THE BEST-RUN BUSINESSES RUN SAP

Blue Coat and SAP: Network Infrastructure Enhancements for Successful Enterprise SOA Deployments

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1 Business Trends Forcing Technology Evolution

A number of important drivers affect the way today's enterprises use and deploy business applications and support infrastructure in order to grow their business to remain competitive:

- **Globalization and Mobility:** More business than ever is done in branch offices, remote sites, and by remote and mobile users, which all need access to business applications hosted in one or more datacenters.

- **The Extended Enterprise:** Business processes do not end at corporate boundaries any more. The business application evolution enables today's business process changes within enterprises. Business processes have moved from real-time headquarter-only processes via web-enabled extended applications towards the "extended enterprise" (Fig. 1) of today, that now includes partners, suppliers, customers, and contractors. Enterprise service-oriented architecture (enterprise SOA) principles become the application architecture of choice to support the increasing demand of application integration and adaptability to rapidly changing business process requirements.

- **Compliance and Consolidation:** While the enterprise itself is now extended and globally distributed, applications which were formerly hosted and operated locally are now centralized. Cost is a driver of this consolidation, but compliance (with regulations such as Sarbanes-Oxley, GLBA, HIPAA, etc.) is the catalyst. As companies are outsourcing and having applications hosted externally, even users based at headquarters might become "remote" users of business applications.

As a result of these trends, the CIO and IT leader today is under pressure to satisfy the demands of both their end users and their CFO. Today's IT organizations need to provide reliable, highly available, secure and well performing access to applications; a consistent user experience for users everywhere at the same or reduced costs.

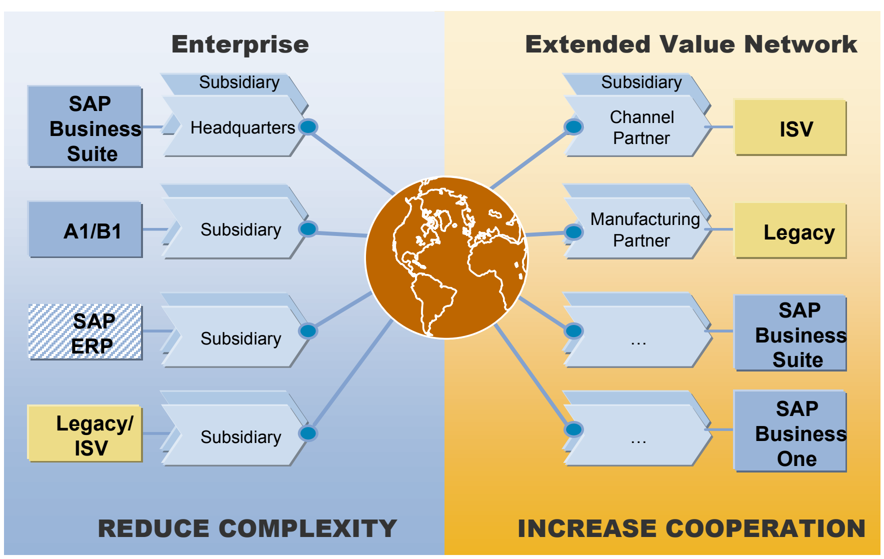

Figure 1: The Extended Enterprise

The enterprise push to globalize and accelerate business processes, combined with the need to comply with regulations and manage risk is driving the evolution of the SAP ERP software platform to support an enterprise service-oriented architecture.

Enterprise SOA is a blueprint for an adaptable, flexible, and open IT architecture for developing services-based, enterprise-scale business solutions. Enterprise SOA extends the Web services model, chaining many Web service-enabled business transactions together to achieve the overarching business process of an enterprise-level 'composite application'.

The different parts of a composite application not only need to connect end-users with different business functions within an ERP system, they also need to connect a variety of such systems together – each of which may reside in different company datacenters or altogether outside of a company's network (e.g., linking to a business partner's ERP systems). Thus, while classical ERP applications are mostly head-quarters-centric software deployments with application servers and end users in a shared local area network (LAN) environment, Enterprise SOA application software components and end users are spread out worldwide and connected via a wide-area network (WAN) infrastructure.

Not having all business connectivity in a LAN adds a new set of requirements for supporting network services in a distributed application deployment. It is essential to consider the impact on, and requirements for a company's global network infrastructure from the earliest planning stages of any Web-enabled and Web-service based application implementation project, including Enterprise SOA implementations.

SAP provides Best Practices for ensuring their applications are configured and installed for optimal performance. Across the WAN, network issues including latency, reduced bandwidth, congestion, contention, and packet loss contribute to less than desired performance of the network for SAP® applications. The Blue Coat application delivery solution and SAP applications jointly provide an optimized solution for our globally operating customers. This paper is based on the results of an SAP Enterprise Services Community program project, in which a number of leading network and test solution vendors and SAP teamed up to build a production-like enterprise SOA–based application landscape, including the simulation of remote end-users and applications.

2 Requirements for and Design of the Test Landscape

The goal of the test landscape design was to incorporate many of the features that customers would need in an enterprise SOA deployment across a WAN infrastructure. In detail this meant:

1. Using the SAP NetWeaver® technology platform integration components (Figure 2) like SAP NetWeaver Portal for people integration.
2. Using SAP composite applications and enterprise SOA concepts for building integrated business processes.
3. Building a production-like application and network infrastructure with secure access, simulated WAN links, and scalable multi-instance deployments of all SAP NetWeaver and business application components.

To fulfill the first two requirements a three component landscape consisting of the SAP NetWeaver Portal component, a composite application component and an ERP backend component was constructed in the SAP Co-Innovation Lab, where testing took place. While typical user interaction was covered with scenarios implemented in SAP NetWeaver Portal, the important web-service call element for enterprise SOA was implemented between the composite application and the backend system.

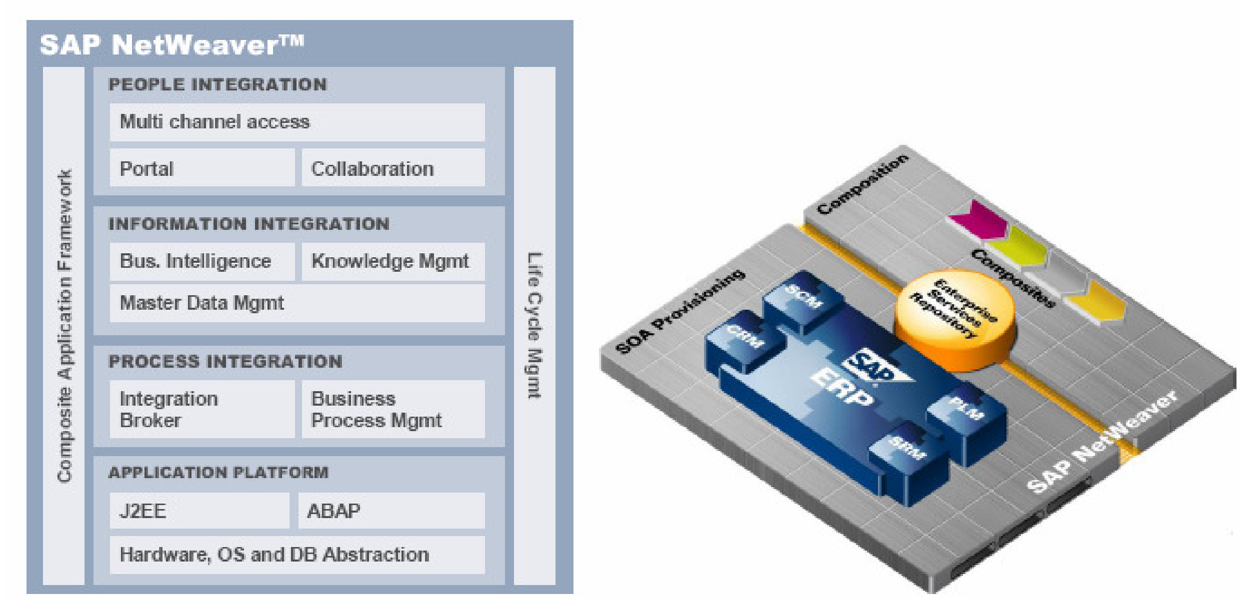

Figure 2: left: SAP NetWeaver® Technology Platform; right: Building Business Scenarios Based On Enterprise Service-Oriented Architecture Principles

In order to create a more production-like infrastructure, the three components were deployed onto three separate hardware servers and all components set-up with two instances. A real production landscape might have a very large number of instances for any component depending on the processing volume and high availability requirements.

