Zeus ZXTM and BEA WebLogic

A Broadband-Testing & Zeus Performance Study

First published September 2006 (V1.0)

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Improving BEA WebLogic Performance

BEA WebLogic is a powerful, mature J2EE Application Server, forming the basis of one of the leading internet application development platforms. Zeus' ZXTM Traffic Manager was the first application traffic management product to pass BEA's stringent Validation Program, so customers can be assured of seamless interoperability between the two products.

Zeus Technology commissioned Broadband-Testing, a respected independent performance specialist, to investigate how ZXTM's Application Acceleration capabilities could improve the performance and reliability of BEA WebLogic server. Key findings include:

- ZXTM could **double the transaction rate** that could be achieved from WebLogic, with no additional software or server tuning.
- **Transactions were over twice as fast** when using ZXTM, under sustained load from multiple clients.
- Using ZXTM to decrypt SSL traffic provided **over 15-times the SSL performance** – enough to saturate the WebLogic server with regular requests.
- **Errors were totally eliminated** for all but the most demanding tests.

Many BEA WebLogic deployments use the open source Apache server to front-end WebLogic. Please refer to Appendix 1, where we present the results of using ZXTM to manage traffic to the Apache server.

What is ZXTM?

Zeus' ZXTM (Zeus Extensible Traffic Manager) operates at both Layer 4 (L4) load-balancing and Layer 7 (L7) intelligent traffic management levels and it *is* Ethernet-based but it is *not* a switch, or really any kind of "Ethernet device" per se, but effectively a server-based network appliance which is sold as software or an appliance.

It therefore typically sits in front of the server farm, behind the Internet gateway, from where it conducts traffic management in a wide number of different ways, none of which simply involve throwing raw bandwidth at it.

Being an appliance, rather than a switch, this means ZXTM works on a simple gateway principle – one way in, one way out (though in practise this is likely to be multiple, trunked Gigabit NIC connections) sharing Gigabit Ethernet switch capacity with the server farm. With its multi-faceted redundancy configurations, it also means that huge clusters of distributed ZXTM devices can be created offering both extreme levels of performance and extreme levels of resilience (see later).

ZXTMs feature set is extensive, covering intelligent load-balancing and every aspect of L7 traffic management: throughput, compression, data manipulation, security – such as DoS protection – server and application optimisation, migration tools… The company has unashamedly looked at F5 – as the market leader – and sought to equal or better every element of its own products. The result is what would be a very comprehensive set of capabilities for a *mature* product, let alone a relatively new kid on the block.

One excellent example of this attention to detail lies in ZXTMs TrafficScript feature for deep packet inspection and manipulation. This is quite simply *the* most comprehensive, rules-based methodology for traffic control available on anything we've seen.

So what ZXTM is all about is not throwing more bandwidth at the problem but, instead, throwing intelligence at it. Never mind the width, feel the quality as you might say…

Test Background

Broadband-Testing conducted a series of tests to investigate the performance profile of BEA WebLogic, and the effect of using a ZXTM 7000 Appliance to accelerate transactions on the server.

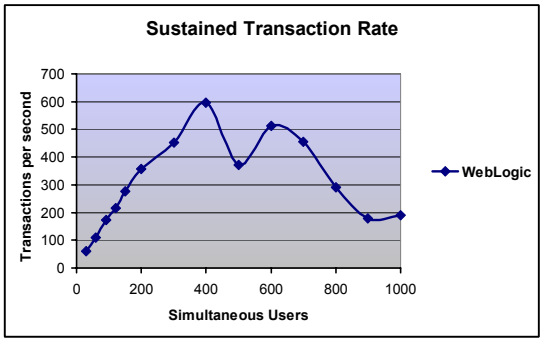
The tests evaluated BEA WebLogic 9.1 running on RedHat Enterprise Linux release 4.0 on a Sunfire v20Z server with 2Gb memory and an Opteron 244 processor. WebLogic and RedHat were fully up-to-date, and BEA's RedHat Performance Pack was installed.

