White Paper

Web Services Meet the Network

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Executive Summary

The computer era has been highlighted by vast innovation leading to staggering productivity improvements. In spite of this progress, application integration remains the technology equivalent of Sisyphus pushing a bolder up hill – forever.

Industry standards like EAI and component architectures such as CORBA have provided some help but CIOs remain buried by application integration scope and complexity. This situation is quickly becoming untenable. Why? In our globally-connected economy, the application integration burden can constrain business flexibility leaving companies at risk. Clearly, something must be done.

Fortunately, there is hope. Web standards like HTTP, XML, and Web services have become the foundation for Service Oriented Architecture (SOA) that promise an on-demand infrastructure to ease application integration, increase IT productivity, and address business needs. This white paper concludes:

- **Web services implementation can be tricky.** While standards and technologies continue to advance, Web services implementation can introduce serious security, complexity, and performance problems. These issues can be devastating leading to time consuming re-designs or project termination.

- **Implementation demands pragmatism.** While Web services promise "blue sky" benefits, ESG believes that CIOs should proceed slowly and with a phased approach. This should begin with technology adoption (i.e., Web services), then proceed to include a contained pilot project, a business-specific SOA implementation, and finally an enterprise-wide SOA deployment.

- **Web services span the technology stack.** Unlike previous application architectures, Web services require an architecture that turn technology layers into an integrated system. As such, it is necessary to view the IT infrastructure from the "bottom up" and consolidating specific security, message routing, and application services and operations in the network. ESG calls this architecture Persistent Network Application Processing (PNAP).

- **Early successes abound.** PNAP remains a vision but there are numerous early examples of successes today. Recently acquired by IBM, DataPower, a leading provider of SOA appliances, certainly fits in this category.

Seamless Application Connectivity: The Holy Grail

In 1964, the IBM System 360 architecture brought business computing to the mainstream. At the same time, it also inaugurated a limitation that has plagued large organizations ever since – application integration. How can disparate software applications communicate and share data? This issues still dogs company to this day -- enterprise companies spend about 50% of their IT budgets on personnel, software, and services focused on Enterprise Application Integration (EAI).

The software industry has certainly offered a number of potential solutions to the application integration enigma. Some examples include Electronic Data Interchange (EDI), the Common Object Request Broker (CORBA), the Distributed Component Object Model (DCOM), and Remote Method Invocation (RMI). While offering some value, each of these initiatives fell short of what's really needed – a set of platform independent standards that enable application integration and dynamic any-to-any connectivity – in real-time.

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The rise of the Internet in the 1990s finally led to a breakthrough. With the Hypertext Transport Protocol (HTTP) and Extensible Markup Language (XML) standards in place, researchers from DevelopMentor, Microsoft, and UserLand developed the concept of Web services. In general terms, Web services describe a set of web standards that have the potential for:

- **Easier integration.** Connecting different applications often required expensive, complex, and time consuming custom coding. Since Web services share business logic, data and processes through standard programmatic interface across a network, they are designed to enable different applications from different sources to communicate with each other without the coding burden.

- **Rapid application development.** Since Web services ease application integration, companies can focus development efforts on new business logic to automate processes, connect the supply chain, and increase operational efficiencies.

- **A loosely coupled architecture.** Unlike traditional integration methods, Web services are designed to provide dynamic "any-to-any" connectivity creating an on-demand IT infrastructure. As Web services penetration continues, organizations will be able to open their applications to new customers, suppliers, and business partners on-the-fly. This will greatly accelerate a company's ability to drive new revenue, outsource non-core processes, and cut costs.

After years of application integration frustration, IT managers certainly welcome any improvements but Web services also have the potential to help companies gain flexibility and move IT closer to the business by managing business processes through a Service Oriented Architecture (SOA). Simply stated SOA maps business processes (like improving customer relations, supply-chain integration, or sales operations) to IT by grouping applications together as "services." Web services standard interfaces act as the "glue" enabling this connectivity. In this way, SOA unifies stovepiped applications and systems to support existing and future business needs while enhancing the flexibility, speed, and efficiency of IT. A recent Information Week survey illustrates the value of these benefits. More than half of all users interviewed say that standardization, business-process automation, and business flexibility drove their decision to invest in SOA (see Figure 1).