To include aspects of the global use and deployment of enterprise SOA applications, the hardware servers were assumed to be located in different datacenters. This adds the need for a number of network services, which would typically reside in an edge environment or demilitarized zone (DMZ) inside the data centers. If end users reside in a branch office, a small edge environment/DMZ might also be implemented at the end users' location.

In between data centers and remote end users, customers would use company intranets or the Internet. Such long-distance network connections were simulated using a WAN emulation appliance from Shunra Software Ltd. This emulator can be configured for the various latency, bandwidth, and package-loss conditions of real-world WAN connections.

A fourth server with the HP LoadRunner tool was added to represent the remote end-user community. It simulated end users executing business scenarios, which in turn triggered Web-service inter-component network traffic throughout the application.

To complement SAP application components, Blue Coat was added to enhance the existing network services and infrastructure. Blue Coat products feature the ProxySG appliance, with MACH5 (Multiprotocol Accelerated Caching Hierarchy) technology, which enables organizations to accelerate delivery of all key productivity applications. Blue Coat uses five different acceleration techniques that work in concert – Bandwidth Management, Protocol Optimization, Object Caching, Byte Caching, and Compression. Combined, these technologies enable more solutions to common networking challenges than competing approaches and return control of the WAN back to the business.

All of these techniques work together to optimize delivery of applications to remote locations, but object caching is especially important: SAP Web applications may cache 90% of its web objects in the browser.

For example, if the object cache contains an outdated copy of a document, the byte caching capability has patterns and tokens that require only the tokens, plus the changes to be sent.

What little is sent is first compressed and then protocol optimized (reducing bandwidth consumed and latency/round trips). All of this is prioritized according to the enterprise's preferences, using bandwidth management, such that the important applications, users, or groups get through first with the bandwidth they need. Bandwidth management is also extremely important, since SAP application developers or administrators usually do not have control over the WAN, and cannot always guarantee reliable access from remote users that are located throughout the world.

By combining these technologies into a single solution, Blue Coat gives organizations the complete toolkit they need to optimize their entire WAN, covering more application types with more technologies than any other optimization, acceleration, or application delivery solution.

Blue Coat ProxySG appliances are deployed on both sides of a WAN network, with a basic transparent deployment shown in Figure 3. Blue Coat ProxySG appliances run a secure hardened operating system, with a common administrative interface across all ProxySG deployment scenarios, reducing the administrative overhead, while providing acceleration and performance improvements on a secure and reliable platform.

Overview of Blue Coat MACH5 Technology

Bandwidth Management/Traffic Shaping
This technique assigns a priority to a particular type of application, user, or group traffic based on administrator assigned variables. With this technique clear network service level agreements (SLAs) can be delivered for applications.

Protocol Optimization
Protocol optimization takes standard protocols that are inefficient over the WAN (e.g., HTTPS, HTTP, TCP) and makes them more efficient – typically by converting a time-consuming serial communication process into a more efficient parallel process. While protocol optimization does not reduce the amount of bandwidth an application consumes, it can greatly accelerate delivery of applications and reduce latency in the process.

Byte Caching
Byte caching is as it sounds – caching of repetitive patterns in the byte stream. Byte caching observes repetitive patterns in application traffic, symbolizes those patterns with a token, and sends the token in lieu of the bulky traffic. These tokens are typically only a byte or two in size, but symbolize significantly larger blocks of data.

Object Caching
Object caching less granular than byte caching and it is protocol specific. If the cache contains the object, the user is immediately served the object from a local store – virtually eliminating latency and WAN bandwidth consumption. If the cache does not contain the object (or contains an outdated version of the object), then for that particular transaction, a new object must be reloaded into cache and the performance gains are realized the next time the object is requested.

Compression
Inline compression can reduce predictable patterns even on the first pass, making it an ideal complement to byte caching technology.

3 Test Scenario and Network Design

An SAP landscape can encompass everything from very transactional operations (for example, Financial Accounting [FI], Sales and Distribution [SD], and so on) to operations requiring large data transfers (Business Intelligence [BI], Knowledge Management [KM], or large web-service/XML-related application to application data transfers). A typical scenario starts with an end user requesting the SAP NetWeaver Portal login page, then submitting user/password credentials and getting the Portal's first page, commonly referred to as the "welcome" page. From there, the user typically navigates through a few steps to a more specific transaction and operation, which then triggers activities in other enterprise SOA components like composite applications or the architecture backend.

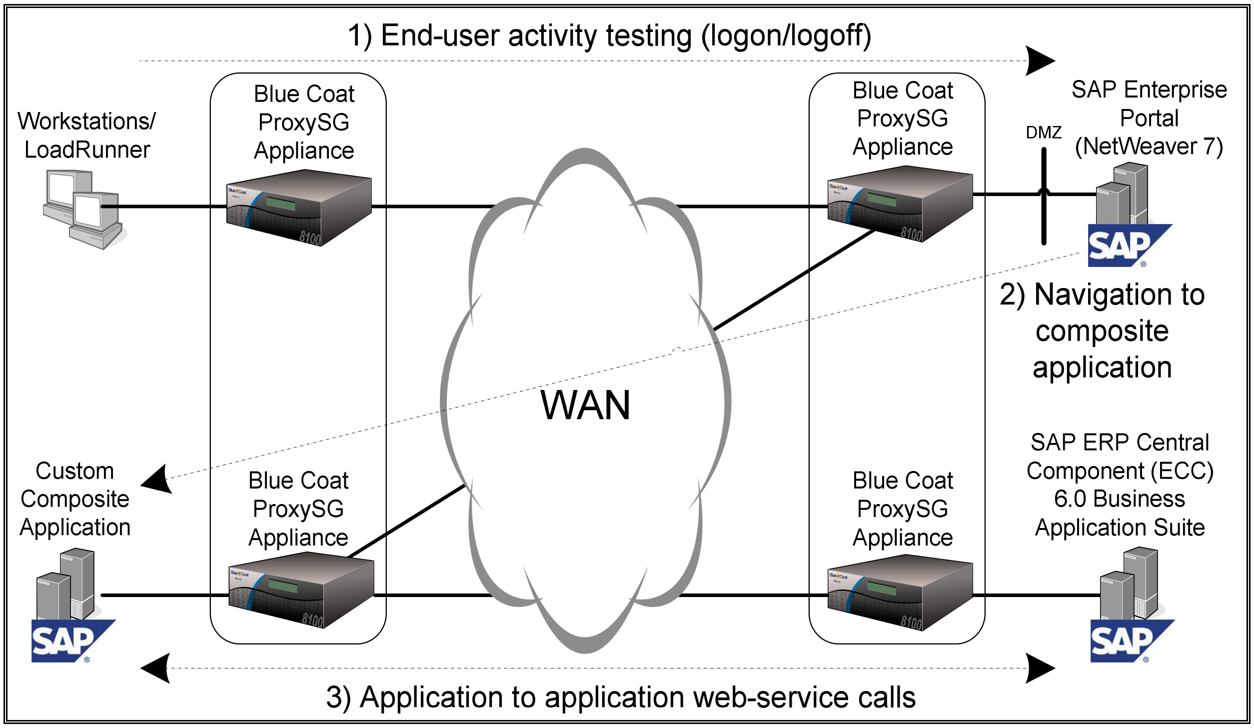

Figure 3: The above diagram illustrates how Blue Coat ProxySG appliances were deployed in the test landscape, with the dotted arrows illustrating how the various components interact. For practical reasons, the outlined appliances were combined into one, with application traffic crossing back and forth.

