

Solution Brief

Implementing Continuity of Operations and Disaster Recovery (COOP/DR): How Juniper Networks Enables COOP/DR over the WAN

In a post-September 11 world, civilian federal agencies, the Department of Defense (DoD), and the intelligence community have all made it a priority to develop plans for ensuring continuity of operations and recovery in the event of a disaster. While guidelines and regulations, such as Presidential Decision Directives 63 and 67, have been in place for some time, September 11 brought into sharp focus the need for the capability to maintain mission-critical functions in the wake of a variety of potential emergencies.

Regardless of the cause of disruption, civilian and military agencies recognize that they must continue to deliver services, even without the benefit of their regular communications infrastructure, information systems, or even facilities. As history has shown, in the wake of natural disasters such as hurricanes and earthquakes, terrorist attacks, industrial accidents, or other unexpected disruptions (such as the Northeastern Blackout of August 2003), pieces of critical infrastructure can be lost for days or even weeks.

“Every place I visited in Southwest Asia, almost without exception, the message was, ‘We need more bandwidth.’”

Lieutenant General Steven Boutelle
CIO, Department of Army Staff

Taking proactive measures to avoid or lessen the impact of a disruption is crucial to maintaining operations, according to the Intergovernmental Advisory Board (IAB). Those measures should include both backup strategies and detailed risk analysis. The IAB notes that having geographically diverse backup facilities and systems can reduce disruption when critical infrastructure in one location goes down. For example, in response to Hurricane Isabel, some agencies were able to continue operations by switching to backup systems and locations outside the impacted areas.

Bandwidth Shortages Hamper Disaster Recovery Strategies

Continuity of operations planning and disaster recovery (COOP/DR) encompass a range of policies and procedures – everything from formalized roles and designation of a dedicated recovery team to backup procedures and facilities.

Unfortunately, many federal agencies, the DoD, and the intelligence community lack the budget for backup facilities, which would include a fully mirrored or duplicate set of systems. Consequently, the predominant approach agencies are taking is to replicate data between primary sites and geographically diverse secondary locations.

As agencies begin to implement this strategy, however, they’re encountering a major impediment: a lack of bandwidth. For example, in a recent interview with *Military Information Technology* magazine, Lieutenant General Steven W. Boutelle, the Department of the Army Staff’s chief information officer, cited “allocation of bandwidth” as the most critical information-related issue facing U.S. forces in Southwest Asia. “Every place I visited in Southwest Asia, almost without exception, the message was, ‘We need more bandwidth,’” noted Boutelle. “So we’re really looking at the refinement of the allocation of bandwidth, of how it’s allocated across the theater and around the Army.”

The Army isn’t alone in its bandwidth challenge. Lack of bandwidth is a problem that affects IT managers across federal agencies and commercial institutions alike. Yet federal agencies must find a way to transport both COOP/DR-oriented data and regular operations data across bandwidth-constrained WAN links. And the bandwidth problem is only getting worse as organizations identify a broader set of data that must be included in their COOP/DR plans. Recent emergency situations have demonstrated that, to be fully functional at multiple locations, agencies need to back up operational information such as personnel records and e-mail along with high-priority, mission-critical data.

What IT managers at military units and federal agencies need is a way to efficiently utilize scarce WAN resources so they can accommodate both operations traffic and critical backup traffic to meet COOP/DR requirements. They need a reliable, comprehensive WAN optimization solution that enables them to approach the level of disaster readiness of a fully duplicated site but without compromising day-to-day operations. Such a solution must leverage the existing infrastructure without requiring upgrades, redesigns, or investments.

Implementing COOP/DR across a WAN: What's Required

Effective WAN optimization must increase bandwidth to give IT managers the “head room” they need and must accelerate application performance to accommodate COOP/DR traffic. However, a WAN optimization solution needs to provide more than just additional bandwidth. Other features, such as application prioritization and Quality of Service (QoS), must work with compression and acceleration to improve overall WAN performance, ensuring that COOP/DR traffic doesn't negatively impact mission-critical or time-sensitive applications.

To be truly effective in a COOP/DR scenario, the WAN optimization solution must satisfy a multitude of requirements. These include:

Increasing WAN capacity intelligently to accommodate COOP/DR traffic

To be effective for COOP/DR, a WAN optimization solution must both increase WAN capacity and streamline replication processes so “recouped” bandwidth is used intelligently. Data compression is the key technology needed to “create” bandwidth. Compression allows for greater volumes of traffic to traverse a WAN link, enhancing data-replication operations. Rapid replication is essential for completing data backups within a reasonable timeframe as well as for getting backup sites up and running quickly in a disaster-recovery scenario.

