NetForecast

# Business Value of Performance – The Riverbed Experience

By Peter Sevcik and Rebecca Wetzel
March 2006

Many vendors claim to improve the performance of networked applications—but what does that really mean for your business? NetForecast's mission is to document the value of better performance.

To justify a technology purchase, you must ensure the technology will deliver maximum business benefit. Although vendor-provided data is useful, there is no substitute for actual user experience. With this in mind, NetForecast interviewed 11 Riverbed customers to learn firsthand how Riverbed's Steelhead® solution delivers business value.

Business Value of Performance

Every day new business applications are unleashed onto wide area networks. Networked applications that perform well for users promote healthy, prosperous businesses. But often when applications that perform well over local area networks are moved onto a wide area network, application design characteristics and distance conspire against a satisfactory user experience. Such performance challenges frequently frustrate users, hobble efficiency, and compromise business goals.

Business

Users

Infrastructure
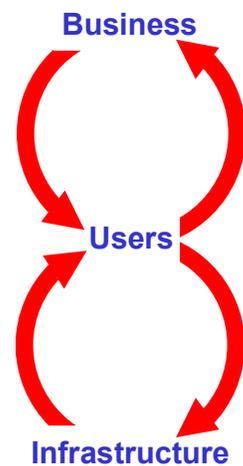
Improving networked application performance has business value, the nature and magnitude of which often varies based on who is doing the evaluation. The users' experience is the best measure of performance, and depending on the evaluator's role within the organization, the business benefits that accrue from a good user experience are often perceived differently.

A business manager is likely to view the business value of performance in terms of how it increases sales, improves competitiveness, and/or helps work get done faster. An IT manager on the other hand, is likely to perceive the business value of performance in terms of IT infrastructure cost savings, fewer calls from disgruntled users, and improved IT staff productivity.

This study links application delivery performance with business goals for a variety of enterprises and perspectives—and documents the tangible business values experienced by customers using Riverbed's Steelhead appliances.

Business Value Experienced by Riverbed Customers

NetForecast's research identified four primary business values realized by enterprises using Riverbed products to optimize application performance. These benefits include:

- **Faster application response time**
- **Improved staff collaboration, productivity, and flexibility**
- **More agile infrastructure at reduced IT costs**
- **Lower bandwidth costs**

The Riverbed Solution

Riverbed supplies a symmetrical (i.e., dual-ended) application acceleration product called Steelhead that addresses performance problems introduced when applications operate over a WAN. Steelhead appliances work together as a system of distributed devices in remote offices that communicate with a primary Steelhead appliance at a data center as

shown in Figure 1. Appliance sizes vary to accommodate traffic needs ranging from a large data center to a small office.

Steelhead appliances terminate TCP connections at both the remote office (client), and data center (server) sides, and the device pair applies four increasingly powerful acceleration techniques—TCP acceleration, dynamic compression, dictionary compression, and transparent turn reduction—to the traffic
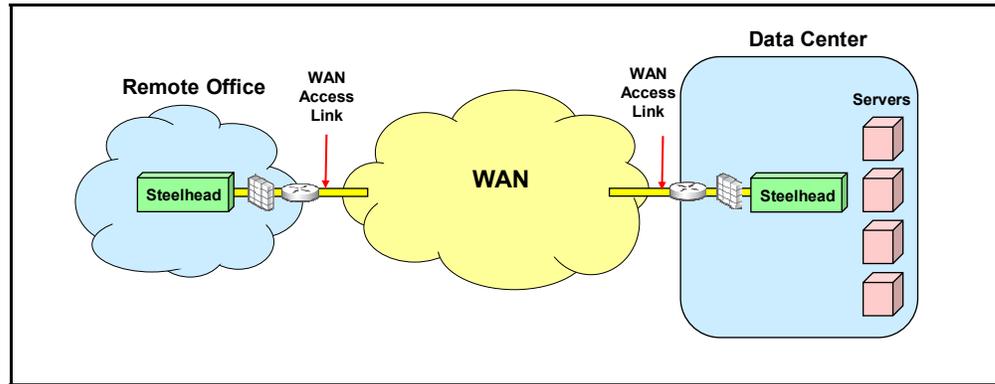

Figure 1 – Typical Steelhead Deployment

Application content transiting a Steelhead for the first time, during what is known as the cold pass, is accelerated using TCP acceleration and dynamic compression. These are the first steps in reducing bandwidth and speeding application response time.