Tests were performed in the SAP Co-Innovation Lab, where SAP provided automated test scenarios that reflect the most typical technical usage cases and the common application execution flows described above. These test scenarios, scripted for HP LoadRunner, were designed to simulate end user behavior and application to application traffic. The sections below will describe the different test scenarios, network design, and measurements that were recorded to gauge the effects that WAN conditions have on end user response times. Tests with Blue Coat show not only response time improvements, but significant decreases in bandwidth usage, reduced server CPU utilization, and ensured high reliability and availability to mission critical business applications.

3.1 Measuring the effects of WAN impairment

In order to achieve the most complete coverage of SAP applications, four tests were provided by SAP. The tests were broken into the two different groups, End User Scenarios and Application-to-Application Scenarios - each of these are discussed in greater detail later.

- End user scenarios: Two tests were provided that simulate the activity and behavior of end users.
- Application-to-Application (A2A) scenarios: Two tests were provided to simulate the behavior of web service calls that are a typical characteristic of enterprise SOA.

Since WAN conditions can vary dramatically in a distributed enterprise, Blue Coat and SAP modeled network conditions typically seen in customer networks, and iterated through the tests above. Important network parameters are bandwidth, latency and packet loss. While bandwidth is a well known parameter and is what IT departments pay line providers such as telecommunication companies for, latency and packet loss are also very important. Latency is the network delay due to signals only traveling at finite speed over long distances, and can be as much as 2 seconds in slow networks, such as a satellite link. Packet loss is a phenomenon occurring on low quality connections and has the effect of further reducing network data transfer times. Network vendors need to be able to handle a wide variance with all three parameters, since differences in the network have semi-predictable affects on performance.

Parameters for the two network cases in the test landscape are described in the table below:

	Bandwidth	Latency	Packet Loss
North America DSL WAN link with packet loss	768 Kbps	40 msec	1%
Intercontinental T3 WAN link with packet loss	45 Mbps	300 msec	1%

Depending on the test scenario, baseline measurements were recorded for the WAN only (without Blue Coat) to quantify response time degradation, bandwidth usage, and/or server CPU utilization.

Initial testing was then performed to verify that Blue Coat did not negatively affect SAP application functionality, and that business functional problems did not occur. It was found that Blue Coat can be deployed transparently in the network and transparently to the end-users, and does not functionally break any of the SAP applications.

Finally, with Blue Coat added to the network infrastructure, the above tests were iterated through the different network conditions. Measurements were again recorded that demonstrated increased performance, value-added security enhancements, as well as improved reliability and availability – these three categories are important for any application or network infrastructure enhancement.

3.1.1 Performance Improvements and Enhancements

SAP application performance is measured by response time, or by the time it takes to complete an operation or transaction. Baseline measurements at "LAN" speed show that application response time is usually very quick, with response times measured at less than 1 second. However, baseline WAN measurements show that performance degrades rapidly for varying reasons from reduced bandwidth, to added latency or round trips, to packet loss.

Another performance measurement was bandwidth utilization. These measurements were observed on the WAN emulator's real time statistics, with historical statistics taken from the Blue Coat Management Console, or user interface.

A third measurement was the CPU usage of the SAP application hardware server under high load.

3.1.2 Security Improvements and Enhancements

Since SAP applications are capable of running services for either HTTP or HTTPS, customers have a choice of using HTTPS encryption maintained end-to-end (from browser to server) or have it terminated near the DMZ or branch appliance. Business data confidentiality only requires that any WAN application delivery or WAN optimization solution preserve encryption and security over the WAN. For the testing, we chose to deploy Blue Coat transparently and maintain end-to-end encryption, which is more secure and therefore of higher value to our customers. This is the more difficult deployment scenario, since Blue Coat needs to remain transparent to the end user and application. By decrypting (and then re-encrypting) the HTTPS/SSL connection, Blue Coat can perform more specific optimizations, such as object caching and byte caching.

In addition, Blue Coat can provide additional security enhancements to protect your existing WAN infrastructure by accelerating only business applications, and eliminating or controlling unnecessary or unwanted traffic, including the detection of Web 2.0 threats - even if it is encrypted or hidden by

HTTPS/SSL. By decrypting HTTPS/SSL traffic and integrating into your security infrastructure, Blue Coat gives enterprises the visibility and granular control of all users, applications, and all WAN and internet traffic.

3.1.3 Reliability and Availability Improvements and Enhancements

SAP applications are business and mission-critical, so reliable and available access to applications, data, and services are essential for any distributed enterprise or organization to be successful. Reliability and availability enhancements can be demonstrated by adding complementing features to a SAP deployment, such as adding a device that performs load balancing functionality, or by adding a device that can ensure Quality of Service (QoS).

Blue Coat worked with SAP to enhance the testing infrastructure to simulate a "real-world" WAN, where WAN bandwidth is congested because of other business applications, or in some cases, even unwanted traffic.

In a first step, without Blue Coat controlling the WAN traffic, the effect of bandwidth congestion on SAP NetWeaver Portal response times was demonstrated. WAN saturation was achieved by using a network traffic load generator from Spirent Technologies. This multi-protocol and multi-application test, including SAP traffic and other network traffic, demonstrated that WAN congestion and contention can be an issue and cause end-user response time for SAP applications to severely degrade (in some cases even cause the browser to timeout). In the case of timeouts, a point is reached where network congestion makes SAP NetWeaver Portal practically inaccessible to remote end users - a very undesirable condition for both network and application administrators.

