

## **Radware Application Acceleration**

*Accelerate Applications for Best User Experience & Improved Productivity*

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# Application Acceleration Technologies



## Executive Summary

Growing reliance on web-enabled applications for online business activities as well as organizations' intranet applications, has revolutionized the way customers and employees access business applications, greatly increasing accessibility to anyone, anywhere, anytime. Add to this, the exponential increase of workforce mobility and data centers consolidation in recent years and it becomes apparent that application response time is more critical to business operations than ever before. However, productivity and satisfaction levels of customers and employees are severely hampered by long latencies, protocol "chattiness," and larger transaction volume. These challenges have direct impact on companies' bottom line. It is estimated that for a medium-sized enterprise<sup>1</sup> performance degradation accounts for an annual loss of ~\$260,000, in revenue and productivity.

Organizations of all sizes must address these response time challenges or face loss of business and operational inefficiencies. Radware's comprehensive set of acceleration tools (Web compression, image optimization, caching, connection pooling, SSL offloading, Bandwidth Management, server load balancing, wireless TCP acceleration, TCP optimization etc.) help organization overcome such challenges by enabling them to accelerate application delivery, guarantee customer satisfaction and increase productivity while reducing bandwidth consumption and server load.

## Implications of Slow Response Time

Poor application performance and slow response times to employees, partners or customers creates a negative business impact that has severe financial implications, almost as much as complete downtime. In a research conducted recently<sup>2</sup> 33% of the frustrated online-shoppers attributed their dissatisfaction to the Web site being too slow or taking too long to render. Approximately 75% of online shoppers who were troubled with a retail site's performance indicated that they would no longer buy from that site. It was also noted that the experience shoppers have on a retail site colors their entire view of the company behind it, which means in a case of poor performance diminished goodwill, negative brand perception and significant loss in overall sales.

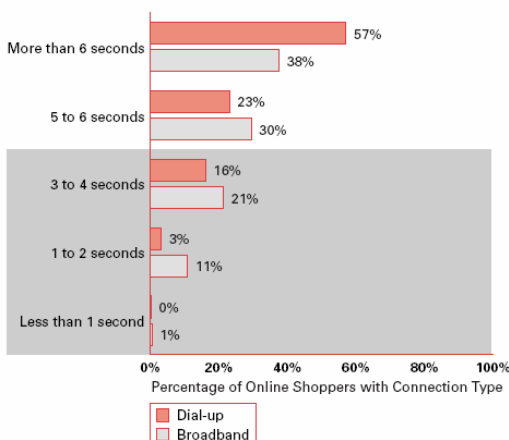


Figure 1: Length of Time Online Shoppers Will Wait for Web Page to Render, by Connection Type

<sup>1</sup> "The Costs of Downtime: North American Medium Businesses 2006" Infonetix, March 2006

<sup>2</sup> "Consumer Reaction to a Poor Online Shopping Experience", June 2006 JupiterResearch,



As can be seen in figure 1, 33% of consumers shopping via a broadband connection will wait no more than **four seconds** for a Web page to render.

## Application Delivery Performance Challenges

Because of the explosive growth and reliance by businesses on their networked applications, the demand for increased throughput and accelerated performance continues to grow. Businesses continue to provision more bandwidth and continue to scale their own network in order to keep up with the demand that the growing number of applications, number of users and general traffic volume requirements place on the network. However, examining the root causes of performance degradations shows that are many elements that contribute to it, and more bandwidth provisioning is not necessarily the right approach to mitigate latency and sluggish application delivery. There are five main drivers of application delivery performance challenges:

- 1. Data centers consolidation** – This trend leaves fewer global hubs. For example, Microsoft which consolidated its data center infrastructure from 24 locations in 2002 to four locations in 2005. This poses significant challenge on data center infrastructure ability to cope with growing transaction volume and deliver consistent service to far-flung users and remote branch offices.  
**Outcome** - Overloaded servers, growing distance to end users.
- 2. Growing distance to end-users** – End users are becoming more globally and geographically dispersed, it is estimated that 80% of business constituents of mission critical applications access applications via the WAN.  
**Outcome:** Greater latency and slower response time
- 3. Increasingly mobile workforce** – It is predicated that by 2008 there will be 878 million mobile workers globally. Current IT infrastructure fails to identify the varying user types and perform content transformation to align content with end-user device capabilities (access speed, display resolution, etc.).  
**Outcome:** Greater latency. Unsuitable content size to meet the needs of varying end-user types e.g. (PDAs, cell phones, broadband, etc.)
- 4. Non-optimized protocols** – The movement from specific proprietary protocols to more ubiquitous standardization such as existing web protocols like HTTP/HTML and XML has resulted in inefficiency of dealing with the new types of multi sequence and high bandwidth web traffic as these protocols were originally designed for dial-up speed applications and one way transfers of data between two machines.  
**Outcome:** Significant latency of web/XML based application
- 5. Lack of prioritization - Not** all traffic that traverses the network should be treated as equal. Current networks infrastructure lack the ability to prioritize traffic based on how critical the traffic or end user is to the core function of the business (or revenue) and hence fail to align bandwidth usage with business objectives.  
**Outcome** – Inefficient bandwidth usage, improper handling of delay-sensitive, revenue producing or mission critical applications.

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- 6. **Growing transaction volume** – web application are rich in their visual content and hence consume more bandwidth than traditional client–server applications. This trend will intensify in the future as enterprises will adopt Web 2.0 tools like blogs, wikis and Web video and bring today's networks to their knees in the process.  
**Outcome** – overloaded servers and WAN connections and as a result, sluggish performance.

## Radware Solution for Application Acceleration

AppDirector and AppXcel deliver fast user response times, boosting performance by 500% and more. By using superior Layer 4-7 application acceleration and optimization technologies, service bottlenecks at the data center are eliminated, providing the best end-user experience everywhere across the WAN.

Radware uses a comprehensive set of acceleration services and technologies to provide end-to-end business-smart acceleration of web and SSL-based applications as well as any IP-based applications for all types of clients such as desktops, PDAs and smart phones for complete transaction reliability, accelerated response times and cost-effective scaling.

Figure 2 shows the domains to which these various acceleration services are mapped. The services shown on the left hand side focus on optimizing servers' performance by offloading CPU intensive tasks and real time selection of best performing server. The services listed on the right mitigate latency and accelerate content delivery to end users. Thus, acceleration techniques must address speed associated with application server response and interfacing with end user for true maximum optimization.

In the following sections we will review each of these acceleration service engines in greater details.