Web Services Implementation and SOA Challenges Remain

Clearly, EAI has always been an IT albatross so SOA and Web services seem like a promising alternative. In fact, the Information Week survey supports this conclusion as 41% of respondents say that SOA or Web services are very important to their business goals. Unfortunately, implementing SOA based on Web services is still falls short from being a "turn-key" solution. Web services implementation remain difficult because they:

- **Introduce numerous security concerns.** Since Web services provide application integration and data sharing through standard protocols, they also have the potential to open back doors for malicious code and hacking exploits. Many companies are so concerned about Web services security that they eschew external connectivity entirely making Web services interfaces accessible solely to internal trusted systems. To alleviate the threat of a security breach, Web service security must include content inspection, AAA (authentication, authorization, and auditing), integrity checking, and encryption to address both security threats and provide secure enablement .

- **Add complexity to development processes and network architectures.** Sorting through the growing volumes of Web services standards can be a daunting task. In fact, when asked to comment on the direction of Web services standards, Tim Bray, co-inventor of XML commented Web services standards have become, "bloated, opaque, and insanely

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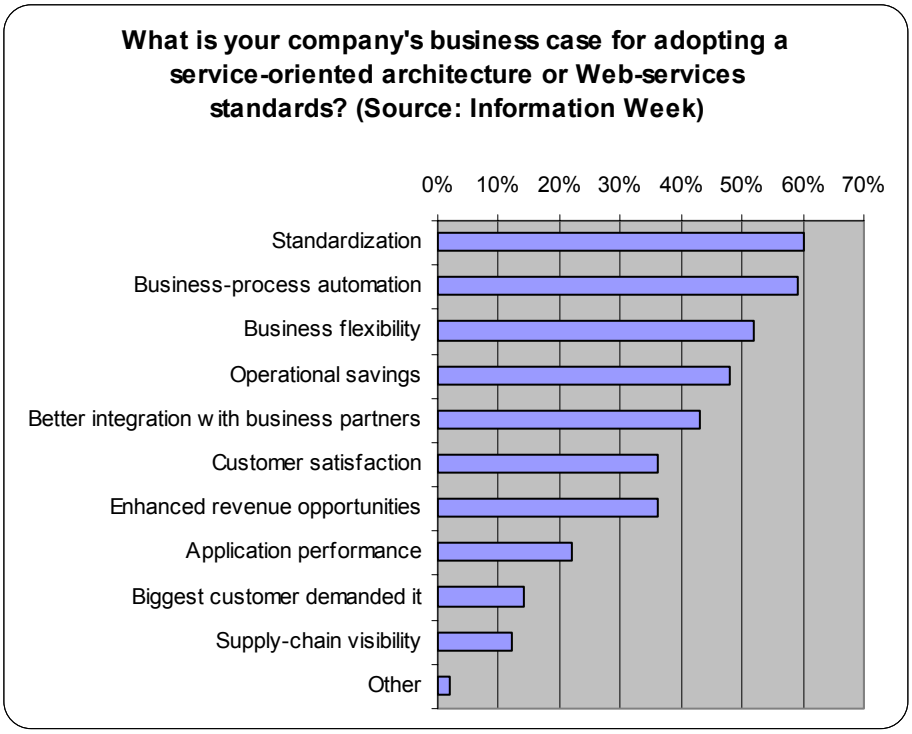
complex." Web services also demand new skills, development tools, and testing methods. Finally, Web services can introduce architectural complications as

Figure 1. Business Case for SOA



multiple back-end systems call shared services distributed throughout the network. In the Information Week survey, 26% of respondents claimed that Web services "introduced more complexity into their IT system."

- **Create application latency and performance bottlenecks.** Web services architectural complexity can mean that services that used to execute locally now require calling a service across the network. This can introduce system latency and disrupt application flow. In addition, Web services require a number of processor-intensive operations like schema validation, XML transformation,XPath filtering, and encryption. These functions alone can bring applications to their knees.

- **Can be inflexible.** In spite of tremendous innovation, Web services and SOA can still be considered in their infancy. This means that today's implementation must provide flexible options for future – and often unanticipated – requirements. Ironically, many current Web service infrastructures are built using proprietary tools that "hard code" services in servers or supersede impending industry standards with their own software glue. This may fulfill short-term needs but may also require expensive "forklift" upgrades in the future.