In addition to compression, an effective WAN optimization solution must also eliminate repeated large file transfers. In day-to-day operations, only a small percentage of an agency's total data will change. Precious WAN bandwidth should not be wasted on the retransmission of large volumes of data for COOP/DR purposes. An effective WAN optimization solution must be intelligent enough to recognize these large redundant patterns in transmitted data and eliminate them to reduce the load on the WAN.

Likewise, an effective WAN optimization solution should support full-volume transfers, which can greatly simplify the initial implementation phase of a COOP/DR plan. Enabling the initial data-replication process to take place over the WAN, rather than requiring the use and distribution of tapes, can dramatically reduce the time it takes to transfer large databases from one location to another. It also eliminates the problem posed by incompatible tape-based systems at different locations.

Ensuring bandwidth availability for day-to-day operations traffic

Simply optimizing WAN links is not sufficient to ensure that bandwidth is always available for operations traffic. A WAN optimization solution must include QoS controls that ensure extra bandwidth isn't consumed by non-essential communications. These QoS controls must be intuitive and easy to use, allowing IT managers to prioritize mission-critical and delay-sensitive applications and allocate WAN bandwidth so that applications perform predictably. For agencies that operate 24x7, data-replication operations must be able to run continuously to ensure data integrity and complete backups. Likewise, this capability is critical to an increasing number of agencies that have little or no “quiet time” on their WAN to dedicate to data replication.

Accelerating IP applications. Many federal organizations have a highly distributed operational environment – from CONUS/OCONUS sites to remote AORs and foreign posts – and often implement satellite links as part of their WAN architectures. While these links provide connectivity, their sub-rate connections and high latency pose significant challenges for bandwidth-constrained agencies. Connection-oriented protocols such as TCP perform poorly over satellite links, while web-based transactions suffer sluggish performance due to high protocol overhead. Satellite links are also extremely expensive and, in some cases, technically impossible to upgrade, exacerbating the challenge of implementing COOP/DR.

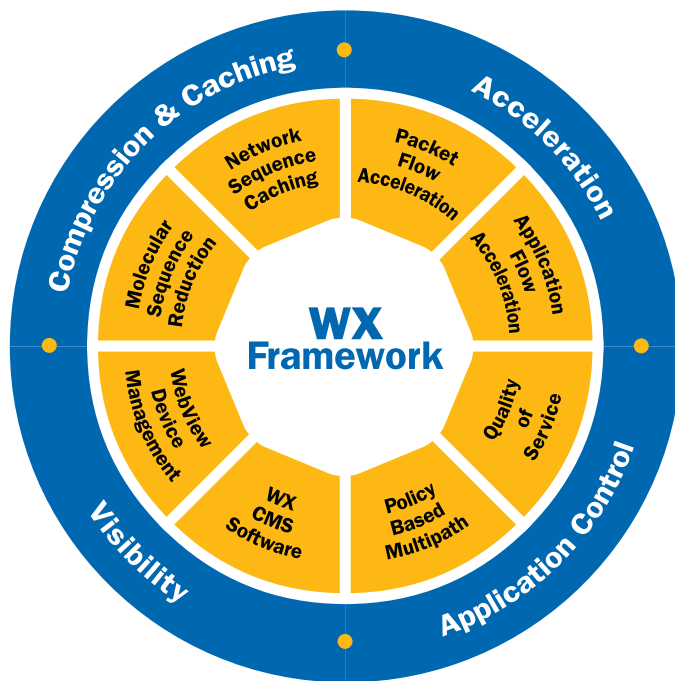
“We had to find a way to continue to provide our users with adequate response time without dramatically increasing our telecommunications costs.”

Al Canfield
Network Administrator
US Army Corps of Engineers

An effective WAN optimization solution must minimize the shortcomings of satellite links and maximize link capacity. Specifically, a WAN optimization solution must include the ability to optimize TCP/IP flows to allow for more frequent replication operations with optimal application performance across the WAN.