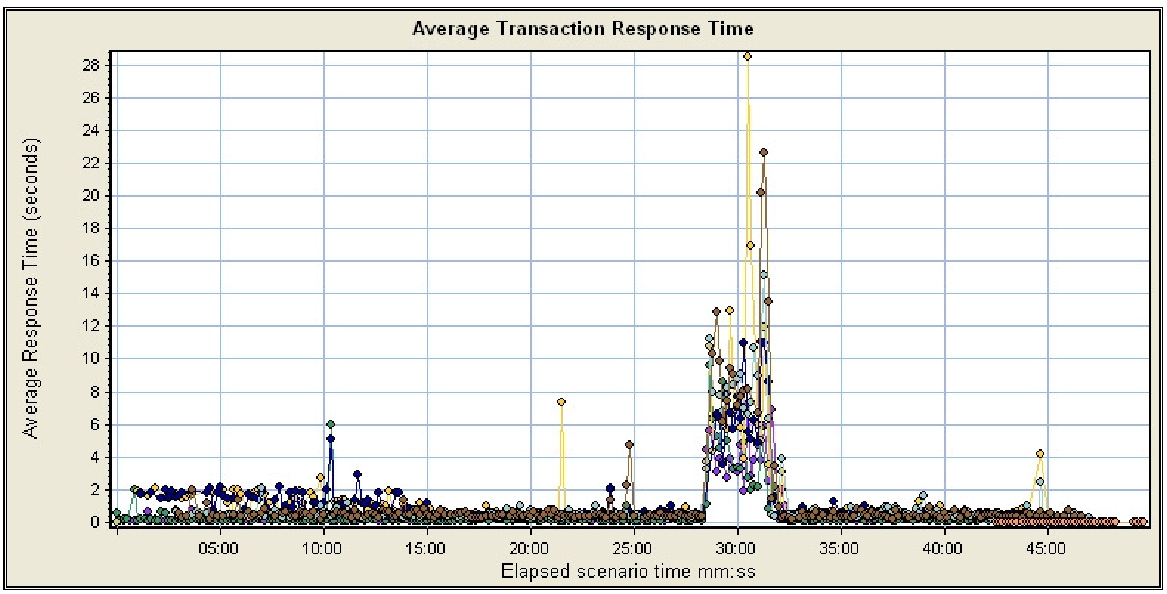

Figure 4: Graph showing that response times severely degrade when the WAN is saturated, as demonstrated by the spike at around 30 minutes.

As will be shown in chapter 4.5, Blue Coat can completely restore accessibility and accelerated response times of SAP applications in cases of congested bandwidth from other applications or unwanted WAN traffic.

3.2 End User Test Scenarios

End user test scenarios simulate and measure the high expectations users have for Web-enabled applications. Users of the "Web" have an expectation that entire Web pages will be displayed in a few seconds. Navigation and browsing should be quick, with normal transactions also completing almost instantaneously. Anything that takes longer leads to unhappy, frustrated, and unproductive users. This can in turn cause users to bypass processes, or revert back to processes that bypass accountability and documentation requirements. For these scenarios, the following measurements were taken:

Average Response Time – average time taken during the entire test run. This includes the response times with an empty browser cache and with a pre-filled browser cache.

Bandwidth Utilization – Total WAN throughput needed for the test, measured in megabytes.

Server CPU Utilization – Peak CPU usage, measured in percentages.

3.2.1 Logon/Logoff

Typical enterprise SOA scenarios start with an end-user accessing the SAP NetWeaver Portal login page and then entering authentication credentials into a form. The user then presses submit or login and gets what is commonly referred to as the "welcome" page in return. This login process can take a long time when performed under WAN conditions, since a high number of HTTP requests will need to be made. In a LAN, the high number of requests is easily handled; but in a WAN, the packet loss, bandwidth limitation and network latency increase response times dramatically and add to a negative user impression, especially on a first time login.

To simulate a user's experience logging into a system across the WAN, where latency and packet loss can cause extended login times, Blue Coat used a LoadRunner system to simulate 150 concurrent users for the DSL case, and 300 concurrent users for the T3 case. The number of users was adjusted for the different WAN scenarios because it was determined that without application delivery, slowdown was observed due to limited bandwidth. The test started with one user and then over five hours, ramped up to 150 or 300 users. Each of these users logged on to the Portal, viewed the homepage, logged off after approximately 100 seconds, logged back on again, and so on. The test measured the portal's ability to maintain connections to these users and to handle handshakes related to SSL encryption and other basic housekeeping tasks required just to keep a user's connection alive.

3.2.2 Large Document Download

A most challenging case for acceptable response times over a WAN link is the download of large size objects, such as a document or training video. In contrast to the login welcome page degraded response times are not caused by a large number of http requests for the build up of a web page. Instead, the download of a large data object causes a lot of network roundtrips on the TCP/IP protocol stack underneath the HTTP/HTTPS protocol. Thus this test case is structurally very different and complimentary to the login/logout test.

Large object downloads from SAP NetWeaver Portal occur in the context of the built-in Knowledge Management (KM) functionality of the Portal. One KM function is to be a document repository and the chosen scenario for this test was the download of a 5MB PowerPoint document by an end-user. Other examples could include data returned from a large search or the download of a training video.

3.3 Application to Application Test Scenarios

A new element of Service Oriented Architectures is that business application services are not only provided directly to the end-users but that for further automation of complex business processes applications can retrieve and exchange business data directly from each other. Such Application to Application traffic can be facilitated by web-service calls using XML data formats embedded in SOAP and http protocols. In the test landscape shown in figure 3 such calls happened in the path marked as number 3). Two test scenarios are detailed in the following sections, with the following measurements taken:

Peak Response Time – Time taken for the last iteration to complete, since these tests slowly ramp up.

Bandwidth Utilization – Total WAN throughput needed for the test, measured in megabytes.

3.3.1 Customer Fact Sheet (CFS)

The Customer Fact Sheet (CFS) test is derived from the Customer Fact Sheet Enterprise Service Bundle of SAP. This web-service retrieves a list of past purchase order data of a customer for a sales manager from an ERP backend system.

In contrast to typical end-user scenarios, object caching cannot be applied to web-service call responses. Therefore, the Customer Fact Sheet test can only be accelerated through protocol optimizations and pattern or byte caching. Also since the repeated patterns in the form of the XML tags are usually small, this test is a good measure of the byte caching heuristics and algorithms for WAN Optimization or WAN Application Delivery vendors.

To make this test even more relevant to production application environment usages, it was possible to vary the data volume transported by the web-service calls. A customer might have done just a handful or in other cases hundreds of purchase orders in the past. Accordingly a CFS list might contain only a few or hundreds of line items. In the later case the size of web-service calls can be some MB and in our tests we varied that size from some KB to about 3MB.

3.3.2 Technical Document Management (TDM)

The Technical Document Management (TDM) test is derived from the Technical Document Management ES Bundle. It performs a PDF document exchange via a web-service call between the backend and the composite component in our test environment. Similar to the CFS case the document size could be varied. Most commonly we used 1MB size documents. Even more difficult than in the CFS case, the document contained completely new random data with each call and therefore only TCP protocol optimizations and compression can have an accelerating effect.

4 Benefits of Optimized WAN Application Delivery

Usually security, application delivery, and WAN optimization (or WAN acceleration) are distinct technologies often deployed using multiple network appliances. However, Blue Coat is able to combine elements of these technologies into a single, robust and easy to manage appliance. This chapter describes the enhancements provided by the Blue Coat Application Delivery Network, which offers acceleration of critical applications without compromising security, while adding improved security, visibility, and control for your WAN and network infrastructure. The different measured improvements are listed in the following sub sections.

4.1 Performance Improvements for End User Scenarios

In the charts in sections 4.1.1 and 4.1.2, the measurements shown are the average response times for the entire test run. The meaning of each measurement is described below:

Blue Coat – Measurements taken with WAN impairment and Blue Coat. This is the average response time over the entire test run.

WAN Only – Baseline measurements provided by SAP, with WAN impairment, but without Blue Coat. This time is an average of the entire test run, so most accurately depicts an end users' experience with a pre-filled browser cache.

NOTE: Tests with an empty browser cache may take considerably more time than what is shown in these graphs, because the recommended configuration of SAP application servers is for one week expiration of cached content. Without Blue Coat, each user will have to experience login times of 30-60 seconds at least once a week. With Blue Coat, the weekly update needs to happen for only one user before others in the same branch see benefits. Alternatively, each user will see accelerated login times if the Blue Coat object cache or byte cache is pre-populated.