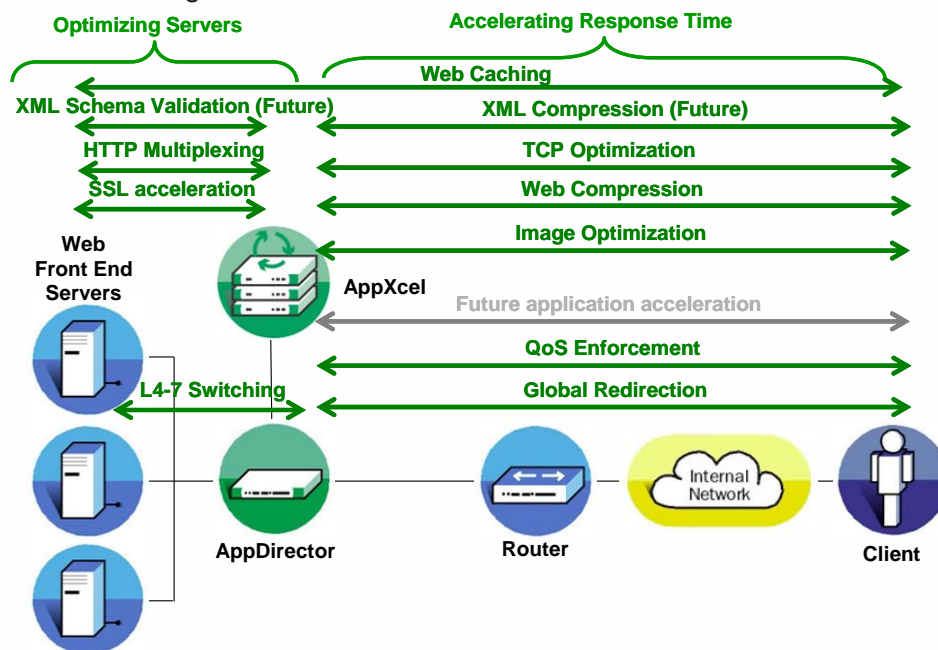


Figure 2: Radware Acceleration Technologies



## SSL Acceleration

The proliferation of new web enabled applications coupled with the trend of data center consolidation put great strain on web application servers that need to cope with ever increasing transactions volume. Growing portion of these applications use SSL (Secure Socket Layer) encryption as mean to secure and protect the privacy of sensitive information, common examples are e-commerce shopping carts, e-banking, and more. However, servers are very inefficient in processing encrypted transactions. Processing encrypted transactions require a much higher allocation of CPU resources than do simple Web page serving, in some cases, as seen in figure 3 performing SSL encryption/ decryption is 100 times more demanding than handling the same request as clear text. Performing these SSL calculations slow Web server performances, leading to inconsistent user experience, and even downtime.

Radware AFE solution relieves Web servers of performing CPU intensive SSL calculations by handling all the associated encryption, decryption, session and certificate management tasks. Unlike Web servers, Radware AFE solution is optimized to perform SSL calculations, using dedicated ASIC-based hardware & software. Offloading these SSL calculations relieves Web server CPUs allowing it to serve the application in a greater efficiency.

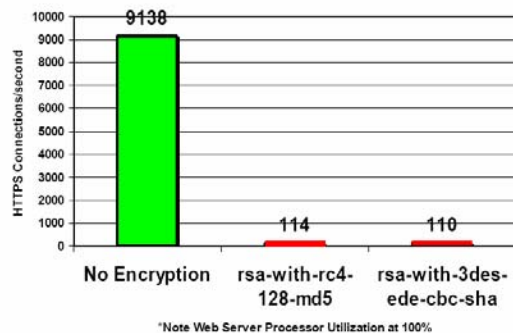


Figure 3: Handling encrypted requests vs. clear text

Radware SSL offloading capabilities perform up to 32,000 new TPS scaling up to 140,000 TPS to dramatically increasing server capacity and performance transparently to the user and the application.

Radware centralized tamper-resistant certificates/keys protection and management greatly reduce complexity and costs of managing SSL keys and certificates on individual servers. The saving is even greater in environment that requires physical tamper-resistance as it is defined by FIPS 140-2 Level 3 certification compliance, in order to prevent attackers from gaining access to sensitive information contained in the module. This centralized management approach also simplifies monitoring of SSL performance as well as auditing of any configuration changes which is required for regulatory compliance.

## Web Compression

Today's Web-based applications which are richer in their textual and visual content still run over non-optimized HTTP protocol, which was originally designed for dial-up speed applications and one way transfers of data between two machines, and is therefore less efficient at dealing with the new types of multi sequence and high bandwidth web traffic. This "chatty" nature of HTTP and the



growing volume of each transaction, due to the richer content, slow response time considerably and consume expensive bandwidth.

Radware hardware-based compression solution can ensure optimal application delivery and bandwidth savings, as can be seen in figure 4, thru compression of web pages such as HTML and JavaScript in real-time before transmission on the network. This is important especially for small remote offices and home offices users where bandwidth may be limited. This dynamic HTML compression accelerates traffic by reducing the payload using an open compression standard (gzip and Deflate), providing a powerful performance boost since HTML is an ASCII text, which is highly compressible.

The support of industry-standard gzip algorithm (as well the Deflate algorithm) ensures compatibility with virtually all popular web browsers without requiring any special software installation on the end-user machine.




	Total page size	Page size (after compression)	Ratio
	161.1K	107.1K	34%
	91K	52K	43%
	77.8K	28.8K	63%

Figure 4: Web compression of popular web sites

## Image Optimization

Application response time can be further accelerated by compressing and caching images. For example, when an image is requested for the second time, Radware's AFE solution can serve the image faster and offload the servers by fetching the image directly from the device's local cache. Image compression can significantly reduce files size, and therefore can both accelerate response time and reduce bandwidth consumption.