Comprehensive, easy-to-use management and monitoring tools

Good management tools are an essential part of an effective WAN optimization solution. Such tools must provide a unified, intuitive method for configuring and managing the WAN optimization platform. They must also include real-time monitoring and reporting capabilities, which are essential for giving federal IT managers visibility into application performance over WAN links. Reports showing details such as top talkers, coupled with the ability to capture packets, can help IT managers understand and identify the root cause of problems and quickly resolve them. In addition, IT managers need visibility into the day-to-day behavior of the WAN optimization platform, including compression performance, WAN utilization, application acceleration, bandwidth usage by application, and QoS delivery.



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.

Flexible deployment

An effective WAN optimization solution must be easy to configure and deploy, supporting auto-configuration and auto-deployment for those locations where trained IT staff are not on site, such as remote field deployments or other similar “lights out” environments. Centralized IT staff must be able to easily monitor, reconfigure, and maintain remote equipment and deploy software upgrades as needed. Deployment should require no changes to existing applications, networks, routers, or WAN interfaces, and must be transparent to IPsec VPNs, in-place encryption methods, and MPLS networks supporting QoS. In addition, WAN optimization platforms targeted for COOP/DR deployments must accommodate various data replication models, working in both one-to-one and cascading scenarios, as well as handling both on-going replication and periodic backups.

Highly reliable platforms

Given their critical role in supporting backup for COOP/DR implementations, WAN optimization platforms must be highly reliable. In addition, they must include by-pass features that ensure that failure of a WAN optimization platform will not impact WAN operation.

Juniper Networks: WAN Optimization for COOP/DR Implementations

Juniper Networks offers powerful application acceleration solutions that readily address the data backup portion of COOP/DR over wide-area links. Based on the company’s unique WX Framework™, a set of interdependent and complementary technologies that work together to optimize WAN and application performance, the WX™ and WXC™ application acceleration platforms continuously share information to ensure they both have knowledge of the WAN link from both ends. This distributed stateful intelligence enables the WX and WXC platforms to tune their settings in response to changing conditions, ensuring maximum performance for COOP/DR projects in a dynamic WAN environment.

The WX Framework integrates a set of interdependent technologies, including:

- The patented Molecular Sequence Reduction™ (MSR™) technology, next-generation compression that instantly increases WAN capacity.
- The patent-pending Network Sequence Caching technique, which eliminates large redundant data patterns, storing these longer patterns on hard drives for longer periods of time, thereby improving data reduction results.

- Quality of Service (QoS) and bandwidth-management tools that let IT managers prioritize mission-critical applications and time-sensitive traffic relative to other traffic types, such as COOP/DR traffic.
- Packet Flow Acceleration™ (PFA™) technologies that reduce the impact of latency on TCP-based applications.
- Application Flow Acceleration™ (AppFlow™) techniques that optimize application-specific protocols for Exchange, Microsoft file services, and web traffic, improving the response times of applications using MAPI, CIFS, and HTTP.
- Policy-Based Multipath™ (Multipath™) path selection technology, which allows IT managers to define which applications follow which paths when multiple WAN links are available, and supports automatic diversion to an alternate path if performance degrades or a link fails.
- Management and monitoring tools such as the WX Central Management System™ (CMS™) software, which provide IT with a single, unified view into their distributed applications and networks.

These technologies work together to transparently improve WAN performance and efficiency, enabling IT to meet the challenges of implementing a COOP/DR backup strategy without impacting day-to-day operations.

With the WX and WXC solutions, federal agencies, DoD units, and the intelligence community struggling to deploy a cost-effective COOP/DR plan can:

Intelligently increase WAN capacity to accommodate COOP/DR traffic

The WX and WXC platforms utilize MSR and sequence caching technologies to reduce the amount of traffic traversing the WAN link, delivering a four- to ten-fold increase in WAN capacity. Federal agencies gain sufficient bandwidth to support day-to-day operations data flow as well as COOP/DR data over existing WAN links.

To reduce traffic on the WAN link, MSR compression identifies repeating patterns in the data stream across multiple packets, applications, and sessions, and replaces those patterns with a label. The labels and their associated patterns are stored in memory in WX or WXC platforms at both ends of the WAN link; the destination device restores the data and forwards it to the end station.

Sequence caching also uses labels in place of repeated pattern sequences. Unlike the MSR technique, however, sequence caching pattern sequences are stored on hard disks, increasing the size and length of time the patterns can be stored. As a result, the sequence caching technology can eliminate repeated patterns even when the previous pattern was sent weeks earlier.