The 150 and 300 user logon/logoff tests were also used to measure the effectiveness of network vendors to offload the application servers. These charts are shown in section 4.1.3 and 4.1.4, with the meaning of each measurement described below:

Blue Coat – Server CPU measurements taken with WAN impairment and Blue Coat. This is the peak server CPU measurement over the entire test run.

WAN Only – Server CPU measurements provided by SAP, with WAN impairment, but without Blue Coat. This is the peak server CPU measurement over the entire test run.

4.1.1 Response Time Measurements, North American DSL Branch Offices

The first test modeled a North American DSL branch office (Assumptions: Bandwidth = ADSL (768 Kbps); Latency = 40msec; Packet Loss = 1%). The graphical comparison of login response time is shown below, depicting the average response times with and without Blue Coat.

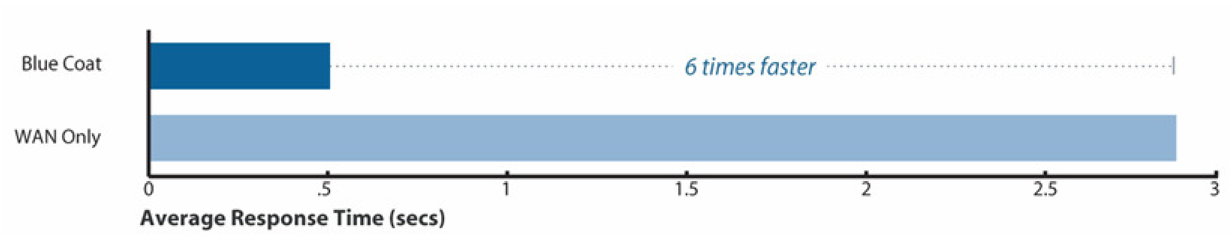

Figure 5: Response time measurements for a 150 user logon/logoff test to the SAP NetWeaver portal from a North American DSL branch office, accelerated through compression, object caching, protocol optimization, and byte caching.

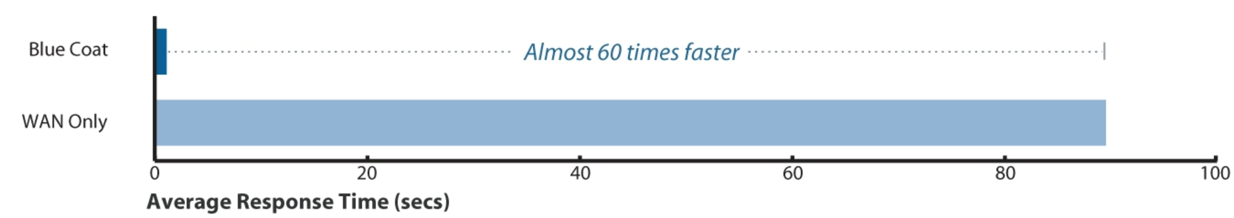

Figure 6: Response time measurements for download of a 5MB presentation from a North American DSL branch office, accelerated through compression, protocol optimization, and byte caching.

4.1.2 Response Time Measurements, Intercontinental T3 Branch Offices

The second set of tests modeled a large intercontinental branch office (Assumptions: Bandwidth = T3 (45 Mbps); Latency = 300msec; Packet Loss = 1%). Latency is increased to 300 msec because of the greater distance, and the WAN pipe is larger because of the size of the branch office.

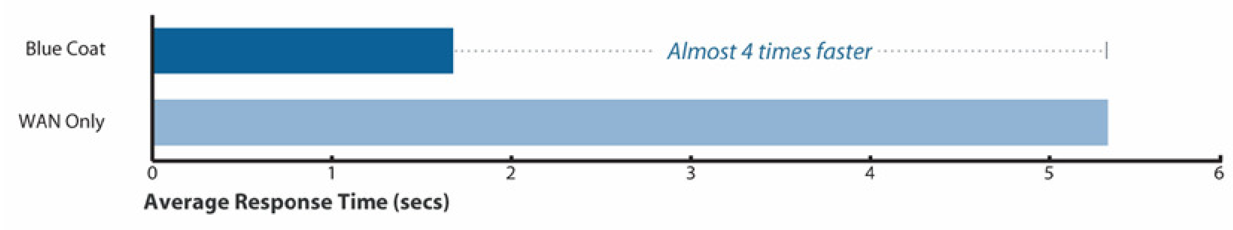

Figure 7: Response time measurements for a 300 user logon/logoff test to the SAP NetWeaver portal from a large intercontinental branch office, accelerated through compression, object caching, protocol optimization, and byte caching.

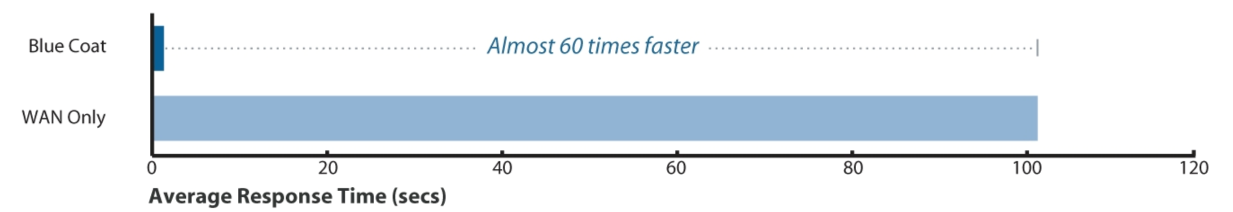

Figure 8: Response time measurements for download of a 5MB presentation from a large intercontinental branch office, accelerated through compression, protocol optimization, and byte caching.

4.1.3 Server CPU Measurements

The logon/logoff tests described above also measured the server CPU utilization, and showed performance improvements as detailed in the charts below.

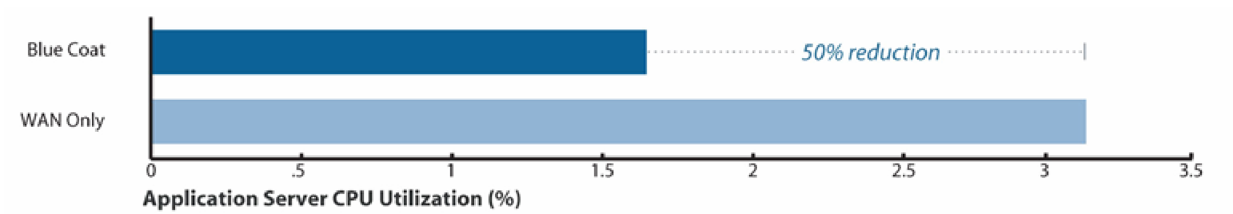

Figure 9: A 150 user logon/logoff test for North American DSL branch offices showed Blue Coat reduced Application Server CPU utilization by 50%.

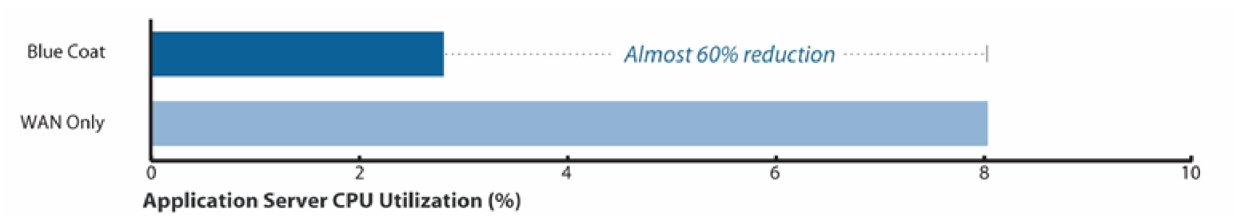

Figure 10: A 300 user logon/logoff test for the intercontinental T3 branch offices showed Blue Coat reduced Application Server CPU utilization by 60%.