Radware's Image optimization provides customizable reduction of images' color schemes, yielding as can be seen in the example of figure 5, 77% file size reduction and hence response time acceleration by a factor of 4.3

## Aligning content size with end user's access speed

Content transformation and manipulation (i.e. the ability to rewrite, optimize, and transform content) is a key capability in today's converged application delivery world. As different end user devices (smart phones, PDAs, Desktops, hybrid devices) have varying capabilities and access speeds there is a need to transform a business application to optimize the user experience for a specific device.

Radware's content transformation capabilities can identify what end-user device is being used, based on HTTP user-agent header information, and deliver content (images/graphics and text) which is aligned with the end-user device capabilities, in the most optimal manner while enforcing the enterprise policy in terms of optimizing bandwidth, optimizing user experience etc.



## From the desktop...



**256 colors image: 2.15MB**

## ...To PDAs



**4 colors image: 500KB  
(77% Saving)**

Figure 5 – Customized Image compression per user type

## Caching

Web pages are composed of a series of objects. Many of these objects are static objects that are the same from page to page. Radware AFE can automatically recognize requests for such objects and retrieve them directly from the device's local cache without fetching them from the web server. This capability offloads the server from dealing with unnecessary requests and as the same time accelerates objects delivery to the end-user.

Caching can also save transformed objects at the cache such as different versions of a given image that has been compressed and optimized differently for various end users and end users' devices (as it was explained in the Image optimization section).

Radware's caching is fully compliant with RFC 2616 of HTTP 1.1. It respects all relevant HTTP Headers (such as: Cache-control, Expires, Authorization, and Pragma), which are the Web Application means of dictating which content is to be cached and when it should be refreshed.

## HTTP/ HTTPS Connection Pooling/ Multiplexing

Managing establishment and tear-down of thousands sessions can consume substantial amount of CPU and memory resources and as a result slow down server operation.

Radware's AFE optimizes HTTP and TCP connections handling by opening a limited number of sessions to the application servers, while managing many users' sessions by itself. Reusing connections between itself and the server, offloads the servers from unnecessary connection management overhead and accelerate response time by eliminating the need to start a new connection for each object, hence saving the time starting each individual connection takes.

## TCP Optimization

Radware supports extensive list of Internet standards (RFC) that improve TCP/IP operation. These techniques help TCP to eliminate lag times, increase session efficiency and accelerate application response time in a wide range of high latency and/or high packet loss environments.

- **TimeStamps and Windows Scaling** (RFC 1323) - allows for selective use of timestamps which add data to the TCP segment to aid with other optimizations.
- **Limited and Fast Re-Transmits** (RFC 3042 and RFC 2582) – Allows for efficient re-transmission of lost data to eliminate the effects of timeouts from packet loss.

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- **Delayed and Selective Acknowledgments** (RFC 2018 and RFC 2883) – Allows for faster handling of lost and reordered packets on WANs.
- **Adaptive Initial Congestion Windows** (RFC 3390) – Studies show a 30% gain for HTTP transfers over satellite links and 10% improvement for 28.8 kbps dial up, with no accompanying increase in drop rate.
- **Slow Start with Congestion Avoidance** (RFC 2581) **TCP Slow Start** (RFC 3390) – Allows for increased bandwidth utilization across links for higher throughput rates on existing public internet connections and leased lines.

## Accelerating Wireless Communication (WTCP support)

Extending the reach of Web-based applications to wireless and cellular users can increase the accessibility of these applications to mobile users. However, these media connections, which are often limited in capacity use unique communication protocol (WTCP- Wireless TCP), are not compatible with the TCP protocol supported by web application server. Radware provides unique support in WTCP bridges the gap, enabling cellular and wireless users' full accessibility to all web-based applications in an unprecedented speed.

