IMPROVING SATELLITE DATA DELIVERY

Juniper Networks Accelerates Application Performance over Today's Satellite Networks

Challenge

Royal Caribbean International provides cruise vacations to millions of guests. They wanted to move more applications onto their ships and islands, but their satellite communication links were already too congested, and buying higher-speed links would have increased monthly budgets by 20 percent.

Solution

Royal Caribbean installed Juniper Networks WX Series Application Acceleration Platforms on its ships, islands, and at other terrestrial sites. This doubled the effective bandwidth on satellite links, and the Juniper Networks WX Central Management System software provided the IT staff with comprehensive monitoring and control.

Benefits

- 100% increase in throughput of existing satellite links
- $1.3 million in annual bandwidth savings
- Ability to deploy applications locally on ships
- One month return on investment

Ships at sea, offshore oil rigs, military operations, remote outposts, and underdeveloped regions would be cut off from the rest of the world without satellite networks. These satellite networks have been essential communications lifelines for remote sites that are not, or cannot be, served by the globe's terrestrial network infrastructure. And they can back up wired environments in the event of a network failure.

Despite this critical dependency on satellite communications, the basic hub-based satellite network infrastructure remains trapped in the pre-Internet era and is unsuited to today's Ethernet and IP network architectures. Serious latency and jitter problems preclude the use of typical satellite networks for advanced IP applications—especially those with real-time requirements.

The standards-based equipment that dominates the IP world is largely lacking in satellite networks, and no multivendor interoperability or shared service-provider bandwidth is available for use in VPNs. Fortunately, technology can now improve the performance and cost-effectiveness of satellite networks, enabling them to play a more effective role in today's IP environments.

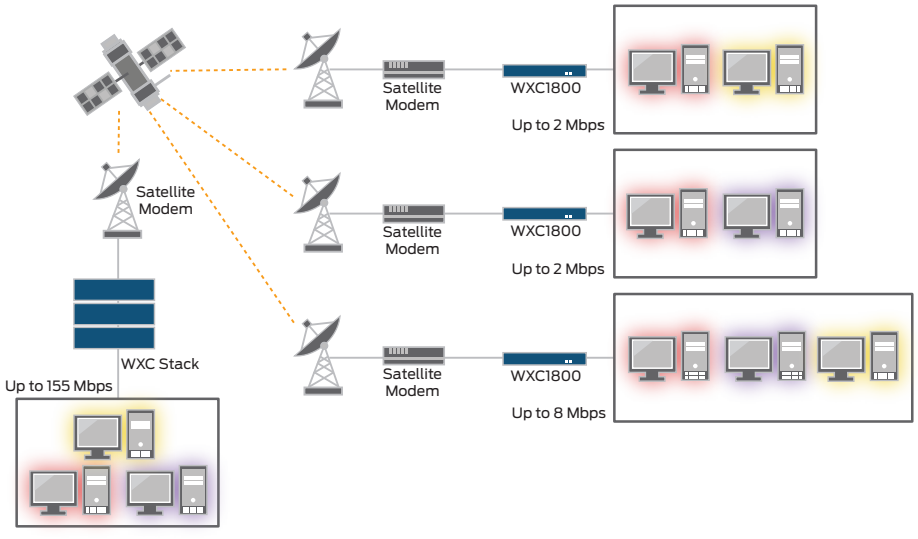

Figure 1: Speeding Satellite Communications—
Juniper Networks provides application acceleration and bandwidth optimization solutions ranging from hub locations to small remote sites in satellite networks.

The Challenge

If satellite communications are to provide business-class service, they need to undergo a radical transformation. Satellite networks must meet the performance level that enterprises have come to expect from all IP broadband-access infrastructure.

> "Our international users were complaining about waiting two or three seconds to make connections with our data center. The Juniper Networks WX Series and WXC Series Application Acceleration Platforms have eliminated many application performance issues and dramatically improved response times."
>
> Bill Pappas
> VP & Chief Technology Officer, DIMON

More Efficient Over-the-Air Interface

The most expensive piece of satellite-based communications is the over-the-air interface, so increasing its efficiency can have a major impact on link performance and cost. However, efforts to enhance the capabilities of satellite networks have largely ignored this critical component, despite the fact that payload compression can enable the delivery of more data across the same infrastructure, thus reducing costs and supporting a broader range of applications as well as expanding the customer base.

