Juniper NETWORKS

Solution Brief

VoIP on the WAN: It's a Matter of Priorities

Internet technology is rapidly virtualizing business, and many employees already work outside corporate headquarters. Voice is now moving onto the same IP-based data WANs, enabling enterprises to consolidate network infrastructure and paving the way for a new generation of voice-enabled applications.

Prioritization and compression make a powerful combination, and the WAN optimization platform should not force organizations to choose one or the other.

VoIP has on-demand, real-time requirements that are not necessary for most data applications. VoIP creates new challenges for IT managers when it is integrated onto the existing IP data network. VoIP packets must be efficiently transported throughout the WAN to ensure high quality voice communications, even when the network is experiencing high utilization.

Within the enterprise campus, a switched LAN architecture combined with high bandwidth can typically do a satisfactory job of accommodating the needs of VoIP. However, the WAN presents a much more challenging environment. WAN bandwidth already represents the second-largest IT expense, and simply adding more doesn't make WAN links voice-friendly. Latency, jitter and packet loss are common VoIP challenges that must be accounted for to ensure high-quality VoIP communications

WAN optimization frees up WAN bandwidth and gives voice and other real-time traffic the quality of service they require. To deploy VoIP successfully, IT needs the ability to shape, compress and prioritize other traffic as it moves onto and through the WAN. Deploying these capabilities as part of a broader WAN optimization effort provides many benefits.

VoIP Performance Requirements

The Internet Protocol is a best-effort protocol and was not designed for real-time applications such as voice. Most of today's data applications (web browsing, e-mail, etc.) work fine with best effort delivery. However, additional requirements must be met to ensure effective delivery of voice, video and other real-time applications. For today's IP data networks to support real-time applications, four key performance issues must be addressed: bandwidth, latency, jitter, and packet loss.

Bandwidth

An uncompressed voice conversation across a traditional analog telephone network requires only 64 Kbps of bandwidth, and about 60 percent of that bandwidth is wasted on silence. On IP networks, digital technologies recapture the silent time and compress the actual sound down to as little as 5 Kbps, not including the IP packet overhead. Figuring on 14 Kbps to 24 Kbps per voice session is considered adequate when planning VoIP networks.

Latency

Unlike many data applications, voice cannot tolerate high levels of latency or delay. Toll-quality voice requires that sounds take 100 ms or less to travel from the speaker's lips to the receiver's ear. Delays exceeding 150 ms can start to irritate callers. When delays approach 500 ms, voice communication becomes impossible without reverting to the old practice of saying "over" to signal the end of a transmission. In addition to the latency physically present on the WAN link, VoIP protocols such as SIP, MGCP, and H.323 can introduce additional latency

Jitter

The irritation that latency creates for listeners is further compounded by jitter, which is variation in the delay of sequentially transmitted packets. When the packets are carrying voice, this variable delay should not exceed 50 ms for toll-quality voice. Buffers and queuing mechanisms are often used on VoIP equipment and routers to reduce jitter, but these approaches can introduce their own delay.

Packet loss

Voice can tolerate some packet loss, because the human brain automatically and unconsciously fills in small sound gaps. However, packet loss has to be kept to 1 percent or less for toll-quality voice, and conversations start to break up when losses exceed three to five percent.

Because voice is so time-sensitive, the connection-oriented Transmission Control Protocol (TCP) is not used for transmitting VoIP packets. Instead, VoIP relies on the lighter, connectionless User Datagram Protocol (UDP). Since UDP cannot control the order in which packets are received, the actual voice content is encapsulated via Real-time Transport Protocol (RTP). Voice transmission architecture is thus RTP over UDP over IP.

Optimizing WANs for VoIP

WAN optimization can enable organizations to deploy VoIP across the existing IP data network – many times without the need for bandwidth upgrades. WAN optimization uses compression techniques to ensure latency, jitter and packet loss is kept to a minimum as VoIP packets traverse through the WAN.

Minimize WAN latency

Most latency-reduction techniques typically affect TCP. However, VoIP uses UDP. Also, traditional data-compression methods introduce up to 30 ms of delay as they process the data for faster transmission. While most data applications can afford the wait, voice is unable to absorb this additional up-front latency. The keys with latency reduction, then, are making sure the WAN optimization platform does not slow transmissions and accelerates other applications even while giving VoIP the service it needs.

