network.
- Look for configuration errors, such as routing mistakes. If an application is being misrouted between locations, correct the configurations.
- Look for timing mistakes. If an application backup is being performed during the wrong time of day, redefine the process. Confirm changes using the *nGenius* System.

Establish parameters for bandwidth upgrades

- After removing unwanted applications from the network and re-engineering traffic where possible, use the baselines collected in the Assessment phase and add projections on VoIP activity in order to determine expected volume for each critical network segment, looking most specifically at peak hours of traffic. These calculations will help to determine which segments will require upgrades before VoIP deployment.

Investigate and troubleshoot subtle problems

- For anomalies uncovered in the audit, use the *nGenius* System to further investigate and troubleshoot the root cause of the irregularities and take action to solve those problems.

Establish post-deployment alarm thresholds

- Decide upon the appropriate level of utilization for each segment (for example 70% utilization on the HQ to London segment) and set alarms in the *nGenius* System accordingly. *nGenius* sends notifications, displays alarms in the product console and forwards SNMP traps to an alarm management system of choice.
- Decide which business applications require utilization alarms, such as CRM or VoIP. For example, if VoIP is projected to consume 10% of the traffic on the campus links, set an alarm on 10% for RTP, so that there will be quick notification if traffic is higher than initial estimates. Another example would be if the Market Data transmitted over IP Multicast to the trading floor should always be 5% of the traffic, a declining utilization alarm could be triggered when IP Multicast falls below 5%.
- Establish and set response time thresholds for each key business application such as SAP or Siebel, based on response time metrics gathered in the assessment phase, in order to protect service levels delivered to end users

Establish QoS policies

- After interviewing stakeholders to establish the use of each key business application, form a task team and establish QoS priorities for business applications. Many organizations put voice in the highest priority class, followed by revenue- and customer-affecting applications in a secondary class, and e-mail and web browsing in the lowest class. Including stakeholders in the task force helps them understand the parameters as well as contribute to the process.

Impact Analysis - Is Everything Running as Smoothly as Planned?

“It is critical to understand how enterprise applications will interact with the PBX/IP telephony.”

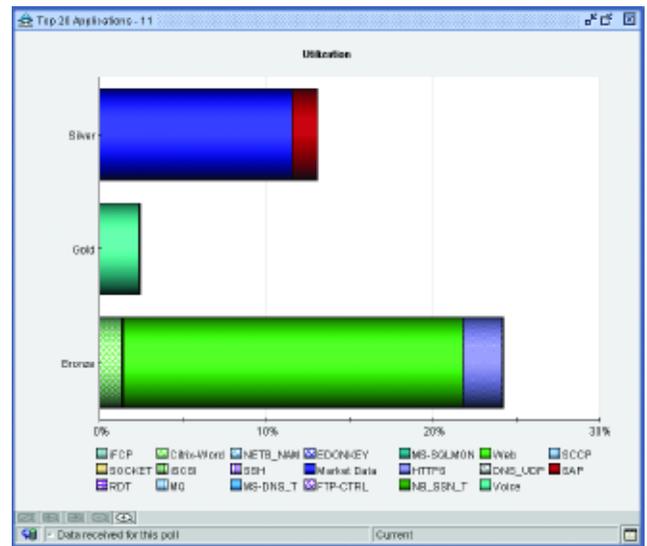
Gartner

When rolling out a new application, real-time monitoring is required in order to understand the success of the deployment and its impact on other applications. As VoIP is rolled out, the *nGenius* Solution has this real-time information, plus the power and flexibility to help monitor and troubleshoot as glitches pop up. It displays voice and other business applications side-by-side as they compete for resources, tracks the response time of critical applications, and when necessary, even delves all the way into the packet level to help troubleshoot the most complex problems.

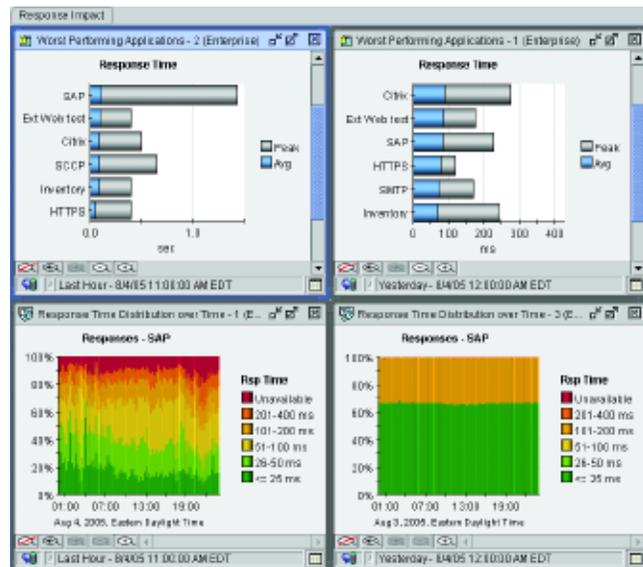
Pay close attention to generated alarms. In the Planning phase, utilization, application and response time alarms were set based on baseline performance and VoIP impact expectations. The *nGenius* Solution sends immediate notifications when unexpected performance issues occur, so that action can be taken and the continuation of networked business services can be ensured.