TCP acceleration overcomes TCP performance inefficiencies that slow traffic over high bandwidth, high latency connections, and it greatly enhances throughout during packet loss. Dynamic compression accelerates traffic by reducing the payload similar to "zipping" a file, but dynamic compression benefits the entire data stream not just files within the stream. TCP acceleration and dynamic compression operate on all TCP traffic, and the destination Steelhead appliance reconstitutes the original content, delivering it to the end user over a standard TCP connection.

While the source Steelhead provides an initial performance boost to cold pass data, it also applies two additional techniques, a unique patented implementation of dictionary compression to previously seen, or "warm" data, as well as transparent turn reduction. Riverbed's dictionary compression (which they call Data Streamlining) tags a variable portion of payload called a "segment" with a small reference number. In the cold pass, the source Steelhead sends the reference numbers to the destination Steelhead appliance along with the dynamically compressed data. Both the destination and source Steelhead appliance store the original content along with the reference numbers on disk (a.k.a., the local data store). The references are organized hierarchically, which means there may be many reference numbers for the same content as shown in Figure 2, and a single reference can represent a very large amount of data.

The source Steelhead appliance scans the flows across all TCP connections to identify recurring data within a transmission. If a segment or group of segments does recur, the source Steelhead sends the reference number instead of the payload. For example, the entire payload in Figure 2 can be identified by reference numbers 2, 6, and 4. The destination Steelhead already knows that 6 is actually 7, 1, 3, and that 4 is made up of 9, 5, 8, however, since the example shows that some part of segment 9 has changed, the revised payload will be represented by the sequence: 2, 6, "new 9", 5, 8. The destination Steelhead appliance then inserts the original segment into the traffic stream and delivers it to the end user.
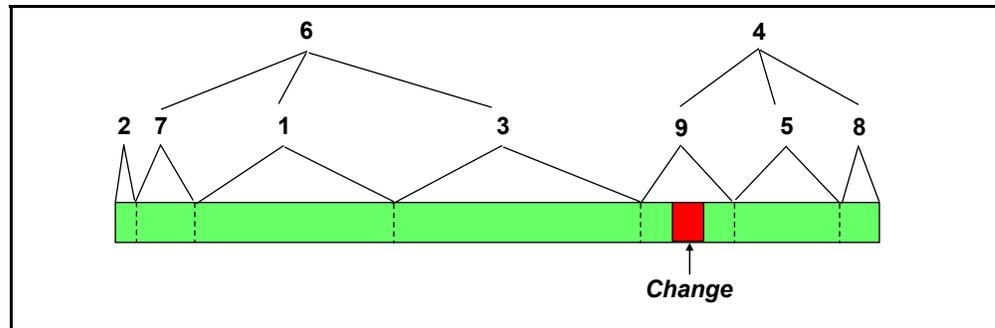
Figure 2 – Hierarchical References Numbers to Varying Segment Sizes of Payload

This behind-the-scenes activity is completely transparent to the user who receives the content as sent, only faster. The compression result achieved from sending the reference number instead of the original payload is proportional to the size of the original group of segments. For large files the compression result can easily be 100:1 or better.

It is important to note that dictionary compression *is not the same as file caching*. A dynamic (pull rather then push or pre-populated) file cache system also sends a reference number representing a known file is being sent again, however, file caching resends the *entire* file if any aspect of the file or the file name have changed. Dictionary compression can retransmit the segments which include the changes, without sending the entire file. Also, dictionary compression segments and references can be shared across applications, whereas caches are application-specific and cannot share content across applications.

Riverbed appliances apply a final, extremely powerful acceleration technique called transparent turn reduction (which they call Application Streamlining), to application flows for which the Steelhead appliances can decode the application logic during client-server interactions. Some applications produce huge numbers (hundreds, even thousands) of turns or "non-productive" network roundtrips (a.k.a., chattiness). Riverbed's transparent turn reduction technology supports HTTP as well as Microsoft's file sharing (CIFS), database (SQL), copy (RoboCopy), and Exchange (MAPI) protocols.

When the Steelhead appliances understand an application's turn process, they anticipate what the other side will do and perform each turn locally rather than remotely—and therefore much more quickly. The source Steelhead appliance then bundles the final content into a single turn over the WAN (applying one or more of the previously described compression techniques as appropriate). The entire process is completely transparent to the client as well as the server software.

