Optimize NetApp SnapMirror over the WAN with Cisco Wide Area Application Services

What You Will Learn

With rapidly growing data stores, increasing regulation, and the need to operate in a 24-hours-a-day global marketplace, IT managers are challenged to protect their data and maintain business continuity. The NetApp SnapMirror application allows storage managers to replicate data between data centers to enable faster recovery for business-critical applications in the case of a disaster. Data replication is typically performed over the WAN, which introduces impediments to performance when compared to the LAN, due to distance and congestion and in many cases reduced bandwidth. Cisco® Wide Area Application Services (WAAS) Software is an application acceleration and WAN optimization solution that allows storage managers to dramatically improve NetApp SnapMirror performance over the WAN. As this document shows, using testing performed by Cisco, the optimizations provided by Cisco WAAS bring dramatic throughput improvements, leading to decreased replication times and improved bandwidth efficiency when using NetApp SnapMirror.

Challenge

NetApp SnapMirror combines disaster recovery and data distribution capabilities in a software solution that supports the business continuity requirements of the global enterprise. NetApp SnapMirror mirrors data to one or more network controllers over LAN or WAN connections. While NetApp SnapMirror has built in optimization mechanisms for data distribution, which can provide considerable benefit under normal conditions, on WAN links, where congestion and latency affect performance, storage administrators may not be able to complete replication jobs during the available backup time. This situation occurs because the rated throughput of high-bandwidth links cannot be fully utilized due to TCP behavior under conditions of high latency and high packet loss. In this situation, specific optimizations are needed to overcome the limitations of the WAN and to increase the throughput of storage replication jobs.

Cisco WAAS is a powerful application acceleration and WAN optimization solution that improves the performance of any TCP-based application operating in a WAN environment. Cisco WAAS uses a combination of TCP acceleration techniques and bandwidth optimization capabilities to overcome the most common challenges posed by the WAN. For storage replication applications, Cisco WAAS provides optimizations that are tuned to benefit the special circumstances encountered under high network traffic loads, especially with the high-bandwidth and high-latency WAN links that are typically found in storage replication environments. As the test results show, NetApp SnapMirror performance can greatly benefit from the optimizations provided by Cisco WAAS, allowing storage administrators to meet their business continuity objectives when replicating storage data over the WAN.

Cisco WAAS Replication Accelerator Mode for NetApp SnapMirror Optimization

Cisco WAAS uses several WAN optimization techniques, including TCP optimization called transport flow optimization (TFO), caching and compound compression known as data redundancy elimination (DRE), and persistent Lempel-Ziv (LZ) compression, to improve application performance over the WAN. For organizations with limited backup or replication time frames but ever-increasing amounts of data to protect and replicate to remote disaster-recovery sites, Cisco WAAS can help transfer more data between data centers within a shorter period of time by increasing the utilization of the WAN connection and eliminating the transfer of redundant data across the WAN link.

Data center storage replication applications, such as NetApp SnapMirror, differ in nature from many other TCP-based applications due to their mode of operation and deployment environment. Data center storage replication applications are usually deployed over high-speed links and transfer large sets of data across the WAN using a limited number of TCP sessions. As a result, these applications face unique challenges in utilizing the available bandwidth and achieving satisfactory performance.

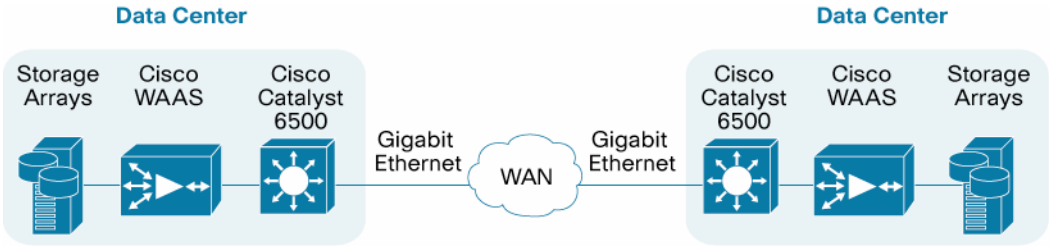
To address the challenges of replicating data traffic over the WAN, Cisco WAAS has been tuned for storage replication applications. Cisco WAAS Release 4.0.19 is especially designed to accelerate replication tasks between data centers. This release introduces a new, dedicated device replication accelerator mode. The Cisco WAAS replication accelerator mode is optimized for high-speed links and is tuned to better utilize memory and disk resources during replication optimization. The replication accelerator mode is supported on the Cisco WAE-7341 and WAE-7371 Wide Area Application Engine high-end appliances.