Because sequence caching can identify large redundant data patterns over long time intervals, it eliminates repeated transfers of large files, making backup much more efficient. In contrast to file caching, the sequence caching technique can recognize repeated data even when a file has been modified. The dramatic reduction can significantly speed the delivery of both operational data as well as COOP/DR traffic.

Working together to eliminate repetitive network traffic, the MSR and sequence caching technologies reduce data flow over WAN links by up to 90 percent, generating significant excess capacity to accommodate COOP/DR traffic and improve WAN efficiencies.

While the MSR and sequence caching technologies increase WAN capacity, the WX Framework's QoS and application-acceleration techniques enable IT to use the WAN to transfer very large databases – a more efficient solution than traditional tape-based methods. Typically, IT sends tapes to different locations to initialize replicated data stores, since performing this task over a non-optimized WAN link is prohibitively time consuming. The WX and WXC platforms allow IT to efficiently transfer this data over the WAN link without impacting general operations, adding a new level of convenience to the data replication process – and eliminating the problems that arise when different locations have incompatible tape systems.

Ensure bandwidth availability for day-to-day operations traffic

The easy-to-use, template-based bandwidth-management tool available with the WX and WXC platforms – including QoS and bandwidth allocation – allow federal IT staff to prioritize applications across WAN links and allocate bandwidth among different applications. With these tools, IT can ensure that data replication does not interfere with day-to-day operations traffic.

The QoS tools let IT define minimum and maximum throughput levels for mission-critical and delay-sensitive applications, as well as data-replication traffic, to achieve the best traffic mix and utilization of a given link. For example, IT could allocate a small percentage of the WAN link to data replication and set it to run continuously, ensuring that backups will always complete and that data integrity – and therefore operational readiness – remain high without negatively impacting other applications.

The WX and WXC platforms support up to 16 QoS traffic classes. Classifications can be based on a variety of factors, from IP headers and TOS/DiffServ information to the actual payload content. Other bandwidth management features include setting minimum and maximum bandwidth levels per application to ensure sufficient throughput while preventing applications from using up all available bandwidth.

Accelerate applications

The WX Framework addresses the inherent latency and throughput limitations of satellite links with the innovative Packet Flow Acceleration (PFA) technologies. The PFA techniques dramatically improve application response times by minimizing the impact of WAN latency, allowing TCP/IP traffic to flow faster and enabling frequent replications. PFA techniques can dynamically adjust the window size of older TCP clients, sending 64 KB window sizes between devices even if the sender or receiver supports only 16 KB. Local buffering within the devices ensures TCP hosts are never overrun.

Rather than slowing application response times while an application waits for acknowledgements on TCP, Active Flow Pipelining™, a component of PFA, utilizes a UDP-based reliable transport protocol in lieu of TCP to dramatically increase application throughput on high-bandwidth or high-latency links. The suite of PFA techniques allows IT to maximize utilization across the WAN, transparent to the applications and network equipment, and speed the completion of data replication and other COOP/DR traffic transfers.

To accelerate applications that are constrained by their own protocol behavior, the WX Framework also includes Application Flow Acceleration™ (AppFlow™) techniques that boost the performance of Microsoft Exchange, Microsoft file services, and web-based applications.

For Exchange, the AppFlow technique pipelines the hundreds or even thousands of round-trip times (RTTs) required to complete a single transmission, sending as many of them in parallel

as needed to fill the available WAN capacity. Messages are delivered at LAN speeds, boosting productivity and improving collaboration.

For Microsoft file services using the Common Internet File System (CIFS), the AppFlow feature pipelines read and write operations, sending data blocks in parallel to fully utilize WAN capacity. By the time a client requests the data blocks, they already reside on the nearby WX or WXC platform, which forwards them at LAN speeds, enabling large files to be transferred over wide-area links much faster.

For web traffic, the AppFlow technique enables WX and WXC devices to learn and cache objects associated with URLs. The WX and WXC 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.

Robust management and monitoring capabilities

The WX and WXC platforms include a set of management tools designed to help IT managers achieve maximum WAN optimization with minimum overhead. These tools include WebView – secure, web-based software built into each platform for device-level management – and the WX CMS software, which enables system-wide control, monitoring, and automated deployment. With WX CMS software, IT can configure and manage multiple WX and WXC platforms from a central location and gain a unified view into key metrics, including compression performance, application acceleration, WAN utilization, QoS, and bandwidth allocation.

