



Requirements for Performing WAN Acceleration on High Capacity WAN Links

THE SKINNY ON FAT PIPES

Disaster recovery, server centralization and other strategic initiatives are increasing the amount of data on the Wide Area Network (WAN), resulting in a growing demand for high capacity WAN connections. These larger WAN links have unique performance, scalability, and configuration challenges that affect application delivery, and therefore must be taken into consideration when deploying a WAN Acceleration device.

This paper discusses how large WAN links differ from their skinny brethren, and explains the impact that this has on WAN optimization. It highlights what characteristics are required in a WAN acceleration device to overcome these challenges, and cites specific examples of how real enterprises are using Silver Peak's scalable WAN acceleration solution to improve application performance in fat pipe environments.

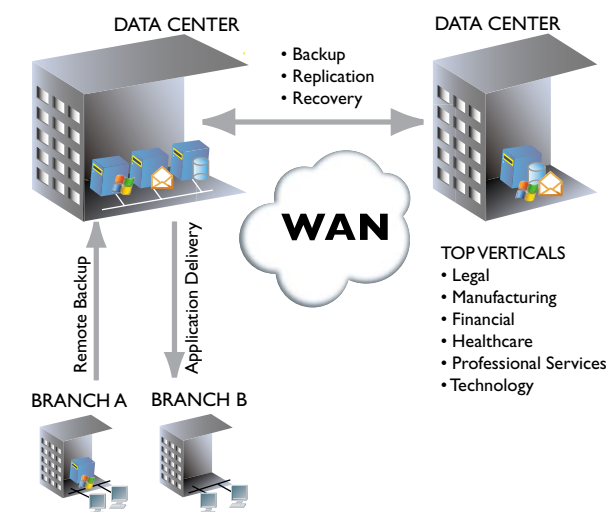
Characteristics of a "Fat Pipe"

A high capacity WAN link (a.k.a "fat pipe") is simply defined as a WAN connection that

supports 30 Mbps or higher throughput. One often sees such a connection between large data centers, disaster recovery facilities, regional hubs, and when communicating to large branch offices (typically with highly skilled remote employees, such as law firms, professional services firms, healthcare institutions, manufacturing facilities, and financial institutions.)

There is no magical association with the 30 Mbps number - it is simply an artificial line drawn in the WAN sand chosen for the commonality of DS-3 connections in large enterprises, and the fact that most WANs at or above this speed display the following common characteristics:

- **Bandwidth challenges.** Even though fat pipes offer significantly more bandwidth than alternative WAN links, that bandwidth is still a fraction of the throughput offered by Local Area Networks (LANs), which often run at Gigabit per Second (Gbps) speeds. As a result, applications still must compete with one another for limited bandwidth resources.



As data volumes increase, more enterprises are turning to "fat pipes" to support data center and branch office needs



When distance is introduced into the equation, an additional bandwidth challenge can emerge on fat pipes. High latency can prevent enterprises from effectively achieving their maximum WAN capacity. Even though hundreds of Mbps might be more than adequate throughout to support an enterprise's traffic delivery needs, if the company can only achieve 10 or 20% utilization on that WAN link application performance will suffer. Furthermore, the accounting department will be none too pleased given the amount of money spent on bandwidth that is not being utilized.

- **Large volumes of data.** By their very nature, high capacity WAN links are meant to support large volumes of network traffic. Depending on the size of the WAN connection, this can easily be Terabytes of data each day, as opposed to the Megabytes that are traditionally seen on smaller WAN links. In addition, fat pipes typically support many more simultaneous users than smaller WAN links. This can result in tens of thousands of simultaneous TCP flows between office locations.
- **More applications.** The general makeup of traffic on high capacity WAN links often differs from smaller branch office connections. For example, in addition to traditional user productivity tools, such as file services, email, and web traffic, large WAN links often support more server-based traffic, such as replication, backup, SQL transactions, and disaster recovery. This mix of

