SOLARWINDS WHITEPAPER

VoIP Management Essentials

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Executive Overview

The rapid change from legacy packed switched voice services to Voice over IP (VoIP) has created new challenges in understanding and managing today's voice networks. Voice support had migrated away from a dedicated Voice Support Group and now rests entirely on the Network Support Group. As with any new technology, the transition to VoIP brings new challenges and expectations. Legacy voice systems were built to support a 99.999% (five nines) uptime service levels, and they did well supporting that expectation. The legacy path to five nines support was typically closed with proprietary systems that, by their nature, are only managed with vendor tools. Equipment vendors publish tools as a cost center. Their money is made by selling equipment, not tools. Tools are a distraction from the main business and receive little development focus.

With the move to VoIP, VoIP tools moved from voice switching vendors to network vendors. Two paths for VoIP management emerged: appliance based VoIP monitoring and software solutions. Appliance based systems offer some insight into specific calls and statics about individual calls at the cost of a lack of focus on overall call capabilities. Also, appliance solutions lack the ability to predict VoIP capabilities before a problem occurs. In contrast, software solutions such as SolarWinds Voice and Network Quality Manager (VNQM) offer the ability to track call-by-call quality, as well as predict the ability of VoIP systems to handle calls before an issue arises. SolarWinds VNQM tests VoIP quality from multiple sites, 24 hours a day, 7 days a week. It can also test several essential network services such as DNS, HTTP, and FTP. As a non-appliance solution, SolarWinds VNQM offers superior management at a fraction of the cost of appliance-based solutions. In addition, VNQM fully integrates with SolarWinds Network Performance Monitor (NPM).

VoIP Overview

VoIP has been a rapidly emerging technology over the past fifteen years. In the early 1990s VoIP was little more than a promise of high quality inexpensive voice technology. Over the next ten or so years a battle was fought over the best way to convince network managers to convert legacy analog voice services to VoIP. One issue that stood in the way of VoIP was acceptance. This was partially due to the ability of equipment vendors to prove and deliver ROI for a new technology. During that time, legacy voice prices were in a free fall and that cast doubt on the ROI of VoIP services. One goal of IT technology is to provide better service at a lower cost, so solid ROI data is always necessary.

Once early adopters made the change to VoIP, the VoIP vendors were able to deliver compelling ROI data and many legacy long haul carriers announced they would no longer offer or support traditional long-haul voice services. From then on, VoIP had little to no resistance in becoming the de facto voice technology. Now voice

and networks use the same wires, switches, and MPLS routers. They even act as a power supply to phones, using power-over-Ethernet (POE).

The Final Goal – Ubiquitous VoIP Services

Today the conversion to VoIP is almost complete and you'd have trouble finding a business that still relies on legacy voice services. What used to be an entire cost center completely focused on supporting voice is gone. Expectations for voice quality and reliability have not changed since the VoIP conversion. The bar has been raised for expectations of network services. MPLS (Multiprotocol Label Switching) is now the WAN technology of choice and all resistance to converting to VoIP has been eliminated. MPLS offers WAN services with very high quality and a guaranteed quality of service throughout the network. MPLS latency is typically about one-fifth to one-tenth that of Frame Relay networks and the cost of MPLS keeps falling, making it a great fit for VoIP. Now, even small companies are making the VoIP transition.

MPLS – Good News and New VoIP Management Challenges

While MPLS makes global VoIP a reality, it also comes with new VoIP management challenges. MPLS traffic runs over Virtual Private Network (VPN) connections that carry encrypted traffic. This means that in the core of an MPLS WAN connection, the traffic cannot be analyzed. All MPLS traffic management must happen at the egress/ingress points (i.e., the customer-premises routers). MPLS provides a full mesh network, meaning than any site can communicate directly to any other site creating a web of WAN virtual connections. The number of virtual connection in an MPLS network is equal to n (n-1) where n is the number of MPLS sites. So, in a 20 site enterprise MPLS network the total number of connections is 380 connections! The challenge in managing 380 voice connections could be monumental.

A Short Technical Discussion of VoIP

The exceptions on voice came from normal conversations. Assuming both parties are speaking the same language the conversion should be full duplex (both parties can speak at the same time, there should be minimal delay hearing a party speak, and the conversation should be heard in a comfortable volume, without choppy bits of words). VoIP needs to deliver these same qualities but it must use technologies for each case. Below, we'll look at how each technology is addressed.