Increasing WAN capacity

Congestion slows performance on most WAN links, so data compression is a key element of WAN optimization. Good compression algorithms can increase effective WAN throughput dramatically. The voice traffic itself has already been compressed as much as 10:1 by today's codecs, so further compression does not help much. Where compression has value, though, is in reducing the headers on voice packets. Since voice packets are quite small, the header is significant as a percentage of the total packet size. The ability to compress even just the headers can reduce the total VoIP traffic by as much as 30 percent

Giving voice priority

Occasional congestion is inevitable, despite all compression efforts. When a link is bandwidth-constrained, the WAN optimization platform needs to impose quality-of-service (QoS) rules that give voice priority as traffic moves from the enterprise LAN to the WAN. The QoS parameters need to ensure voice has a smooth end-to-end delivery, insulated from the impact of bursty data traffic. The solution should also respect any QoS rules already in force. Prioritization and compression make a powerful combination, and the WAN optimization platform should not force organizations to choose one or the other.

Manageability

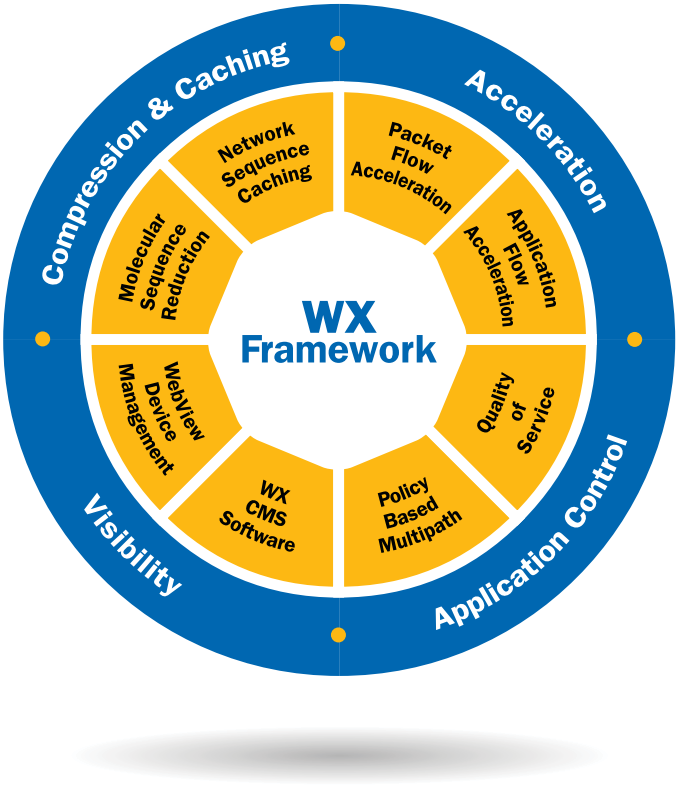
Voice is a real-time application, so the WAN optimization solution must have a management platform that enables real-time monitoring and reporting. A very granular, application-level view of network performance and link utilization is essential for effective bandwidth management. Network managers need such visibility to plan VoIP rollouts and to support ongoing VoIP operations. The management software should include comprehensive reporting tools that provide insight from multiple perspectives – by application, by destination, and by path. These tools should identify the bandwidth hogs and show the impact of prioritization.

Easy deployment

The WAN optimization solution should drop smoothly into the enterprise infrastructure. Implementation does not typically require changes to existing applications and it should work transparently with IPsec VPNs and MPLS. Multiple deployment options are also important; the solution needs to support a mix of LAN-to-WAN architectures at the various remote sites and help enable incremental VoIP migration.

Juniper Networks Optimizes WAN Links for VoIP

Juniper Networks delivers a complete family of application acceleration platforms that improve application response times within central sites, to branch offices, and for remote users. Two members of that family – the WX™ and the WXC™ application acceleration platforms – specifically improve the performance of applications running over wide-area links, including VoIP.



The WX Framework integrates key technologies that work together and influence each other, providing IT with distributed stateful intelligence about their WAN links and applications.

The WX and WXC platforms are based on the unique WX Framework™, which integrates powerful compression and caching, acceleration, application control, and visibility capabilities that enable the WX and WXC platforms to ensure maximum application performance in a dynamic WAN environment. With the capabilities enabled by the WX Framework, the easy-to-deploy WX and WXC platforms include comprehensive real-time management tools and support incremental VoIP rollouts.