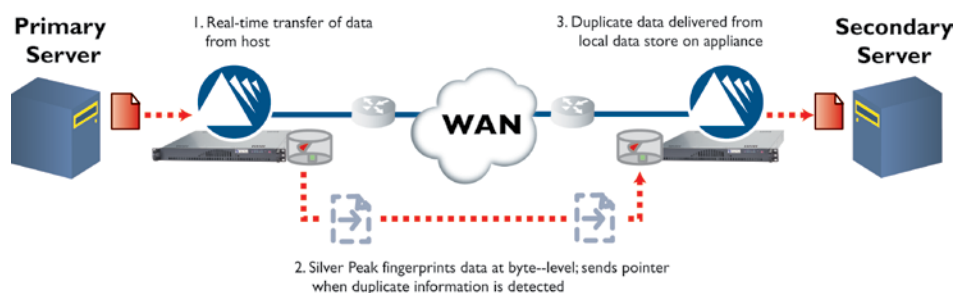
traffic places unique performance requirements on fat pipes.

- **Complex configuration.** Fat pipes are traditionally more complex to deploy than smaller ones, especially when used to connect large data centers. For example, these environments often must be configured to handle failover, which introduces a certain degree of complexity as protocols like VRRP and WCCP are introduced into the equation. In addition, there are often complex routing behaviors that must be dealt with (i.e. multiple paths in/out of the office; asymmetric routing) and advanced policies that must be enforced (e.g., Quality of Service and security).
- **Security.** As fat pipes carry large volumes of sensitive corporate data there is a higher tendency for enterprises to use encryption on these connections (as opposed to smaller branch office links, which only support a small fraction of the enterprise's overall data set).

WAN Acceleration Challenges

While large WAN links are not new, the optimization techniques used to improve application performance on these links has changed significantly in the past 2 years. Most notably, traditional compression, QoS, and TCP acceleration techniques have been augmented with the introduction of disk based data reduction.

Disk based data reduction works by placing a WAN acceleration appliance with dedicated local drives in each office location (such as a data center and disaster recovery facility). The appliances monitor all server/server and client/server communications in real-time, "fingerprinting" data sets and storing a single instance of each piece of information locally for future reference. Whenever duplicate data is sent between communicating devices, the appliances detect this and send a reference across the WAN instead of the actual data. The information is then delivered from the local data store on the far end appliance. This eliminates the transfer of duplicate data across the WAN, which can eliminate over 95% of WAN traffic. In addition, it leads to LAN-like performance across the WAN as information is delivered locally whenever possible. Disk based



Disk based data reduction improves WAN efficiency and application performance by eliminating the transfer of duplicate data across the WAN



data reduction yields 10-20x (90-95%) average performance improvements across the WAN, with peaks exceeding 100x (99%) under the right circumstances.

There are unique challenges associated with performing disk based data reduction on high capacity WAN links. For one, it involves lots of parallel reads and writes to disk at very high speeds, which requires efficient fingerprinting algorithms and significant hardware processing power. Secondly, a significant amount of storage capacity is required on data reduction appliances to handle the large volumes of data produced in fat pipe environments. In addition, extremely efficient methods of indexing/storing are required to access and retrieve this data over time.

The diverse makeup of traffic traversing large WAN links also has an impact on data reduction. In addition to “bulk TCP” applications, such as email and file, high capacity WAN links also must support real-time traffic, such as data replication, SQL, voice and video. As many of these applications run over UDP (not TCP), scalable data reduction solutions must work across all applications, regardless of transport protocol. In addition, the fingerprinting process employed by data reduction appliances cannot add more than a few milliseconds of latency, and must deliver consistent latency throughout the course of operations. Applications like data replication perform poorly when latency fluctuates. As a result, the wrong WAN acceleration solution can cause more harm than good in some instances..

Silver Peak’s Scalable WAN Acceleration

The Silver Peak solution was designed from the ground up to deliver the best performance, scalability, and management on high capacity WAN links.

Performance

Hardware architecture. Great performance starts with the underlying hardware. Silver Peak is the only WAN acceleration vendor that provides a complete family of appliances designed on multi processor, multi-core 64 bit processors for advanced performance and increased memory addressability. Dedicated, multi-Gigabit per second (Gbps) security processors offload all key management and encryption functions to ensure full speed throughput for Network Memory and for high throughput encryption of network traffic with IPsec and SSL.