Choppy Conversations: While it's acceptable for humans to speak in choppy phrases, VoIP's job is to accurately reproduce those choppy phrases across the VoIP network.

VoIP addresses this issue by chopping up VoIP communications into packets that are transmitted exactly 20 milliseconds apart, far too small for humans to detect. If the packets are received by the next VoIP device at 22 milliseconds, the transmission is marked as being good for a factor called jitter.

The sending device also time stamps when the packet was sent and how long it took the receiving device to acknowledge the packet was received. If the receiving device never acknowledges the packet was received, we have a lost packet.

So, the three metrics we use to measure the ability to carry voice calls are:

1. Packet Jitter
2. Packet Delay
3. Packet Loss

VoIP venders have borrowed a term from legacy voice services called the MOS, or Mean Opinion Score. This is the overall score for a voice call as interpreted by the call participants. Because VoIP call quality is part objective and part technical, VoIP vendors have created a predictive MOS score using jitter, delay, and packet loss. This is quite valuable because all of the factors that create the MOS score are allowed to be expressed in a single number. A MOS score of 5 is a perfect call. A MOS score of about 2.4 is a difficult to understand call, while MOS scores of 1 or less are impossible to understand.

VoIP Call Managers are the brains behind VoIP. Call Managers set up and tear down calls and record information about the call. This information includes call origination, destination, success/failure, and call duration. The managers even estimate the call MOS.

Now that we have an understanding of call quality and how call quality is measured, we can start to look at some hypothetical call quality issues in managing VoIP.

VoIP Use Case 1 – A Customer Call Center

Our first case is a 500+ person manufacturing company that makes hard to find specialist tools. Customers expect a high level of quality for these tools and a high level of customer support as well.

All incoming calls are routed using VoIP over MPLS to the proper call center by current call center load. Customers calling a call center have the following in common:

1. They have run into an issue and are anxious to reach a resolution.
2. They are expecting prompt and efficient service.

3. Any delay in starting the technical resolution process leads to greater anxiety and frustration.
4. They have experienced poor service with call centers in the past and can become angered by a similar experience.
5. The call center staff desires to provide high quality support and rapid resolutions.

Through slow growth, this company had done well but is now growing beyond the limits of their initial design. While the call center is doing a fair job, some pain is starting to emerge when the call center slows down. Some calls are so bad right off that the customer has to hang up and dial in again, and goes back to the end of the queue. As this continues, the number of calls in the queue increases as the number of call errors increases. This situation escalates into call answer delay and service delay. While the call center bandwidth had been carefully measured to support the normal call load, it was not designed to handle the snowballing of a meltdown failure. The call level trips the wait queue and callers are asked to wait in the dreaded music queue.

No doubt, customer service is being affected and if somebody does not begin correcting the issue, it will just get worse.

What was done to assess the issue?

The IT department did a good job using their network management system to discover that the packet delay started to rise before the issue, but they had seen worse delays in the past with no call quality issues. They also noticed some delay in the connections but did not know how much that could affect voice calls. They had no method of measuring jitter so they had an incomplete tool set. After reporting the issue of having insufficient tools to manage VoIP and assure quality calls, they procured SolarWinds Voice and Network Quality Manager and can now test for declining MOS call quality 24 X 7. With the new VNQM capabilities, the engineers placed VNQM software probes strategically around the MPLS WAN to ensure call quality to and from each primary site. The VNQM software probes create simulated calls across the network to find issues before they disrupt call quality during call center hours.

Now, VNQM is ensuring call quality and also testing critical network services such as DNS, HTTP, DHCP, and many others.

The VNQM Value

Managing VoIP with an NMS Only	Managing VoIP with NMS and VNQM

No single indication of voice issues	MOS score measures call quality
Difficult proactive management	24 X 7 MOS measurements warn on an impending issue
Engineers have to guess at the cause	MOS ties the symptoms to the cause
No call records	Call-by-call MOS records
No call success records	Call-by-call success/failure and which side terminated call

VoIP Use Case 2 – Multisite Enterprise Business

A large retail store has several outlets throughout the United States and Canada offering outdoor gear and sporting goods. Customers use phones in the stores to place orders for out-of-stock items and to speak to customer service for order tracking and other assistance. If a customer prefers to use their own phone, they are routed into the same queues as customers using the in-store phones. All of these calls are VoIP over the business's MPLS lines and all are routed to the central call center.