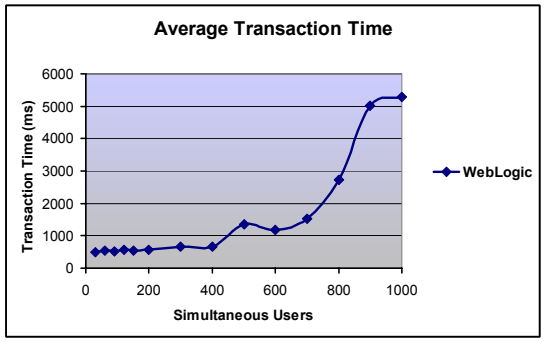
The tests used two Spirent Avalanche clients to generate traffic loads and analyse the results.

Zeus gratefully acknowledges the assistance and expertise of the Broadband-Testing team who oversaw and validated many of the tests in this report.

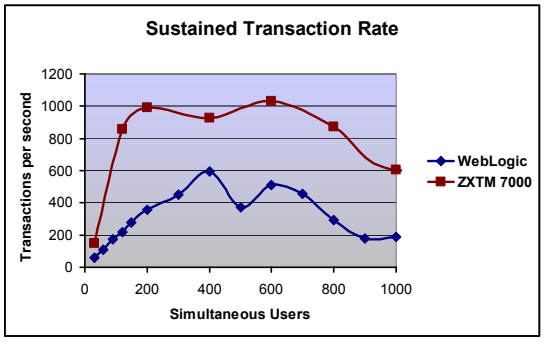
Key Finding 1: WebLogic's performance improved with ZXTM

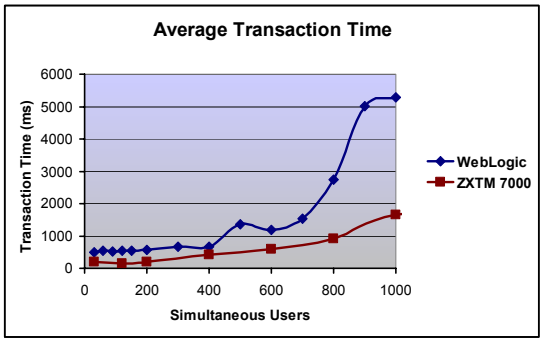
Broadband-Testing used Spirent Avalanche clients to simulate varying numbers of users accessing the JSP front page provided with the WebLogic server.





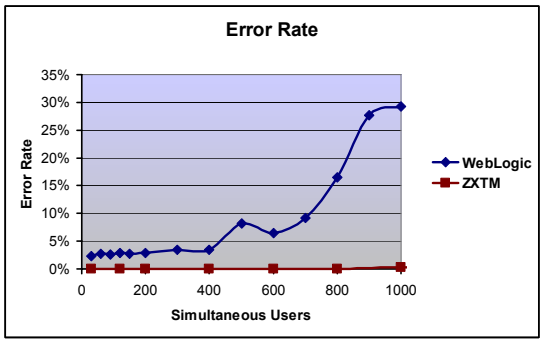
A ZXTM 7000 Appliance was then used to manage and marshal the HTTP requests to the WebLogic server:





ZXTM doubled the number of transactions per second that could be achieved from the WebLogic server.

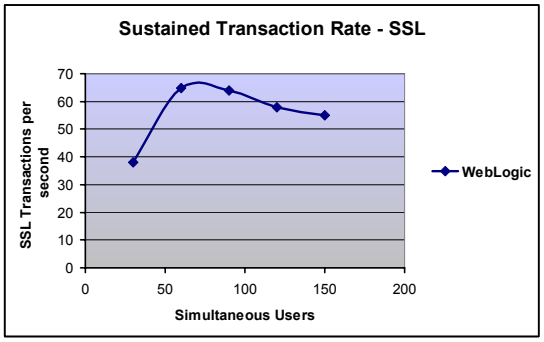
Many connection failures and timeouts were observed when testing the WebLogic server. End users would have experienced slow web browsing and broken pages. When using ZXTM, errors were totally eliminated for all but the most heavily loaded tests:

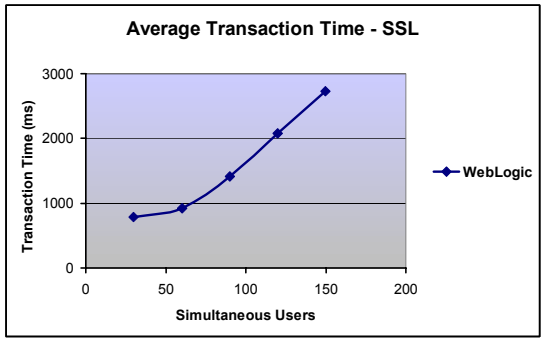


Key Finding 2: Accelerating SSL on WebLogic server

SSL is very processor intensive and puts a limit on the capacity of a web site or service. Broadband-Testing investigated WebLogic's SSL performance, measuring the performance of SSL transactions by requesting the main JSP front page with no SSL session reuse.

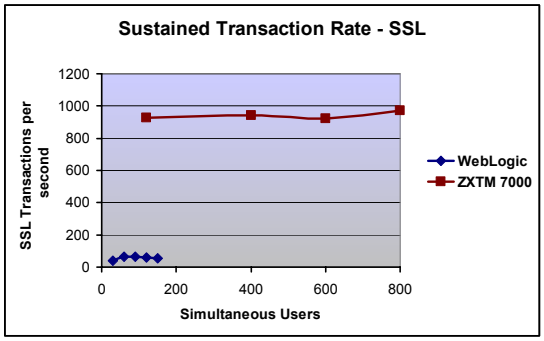
The WebLogic server was tested directly. CPU utilization consistently reached 100% in these tests, but the server became overloaded with more than 60 simultaneous users, processing transactions increasingly slowly.

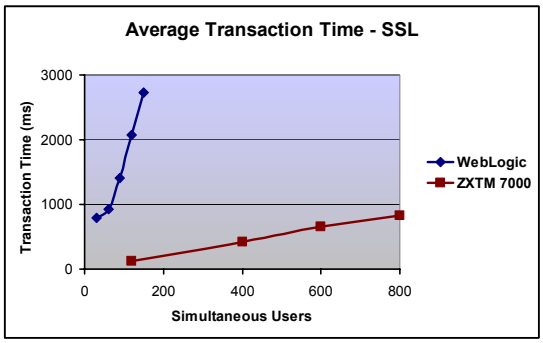




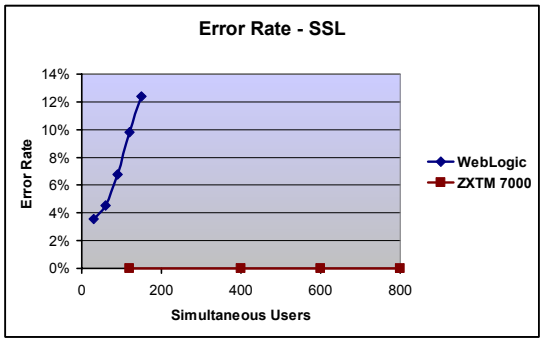
The tests were aborted at 150 simultaneous users because the error rate reached an unacceptable level.

Then a ZXTM 7000 Appliance was used to transparently decrypt SSL traffic on behalf of the WebLogic server, so that it processed unencrypted traffic only.





During the tests, many of the connections to the WebLogic server failed due to timeouts. When ZXTM was used to decrypt the connections, almost no failures were observed:



Analysis: Accelerating WebLogic with ZXTM

ZXTM functions as an application proxy, managing client side connections and maintaining shared server-side keepalive channels. It is capable of processing hundreds of thousands of simultaneous client connections, reducing them down to a much smaller number of server keepalive connections.

It was hypothesized that the ZXTM 7000 Appliance could manage connections on behalf of the WebLogic server to deliver better, more even performance.

Broadband-Testing performed a number of tests to ascertain whether a ZXTM 7000 Appliance could effectively accelerate a WebLogic server. Broadband-Testing used Spirent Avalanche load generators to perform the tests, and Spirent software to collect and analyse the results.

Testing ZXTM's Acceleration Benefits

The Spirent Avalanche clients were configured to simulate various numbers of users, each of whom repeatedly requested the JSP front page of the WebLogic example server. The clients did not request Keepalive connections.