Superior Data Reduction. Silver Peak’s Network Memory is the industry’s premier platform for disk based data reduction. Silver Peak is constantly enhancing this technology to deliver the best performance on all enterprise applications. This includes continual improvements to Network Memory’s pattern recognition capabilities, coupled with faster reads and writes to disk at high WAN speeds. The result is superior performance for a variety of application environments, including interactive saves (e.g., Microsoft Excel) and applications with high volumes of sustained traffic (e.g., data replication and video streaming).

Network Memory is significantly different from other data reduction solutions offered on the market today. While other vendors

employ session buffer architectures that require blocks of data to be aggregated before making a data reduction decision, Silver Peak has a packet-oriented architecture whereby variable length redundant patterns are detected down to byte level resolution. Silver Peak’s pattern matching process is not based on a fixed block size, as is the case with other solutions. This provides better granularity when matching patterns and leads to less latency and higher data reduction results. This becomes particularly apparent when performing data replication and backup across the WAN, which involve the transfer of large streams of data that typically have undergone some form of de-duplication (i.e. the removal of repetitive data by the storage application). Silver Peak’s method of data reduction excels in these environments by finding more pattern matches within the streams themselves (in addition to between streams). This results in the best “first pass” performance numbers.

Optimization Features. Silver Peak provides a wide array of optimization techniques to deliver the best performance across different types of applications and different WAN environments. In addition to disk based data reduction, Silver Peak’s NX appliances support traditional compression (LZ, header, crossflow), TCP acceleration (selective acknowledgements, adjustable window sizing, etc), and advanced Quality of Service (QoS) techniques. Silver Peak also provides loss mitigation using adaptive Forward Error Correction (FEC), which delivers 8x better performance than the competition in environments with high packet loss (e.g., IP-VPNs and MPLS). All of Silver Peak’s features can be applied to both TCP and UDP traffic.



Scale

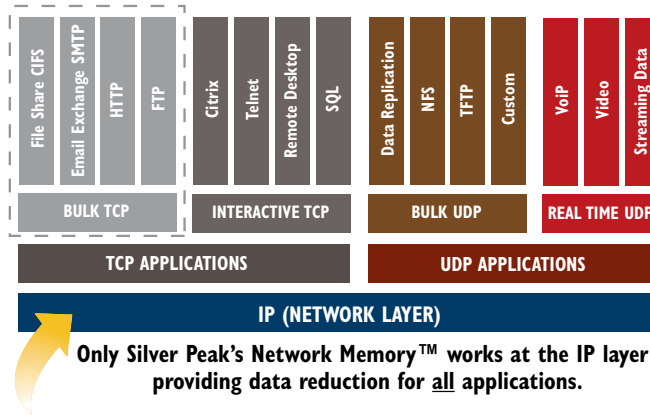
Large Local Data Store. NX appliances offer 3x the data store as the next closest competitor. The NX-8500, for example, leverages 7 TB of local disk to ensure the best data reduction performance over the longest period of time.

Single Instance Networking.

Vendors use different methods to store data when performing data reduction. Some techniques are more efficient than others, resulting in better usage of available storage space. Silver Peak, for example, stores a single instance of information for all offices connected to an appliance; other solutions store a separate instance for each individual WAN link. The effective storage capacity of the first method is much greater than the second. Given these differences, two appliances with equal stated storage capacities may not perform identically over time.

Industry Leading Application Breadth

Most data reduction solutions focus on this traffic only

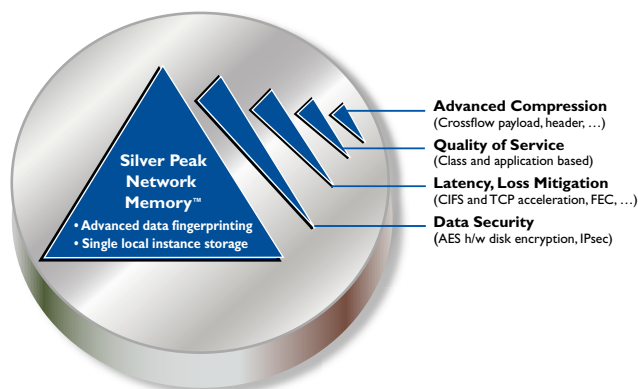


High Flow Count. A single Silver Peak NX appliance can support up to 256,000 flows, which is almost 7x the capacity offered by alternative solutions. This enables a substantially higher 'fan-out' from the data center, as well as the ability to support thousands of simultaneous sessions across the WAN (e.g. data replication). In the Silver Peak solution, there are no artificial TCP flow limits that prevent the NX appliances from reaching their stated WAN throughput capacity. This enables enterprises to scale in a cost effective manner.

