

Accelerating WAN Applications

Transaction and File Transfer Acceleration

Overview: Accelerating WAN Applications

Latency causes havoc on wide area networks by causing increased delays and under-utilization of links. When lost packets, latency, and under-utilization of bandwidth bog down transport and application response times, adding bandwidth to already under-utilized links is useless. What is needed is a combination of transaction acceleration and file transfer acceleration.

Transaction acceleration overcomes the delay associated with the ongoing “chatter” in client/server and Internet environments. Unnecessary and slow round-trips of ‘chatter’ cause poor transaction response times. Packeteer® provides transaction acceleration that reduces round trips and application wait times.

File transfer acceleration is needed to make maximum use of available bandwidth and speed delivery of large files. Packeteer’s file transfer acceleration overcomes inherent TCP protocol limitations by expanding window size and managing the effects of packet loss to increase the speed of transfers.

This paper will provide a basic understanding of the technical problems and their impact on business operations, as well as the basics on how Packeteer’s SkyX® acceleration overcomes these challenges.

The Latency Problem

Latency is inherent to moving packets around a network; put simply, it is the time it takes for a packet to travel from source to destination. Therefore, flows cannot ramp up to take advantage of the available bandwidth and the result is longer connection setup times and underutilized links.

Understanding Network Limitations

TCP is a reliable protocol used for transmission of data over IP networks. However, there are inherent TCP behaviors that work against higher latency connections. TCP utilizes a sliding window mechanism to limit the amount of data in flight at any time. When the window becomes full, the sender stops transmitting until it receives new acknowledgments. Over long distance networks, where acknowledgments are slow to return, the TCP window size often sets a hard limit on the maximum throughput rate.

How much bandwidth is being wasted?

Windows 2000 has a window size that can transport up to approximately 16 k of data. Depending on the distance of the link, it can take anywhere from 15 to 600 ms to get the acknowledgment (ACK). As distance increases, so does the wait time for the ACK. Once the ACK is received,

the next 16 k of data is sent. This same process happens for every window (16 k of data). The result is that large links become less and less utilized as delay increases because valuable time is spent simply waiting for acknowledgements. Consequently, the data cannot be sent fast enough in order to use the available bandwidth.

WAN Link	Typical delay due to distance	Windows XP maximum throughput	Windows 2000 maximum throughput
Same City	15 ms	32 Mbps	8 Mbps
Regional	30 ms	16 Mbps	4 Mbps
Across a Continent	100 ms	5.2 Mbps	1.3 Mbps
Between Continents	200 ms	2.6 Mbps	640 Kbps
Satellite	600 ms	850 Kbps	213 Kbps

The above chart shows the typical delay due to distance and the typical maximum throughput for Windows XP and Windows 2000. To determine the maximum throughput, 64 k default window size for Windows XP and 16 k (average) window size for Windows 2000 was used.

A typical example is in large data center-to-data center WAN links. Large WAN connections (DS3, 45 Mbps, OC-3/STM-1/155 Mbps) between data centers have become more affordable and, therefore, more commonplace. Having a large connection to speed the rate of disaster recovery backup, server synchronization, and distributed storage is now a sound concept. Most server mirroring and disaster recovery solutions use TCP protocols for their file transfers.

100 ms average delay (e.g. across continent connection)

Link Size	Windows XP maximum throughput	Potential wasted bandwidth	Windows 2000 maximum throughput	Potential wasted bandwidth
512 k	5.2 Mbps	0	1.3 Mbps	0
2 MB	5.2 Mbps	0	1.3 Mbps	0
10 MB	5.2 Mbps	4.8 Mbps/48%	1.3 Mbps	8.7 Mbps/87%
45 MB	5.2 Mbps	39.8 Mbps/88%	1.3 Mbps	43.7 Mbps/97%
155 MB	5.2 Mbps	149.8 Mbps/96%	1.3 Mbps	153.7 Mbps/97%

Assume a business is running Windows XP. With a link size of 45 MB, approximately 88 percent of the bandwidth is being wasted due to TCP and window size limitations. Once again, user expectations are that the larger link size will allow for more efficient backups and synchronization. When this expectation is not met, the assumption is that more bandwidth will solve the problem so the business upgrades to a 155 MB link. This only creates more waste since approximately 96 percent of the bandwidth is not utilized.