Figure 3 illustrates how Riverbed's system applies increasingly powerful acceleration techniques to networked application traffic.
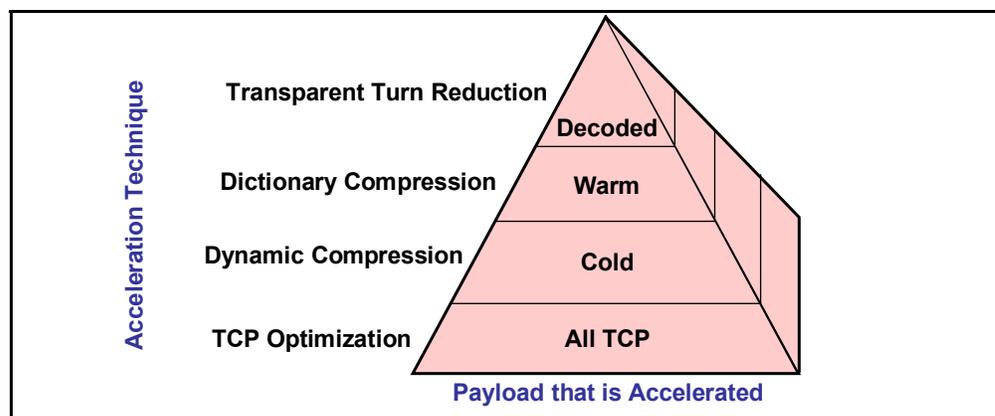

Figure 3 – How Multiple Techniques Build Increasing Acceleration

The NetForecast Methodology

NetForecast performed primary research to gather information about the business benefits experienced by enterprises using Riverbed's Steelhead technology. We performed in-depth telephone interviews with employees responsible for application performance in 11 enterprises. All of the enterprises surveyed were using Riverbed's technology to optimize the performance of applications over enterprise-wide networks.

The Companies We Interviewed

The 11 companies interviewed included three manufacturing companies, two architectural firms, a global financial services firm, an insurance company, a trucking company, a power company, a public relations firm, and a contractor to a European navy. The firms ranged in revenue from $40M to $76B, and varied in size from 325 to 300,000 employees. Some had wide area networks interconnecting as few as seven offices, while the financial services firm interviewed interconnected approximately 8,500 sites in North America alone.

The companies originally deployed Riverbed to address a variety of challenges, the most common of which was to enable server centralization, followed by enabling better collaboration among offices, and lastly to make the most of existing bandwidth.

All of the companies interviewed use Riverbed's products to accelerate Web applications and mail, and ten of 11 accelerate file sharing applications such as Lotus Notes, Unix NFS and/or Windows file sharing (CIFS). Approximately one half use Riverbed to accelerate database, client-server, and file backup/replication applications, and just under one half use it to accelerate CAD/CAM, file transfer/distribution, some flavor of custom in-house applications, and/or document management systems.

Key Findings

Riverbed's ability to speed business processes clearly ranked as the most important business benefit the companies interviewed experienced. Several companies even found that the Riverbed-enabled process acceleration made the Steelhead technology indispensable to their businesses. Such business process acceleration proved a special boon when inter-office collaboration was important to the company's long term success.

The agility with which Riverbed enables companies to set up shop anywhere and do so quickly was also important to many of the firms interviewed, as were server, bandwidth, and staff cost savings resulting from application performance improvements.

For some of the IT professionals interviewed Riverbed's technology has strategic, not simply tactical importance. According to a senior network engineer at one of the world's largest financial institutions, "Everyone throws around paradigm changes left and right, but this really is an enabling technology that changes how you think about how to deploy applications, and how to do bandwidth analysis."

Faster Application Response Times

Overall, the companies interviewed experienced substantial response time improvements for Riverbed-accelerated applications, and they experienced especially striking results for applications involving large file transfers. A telecommunications equipment manufacturer told us that some large file download time diminished from two hours to less than ten minutes. The power company experienced a ten-fold decrease in times needed to transfer large files to and from corporate servers, and according to a network manager at the company; "The first pair we got we put in an office for about a week, and then we took them out to put them into another office. The people in the office that we pulled them out of complained loudly because things got slow again."