4.2 Performance Improvements for A2A Test Scenarios

The next set of measurements recorded results for the Application to Application (A2A) tests. Up until the A2A tests, all testing had been measuring average response times, with WAN simulation only and then with Blue Coat. The A2A scenario is structured differently, using a ramp up of 10 to 50 iterations. Depending on the scenario, each successive iteration was designed to return an increasing amount of data, or additional random data. As such, measurements are only taken for the "peak" response time, during the final iteration because of the slow ramp up.

Blue Coat – "Peak" measurements taken with WAN impairment and Blue Coat. This is the maximum response time recorded, usually during the last iteration because of the ramp up.

WAN Only – Baseline measurements provided by SAP, with WAN impairment, but without acceleration. This time is the maximum response time recorded, usually the final iteration because of the ramp up.

4.2.1 Response Time Measurements, North American DSL Branch Offices

The first set of A2A tests modeled a North American DSL branch office (Assumptions: Bandwidth = ADSL (768 Kbps); Latency = 40msec; Packet Loss = 1%)

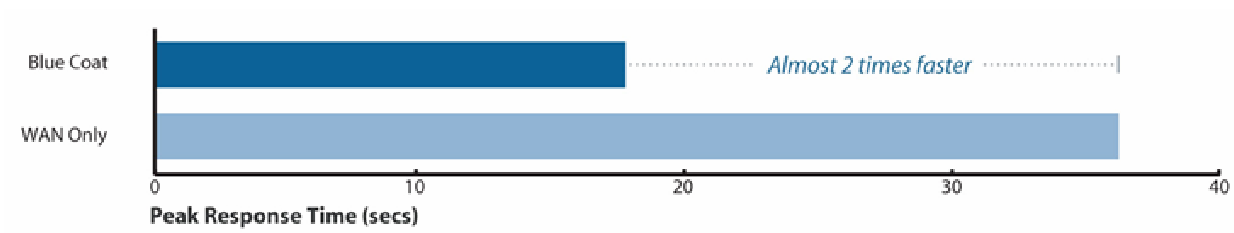

Figure 11: Response time measurements for the A2A web service call generated when performing operations from a North American DSL branch office via the "NTS Customer Fact Sheet Tag", accelerated through compression, protocol optimization, and byte caching. The XML data size was about 3MB for this measurement corresponding to 1000 line items.

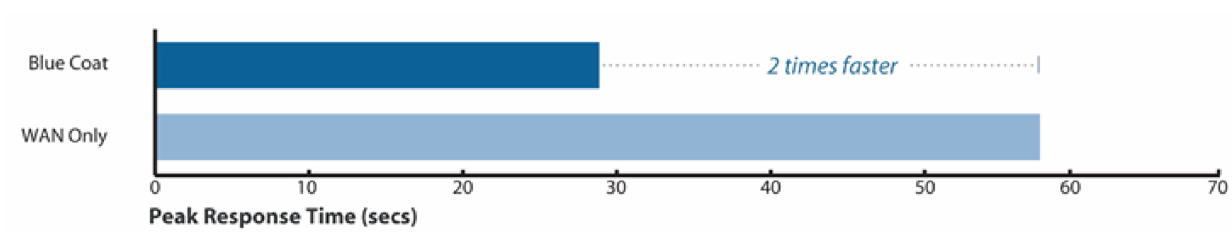

Figure 12: Response time measurements for the A2A web service call generated when performing operations from a North American DSL branch office via the "NTS Technical Document Management Tag," accelerated through compression, protocol optimization, and byte caching. The web service size was 1MB.

4.2.2 Response Time Measurements, Intercontinental T3 Branch Offices

The second set of A2A tests modeled a large intercontinental branch office (Assumptions: Bandwidth = T3 (45 Mbps); Latency = 300msec; Packet Loss = 1%)

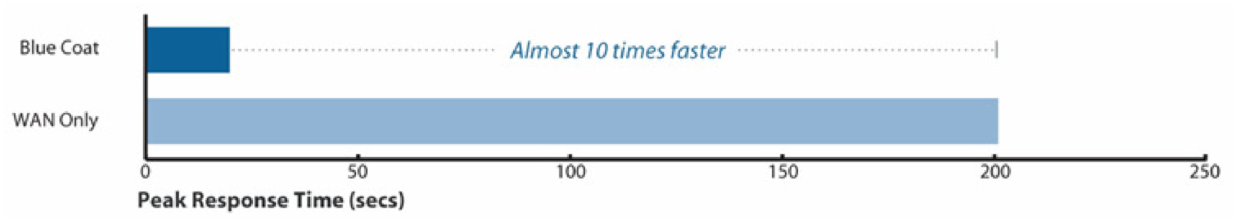

Figure 13: Response time measurements for the A2A web service call generated when performing operations from a large intercontinental branch office via the "NTS Customer Fact Sheet Tag", accelerated through compression, protocol optimization, and byte caching. XML data size was about 3MB for 1000 line items.

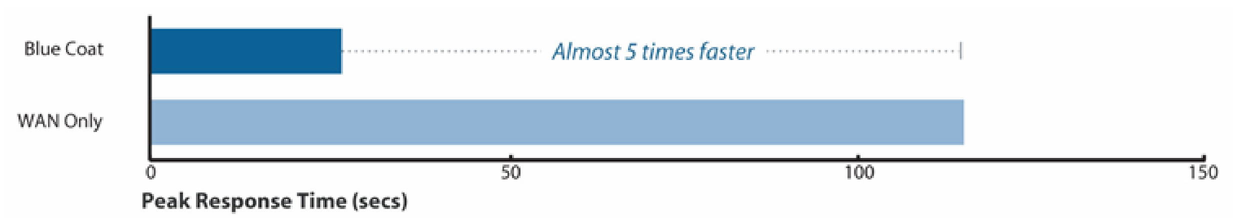

Figure 14: Response time measurements for the A2A web service call generated when performing operations from a large intercontinental branch office via the "NTS Technical Document Management Tag," accelerated through compression, protocol optimization, and byte caching. The web-service size was about 1MB.

4.3 Bandwidth Measurements and Improvements

As typical with any application delivery solution, bandwidth reduction measurements remain constant across varying network conditions. Therefore, they are only shown once below.

Caching and compression of data that traverses the WAN can dramatically reduce the bandwidth used by applications, resulting in significant bandwidth savings (in some cases almost 99%). This benefit not only applies to SAP application traffic, but also to the other types of traffic that can be optimized by Blue Coat. As a result, enterprises have an alternative solution to the constant cycle of WAN bandwidth upgrades. Also, other applications or data that need to traverse the WAN will also see improvements.

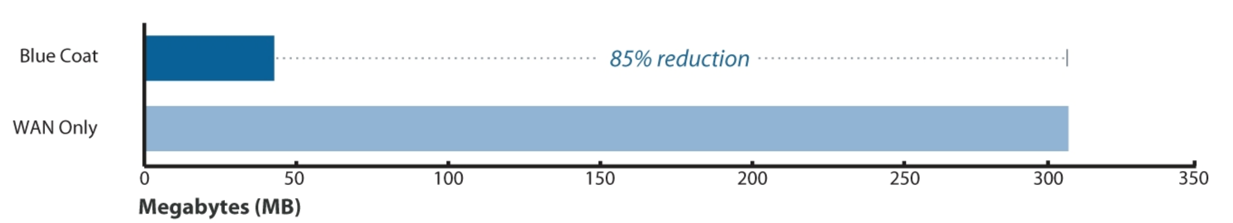

Figure 15: Bandwidth Utilization – Logon/Logoff Tests. Bandwidth reduction of more than 85% was seen for the both the 150 and 300 user logon/logoff tests.