## L4-7 Switching – Business Smart Traffic Management

Radware AFE uses advanced Layer 4-7 switching algorithms and application intelligence to align IT operations with business requirements, eliminating traffic surges, server bottlenecks and downtime for accelerated and assured application access. Powered by strong classification engine, this intelligent application delivery solution extracts granular application/business-specific information and at the same time, monitors the performance and availability of critical components along the transaction path. Network conditions and application information are then used for real time selection of best performing server, which guarantees accelerated application delivery of wide range of enterprise applications such as SAP, Oracle, BEA-WebLogic, Web applications and Portals, Citrix, VoIP, Streaming media (RTSP) and Web Services.

Optimizing the usage of IT infrastructure allows extraction of greater value from existing servers, cost effectively grow your infrastructure, and fully protect investments for best CAPEX and OPEX. See [Saving Cost of Web application Infrastructure](#) section to learn more on how business smart traffic management help you extract greater value from your IT.

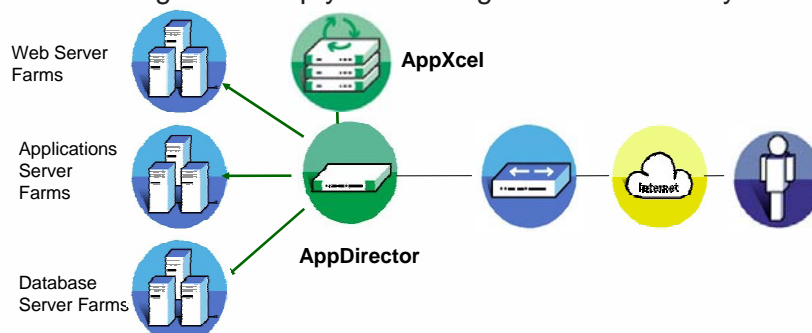


Figure 6: Optimizing IT infrastructure

## Global Service Response Time Optimization

In environments where applications spans across multiple data centers, further service response time optimization can be done by Radware's AFE global solution. In such a scenario, users' transactions will always be redirected to the best performing site.



AppDirector best site selection is based on session identifier, real time site load and patented proximity measurement that measures both latency and hops counts between the user network and each data center. Performing redirection based on these three parameters ensures best response time and transaction completion. See [Radware Superior Global Redirection Solution](#) white paper for more information.

## Bandwidth Management and Traffic shaping

Radware's Bandwidth Management provides comprehensive control over bandwidth resource allocation, prioritizing all network traffic and guaranteeing SLAs (Service Level Agreement) of mission critical and time sensitive applications across the entire network. Automatic application discovery help administrators to gain full visibility into bandwidth consumption of common enterprise applications including non-business application e.g. file-sharing (P2P) application. This information, coupled with a strong classification engine, enables granular classification and control based on any layer 2-7 information (including MAC, VLAN, IP Header information, TCP/UDP header information, URLs, Cookies, Regular Expressions, text, HTTP headers, SMTP fields, RTSP files, etc.) to guarantee proper bandwidth allotment for mission critical/ time sensitive applications while limiting bandwidth usage of non-business related applications. Diversified set of policy enforcement algorithms such as RED/WRED/ WFQ and CBQ provide administrators with the flexibility to select the allocation method that best aligns bandwidth usage with business priorities

Figure 7 shows how logical bandwidth pipes are created for the various enterprise applications where the bandwidth of each application is guaranteed. In a similar manner, such dynamic virtual pipes can be used to differentiate between various branch offices or various classes of users offering full enforcement of premium services and any service pricing models.