When available bandwidth is not fully utilized due to TCP and latency limitations, the result is wasted bandwidth and missed performance targets. Business productivity is negatively impacted when large file transfers are slow. The ability to accelerate large file transfers is the key to resolving these issues.

The Solution

While it is almost impossible to eliminate latency over networks, it doesn't mean the situation simply has to be tolerated or that something can't be done to minimize the impact. Packeteer's SkyX does do something about it.

What's Needed to Accelerate Application Traffic?

Considering the variety of network limitations and their associated impact on costs, a comprehensive solution is needed to address the problem and accelerate traffic. In order to accelerate application traffic, the solution must be able to eliminate:

- ☑ The impact of high latency due to distance delay
- ☑ Poor performance of large flows: large file transfers, disaster recovery backups, database synchronizations, and so forth
- ☑ The effects of high packet loss and retransmissions
- ☑ Wasted WAN capacity and link under-utilization
- ☑ Slow and problematic connections

SkyX Solves these Problems

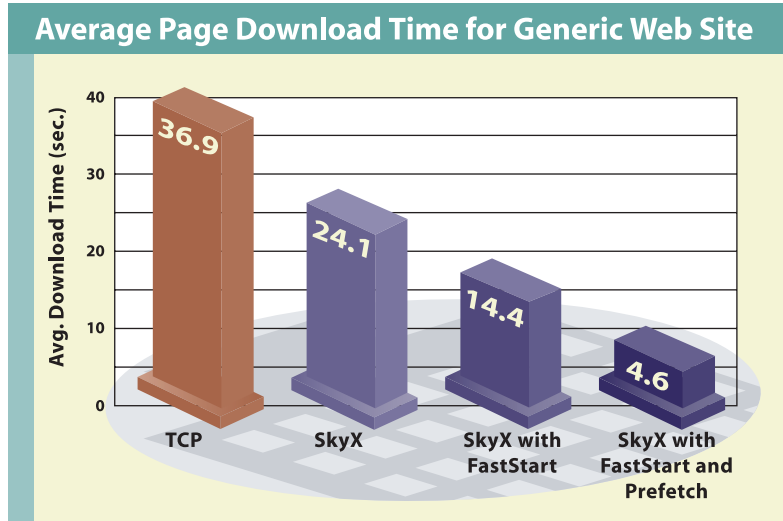
A wide array of technologies is available to increase the window size or just compress traffic. However, they fail to meet users expectations or maximize bandwidth utilization. The exception is Packeteer's SkyX. With this product, it is now possible to eliminate the impact associated with distance latency and bandwidth utilization. SkyX provides acceleration for both transactions and file transfers to enhance network performance.

Transaction Acceleration

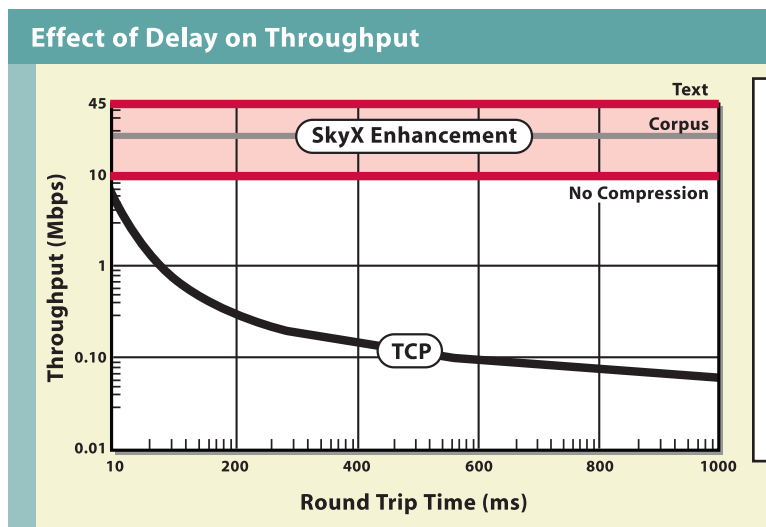
With enhanced HTTP performance, response times improve dramatically. SkyX FastWeb technology, which includes Web Prefetch and FastStart, speeds delivery of embedded objects and Web-based applications. It also further accelerates web downloads by reducing the time needed to establish each new HTTP connection.