Silver Peak also offers multi-flow emulation to overcome flow shaping disciplines that can limit the amount of bandwidth allocated on a single flow (e.g., Weighted Fair Queuing). This ensures superior performance in multi-flow environments through better integration with firewalls, routers, and other network elements that are common in high capacity WAN environments.

Application Breadth. Network Memory is the only data reduction solution that works at the network layer of the ISO stack (as opposed to the transport layer). This means that it works on all traffic, regardless of transport protocol (UDP, TCP, and proprietary). In addition, Network Memory consistently adds <1 ms of latency, making it uniquely suited for all applications, including real-time data replication, voice, video, Citrix, and SQL.

Silver Peak does not alter client/server communications in any way and does not perform application layer modifications that can alter application behavior. As a result, predictable performance gains can be experienced across all enterprise applications.



Silver Peak appliances use a variety of optimization techniques to move large volumes of data in a short amount of time.

Security

Silver Peak protects data at all times – when residing on system hardware and when traversing the WAN. Data security and privacy are achieved with the following techniques:

Disk encryption. Silver Peak uses AES encryption to thoroughly protect all information stored within NX appliances. With dedicated processors for hardware acceleration, disk encryption takes place at line rate, ensuring that data privacy does not come at the expense of performance and scalability.

Secure transport. Silver Peak supports IPsec (using AeS for encryption) to protect data sent between appliances. Dedicated hardware ensures that the IPsec encryption process does not adversely impact the performance of Silver Peak appliances. This paves the way for additional encryption technologies that can be used to secure transmission across the WAN in the future

Secure Access. Access to all Silver Peak devices is tightly controlled using TACACS+ and/or RADIUS. This ensures complete AAA protection, including user tracking and auditing per-command authorization, and group based authentication privileges. Enterprises can use their existing AAA / security infrastructure, eliminating the need to maintain separate databases for administrative passwords, credentials, and other security privileges.

Management/Control

Centralized Policy Engine. Silver Peak's Global Management System (GMS) enables Access Control Lists (ACLs) and other advanced authentication policies to be

centrally configured and enforced. This includes “device authentication”, whereby only valid Silver Peak appliances are allowed on the network, and “connection authentication”, whereby connectivity can only be established between trusted Silver Peak devices (with approved IP addresses).

Silver Peak allows common templates to be used across numerous appliances for simplified configuration and management of QoS, routing, and optimization policies.

Advanced QoS. Silver Peak honors existing tags (DSCP) and enables the creation and enforcement of new traffic management policies that can be applied per flow. QoS policies can be configured by IP address, port range, application, and other commonly used parameters.

Per-application optimization. Individual optimization techniques can be applied on a per-application basis for optimum network performance based on individual traffic characteristics. Silver Peak NX appliances employ stateful deep packet inspection to make

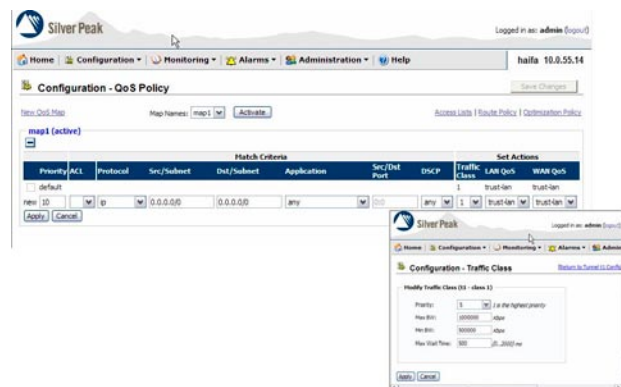
intelligent acceleration decisions when handling applications that use ephemeral (i.e. temporary) ports, such as Voice over IP (VoIP) and FTP. This is in addition to port and flow based filtering schemes, providing granular control and applicability across the widest breadth of enterprise applications.