The WX and WXC platforms reduce latency

By improving the performance and bounding the behavior of non-voice applications as they move across the WAN, the WX and WXC devices create a more controlled environment for VoIP. For example, Active Flow Pipelining™ (AFP™), a component of the WX Framework's Packet Flow Acceleration™ (PFA™) technology, terminates the TCP connection locally and uses a more efficient protocol between devices. Customers see application response times drop dramatically, and business processes complete more quickly. Just as important, the WX and WXC platforms do not introduce latency, performing compression and other features in less than 2 ms.

The WX and WXC platforms boost WAN capacity

The WX Framework defines two approaches to increasing available capacity. With roots in DNA pattern matching, the patented Molecular Sequence Reduction™ (MSR™) technology dramatically reduces WAN traffic by recognizing repeated data patterns and replacing them with labels. MSR compression uses a memory-based dictionary, which it continuously updates, and

MSR compression operates transparently on all IP traffic. It is especially effective at reducing the bandwidth needed for short, chatty applications.

The Network Sequence Caching technology uses hard disks to store longer data patterns for a longer period of time. Sequence caching can recognize repeated patterns between transmissions even when the files involved have been modified. By increasing the effective throughput of existing links, MSR technology – available on all WX and WXC platforms – and sequence caching technology – available only on the WXC platform – make room for voice without constraining data.

Networkwide Visibility
The WX Central Management System (CMS) software provides unified, intelligent insight into application acceleration, compression performance, WAN utilization, QoS, and bandwidth allocation across the distributed enterprise.

Customer Success Story:

Hines & Associates

Business Benefits:

- 450% increase in existing WAN capacity
- Toll-quality VoIP over existing WAN
- Doubled the VoIP call volume on existing WAN
- Enabled incremental VoIP migration
- Improved remote printing
- Avoided $48,000 per year in WAN upgrades
- ROI of less than 12 months

Hines & Associates is a nationwide healthcare management firm serving its clients from 25 offices and two call centers. Operating across so many widely distributed locations, the Elgin, IL.-based company decided to centralize applications on a Citrix platform and start migrating offices to VoIP.

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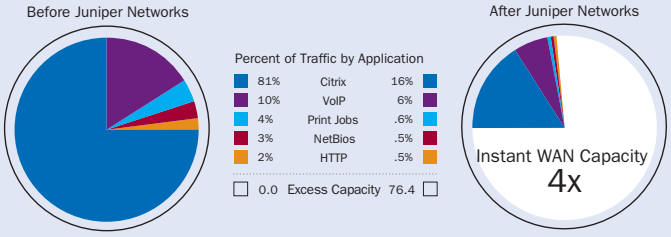
VoIP was rolled out to the two call centers and three other offices, but call quality varied with call volume. Users were also experiencing printing problems with the Citrix applications. Hines considered adding bandwidth with a WAN upgrade, but the cost was $48,000 per year.

Instead, Hines installed Juniper Networks WX 20 application acceleration platforms at the five VoIP-enabled offices. After the plug-and-play installation, the voice and printing problems immediately disappeared, and sufficient capacity remains to support future traffic growth.



The WX and WXC platforms prioritize VoIP traffic

Voice should be able to get preferential treatment if it is to run across IP networks alongside data applications, so strong quality-of-service (QoS) and bandwidth-management capabilities are an absolute necessity. The QoS feature available with the WX and WXC platforms – another critical component of the WX Framework – provides wizard-based configuration and 16 priority levels for classifying application traffic such as voice. The QoS and bandwidth management capabilities honor existing TOS and DiffServ settings and operate seamlessly across service provider networks, including QoS-capable MPLS networks. In addition, the Policy-Based Multipath™ (Multipath™) optimization feature defined in the WX Framework and integrated into all WX and WXC platforms enables the use of parallel WAN links, directing traffic that can tolerate latency over the slower and less expensive paths as needed. Path-selection decisions are made dynamically, based on latency and loss characteristics of each link.

"Juniper Networks eliminated our concerns about VoIP performance and allowed us to make any WAN link VoIP-ready. The solution was plug and play as they advertised."