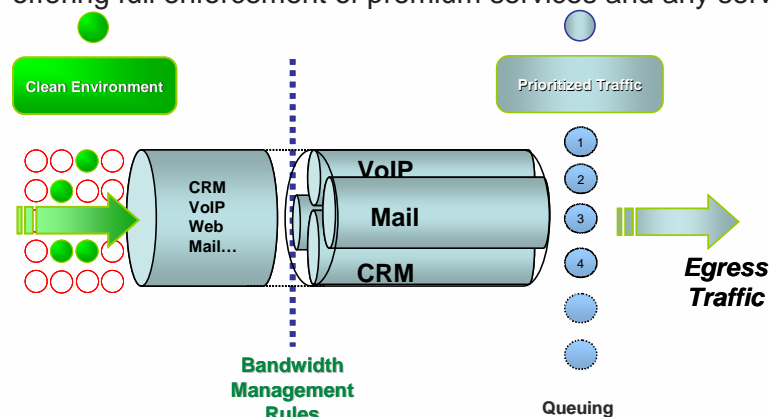


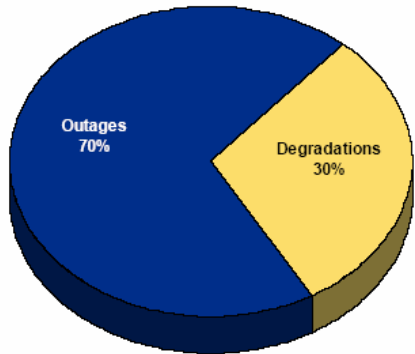
Figure 7: Effective Traffic Shaping & QoS Enforcement

## Cost of Performance Degradation - In Mid-size & Large organizations

The calculations in this section are based on report<sup>3</sup> that shows that 30% of enterprise's revenue & productivity losses are attributed to degraded application performance. The overall down time cost which consists of cost of outages and cost of performance degradation is estimated to be 1% of the annual revenue of mid-size organizations and 3.6% for large organizations.

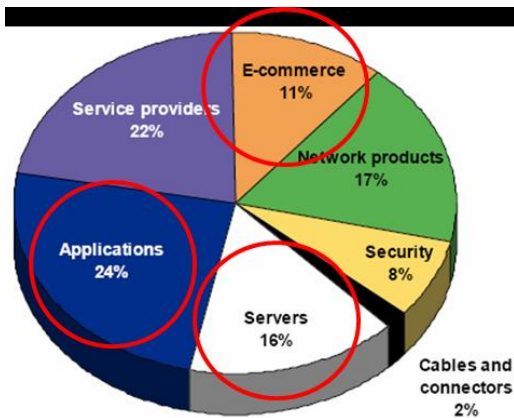
Radware AFE solution can eliminate losses due to performance degradation of servers, application and eCommerce system, circled in red in figure 9, and hence recovers 51% of those losses.

3 "The Costs of Downtime: North American Medium Businesses 2006" Infonetics, March 2006



Annual total: \$867K

Figure 8: Cost of Slow Application Performance in mid-size organizations



Annual total: \$867K

Figure 9: Sources of Slow Application Performance

### Example: Saving Cost of Slow Performance in Mid-size Business

A company with annual revenue of \$150M

Annual losses due to performance degradation:

$0.3 \times 1\% \times \text{Annual revenue} = \underline{\$450K}$

Losses due to performance degradation of servers, application and eCommerce system:

$51\% \times \text{Annual performance degradation losses} = \underline{\$230K}$

### Example: Saving Cost of Slow Performance in Large Business

A company with annual revenue of \$400M

Annual losses due to performance degradation:

$0.3 \times 3.6\% \times \text{Annual revenue} = \underline{\$4.32M}$

Losses due to performance degradation of servers, application and eCommerce system

$51\% \times \text{Annual performance degradation losses} = \underline{\$2.2M}$

### Saving Cost of Web application Infrastructure

Limited visibility into resource consumption and lack of performance optimizing tools leads organizations to over-provisioning as a mean to protect against possible resource failures and spikes in application service demand. While each environment varies, the industry average <sup>4</sup>for server utilization rates is between 15% and 20%; this underutilization drives cost of Web application infrastructure.

Total Cost of Ownership <sup>5</sup>of servers averages \$62,203 for Linux and \$141,193 for Microsoft on an annual basis. Assuming a servers farm that consists of 25 of each – the cost of underutilizing these resources is significant, as can be seen in the table below.

<sup>4</sup> «Application Infrastructure Management», APM Advisors, 2004

<sup>5</sup> Robert Francis Group

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Total Cost of Ownership	\$5,084,900
Under utilization cost @ 20%	\$4,067,920
Under utilization cost @ 40%	\$3,050,940
Under utilization cost @ 60%	\$2,033,960
Under utilization cost @ 80%	\$1,016,980

Table 1: TCO of Linux and Windows Servers

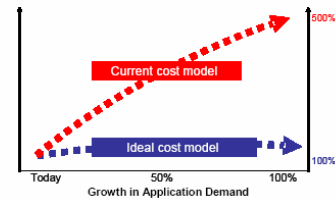


Figure 10: Infrastructure TCO Increases Disproportionately with Application Demand

It is important to note, as can be seen in figure 10, that if demand for Web application services increases by 100% the infrastructure costs will go up by 500%, assuming 20% server utilization is maintained.