Zero touch configuration. Silver Peak dramatically simplifies deployment and reduces configuration errors by enabling NX appliances to automatically download key configuration settings, such as IP addresses, QoS policies, optimization instructions, and predefined configurations.

Taming Fat Pipes - Silver Peak Customer Examples

Health Dialog

More than 19 million individuals, healthcare plans, and physicians have access to Health Dialog's care management and disease management services, making the company one of the fastest growing private organizations in



Silver Peak provides easy to use templates for enterprise-wide policies



the world. To support their rapidly increasing base of constituents, Health Dialog relies on a high-performance Wide Area Network (WAN) that connects its main facility in Boston with health coaching facilities throughout the United States and the United Kingdom. (This WAN is a mix of IP VPN and MPLS, with speeds burstable to DS-3).

Health Dialog had two major initiatives underway that underscored the business need for improved WAN performance and scalability. The company was in the midst of consolidating application servers from its branch office servers into a single collocation facility near its headquarters. Consolidation would improve the IT's ability to control and manage critical servers while reducing overall costs. But consolidation's many benefits could not come at the cost of poorly performing applications, including Microsoft file and email, payroll, Voice over IP (VoIP) and Siebel CRM. In addition, Health Dialog is implementing a business continuity initiative to address their stringent disaster recovery objectives. This will require the transfer of large amounts of replicated data between geographically dispersed collocation facilities.

Results. Silver Peak was chosen for several reasons. One, NX appliances were the best equipped to handle Health Dialog's complex WAN architecture, which involved dual homing to different carriers and establishing granular QoS policies that map to the capabilities present within their AT&T routers. Second, Health Dialog required large data stores on their appliances with high flow counts to handle their traffic volume. This was delivered with Silver Peak's NX-5500, which supports 2 TB of storage and up to 50 Mbps

Sample Performance Improvements on Ernst & Young's High Capacity WAN Link

Application	Without Optimization	With Silver Peak	Peak Improvement
Microsoft file (CIFS)	3 Mbps	160 Mbps to 220 Mbps	73x
FTP	10 Mbps	268 Mbps to 460 Mbps	46x
DoubleTake	10 Mbps	285 Mbps to 460 Mbps	46x
Lotus Notes Client to/from Notes Server	3 to 5 Mbps	9 Mbps to 39 Mbps	8x
Lotus Notes Server to Notes Server	5 Mbps	8 replication streams - 60 Mbps	12x

WAN capacity and 64,000 simultaneous flows. Lastly, Health Dialog liked Silver Peak's ability to support all of their traffic, including DNS, TFTP, SNMP, and others applications that use UDP as a transport protocol.

With Silver Peak's NX appliances in place, Health Dialog is seeing 5-11x (81%-91%) average improvement doing file transfers. On high latency links (100 ms), video image transfers are reduced from 140 seconds to 27 seconds, which is 2x better than the competition. Silver Peak also excelled in high loss environments (IP VPN). Silver Peak's Forward Error Correction (FEC) also helped on Health Dialog's oversubscribed WAN links. With this technology, the company overcame 2% packet loss on one link to reduce a SQL transfer from approx 23 minutes to 2 minutes. This was 8x better than the next closet WAN acceleration device.

Ernst & Young LLP

Ernst and Young LLP, a global leader in professional services, has large data centers and distributed offices throughout the world.

In Canada, for example, the firm is paying for expensive 500 Mbps SONET connections between Toronto and Montreal to serve over 4,000 users. The company rarely could achieve more than 10% utilization on that link, making it difficult to perform real-time data replication using Double-Take software. This also made it difficult to deliver other applications from these offices, including Lotus Notes and Microsoft file services.

Results. After deploying Silver Peak, the firm saw a 46x improvement in the performance of their data replication solution – throughput improved from 10 Mbps to 460 Mbps. Similarly, the company saw significant performance improvements in other core applications being delivered across the WAN, including Microsoft file services (73x), FTP (46x) and Lotus Notes (12x).



Silver Peak

Silver Peak Systems, Inc.
471 El Camino Real,
Santa Clara, CA 95050
408.935.1800
www.silver-peak.com