Chief Information Officer

Managing WAN optimization with WX CMS

Good management tools are an essential part of effective WAN optimization, and the WX Central Management System™ (CMS™) software provides an intuitive, web-based interface for real-time monitoring and reporting. Network managers get complete application-level visibility into WAN traffic and utilization, including the "top talkers" who are consuming the most bandwidth. Other available metrics include compression performance, application acceleration, bandwidth allocation, and the impact of QoS parameters. Packets can also be captured and exported to NetFlow or other third-party analysis applications for further insights. IT can manage as many as 2,000 WX and/or WXC devices from a single console, enabling them to reconfigure and upgrade devices simply and quickly. The WX CMS software interoperates with existing management platforms, and it supports three levels of access: administrator, read/write, and read-only.

The WX and WXC platforms are easy to deploy

The WX and WXC platforms are easy to deploy, requiring no network changes and enabling automated deployment from a central site. In addition, IT can deploy the platforms incrementally, so they can equip locations on a site-by-site basis as VoIP gets deployed to those locations. The WX and WXC platforms are typically deployed behind the firewall or other encryption devices, on the LAN side of the router, and can be installed inline between the LAN switch and WAN router or off-path on a router port. They work across private and VPN networks, and they support reusable templates and pre-staged configurations that enable plug-and-play deployments at remote sites.

WAN Infrastructures Optimized for VoIP

Voice sessions actually require very little bandwidth – less than 15 Kbps each – but that bandwidth must be assured at all times. WAN behaviors that cause enough trouble for latency-forgiving data applications can make time-sensitive voice a non-starter. The WX and WXC application acceleration platforms, featuring the integrated WAN optimization technologies defined by the WX Framework, not only multiply the effective capacity of existing WAN connections, but also ensure voice sessions get the bandwidth they need, when they need it.

"VoIP is a great solution in terms of cost reduction, but we cannot afford poor call quality. The Juniper Networks solutions allowed us to offer carrier-grade VoIP on our existing WAN links without affecting the performance of other applications and without forcing us to upgrade our network."

Senior Director
Telecommunications Company

State-of-the-art compression and sequence caching dramatically reduce WAN traffic loads while sophisticated bandwidth management technology provides a more controlled environment for voice. Easy implementation combined with remote management support incremental VoIP rollouts. By delivering these capabilities, the WX and WXC platforms are enabling organizations such as Hines & Associates to begin their VoIP migration today and start benefiting from convergence and next-generation applications, without making extensive and expensive WAN upgrades.

VoIP on the WAN: The Sweet Sound of Success

WAN constraints that cause enough trouble for latency-forgiving data applications can make supporting time-sensitive VoIP traffic impossible. The unique WX Framework, which defines a suite of WAN optimization technologies that are embodied in the WX and WXC application acceleration platforms, delivers the environment needed for VoIP: plenty of bandwidth; limits on the impact that latency has on other applications; and prioritized service. With the WX and WXC application acceleration platforms, businesses can enjoy the cost advantages of VoIP while optimizing their existing WAN structure, delivering toll-quality voice and accelerating application delivery throughout the enterprise.

Juniper NETWORKS

CORPORATE HEADQUARTERS
AND SALES HEADQUARTERS
FOR NORTH AND SOUTH AMERICA

Juniper Networks, Inc.
1194 North Mathilda Avenue
Sunnyvale, CA 94089 USA
Phone: 888-JUNIPER (888-586-4737)
or 408-745-2000
Fax: 408-745-2100

www.juniper.net

EAST COAST OFFICE

Juniper Networks, Inc.
10 Technology Park Drive
Westford, MA 01886-3146 USA
Phone: 978-589-5800
Fax: 978-589-0800

ASIA PACIFIC REGIONAL
SALES HEADQUARTERS

Juniper Networks (Hong Kong) Ltd.
Suite 2507-11, Asia Pacific Finance Tower
Citibank Plaza, 3 Garden Road
Central, Hong Kong
Phone: 852-2332-3636
Fax: 852-2574-7803

EUROPE, MIDDLE EAST, AFRICA
REGIONAL SALES HEADQUARTERS

Juniper Networks (UK) Limited
Juniper House
Guildford Road
Leatherhead
Surrey, KT22 9JH, U. K.
Phone: 44(0)-1372-385500
Fax: 44(0)-1372-385501

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