Sim. Users	TPS (peak)	TPS (average)	Error Rate	Time
30	65	61.3	2.23%	490 ms
60	115	110	2.71%	543 ms
90	175	171	2.63%	525 ms
120	225	216	2.83%	555 ms
150	290	277	2.73%	541 ms
200	373	356	2.88%	561 ms
300	561	453	3.38%	662 ms
400	717	595	3.44%	672 ms
500	739	370	8.16%	1350 ms
600	926	511	6.40%	1170 ms
700	985	456	9.13%	1540 ms
800	713	292	16.5%	2740 ms
900	531	179	27.6%	5020 ms
1000	787	190	29.3%	5280 ms

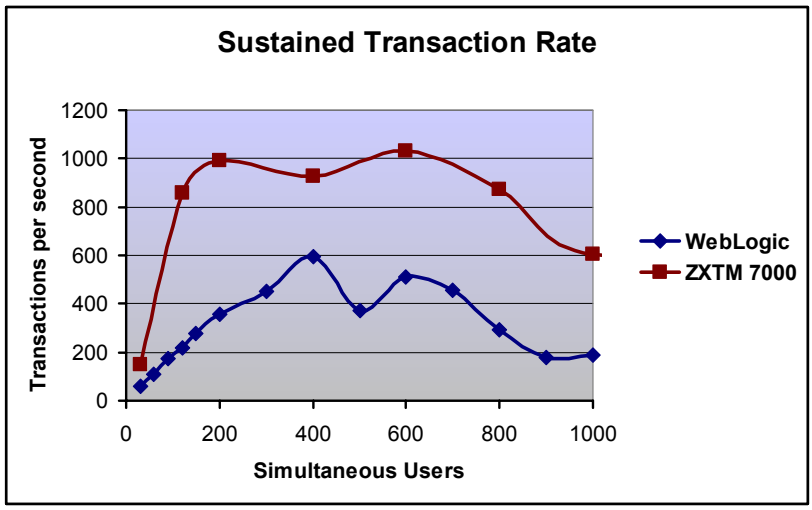
WebLogic Performance

After about 500 simultaneous users, the system became unstable. This was evidenced by the rapid growth in transaction time, the rapid increase in the error rate and the large discrepancy between the peak TPS and the average TPS. The system's behaviour was very erratic.

The test was repeated, using ZXTM to accept the connections from the clients. Identical test settings were used:

Sim. Users	TPS (peak)	TPS (average)	Error Rate	Time
30	151	150	0.00%	201 ms
120	1010	860	0.00%	140 ms
200	1510	992	0.00%	202 ms
400	1120	929	0.00%	431 ms
600	1530	1029	0.00%	583 ms
800	1270	873	0.00%	916 ms
1000	909	605	0.24%	1650 ms

ZXTM + WebLogic performance



The system began to exhibit instability at 1000 simultaneous users, twice the level of WebLogic alone. At this level of activity, despite ZXTM's best efforts at managing the connections to WebLogic, the sheer volume of simultaneous users overpowered the WebLogic server. In a real deployment, this would be an appropriate point to deploy a second WebLogic server and use ZXTM to load-balance traffic across both.

The ZXTM WebLogic system was tested to destruction with very large numbers of simultaneous users:

Sim. Users	TPS (peak)	TPS (average)	Error Rate	Time
1500	668	589	0.22%	2040 ms
2000	589	587	1.14%	2730 ms
5000	595	595	10.5%	6730 ms
10000	516	516	32.9%	15500 ms

ZXTM + WebLogic performance

Even under extreme load, the system is fairly stable. The large error rate comes about because ZXTM queues the connections for the WebLogic server, which processes them as quickly as possible; when there are so many users outstanding, some will inevitably time out.

Why does WebLogic perform better with ZXTM?

WebLogic's Heavyweight Threaded Java Architecture

WebLogic employs a traditional thread-based architecture to manage multiple simultaneous client connections. This design is known to perform poorly under load, or with slow, unreliable clients.

Even with the server self-tuning features in WebLogic 9, serious scalability limits were easily reached in these tests. These limits restrict how many connections the WebLogic server can manage concurrently.