NetApp SnapMirror Performance Optimization with Cisco WAAS

Cisco conducted performance tests of NetApp SnapMirror with Cisco WAAS using the new replication acceleration mode in the Cisco test lab. These tests demonstrated a significant performance improvement, providing higher throughput and considerable time savings for replication jobs.

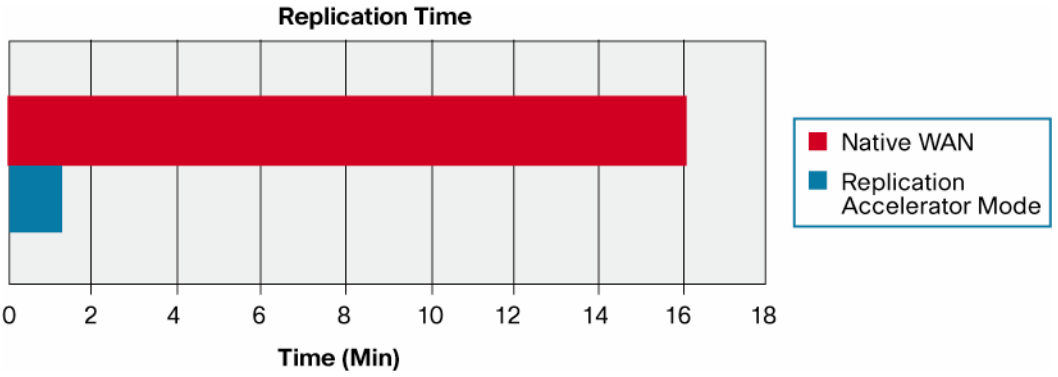
In these tests, two NetApp FAS systems running Data ONTAP 7.2.5 were connected by a WAN simulator with two Cisco WAE-7371 devices. These devices were connected inline as shown in Figure 1 and configured in replication accelerator mode. In situations where greater scale and resiliency are required, Cisco WAAS can be deployed in redirected mode using Web Cache Communication Protocol (WCCP) or a with a server load balancer, such as Cisco Application Control Engine (ACE), allowing clustering of multiple devices for scalability. A link with a bandwidth of 155 Mbps was simulated in combination with a latency of 40 milliseconds. The tests focused on NetApp SnapMirror traffic, which was generated by triggering several synchronization and replication tasks using data types commonly found in enterprises.

Figure 1. Cisco WAAS Inline Deployment Architecture Used for NetApp SnapMirror Storage Replication Testing



The tests highlight the performance improvement delivered by Cisco WAAS for the NetApp SnapMirror application. For cold cache transfers, or the first time that data is transferred over the WAN, Cisco WAAS improves NetApp SnapMirror performance by shortening the time required for replication by more than 10X compared to that for the native WAN (see Figure 2). For hot cache transfers, the improvement is even greater, because Cisco WAAS recognizes any data it has already sent and thereby increases efficiency by eliminating the need to transmit the data again.

Figure 2. NetApp SnapMirror Replication with Cisco WAAS in Replication Accelerator Mode Shows More Than 10X Time Improvement

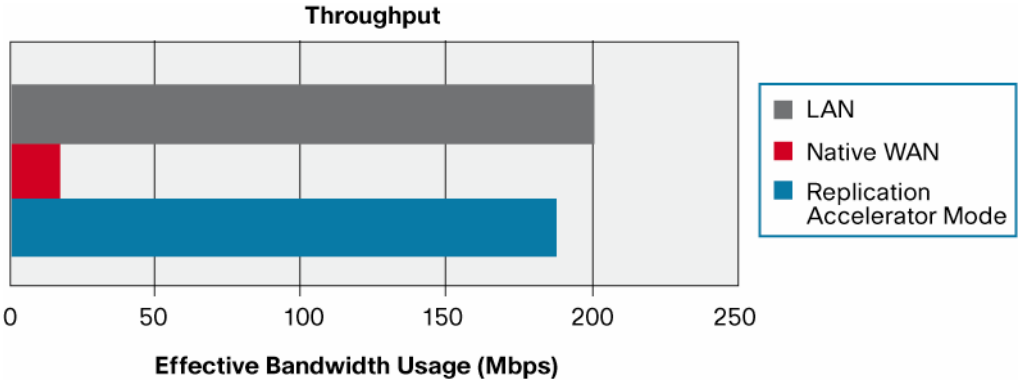


The tests also show that Cisco WAAS replication accelerator mode can utilize more bandwidth, resulting in an effective throughput capacity increase of more than 10X over the native WAN link. Without Cisco WAAS, only 16 Mbps could be utilized on the 155-Mbps link due to constraints including the effects of congestion and latency on TCP behavior.