Radware AFE fixes this fundamentally broken equation by driving servers' utilization rate up to 60-80% and at the same time eliminating server's bottleneck and traffic surges. This helps optimize end-user response time while saving annually, as in the example above, ~\$4,000,000 in application infrastructure cost.

## Application Accelerations – Real life case Studies

### SAP acceleration

Testing of Radware equipment at SAP Enterprise Network Lab (ENL) showed significant performance increase in executing common SAP transactions such as user login, "Create Sales Order", "Get Supplier by Product ID", various navigation steps and "Document Download." In some test scenarios Radware accelerated response time of SAP transactions by up to 50 times faster than normal operation. Figure 11 shows the average response time of the various transactions across 768Kbps line with 30ms delay. (For information on Radware solution for SAP please see Radware Solutions for SAP Environment-Test Summary.)

Key benefits of using Radware AFE in SAP environment:

1. Cut SAP users login time by 50%
2. Accelerate document download speeds by x5 for 200Kbytes and by x 11 for 5Mbyte files.
3. significantly reduces bandwidth costs associated with delivering SAP applications over the WAN
4. Significantly reduce SAP server CPU utilization thru smart load balancing

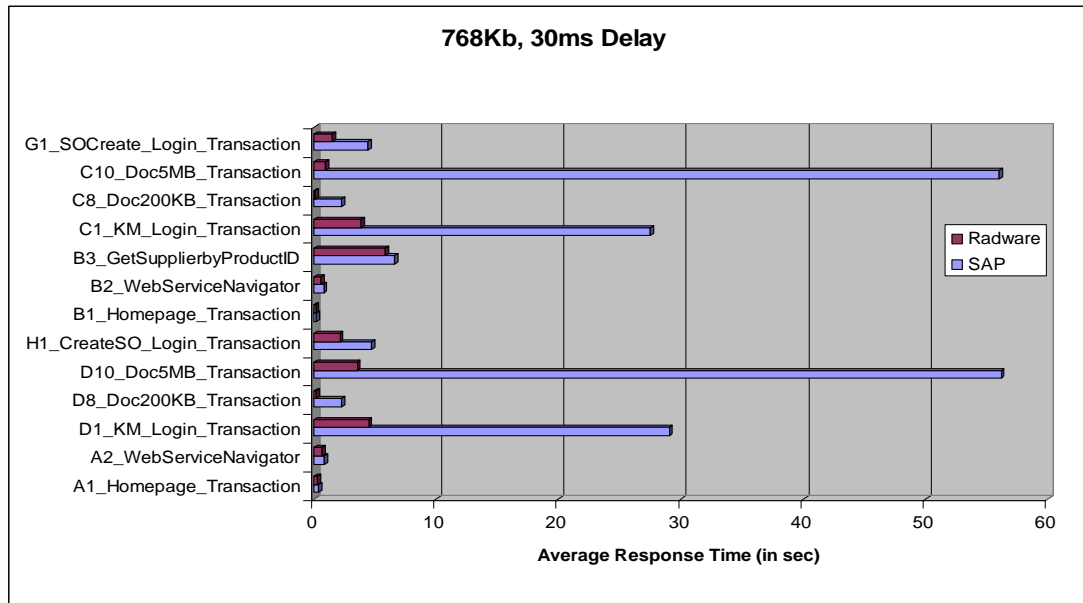


Figure 11: Accelerating SAP



OSRAM is one of the customers who are enjoying from accelerated delivery of its SAP service is OSRAM, OSRAM is one of the world largest lighting manufacturers. This international company, with its headquarters in Munich, employs more than 36,000 people throughout the world. Radware AFE solution provides OSRAM's globally dispersed partners and employees with robust and accelerated access to SAP suit of mission critical applications.