Packet and Web Acceleration

Satellites' inherent 500 ms round trip time (RTT) or more and fixed packet cell size present major latency and performance problems for the connection-oriented TCP protocol. Similarly, the three-way handshake used in Web transactions can make protocol overhead exceed content as a percentage of total packet size, resulting in very sluggish performance. In addition to the handshakes, TCP also uses a system of acknowledgements (ACKs) to ensure reliable delivery, but waiting for those ACKs further slows down applications. For satellites to become a full player in the IP world, some of the RTTs and retransmissions must be eliminated, and a more bandwidth-efficient approach than waiting for ACKs is required.

Quality of Service (QoS)

It takes more than raw bandwidth increases to turn satellite networks into business-class IP networks. The satellite system must be able to recognize and react to different categories of traffic, giving priority to business-critical and/or delay sensitive applications. However, implementing and managing this capability cannot introduce complexity or administrative overhead. The solution needs to include intuitive, wizard-based tools for mapping business policies to appropriate QoS levels.

Reliability and Availability

Satellite links have a reputation for being somewhat capricious, particularly when weather and other uncontrollable factors intervene. Satellite systems upon which businesses rely for their wide area infrastructure must be based on carrier-class platforms that have redundant, hot-swappable components and can guarantee high availability (HA) and business continuity. Satellite platforms also need to minimize packet loss and jitter with state-of-the-art forward error correction and terrestrial-class bit error rates. Security is critical to availability, and satellite systems should offer built-in options for high levels of encryption. They also need sufficient uplink power to provide reliable connectivity, even in bad weather.

Flexibility and Scalability

Traditional satellite networks have been based on large, rigidly architected hubs that make bandwidth available only in big, dedicated chunks. To increase bandwidth utilization and open up the market to customers with smaller bandwidth requirements, network operators need a more flexible architecture that allow hubs to be partitioned easily across various customer networks and bandwidth to be delivered in very granular increments. Hub and remote-site equipment should be available in smaller, more scalable models that consume less power, and operators should be able to add network capacity without interrupting service. The satellite system should include dynamic bandwidth allocation that lets multiple customers share the same bandwidth and run VPNs across it. It should support a variety of network topologies and designs, as well as multiple outroutes and inroutes.

> "When we compared the WX Series and WXC Series products against router compression solutions, it was obvious that (they) offered far better performance, and we could see the improvement immediately with the monitoring tools. The installation was simple, with little ongoing management time required."
>
> Chris Ennevor
> Senior Technologist, Royal Caribbean International

Simple Deployment

Satellite enhancement solutions for retrofitting legacy technologies are inherently complex and undependable. Instead, satellite networking systems should be built from the ground up with IP broadband access in mind. With this approach, the satellite network can depend on simple, turnkey solutions that require minimal integration and can be installed very quickly. The system should help automate deployment through prestaged configurations that leverage implementation efforts across sites.

Manageability

Ease of management is imperative, if network operators and customers are to broaden the use of satellite networks while keeping costs down. The satellite solution must include an intuitive, Web-based management console that provides a single-system view of the entire network. From that console, administrators should be able to monitor, reconfigure, and maintain remote equipment and deploy software upgrades. The management system must provide the monitoring tools needed to gain critical insight into applications running over the WAN and their performance. In addition to a general understanding of WAN health and performance, IT needs visibility into specific results such as compression performance, application acceleration, WAN utilization, bandwidth usage by application, and QoS delivery.

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

The Juniper Networks Satellite Link Optimization Solution

Juniper Networks® offers 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 Series and WXC Series Application Acceleration Platforms—deliver the powerful WAN optimization technologies that make satellite a more cost-effective, business class IP WAN solution.