Customer Success Story:

Unnamed DoD Customer

Business Benefits:

- 100% increase in data replication speeds
- Reduced replication time from 14 hours to four
- Enabled DR site to be operational in less than an hour
- Nine-month return on investment

This DoD customer struggled to maintain day-to-day traffic alongside the data replication traffic needed to implement a COOP/DR plan. The links were already congested with e-mail, personnel, and other files.

To increase the frequency of data replication and to improve the ability to be up and running from a secondary site, this

customer implemented a new data replication system deployed over WX and WXC devices. Initially, the customer could not complete the data replication even in the time frame needed for nightly backups, but the deployment enabled the customer to cut that time from 14 hours down to four.

As a result, the equipment has become a key element of the DoD customer's COOP/DR plan. Any sites that need to have a backup location will be equipped with WX and WXC devices. The benefits of the deployment extend beyond COOP/DR, as well. The customer's other operational traffic is benefiting from the increased application response time and reduced bandwidth consumption that the devices provide, improving users' productivity and avoiding the need to purchase additional bandwidth.

Powerful real-time WAN monitoring and reporting capabilities allow federal IT staff to identify top talkers, report WAN and application performance, and perform troubleshooting and problem-resolution activities such as packet capture. The intuitive GUI provides instant visibility into WAN performance, including both real-time and historical views. Performance data gathered from the WX and WXC platforms can also be exported to third-party tools, such as NetFlow-compatible platforms from Concord or Micromuse, to perform detailed traffic analysis. These reports provide military and federal IT with an at-a-glance view into COOP/DR traffic as well as operational data.

Auto-configuration is particularly useful for remote missions, such as in military field deployments, that may need to deploy WX devices in “lights out” environments.

Deployment flexibility

For agencies looking to implement WAN optimization as part of their COOP/DR strategy, the WX and WXC platforms offer considerable deployment flexibility. The devices are transparent to existing applications, networks, routers, and WAN interfaces, as well as to IPsec VPNs, MPLS, firewalls, and encryption technologies. As a result, the platforms provide significant performance benefits in a non-intrusive manner in any existing network environment. They can be configured to support a variety of data replication models, such as one-to-one or one-to-many models, and backup operations ranging from continuous replication to more bursty, periodic backups.

The rack-mountable WX and WXC devices interface with the network as a two-port LAN switch, deployed either in-line between a LAN backbone switch and a WAN router or off-path attached to a WAN router serving as a collapsed backbone. Supporting 10/100/1000 Ethernet interfaces and installed behind external firewalls and encryption devices, the platforms process all data before it goes to WAN transmission devices, ensuring the most efficient use of critical WAN links.

Core WX and WXC platforms can be installed and configured in less than 10 minutes, saving considerable time and effort. Remote devices are even easier to deploy. IT simply defines configurations in the WX CMS software; when remote devices boot up, they automatically request a temporary address, look up the central WX CMS server, download its configuration, and begin operation. This auto-configuration feature is particularly useful for remote missions, such as in military field deployments, that may need to deploy application acceleration platforms in “lights out” environments.

Highly reliable platforms

The WX and WXC devices are highly robust and will not impact WAN performance should they malfunction in any way. If a device should fail, it automatically switches to pass-through mode, allowing all traffic to flow across the WAN untouched. This approach ensures uninterrupted operations and eliminates the platform as a potential point of failure.

Juniper Networks: The Partner for COOP/DR

The civilian federal agencies, DoD, and intelligence community are under pressure to develop COOP/DR plans. However, WAN bandwidth constraints pose a serious challenge to implementing COOP/DR.

Juniper Networks’ WAN application acceleration solutions address this challenge by enabling organizations to make the most of their existing WAN resources. Not only does the WX Framework multiply the effective capacity of existing WAN connections, but it also accelerates applications and ensures that mission-critical applications receive the bandwidth they need, thus enabling backup traffic to co-exist with day-to-day operational traffic.

The Juniper solution delivers the resources needed to support data replication without requiring any changes or additions to the existing WAN. With a single platform, federal agencies gain WAN capacity, faster and more reliable backups, improved application support, and optimized throughput. Fundamentally, they gain the platform needed to succeed in COOP/DR.



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