As the number of connections increases, and as their duration increase, the server slows down disproportionately.

ZXTM's Lightweight Non-Blocking Architecture

ZXTM's architecture scales with the concurrency of the host hardware. ZXTM runs a single process for each processing unit (core or processor). Each process is capable of managing many thousands of connections simultaneously, switching between them using the OS 'epoll' system call.

This architecture is commonly described as 'select-based', because many implementations use the 'select' system call to inspect many connections and determine which can be processed without blocking; 'epoll' is a more efficient and scalable version of 'select' when inspecting large numbers of connections.

As a result, ZXTM can easily handle very large numbers of simultaneous users without any performance impact.

ZXTM sensitively marshals the many disparate client connections into a small number of fast keepalive connections to the WebLogic server. By minimising the connections to WebLogic and reusing them as frequently as possible, the WebLogic server is kept operating at peak capacity.

Analysis: WebLogic's SSL Performance

SSL performance can be a limiting factor for many sites. Netcraft reported that some banks are shifting logins to non-SSL pages[1], compromising security for performance reasons.

BEA WebLogic is not designed for high SSL performance. If you run a secure application on WebLogic, and it processes more than a few transactions per second, you will need some form of SSL proxy to decrypt the SSL traffic for it.

The SSL Options

Using Apache to proxy SSL

The most common solution is to use a web server like Apache to front-end the WebLogic server. Apache decrypts the SSL traffic, and BEA provides an Apache plugin to forward the request on to a back-end WebLogic server.

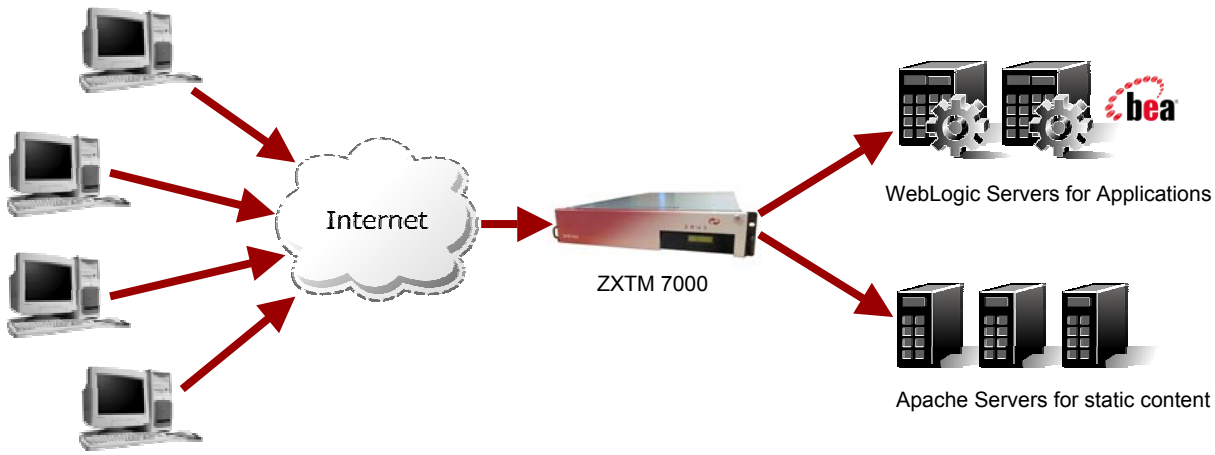
An application running on WebLogic should run identically, no matter where the SSL decrypt occurs. To achieve this, the Apache plugin can add two custom headers to the forwarded request (WL-Proxy-SSL and WL-Proxy-Client-Cert), and the WebLogic server can read these headers to establish the SSL connection parameters.

Note that Apache also has limited SSL performance, and also suffers from many of the scalability problems that WebLogic exhibits. Appendix 1 outlines some performance results for Apache.

Using ZXTM to proxy SSL

ZXTM includes a very high-performance SSL stack, and can also function as an SSL proxy. With a little TrafficScript, it is trivial to add the additional headers to the forwarded connection so that WebLogic can process the connection correctly.