The WX Series and WXC Series platforms are based on the WX Series Framework, a comprehensive set of technologies that adapt satellite to a new set of realities and turn it into a business-class service. Scaling from 64 Kbps to 155 Mbps of compressed output, the WX Series and WXC Series platforms represent a flexible, scalable, and easy-to-deploy WAN optimization solution for satellite networks that sets new standards for reliability, availability, and manageability.

Features and Benefits

More Efficient Over-the-Air Interface

The inability to communicate rich content has been the weak point in satellite performance enhancement efforts. The WX Series and WXC Series platforms fill this gap with powerful compression technologies that dramatically increase the effective payload capacity of satellite bandwidth.

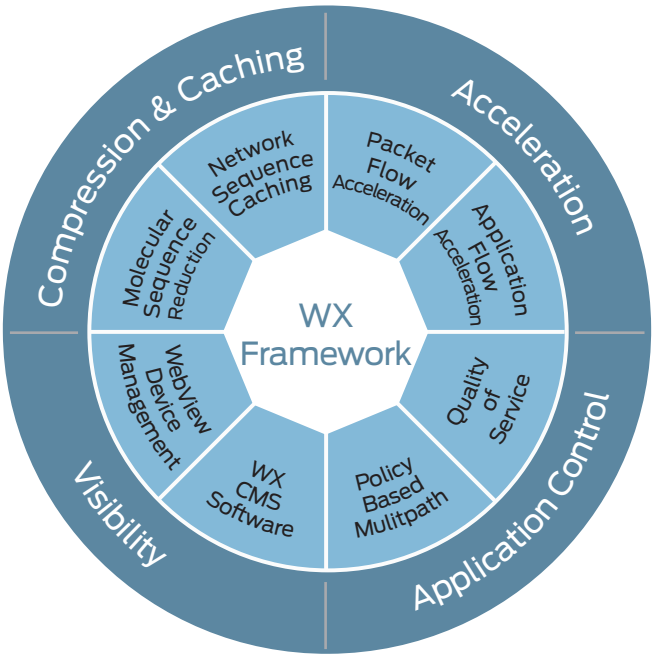

Figure 2: The WX Series Framework integrates key technologies that work together and influence each other, providing IT with distributed stateful intelligence about their WAN links and applications.

The patented Molecular Sequence Reduction (MSR) technology, a critical component of the WX Series Framework, adapts DNA pattern matching techniques for data compression, eliminating repeated patterns in the data stream. MSR compression is augmented by the unique Network Sequence Caching technology that recognizes repetition across larger data patterns and stores them on hard drives for longer periods of time. It does not rely on file-based structures to recognize the repetition, so it eliminates redundancies even on changed files, making it much more effective at reduction than file-based caching. MSR and sequence caching technologies are also application independent, reducing the payload size of all IP traffic.

Application Acceleration

The inherent latency and throughput limitations of satellite networks are addressed with groundbreaking acceleration technologies that speed up application performance, even when plenty of bandwidth is available. The Packet Flow Acceleration (PFA) techniques, for instance, reduce the impact that latency has on TCP-based applications.

Within the PFA feature set, the Active Flow Pipelining feature is most beneficial to satellite links. It terminates TCP and uses a UDP-based reliable transport protocol to send much more data across the satellite link. Typically, applications have to wait for TCP ACKs before sending more data, and with the delay on satellite links, this process seriously limits overall application throughput. By avoiding that wait for the ACKs, the WX Series and WXC Series platforms dramatically increase application throughput—for some customers, their 1 Mbps satellite link can now deliver throughput at a rate of 8 Mbps.

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Retransmissions following an error can also eat up considerable satellite bandwidth. The Forward Error Correction (FEC) technology, another PFA feature, reduces the need for retransmission by making use of recovery packets sent alongside payload packets, indexing them and allowing for reconstruction of lost packets as necessary.