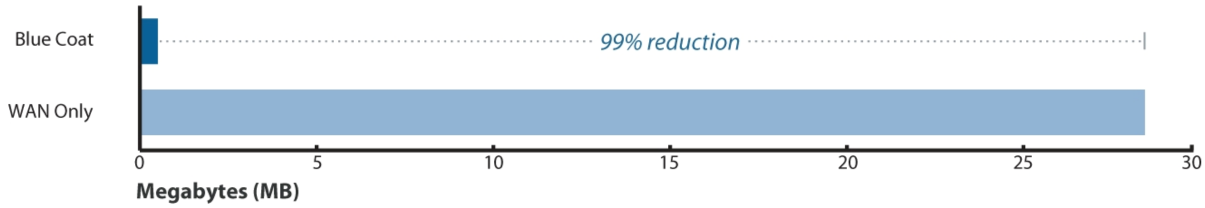

Figure 16: Bandwidth Utilization – Large Document download tests. Bandwidth reduction of 99% was seen for the Knowledge Management document download tests.

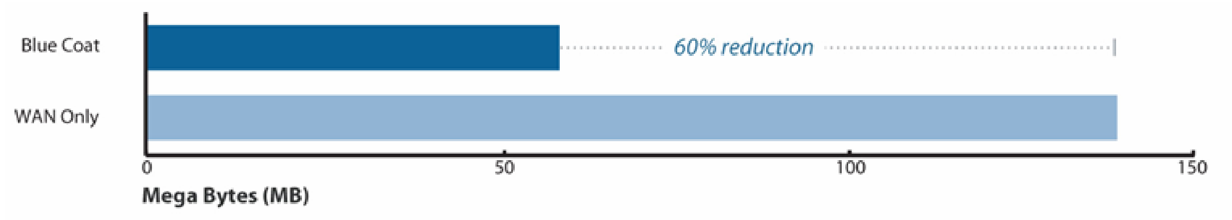

Figure 17: Bandwidth Utilization – Customer Fact Sheet Tests. Bandwidth reduction of 60% was seen for the Customer Fact Sheet tests.

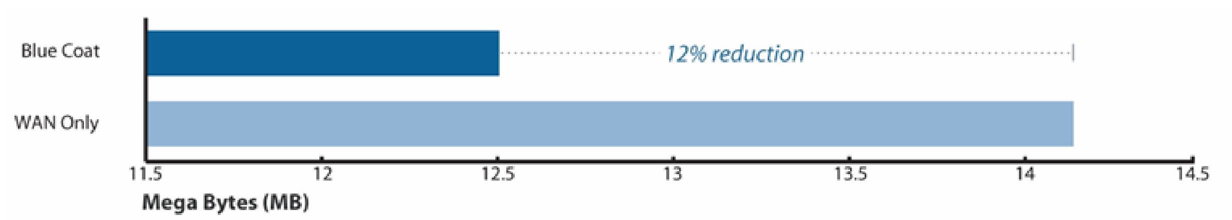

Figure 18: Bandwidth Utilization – Technical Document Management Tests. Bandwidth reduction of 12% was seen for the Technical Document Management tests.

4.4 Security and Reliability Enhancements

Blue Coat was able to secure and control WAN traffic, by ensuring that WAN traffic did not interfere with SAP application traffic. This is demonstrated by the graphs below - the first two graphs represent load tests for the DSL case, and the following graph represents load tests for the T3 case.

4.4.1 North American DSL Branch Office - Reliability and Availability

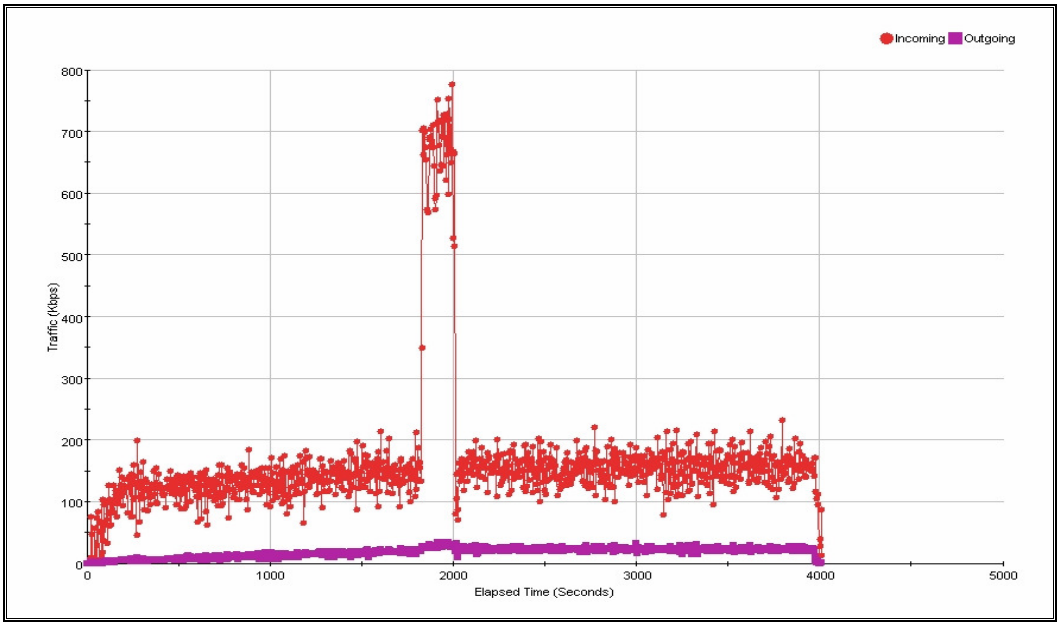

Figure 19: The graph above represents how Blue Coat was able to limit the traffic from a load generator to less than 200Kbps, except for the spike during the middle of the test, when Blue Coat disabled bandwidth management for a short time.