*"The implementation of Radware's solutions has given our Asian plants permanent and fault-free access to the SAP/R3 applications managed centrally in Europe. The deciding factor behind the partnership with Radware was its ability to guarantee the absolute reliability of our networks. We did not find any other vendor who enables us to achieve fail-safe operations while ensuring application performance and availability." Robert Blattenberger, Senior Director of IT at OSRAM*

## Summary

For the foreseeable future the importance of accelerated application delivery and fast response time for business success, is more likely to increase rather than decrease. Analogously the impact of major application delivery impediments, which were described in the beginning, is also going to increase. Mitigating latency contributors and minimizing their business implications is not an easy task given the complexity associated with application delivery. To be successful, IT organizations must implement a comprehensive solution that integrates the key components of server offloading, content acceleration and business intelligence, which aligns IT operation with business objectives.

Radware offers IT managers a comprehensive set of acceleration technologies, which streamlines business operation and delivers end-to-end business-smart acceleration of web/SSL-based applications to consumers and remote end users. These acceleration technologies drive employee productivity and consumers satisfaction level up will while saving cost of IT infrastructure.

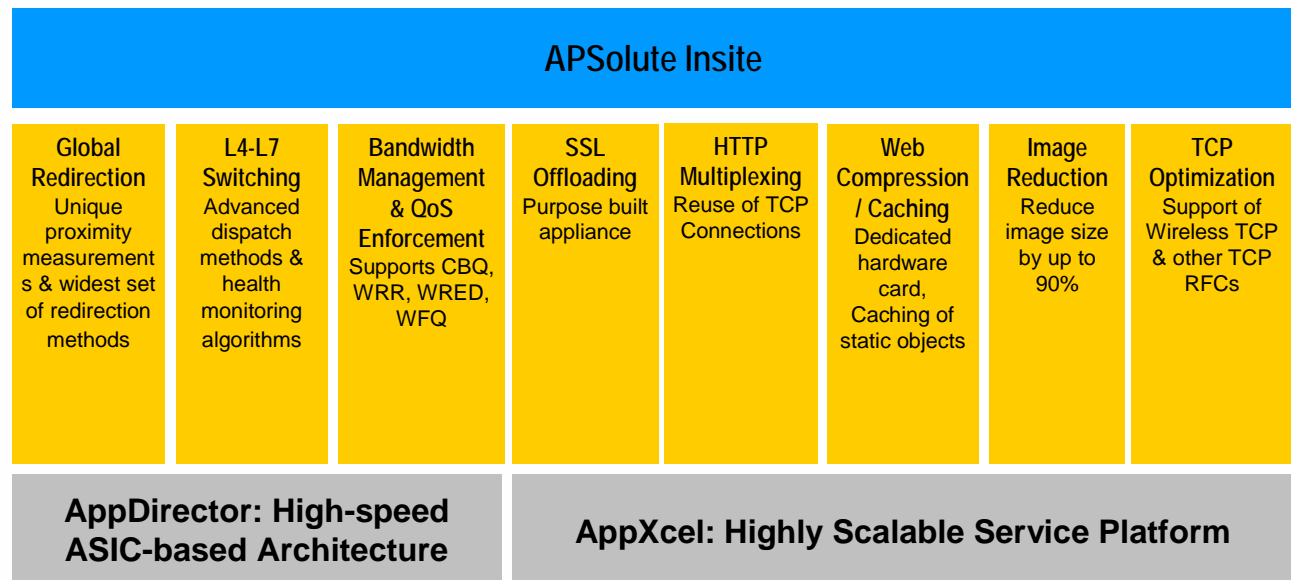


Figure 12: Radware Application Acceleration Technologies

## References

Radware : APSSolute Brochure

<http://172.66.66.11/content/document.asp?v=about&document=2920>

APSSolute Application Front End - solution brochure

<https://www.radware.com/content/document.asp?v=about&document=6353>

APSSolute Application Front End - Data sheet

<https://www.radware.com/content/document.asp?v=about&document=6630>

Radware AFE technical specifications

<https://www.radware.com/content/document.asp?v=about&document=7567>

Radware Superior Global Redirection Solution

<http://www.radware.com/content/document.asp?v=about&document=6292>