For higher-layer support, the Application Flow Acceleration (AppFlow) technology accelerates applications that are constrained by their own protocol behavior, specifically Microsoft Exchange, which uses the Messaging Application Programming Interface (MAPI), Microsoft file services, which uses the Common Internet File System (CIFS) protocol, and Web-based applications using HTTP. For MAPI and CIFS, which break files into multiple blocks that must be individually sent, received, and acknowledged before the next block can be forwarded, the AppFlow technique pipelines the data, simultaneously sending as many data blocks as needed to fill the available WAN capacity.

This process eliminates the hundreds or even thousands of roundtrip times (RTTs) required to complete a single transmission, enabling messages and files to be downloaded at LAN speeds. For HTTP traffic, the AppFlow technique enables WX Series and WXC Series platforms to learn and cache objects associated with URLs, which are typically sent one at a time when a Web page is requested. The WX Series and WXC Series platforms confirm the freshness of each object or pre-fetch them when new or updated versions are available, in advance of the client's request—allowing browsers to display Web pages much faster.

By eliminating the ping-pong behavior associated with these protocols, AppFlow dramatically speeds the performance of Microsoft Exchange, file services and Web-based applications over satellite links, preserving valuable resources and making the most efficient use of limited capacity.

Quality of Service

Applications with a wide range of service-level requirements can be deployed with confidence across satellite networks utilizing the WX Series and WXC Series platforms. IT can use powerful bandwidth management capabilities to assign priority status and bandwidth allocation metrics to various types of applications. The WX Series and WXC Series platforms support up to 16 QoS categories. Classifications can be made by looking at a variety of factors, from IP headers and type of service (ToS)/Differentiated Services (DiffServ) information to the actual payload content.

CASE STUDY

Challenge

As the second largest independent tobacco leaf merchant in the world, DIMON uses VSAT satellite and VPN links to connect its data center with 38 other locations worldwide. Its satellite links had sufficient capacity, but latency was slowing user productivity.

Solution

As a trial, DIMON installed Juniper Networks WX Series Application Acceleration Platforms on the satellite link between North Carolina and an office in Lilongwe, Malawi. The solution immediately reduced connection setup times and improved application response times by as much as 100 percent.

Benefits

- Addressed critical latency issues
- Dramatically increased application response times on all of DIMON's satellite links
- Dramatically reduced connection setup times
- Reduced data replication from 36 hours to less than 13 hours

QoS options include the ability to preserve and see the QoS markings applied by devices elsewhere in the enterprise network. Other features include Committed Information Rates for sites and applications that need dedicated bandwidth, and rate limiting to prevent applications from using up all available bandwidth.

Reliability and Availability

System reliability is ensured by redundancy features and support for HA environments and load-balanced networks. The WX Series and WXC Series devices designed for satellite hub sites include redundant power supplies, and every platform supports fail-safe operation. In the event of hardware, software, or power failures, the platforms automatically enable a bypass mode that lets all traffic pass through untouched, eliminating the device as a single point of failure. The WX Series and WXC Series platforms also support the Policy-Based Multipath feature, which enables IT to define which applications should follow what path in sites with multiple WAN links. In addition to defining the path for specific applications, IT also specifies performance thresholds and dictates whether an application should be moved to the alternate path if performance degrades, if the link fails, or not at all.

Flexibility and Scalability

The WX Series and WXC Series platforms offer satellite networks a very flexible and scalable application acceleration solution that can work in concert with existing bandwidth- and load-sharing capabilities. The devices are available in a variety of configurations—from the Juniper Networks WX15 Application Acceleration Platform for small branch offices and other remote facilities to the Juniper Networks WX100 Application Acceleration Platform, designed for the largest satellite hub locations and other central sites. Once in place, the WX Series and WXC Series platforms can be upgraded to support higher performance levels as needed via software licenses. As networks grow, large installations can be partitioned into smaller domains to increase operational scalability. The WX Series and WXC Series platforms also integrate easily with private IP networks or VPNs.

Easy Deployment

The WX Series and WXC Series platforms are very easy to deploy across satellite networks. The comprehensive WX Series Framework eliminates the need to integrate a string of specialized devices that add complexity and single points of failure to the network and complicate installation and troubleshooting. The WX Series and WXC Series platforms are installed on the LAN side of the network routers and satellite modems, so no routing changes are required; the installation process can be completed in about 10 minutes. An auto-deployment feature is also available. IT in a central location defines configurations for remote sites they know are coming online so that devices for those remote sites never have to come through headquarters. Shipped straight to the site, the remote platforms need only power and Ethernet links to operate.