Similarly, the trucking company we interviewed experienced a ten-fold performance improvement for client software used to access an IBM AS 400 application. "If users' profiles are back at our corporate office, it takes ten to 12 minutes to open the application because of the quirky way it reads in the profile when the client opens. With Riverbed in place it takes under a minute." A semiconductor manufacturer's uncompressed document delivery times were four to five times faster using Riverbed, and compressed file delivery averaged 50 percent faster. According to the company's IT director; "That made working remotely over low latency connections doable, whereas before it was not."

A chemical products manufacturer interviewed experienced an 80 to 90 percent reduction in the "chatter" associated with MS SQL, which resulted in 2x faster SQL query times. The company also experienced 3x faster download times for large file shares once file the file was cached. Additionally, the insurance company interviewed experienced 12x faster FTP performance, 3x improvements for CIFS, MAPI, SMTP, and 2x for HTTP and DNS. The telecommunications manufacturing company interviewed experienced a slight speedup in some SAP functions, which it viewed as helpful to business effectiveness.

Rolling out New Applications Everywhere

For some companies interviewed, the Riverbed products enabled software deployments that would otherwise be out of the question. The power company found that, "Sometimes new applications are such heavy users of the network that without these devices we couldn't run them adequately on slower bandwidth or higher latency links. Some new applications just couldn't be used because the user experience would be poor." And for the financial services firm, "It is allowing us to deploy some applications globally that we would have had a firestorm of user complaints about before in terms of access speeds."

In a somewhat unique application, the Steelhead product speeds a European navy's shore-to-ship Web page download from five seconds to one second over UHF/HF data tunnels and a satellite link. According to the contractor responsible for the installation, after one day, the performance improvement was so dramatic that ship personnel insisted that the technology be permanently deployed.

Improved Inter-office Collaboration

The faster application response times described above are strategically valuable to some enterprises because they enable better inter-office collaboration—and for certain business types such as the architectural and manufacturing firms we interviewed, better collaboration fosters improved competitiveness. With Riverbed deployments, these firms are no longer limited by the physical location of an employee, anyone can work on any project from anywhere. This allows more efficient staff utilization, it enables experts to contribute to projects in ways that would have previously been impossible, and it allows companies to leverage staff globally.

It is hard to overstate the importance of Riverbed-enabled collaboration to some of the companies we interviewed. As the CTO of an international architectural firm put it; "There are 3 major technologies that have changed the way we do business in this firm. One is email, two is the Web, and three is Riverbed. It's that important to us. . . . It has allowed us to do work we could never do before in ways we could never do it. For example, we have work done in Shanghai by people in Denver. That was completely undoable in the past." Because of resulting strategic business benefits, "Our payoff was under 36 days—we didn't even get the bill!"

He explained the technical challenges inter-office collaboration posed to his operation. "[Before] architectural work with the size of CAD files was simply not something you could do in a distributed manner on wide area networks because you would grow old watching your cursor as the file loaded. We would have 4Mb lines between our offices, but we would only be getting 435 to 450Kb per second [because of] the latency in the overhead of the protocols. We dropped in [the Riverbed product] and we're now getting 30 to 40Mb on file loads."

Similarly, an IT manager at one of the manufacturing firm interviewed found that Riverbed-enabled inter-office collaboration reduced product development time, enabling the firm to speed its products to market. And the chemical products company described how Riverbed, "has made our operations more efficient. We have given people tools that they didn't have before so they are more empowered, and we solve problems a lot faster than we used to."

Increased Infrastructure Agility at Reduced Costs

Riverbed enabled a number of the companies we interviewed to add new offices and support existing offices with fewer servers, less bandwidth, and fewer support staff. This combination of benefits provided them the agility needed for corporate expansion because they can set up shop almost anywhere (even where bandwidth and budgets are constrained), and do so more quickly than before.

The IT director of one of manufacturing firms we interviewed noted that; "The number one benefit for us has been the equipment and time savings to set up a new office plus some consolidation of existing offices." Since deploying Riverbed's products, the company added ten new offices with much less infrastructure than previously needed, and the company experienced staff savings because, "[we] haven't had to put in a lot of local infrastructure, which means we haven't had to put in a lot of local people to support it, and that means a big staff savings."