In this scenario, there's an outage in the inventory system so severe that nobody can check which items are in stock and ready to sell. If the item is not in-store, employees might be able to use the VoIP line to call another local store to check inventory for the customer. But, with call demand very high, the number of VoIP circuits begins to saturate. If the company had a product like SolarWinds VNQM, the system would detect the low call quality to the impacted store and fire an alert. VoIP reserves bandwidth for VoIP calls so the VNQM engineer would only have to request more VoIP-protected bandwidth to fix the situation at hand and avoid the issue from ever happening in the future. Without a VoIP management product, the network management engineer would likely see a somewhat busy circuit but since he could not investigate call quality, there would be no way to proactively respond. Without VNQM, the store in question would soon be out of service with no workaround ability to complete sales.

Managing an Outage with an NMS Only	**Managing an Outage with NPM and VNQM**

NMS engineer is busy with system outages. The NMS does not monitor the voice VoIP PRIs.	VNQM engineer is working on voice issues. The VNQM engineer also noticed that all of the incoming voice PRI circuits were full during the issue. Acquiring two additional VoIP PRI lines will help avoid problems during high call volumes.

VoIP Case 3 – International Web Sales Site

This company prides itself on being able to take Web orders from almost anywhere in the word and provide prompt delivery globally. Highly reliable network services make this level of service possibly. The company relies on several distributed NMS systems to keep watch over the network and detect bottlenecks. The network connects into several business-partner networks for tasks like shipping, warehousing, and payment options. Each one of the partners is also heavily invested in VoIP and Web commerce.

Over the weekend, a group of hackers discovered a method for penetrating the company network and cutting off access to the Web pages one-by-one. While this may not be an issue at 1 a.m. Friday night, when Saturday arrives and shoppers start trying to make purchases, the situation quickly becomes a disaster.

If the company is only utilizing an MNS system, nothing may look off. However, if the company is using SolarWinds VNQM, the first Web site to go offline will trigger an alert and an email or page will be sent to the correct department to fix the issue.

This is how it works. Not only does SolarWinds VNQM test VoIP calls 24 X 7, it also tests the ability of critical business systems to be ready for emergencies. VNQM tests HTTP, DNS, TCP connect, and ICMP and ICMP path operations as often as 15 seconds to ensure everything is working properly. All of this ties together. If DNS fails, your clients cannot reach your website on port 80. If port 80 is failing then the website is down.

Not only do *SolarWinds Network Performance Monitor* and *VoIP & Network Quality Manager (VNQM)* keep your business critical processes rolling, together they offer a plethora of outage avoidance capabilities for both the network and VoIP. Visit *www.solarwinds.com* to learn more.

Top 5 reasons to Download SolarWinds VoIP & Network Quality Manager (VNQM)

1. Analyze Call Detail Records generated by Cisco® Call Manager & Avaya® Communication Manager
2. Automatically determine and deploy IP SLA
3. Be notified when key VoIP metrics such as jitter, latency, packet loss, or MOS exceeds thresholds
4. Monitor and troubleshoot VoIP call performance for Cisco & Avaya
5. Gain detailed visibility into performance of Cisco VoIP gateway and PRI trunk utilization

Get a global snapshot of your IP SLA operations with SolarWinds VNQM!

DOWNLOAD FREE TRIAL

About SolarWinds

SolarWinds (NYSE: SWI) provides powerful and affordable IT management software to customers worldwide from Fortune 500 enterprises to small businesses. In all of our market areas, our approach is consistent. We focus exclusively on IT Pros and strive to eliminate the complexity that they have been forced to accept from traditional enterprise software vendors. SolarWinds delivers on this commitment with unexpected simplicity through products that are easy to find, buy, use and maintain while providing the power to address any IT management problem on any scale. Our solutions are rooted in our deep connection to our user base, which interacts in our online community, thwack , to solve problems, share technology and best practices, and directly participate in our product development process. Learn more today at http://www.solarwinds.com.