A typical deployment would use ZXTM to accept and decrypt all connections for the WebLogic service. ZXTM would then load-balance the requests across a cluster of WebLogic servers, using session persistence to honor client sessions. If an organisation were to use Apache to handle static and other simple content types, the ZXTM could classify and route requests accordingly, so the Apache plugin would not be required.



[1] http://news.netcraft.com/archives/2005/08/23/banks_shifting_logins_to_nonssl_pages.html

Testing WebLogic's SSL Performance

Broadband-Testing evaluated WebLogic's SSL performance, with and without ZXTM. Two Spirent Avalanche clients simulated varying numbers of users requesting the front JSP page from the WebLogic Server. The WebLogic server used a 1024 bit RSA private key; RC4 and MD5 were used in the domestic-strength SSL cipher:

Sim. Users	TPS (peak)	TPS (average)	Error Rate	Time
30	59	38	3.54%	786 ms
60	70	65	4.53%	927 ms
90	64	64	6.75%	1410 ms
120	56	56	9.81%	2070 ms
150	54	54	12.4%	2730 ms

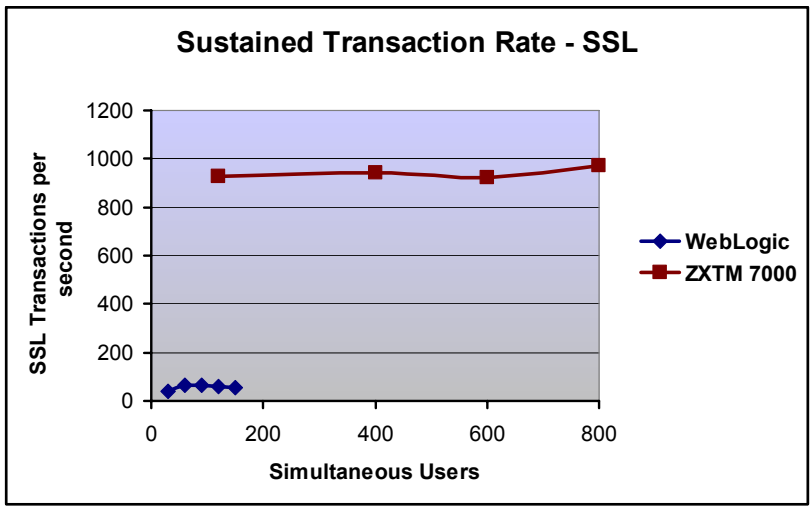
WebLogic Performance

WebLogic ran at a consistent 100% CPU utilization during these tests. The test was stopped after 150 users because the error rate and transaction time was judged to be unacceptable for a real-world deployment.

The test was repeated using ZXTM to accept and decrypt the client connections.

Sim. Users	TPS (peak)	TPS (average)	Error Rate	Time
120	1010	930	0.00%	129 ms
400	1030	942	0.00%	425 ms
600	1080	923	0.01%	650 ms
800	1030	970	0.00%	825 ms

ZXTM + WebLogic Performance



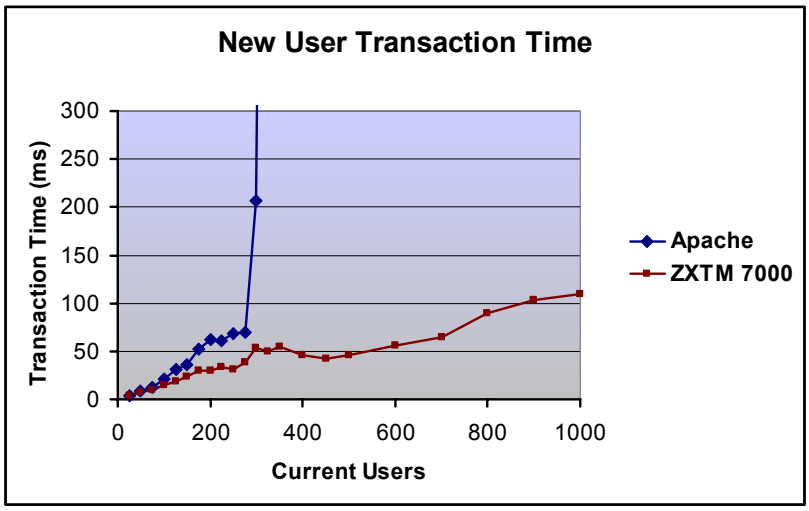
During this test, the ZXTM 7000 ran at about 20-25% CPU utilization. The WebLogic server was maxed out at 100% CPU, indicating that it was the bottleneck in the tests. A single ZXTM could easily front-end up to 4 WebLogic servers to achieve up to 60 times the service capacity.