Server Savings

Savings from server centralization have justified the Riverbed product costs for several of the companies we interviewed. According to the network manager for the trucking company; "We're [now] able to back up across the wire. That could pay for a number of Riverbeds by itself. We were looking at $20 to $30K in backup equipment and licenses to do local backups, and to rely on local staff to change tapes and things like that."

The telecommunications equipment manufacturer interviewed; "centralized all engineering design in one server without significantly increasing the bandwidth to each remote location. That eliminated at least 15 to 20 other servers. If we had distributed these content servers, we would also have needed at least 2 additional servers [per site] to go on the local network. In addition, we would have had to buy software licenses for those servers at $10K per license, and we would have had to do backups and have at least one full time person to take care of the entire infrastructure. We would have had to increase our network bandwidth as well, for at least $1,000 per month for each location. That's a lot, and that's just the bandwidth, not the cost of provisioning and maintaining the additional links."

The insurance company had a similar experience. According to the company's CIO; "[The Steelheads] permitted us to perform server consolidation. Without the Steelheads, we would have had to change the strategy completely such as trying to use Citrix to provide remote access to the centralized servers or more likely, just scrapped the centralization plan all together. We can now open a new small office more quickly since it does not require server infrastructure, [and] my administrative costs are much lower because I'm not running Windows updates on the servers at least every month."

The chemical products company was able to centralize its Exchange environment to eliminate 19 email servers. As the company's CIO explained it; "The servers weren't that expensive, but the main reason was that we didn't want to have to have experts at all of the remote sites. We wanted to consolidate our expertise. We only wanted to have one or two people with that expertise."

Bandwidth Savings

A number of the interviewed firms experienced sizable bandwidth savings. For the chemical products company we interviewed, through bandwidth savings alone the return on their Riverbed investment was less than one year. "We have a $200K investment in

Riverbed products and they save us about $240K a year. We were able to eliminate about ten of our T1s, and that was about the cost of what ten T1s would be."

One of the architectural firms also experienced substantial Riverbed-enabled bandwidth savings. "[It's] like having three times the bandwidth in each office. If we had that, our monthly telecom expense would be about $27,000, whereas now it is about $9,000. That means with the Steelies we've got a WAN that would normally cost an additional $216,000 per year. Compare that to my annual maintenance of $18,000 for the Steelies."

The financial services firm also described impressive bandwidth savings. "We saw a three times capacity increase to a several hundred times capacity increase on the wide area network. So it was a pretty easy sell [Riverbed] in terms of a green dollar ROI. You either upgrade those circuits, or you make a capital purchase and service the user better and more efficiently. Plus it scales better. It was almost a no-brainer. We were able to stop a move from T3s to OC3s, and we will probably remain at T3s into the foreseeable future. We were also able to stop a T1 upgrade to Hawaii."

The utility company was able to eliminate an extra T1 line to a major facility, resulting in a two year payback based on bandwidth savings alone. In another example of bandwidth savings, after deploying Riverbed the insurance company's peak bandwidth utilization dropped by 90 percent, and its average utilization dropped by 70 percent.

Summary of Benefits

Faster application response times translated into improved productivity and strategic competitive advantages for a majority of the Riverbed customers we interviewed. These companies found the physical location of their staff increasingly irrelevant because Riverbed technology improves the performance of many networked applications to the point where anyone can work on any project regardless of which office they happen to occupy.

For most of the companies interviewed, Riverbed was an essential ingredient for successful server centralization. Riverbed enabled companies to add new offices with much less infrastructure and fewer staff resources, and to successfully move existing servers from distributed to central locations, while also reducing bandwidth. Enterprises were able set up shop anywhere, and do so much more quickly and inexpensively than before.

Based on our research findings, NetForecast recommends that enterprises using networked applications in remote offices should consider buying Riverbed's solutions because the Steelhead technology can provide significant business benefits in addition to mere cost savings.

Peter Sevcik is President of NetForecast and is a leading authority on Internet traffic, performance, and technology. Peter has contributed to the design of more than 100 networks, including the Internet, and holds the patent on application response-time prediction. He can be reached at peter@netforecast.com.

Rebecca Wetzel is an Associate of NetForecast and a 20-year veteran of the data networking industry, with unparalleled inside knowledge of the Internet service and product markets. She works with network product vendors and service providers to develop and implement strategies for new IP-based offerings. She can be reached at rebecca@netforecast.com.