Re-evaluate response time of critical applications to ensure they have not been affected by VoIP implementation or adversely impacted by QoS class assignment. If negative impacts are discovered, then further investigation is warranted and a different QoS class may need to be considered.

Confirm voice configuration and quality in order to track the quality of voice delivery once it becomes part of the data network, NetScout developed the VoIP MIB to monitor conversation information, such as IP addresses, phone extensions, connect time of valid calls. It also provides visibility into the leading indicators of a phone users' experience, including, jitter, packet loss percentage, call manager setup time, and number of incomplete calls.



Confirm QoS configuration and success. Detecting any traffic prioritization issues that might cause problems with the newly installed voice or with other critical business applications is essential. The *nGenius* Solution can evaluate the success of those policies, pinpointing any misconfigurations in the QoS implementation and identifying whether the expected changes in response times of key business applications were attained.



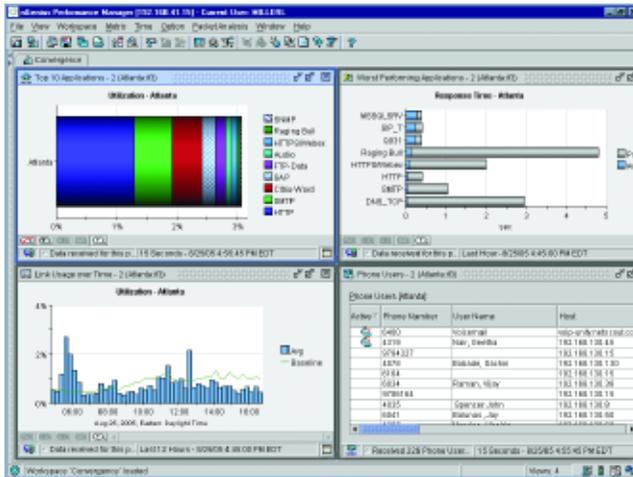
- VoIP metrics available in the *nGenius* Solution:**
- Number of active phone users per network segment
 - Identity of senders and receivers, by IP address, phone number, and user name
 - Utilization for each VoIP-supported protocol
 - Number of valid and incomplete calls per network segment or per specific phone user
 - Total talk time and average duration of calls per phone user
 - Call details and total data volume statistics per conversation pair
 - Quality indicators including jitter, packet loss, and call set-up time
 - Configuration information including DSCP, Codec, and dialing plan

Ongoing Management - How is your network changing and growing over time?

“Enterprises require a solution that manages voice like any other mission-critical network application.”

Yankee Group

The “go live” date of a VoIP installation is only the beginning of the ongoing lifecycle of performance management. This stage of the management lifecycle continues the post-deployment impact assessment and troubleshooting in order to maintain positive performance. Managing the enterprise network and optimizing performance of data and voice applications evolves into a daily, weekly and monthly planning process. Networks are dynamic entities constantly influenced by organizational changes - new applications are added, people and departments move, new devices and technologies are deployed. Companies merge all these events shape and redefine traffic patterns. Monitoring the network's capacity and application performance with the *nGenius* Solution helps to proactively adjust and avoid problems brought about by these organizational changes.



With a converged network, it is necessary to view and manage voice and data applications holistically in order to analyze how they impact one another. The *nGenius* Solution shows voice and all data applications side-by-side, across the enterprise, providing better accuracy and simplicity in troubleshooting, traffic engineering, capacity planning, and reporting, than if separate tools for VoIP and data applications were being used.

Many of the activities discussed above are also required for longer term network and application performance management:

- Continuous monitoring of performance indicators for notification of emerging problems, capacity constraints, and other unforeseen degradations brought on by ongoing change
- Identification of new applications added to the network so that they can be incorporated into current usage and QoS policies or so that rogue and recreational applications can be identified and the mix of traffic on the network can be managed
- QoS policy reevaluation to include newly added applications or to improve the performance of existing business applications by moving them up in category class
- Regular assessment and baselining of logical and virtual segment capacity for the purposes of redistributing load, redesign, or simple upgrades to ensure continued high availability and quality of networked voice and data services
- Forecasting of network growth to verify that capacity is adequate and can be proactively added before congestion becomes an issue

This ongoing proactive management with the *nGenius* Solution helps to identify needed changes and begins the lifecycle process over again. It provides the means to optimize the delivery and ensure the peaceful co-existence of voice and data on the enterprise network.



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