Appendix 1: Apache Performance results

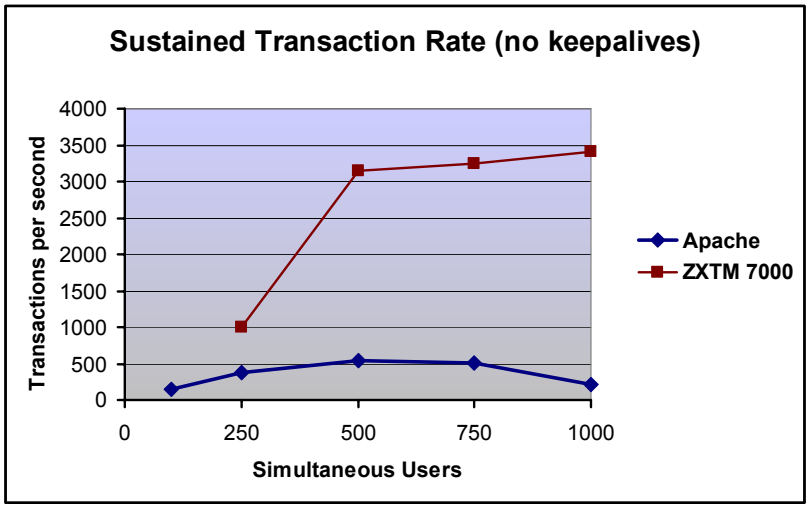
Many organisations use the Apache web server to front-end a WebLogic installation. The Apache server can process simple requests – images, static content and the like – and forward complex requests for web applications to the WebLogic servers running behind it. The Apache server can also offload processor-intensive tasks like SSL decryption from the WebLogic server.

Broadband-Testing conducted a similar set of tests against the Apache server, to determine whether or not ZXTM's acceleration capabilities were effective against it. The key findings were:

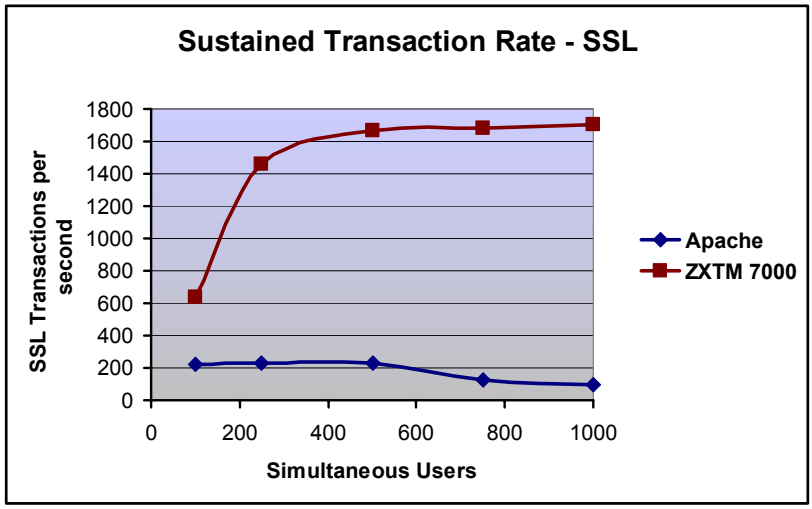
- Apache's Keepalive Implementation gives very inconsistent levels of service when under load. ZXTM can manage Keepalives on Apache's behalf to give **even and consistent levels of service**.