These tests represent one scenario. Results will vary depending on the conditions of the particular network, including bandwidth, latency, and packet loss, as well the nature of the data being replicated and the degree to which it is repetitive.

Latency and bandwidth limitations are common problems that can be costly when significant amounts of WAN bandwidth are unusable, and links are billed for based on their advertised capacity. Cisco WAAS overcomes the bandwidth problem by optimizing the WAN and increasing throughput so that organizations may take full advantage of their bandwidth to meet their data protection requirements. During testing, more than 188 Mbps could be transferred on the same 155-Mbps link (see Figure 3) due to the compression capabilities in Cisco WAAS. This bandwidth utilization over the WAN is very close to the effective bandwidth capacity of the NetApp SnapMirror application, which demonstrated an effective throughput capacity of 200 Mbps in replication testing in a LAN environment.

Figure 3. Throughput Improvement for NetApp SnapMirror with Cisco WAAS Replication Accelerator Mode on 155-Mbps Link



Cisco WAAS Features for Application Acceleration

Cisco WAAS offers these main features for application acceleration:

- **Application-specific acceleration:** By applying acceleration to specific application protocols, Cisco WAAS can effectively overcome the limitations of application operation in WAN environments, such as bandwidth utilization and application-layer latency. Cisco WAAS employs a variety of features for application-specific acceleration, including read-ahead, message prediction, safe data caching, and operation batching, to provide LAN-like application performance over the WAN.
- **Advanced compression:** Cisco WAAS employs two forms of advanced compression to minimize the bandwidth consumed on the WAN. DRE stores application-independent blocks of data found in TCP traffic and uses them to reduce the need to send the same data twice, providing up to 100:1 compression. Persistent LZ compression is applied to further reduce bandwidth consumption and provides up to an additional 5:1 compression for data in transit, even for data that has been optimized by DRE.
- **Transport optimizations:** Cisco WAAS provides optimizations for TCP with a suite of features called Cisco WAAS TFO. TFO improves TCP performance and efficiency in WAN environments. By transparently scaling TCP time frames and using intelligent congestion-management algorithms, Cisco WAAS helps TCP perform more efficiently and effectively over the WAN, improving application performance. With Cisco WAAS, WAN bandwidth is preserved and consumption is minimized, thereby improving application throughput and performance.

Unique Solution for Storage Replication

Cisco WAAS also offers a special optimization mode, called replication accelerator, dedicated to the optimization of data replication traffic from data center to data center. To overcome the limitations of the WAN and meet disaster recovery objectives at a lower cost, Cisco WAAS also offers the following set of features:

- **Autodiscovery:** A Cisco WAE device set up in replication accelerator mode negotiates optimizations only with like peers configured in replication accelerator mode, providing ease of configuration with no disruption of network (Layer 3) services, leading to lower cost of operation.

- **Autoconfiguration:** After set up in replication accelerator mode, all services and application traffic policies are automatically configured to exclusively optimize data replication traffic and automatically bypass regular application traffic.
- **High-speed link optimization:** The TCP flow optimization available in Cisco WAAS addresses the problems inherent to the TCP protocol, such as packet loss and latency, which are higher with high-speed WAN links. Caching, known as DRE, is optimized for storage replication to increase performance.
- **Network deployment modes:** Cisco WAAS can be installed in either inline mode or redirected mode using WCCP (See Figure 4), or with a Cisco ACE server load balancer, or in FCIP environments with Cisco MDS (See Figure 5), to provide deployment flexibility and scalability.

Figure 4. Cisco WAAS Redirected (WCCP Version 2) Deployment Architecture for Storage Replication