Once they boot up, they use Dynamic Host Configuration Protocol (DHCP) to gain a temporary address, use a well-known Domain Name System (DNS) name to find the central management system server, download their image and configuration file, and begin operation. The WX Series and WXC Series platforms support a range of topology options, including point-to-point and multi-point networks. They can be installed inline between a LAN switch and WAN router or off path, attached to the WAN router.

Manageability

The WX Series and WXC Series Application Acceleration Platforms also include an integrated network management system that supports multiple satellite hubs and hundreds or thousands of remote sites. A Web-based console provides a single view of the entire network and access to real-time and historical IP and satellite communications statistics. The secure WebView application, built into each WX Series and WXC Series platform, delivers per-device management, while the WX Central Management System software provides system-wide control and monitoring, and enables automated deployment.

Figure 3: Networkwide Visibility—The WX Central Management System software provides unified, intelligent insight into application acceleration, compression performance, WAN utilization, QoS and bandwidth allocation across the distributed enterprise.

With a wide range of reports on application, site, and link performance based on data provided by the distributed platforms, IT can quickly learn who the top talkers are, what the application mix is, how various links and applications are performing, and monitor device health and status. Other traffic analysis and utilization metrics reveal traffic flows between sites and the impact that QoS configurations are having on applications. In addition, IT can easily schedule software upgrades and changes to QoS policies and distribute them from a central location to multiple devices deployed at remote sites.

Solution Components

The WX Series and WXC Series platforms are based on the WX Series Framework, which defines the specific attributes required to overcome the bandwidth congestion, latency, and manageability issues that impede application performance over the WAN and especially satellites communication. This framework main components are:

- Compression and caching with a patented memory based compression that delivers between 10x to 100x gains
- Application Acceleration with Packet Flow Acceleration for all TCP applications and specific Application Flow Acceleration for CIFS, MAPI, HTTP and SSL applications
- Application control with quality of service and Policy-based Multipath
- Visibility and reporting with global policies and monitoring and 36 pre-defined reports

Summary—Satellite Communications Take Flight with Juniper Networks

Satellite communications offer easily established connectivity to sites that are not served effectively, if at all, by the terrestrial network infrastructure. They also have potential as a parallel infrastructure that backs up terrestrial networks. However, satellite networks are hampered by proprietary, rigid pre-Internet technology that can rarely support business-class performance. Juniper Networks WX Series and WXC Series Application Acceleration Platforms combine next-generation compression and caching, acceleration, application control, and visibility technologies and tools, boosting the performance and efficiency of satellite networks dramatically. The systems are reliable, manageable, and easy to deploy, and the WX Series Framework transforms satellite networks into a cost-effective and well-performing broadband IP access solution that can deliver advanced IP applications virtually anywhere. Configuration templates enable automated deployment of network components at remote sites. New remote locations can be added without increasing satellite capacity.

Next Steps

For additional details about Juniper Networks best-in-class Application Acceleration platforms, please visit **www.juniper.net/app-acceleration**.

About Juniper Networks

Juniper Networks, Inc. is the leader in high-performance networking. Juniper offers a high-performance network infrastructure that creates a responsive and trusted environment for accelerating the deployment of services and applications over a single network. This fuels high-performance businesses. Additional information can be found at **www.juniper.net**.

Corporate and Sales Headquarters
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

APAC Headquarters
Juniper Networks (Hong Kong)
26/F, Cityplaza One
1111 King's Road
Taikoo Shing, Hong Kong
Phone: 852.2332.3636
Fax: 852.2574.7803

EMEA Headquarters
Juniper Networks Ireland
Airside Business Park
Swords, County Dublin, Ireland
Phone: 35.31.8903.600
EMEA Sales: 00800.4586.4737
Fax: 35.31.8903.601

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