Unlike file transfers that typically consist of a single, large download, web traffic is characterized by large numbers of short connections. FastStart and Web Prefetch are specifically designed to optimize the download and display of Web pages.

FastStart saves one round-trip time for each Web object by reducing the handshaking required to establish each new HTTP connection. Using FastStart, SkyX acknowledges TCP connections immediately without waiting for a connection to be established to the web server. This immediate acknowledgement allows the browser to send its HTTP GET request right away. SkyX then combines the HTTP GET request with the XTP connection request. This process delivers the HTTP request to the Web server one round-trip faster. For web pages that consist of large numbers of objects, FastStart greatly improves the responsiveness of the web page display.



Web Prefetch reduces the time required to download and display each Web page by proactively retrieving the embedded graphics and other objects on each page along with the requested HTML file. The server-side SkyX intercepts the HTML files returned by the web server and begins retrieving the various embedded objects on that page on behalf of the browser. The server-side SkyX then pushes the objects to the remote side of the link where they are served by the browser-side SkyX when requested by the browser, thereby avoiding the network delay.



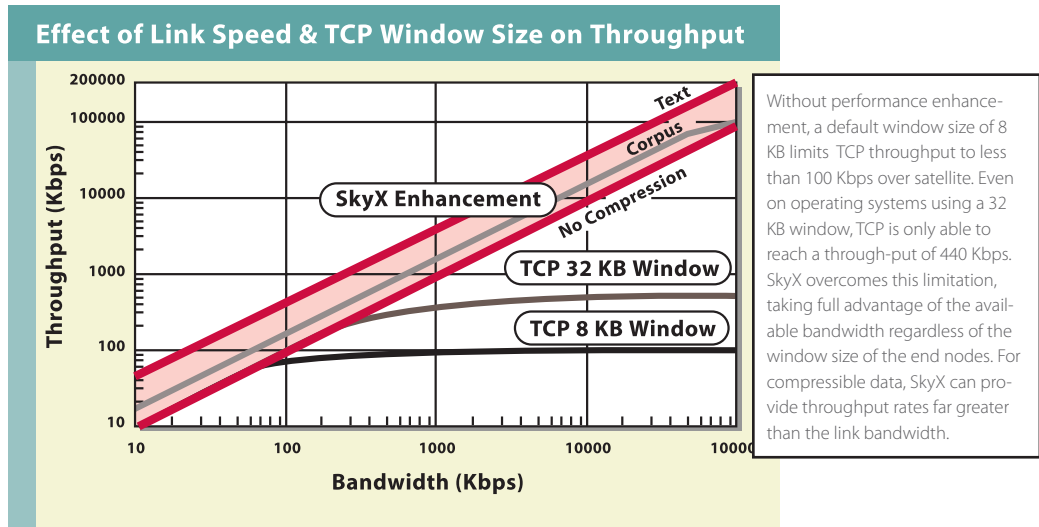
SkyX removes the dependency of TCP on the round-trip time of the link. This figure shows the measured throughput on an error-free, 10 Mbps link. These results illustrate that TCP throughput drops rapidly as the round-trip time increases. In contrast, SkyX is able to maintain full usage of the link regardless of the round-trip time. For compressible text, SkyX consistently delivers throughput rates greater than the actual bandwidth.