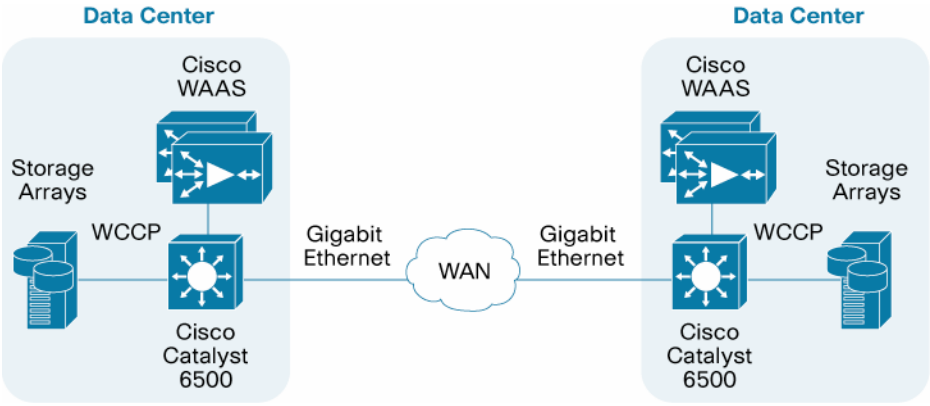
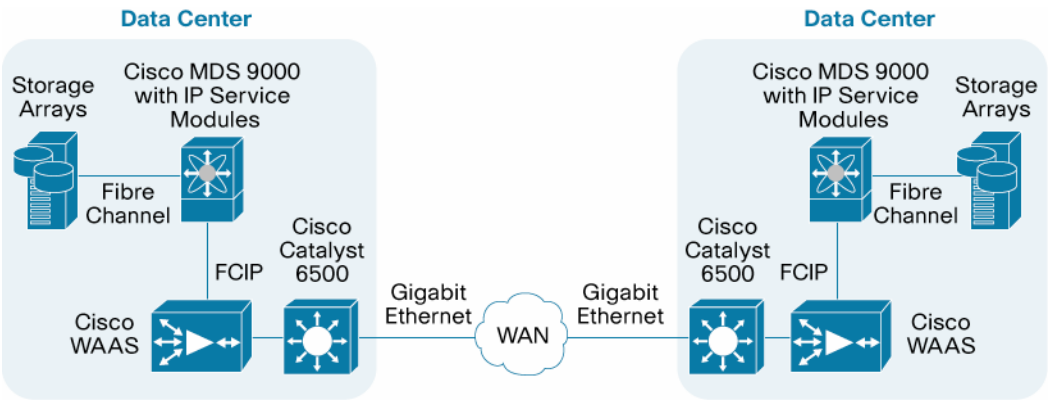


Figure 5. Cisco WAAS Fibre Channel over IP (FCIP) Deployment Architecture for Storage Replication



- **Data-store persistence across reboots:** Cisco WAAS provides quick recovery and continuation of replication operations, increasing performance and reliability.
- **Automatic isolation of branch-office to data center traffic from data center to data center traffic:** When deployed in replication accelerator mode, Cisco WAE devices are dedicated to the optimization of data replication traffic without affecting the performance of business applications. Cisco WAE devices in application accelerator mode can run simultaneously in the same network with Cisco WAE devices in replication acceleration mode.
- **High-availability and scalability:** Cisco WAAS can be deployed in clusters of devices for N+1 scalability and to take advantage of PortChannels in the Cisco MDS 9000 family and

Cisco Catalyst® 6500 Series Switches to improve resilience. Further, hardware-accelerated out-of-path deployment using WCCP increases scalability and reliability.

- **Central management from the Cisco WAAS Central Manager console: The** Cisco WAAS Central Manager console is used to manage multiple Cisco WAE devices running Cisco WAAS for application acceleration between branch offices and data centers and also for replication acceleration between data centers.

Conclusion

Cisco WAAS provides considerable performance improvement for the NetApp SnapMirror application over the WAN by optimizing bandwidth and accelerating TCP flows. The tests results illustrated in this document demonstrate a 10X improvement in NetApp SnapMirror replication time when using Cisco WAAS in replication accelerator mode. The results also demonstrate that Cisco WAAS improves the bandwidth utilization efficiency of NetApp SnapMirror over the WAN and allows it to operate at peak capacity.

When deployed in replication accelerator mode between data centers, Cisco WAAS helps storage administrators meet stringent business continuity goals by efficiently optimizing data replication traffic and overcoming the limitations of long-distance WAN links. By keeping their data synchronized between data centers, using Cisco WAAS in conjunction with NetApp SnapMirror, storage administrators can increase their overall business uptime and reduce the potential data loss and associated business costs in the event of a disaster.

With the replication accelerator mode, Cisco WAAS offers a simple, cost-effective, scalable, and highly reliable solution dedicated to the optimization of data replication traffic between remote data centers. Storage administrators, responsible for disaster recovery and data distribution operations, can deploy Cisco WAAS to meet their data recovery objectives and control their network bandwidth costs by reducing replication time and time to recovery and fully utilizing their high-throughput WAN links.

For More Information

To find out more about Cisco WAAS, visit http://www.cisco.com/go/waas or contact your Cisco account manager.

For more information on NetApp SnapMirror, go to http://www.netapp.com/us/products/protection-software/snapmirror.html.

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