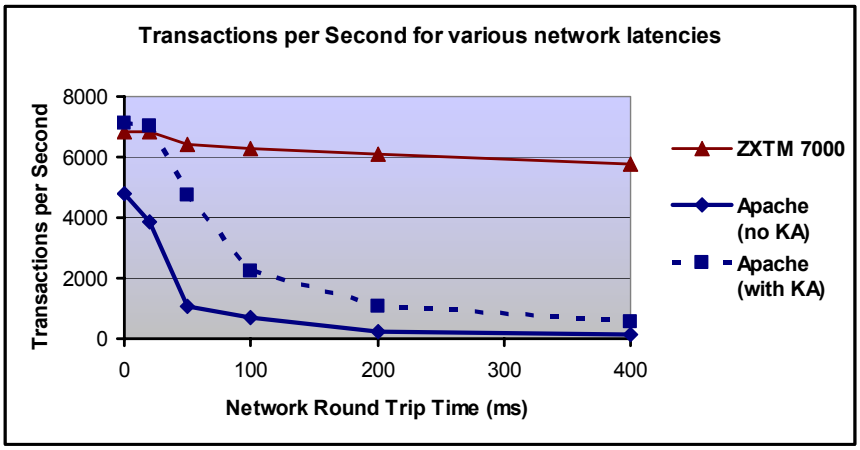
- Apache's performance when not using Keepalives is poor, with large error rates and low transaction rates. Using ZXTM with or without Keepalives totally eliminates errors, and results in an increase of up to **18-times the sustained transaction rate**.



- Apache's SSL performance is sub optimal, with slow transaction times, limited capacity and connection errors under load. Using ZXTM to decrypt SSL traffic provides up to **20-times the transaction rate** and **20-times faster transactions**, with no connection errors.



- Apache performs very poorly on real-world high-latency networks. ZXTM almost totally eliminates the high-latency effects, giving up to **40-times better utilisation**, and **8-times faster transaction times**.



For further information, please refer to the Zeus ZXTM and Apache Web Server Broadband-Testing report published on http://www.broabdand-testing.com/.

About Broadband-Testing

Broadband-Testing is Europe's foremost independent network testing facility and consultancy organisation for broadband and network infrastructure products.

Based in the south of France, Broadband-Testing offers extensive labs, demo and conference facilities. From this base, Broadband-Testing provides a range of specialist IT, networking and development services to vendors and end-user organisations throughout Europe, SEAP and the United States.

Broadband-Testing is an associate of the following:

- NSS Network Testing Laboratories (specialising in security product testing)
- Broadband Vantage (broadband consultancy group)
- Limbo Creatives (bespoke software development)

Broadband-Testing Laboratories are available to vendors and end-users for fully independent testing of networking, communications and security hardware and software.

Broadband-Testing Laboratories operates an Approval scheme which enables products to be short-listed for purchase by end-users, based on their successful approval.

Output from the labs, including detailed research reports, articles and white papers on the latest network-related technologies, are made available free of charge on our web site at http://www.broadband-testing.co.uk

The conference centre in Moux in the south of France is the ideal location for sales training, general seminars and product launches, and Broadband-Testing can also provide technical writing services for sales, marketing and technical documentation, as well as documentation and test-house facilities for product development.

Broadband-Testing Consultancy Services offers a range of network consultancy services including network design, strategy planning, Internet connectivity and product development assistance.

About Zeus Technology

Zeus Technology is leading innovation in application traffic management software. With over ten years' industry experience, the company has developed award-winning solutions that enable organisations to intelligently manage their applications, streamline operations and provide a seamless end-user experience.

Web-enabled businesses rely on Zeus infrastructure products for reliability, scalability and security. Reshaping the market by taking an intelligent approach to application traffic management, Zeus Extensible Traffic Manager (ZXTM) makes your network and web-enabled applications faster, more reliable, secure and easier to manage.

Zeus holds strategic partnerships with world-class companies such as HP, IBM, Sun Microsystems, Intel, AMD, Qualcomm, Clarity Group and Redbus Interhouse, OpenPSL and jetNEXUS. Zeus customers include BT, Cable & Wireless, Document Systems Inc., eBay, Hotel.de, NEC BIGLOBE, Newport City Council, NOB Cross-Media Facilities, PLAY.COM, Federal Railroads Administration, The Institute of Financial Services, Virgin Holidays, The Planet, TD Waterhouse, Telewest, Verisign and We Energies.