SkyX Transaction Acceleration
> Reduce round-trips due to fast start
> Reduce round-trips due to elimination of slow start
> Reduce round-trip waits due to prefetch
> Reduce application wait times due to more efficient retransmission behavior

File Transfer Acceleration

SkyX accelerates all TCP-based applications – including Web access, FTP file transfers, ERP, and email – by replacing TCP with protocol specifically optimized for long delay, high bit error, and asymmetric bandwidth conditions. Experience faster performance of database connectivity, Web applications, and remote access applications while maintaining full TCP reliability and end-to-end flow control.

SkyX transparently intercepts TCP connections from the client and converts the data to the Xpress Transport Protocol (XTP) for transmission over the network. SkyX on the opposite side of the link then translates the data back to TCP for communication with the server.



Without performance enhancement, a default window size of 8 KB limits TCP throughput to less than 100 Kbps over satellite. Even on operating systems using a 32 KB window, TCP is only able to reach a through-put of 440 Kbps. SkyX overcomes this limitation, taking full advantage of the available bandwidth regardless of the window size of the end nodes. For compressible data, SkyX can provide throughput rates far greater than the link bandwidth.

The large XTP window removes the dependency of the network on the bandwidth-delay product, allowing high throughput independent of the TCP window size of the end nodes. To optimize bandwidth utilization, SkyX dynamically adjusts the XTP window size based on the link bandwidth, delay, and number of simultaneous connections.

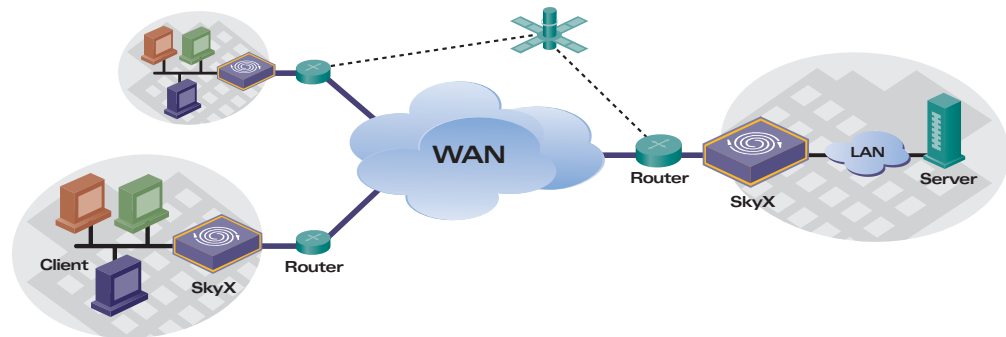
In addition, the data compression functionality offers compression ratios of up to 10:1, with typical traffic mixes realizing 2:1 to 4:1 – increasing the amount of data carried over the link.

SkyX File Transfer Acceleration

- > Increase speed of transfers due to window size expansion
- > Increase speed of transfers due to slow start elimination
- > Increase speed of transfers due to elimination of loss backoff effect
- > Reduce application wait times due to more efficient retransmission behavior

How to Deploy SkyX

SkyX is fully transparent – no changes, modifications, proxies, or settings required. SkyX's efficient protocol-layer architecture delivers higher performance and scalability. And because SkyX can be managed by a browser or CLI, it can be up and running without extensive installation and troubleshooting.



Summary

As networks and applications evolve, new challenges are presented. Having efficient and effective solutions to these challenges is what Packeteer delivers to businesses around the world. Businesses no longer have to tolerate a network that has increasing delays, under-utilization of links, lost packets and latency. SkyX's combination of transaction and file transfer acceleration provides much-needed benefits for optimal business productivity:

- Accelerated TCP over high latency links, such as satellite
- Optimized WAN application performance, link utilization and efficiency
- Enhanced Web-based performance and improved response times
- Maximized bandwidth utilization and ROI
- Expedited delivery of large flows and file transfers

SkyX is part of a complete solution that also includes network visibility, control, and management. Packeteer's solution provides insight into performance issues with application intelligence and real-time monitoring, ensures availability and performance with QoS control, and increases WAN capacity with advanced compression capabilities. For large-scale deployments, centralized management increases efficiency and productivity for low total cost of ownership.