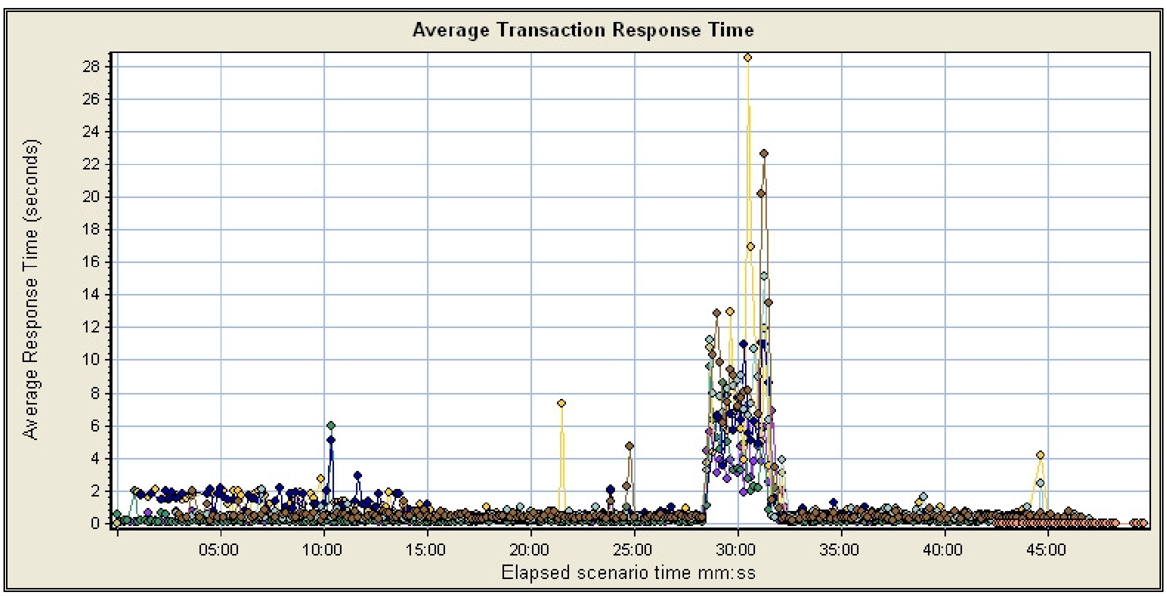

Figure 20: The graph above show the average transaction response times during the one hour test. Response time severely degrades when there is WAN congestion and contention.

4.4.2 Intercontinental T3 Branch Offices - Reliability and Availability

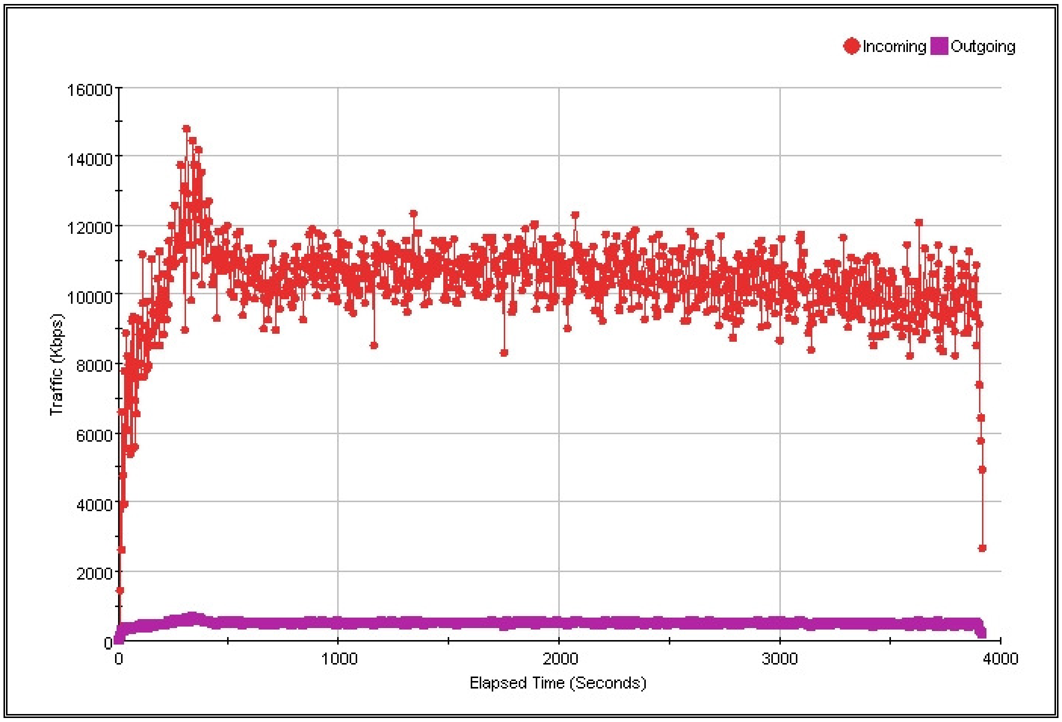

Figure 21: WAN throughput for non-SAP traffic during another one hour test, where the WAN bandwidth was 45 Mbps. The load generators ramped up to fill up the WAN link (trying to generate 45Mbps), but Blue Coat limited the traffic to only 10 Mbps, dedicating the remaining 35 Mbps to SAP application traffic.

In addition to managing and controlling the limited bandwidth for small branch offices, Blue Coat demonstrated robust performance and was able to perform optimizations for larger branch offices, with bigger WAN pipes. As demonstrated in the above chart, Blue Coat was able to throttle non-SAP traffic from the load generator, reducing it from 45 Mbps to 10 Mbps, while still accelerating SAP application traffic and reducing response time, guaranteeing 35 Mbps of bandwidth for SAP traffic. In this particular instance, it was found that configuration of bandwidth management, especially under high load or traffic, did not affect the accelerated response times seen in previous tests.

5 Summary and Conclusions

A number of important business trends affect the way today's enterprises use and deploy business applications. Classical ERP applications are no longer software deployments at corporate headquarters. Application servers and end users are no longer isolated to a shared local area network (LAN). Corporate users are no longer the "local" users. This natural evolution results in enterprise SOA application software components and end users spread worldwide, connected via a wide-area network (WAN) infrastructure. The decentralization of users and the centralization of applications has been challenging modern IT organizations to provide global users with: seamless, secure access to applications; a consistent experience; and high-performing, reliable and available access. To provide this application delivery infrastructure at a low cost while meeting these demanding challenges requires a broad and high performance solution.

A feature rich application delivery solution can enhance your network and help protect your enterprise SOA investment. Improved performance and response times will result in more productive users and quicker adoption of processes and procedures. Reduced WAN bandwidth utilization will allow enterprises to maximize their existing WAN infrastructure and reduce costs, by eliminating expensive bandwidth upgrades. Security enhancements and server offload eliminate scalability and reliability problems allowing enterprises to maximize the efficiency of their existing server infrastructure. Reliable and available access to mission-critical applications protects the WAN and guarantees a high service level for system integrators, application developers, and end users.

The Blue Coat application delivery solution, based on MACH5 technology, provide all these benefits and enhancements on a single platform. Blue Coat enables IT organizations to optimize security and accelerate performance between users and applications by providing intelligent points of policy-based control across the extended enterprise. Using just a single appliance, the Blue Coat application delivery solution can improve performance, reduce server CPU utilization, and guarantee reliable access to applications by securing and controlling your WAN infrastructure.

6 References

SAP References:

Ref 1: SDN http://sdn.sap.com/

Ref 2: ESC http://esc.sap.com/

Ref 3: SAP Co-Innovation Lab: http://www.sdn.sap.com/irj/sdn/coil

Ref 4: Network vendor and SAP: Overview Blog:

https://www.sdn.sap.com/irj/sdn/weblogs?blog=/pub/wlg/7447

Ref 4: SAP Discovery system: https://www.sdn.sap.com/irj/sdn/developerareas/esa/esadiscovery

Ref 5: First ESC Network Group paper:

https://www.sdn.sap.com/irj/servlet/prt/portal/prtroot/docs/library/uuid/805d8c2d-0e01-0010-a694-a94109e88f2a

Blue Coat References:

Ref 6: *Practical Strategies to Accelerate Business Applications Across the WAN* paper: http://www.bluecoat.com/doc/522

Ref 7: *Accelerate SSL Encrypted Applications* paper: http://www.bluecoat.com/doc/794

Ref 8: *Taking Control of Secure Application Delivery* paper: http://www.bluecoat.com/doc/498

Ref 9: *SG Client Extends Application Delivery to End Points* paper: http://www.bluecoat.com/doc/557

Other References:

Ref. 10: Sdforum press release:

http://www.sdforum.org/SDForum/Assets/PDFs/Newsletters/Final_SDFnews_FebMar07.pdf