- **May be a mismatch for existing skill sets.** Application developers at large corporations tend to have a wide variety of programming skills that span mainframe, UNIX, Linux, and Windows platforms as well as multiple application environments. These groups may need extensive training and new development tools before Web services development becomes productive. In addition, business and IT managers may be ill suited to map business processes to IT in preparation for SOA.

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The Web services weaknesses described here present a "Faustian compromise" for CIOs. On the one hand, Web services and SOA hold the future promise of escalating ROI on Information Technology. On the other, present day Web services shortcomings can increase security risks, add architectural complexity and make future changes extremely difficult.

SOA Demands Pragmatic Planning

Like many previous IT endeavors, Web services and SOA are often implemented with a one-off and reactive mentality. Seduced by the promise of easing application integration, accelerating development and lowering costs, many firms jump into Web services, buy development tools, and start coding.

This "seat-of-the-pants" approach is absolutely the worst way to proceed. Given that Web services and SOA continues to be a technology industry "work-in-process," ESG recommends that CIOs should be extremely prudent with Web services and SOA implementations. To accomplish this, companies should:

- **Leverage existing IT investments as much as possible.** To live up to their promise, Web services must fit easily within the existing IT environment. This means that new solutions must plug into diverse system environments including z/OS mainframes and AS/400s, not just Windows, UNIX, and Linux systems. To streamline integration, Web services must also take advantage of existing software providing services like message queuing, Identity and Access Management (IAM), and digital certificates.

- **Embrace open standards.** Yes, navigating through Web services standards can be difficult but the alternative is proprietary technology and vendor lock-in. Savvy CIOs will follow both Web services standards activities and key vendor roadmaps. While Web services standards remain immature, they do provide the best hope to deliver strategic benefits for security, management, and flexibility.

  Plan for development and architectural flexibility. When asked to comment about change in organizations, management expert W. Edward Deming once said, "It is not necessary to change, survival is not mandatory." CIOs should take this sagacious advice to heart by ensuring that their Web services offer development and architectural flexibility so today's tactical implementations can grow to meet strategic enterprise needs over time. For example, new business processes may demand enhanced security, higher transaction rates, or outsourced functions. A flexible Web services architecture should be able to accommodate these kinds of changes with relative ease.

- Seek help from an expert. Since business professionals and IT staff may be lacking in Web services technical skills or the business process mapping needed for SOA, it is certainly worthwhile to seek external expertise. Given SOA's tight cooperation between business and IT, it is best to select a services company that can address both of these areas.

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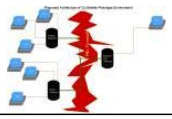
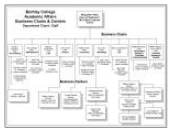
SOA Adoption Should Proceed In Phases

In addition to the high-level advice described about, it is also important to remember that SOA is no different than other complex IT projects. As such, SOA should be phased into through a

Figure 2. The four levels of SOA adoption

	Phase	Activities	Metrics
	Technology Adoption	Map a business process to IT resources. Implement web services.	•Number of people trained •Number of web services deployed
	Pilot Project Adoption	Implement pilot SOA that transforms a business process	•Number of manual tasks automated •Lower cost •Process acceleration . . .
	Business Level Adoption	Extend SOA to business processes across a line-of-business	•Number of manual tasks automated •Lower cost •Process acceleration . . .
	Enterprise Level Adoption	Extend SOA to business processes across the entire organization	•Number of manual tasks automated •Lower cost •Process acceleration . . .

number of adoption levels and success metrics. The adoption levels should include (see Figure 2):

1. Technology adoption. This first phase means implementing Web services on a tactical basis to begin to weave individual applications into services that can support business processes. The technology adoption phase should also include the adequate levels of training, tools selection, and professional services help.

2. Pilot project adoption. As a proof of concept, CIOs should integrate the phase 1 web-services implementation to transform a business process. This involves working closely with a business unit for project design, implementation, troubleshooting, and monitoring. Success should be measured with business metrics. Were processes accelerated? Were manual tasks automated? Was the company able to deliver a new capability to customers?

3. Business level adoption. The pilot project should mushroom into a more comprehensive SOA implementation across the chosen business unit. Assuming that the second phase produced worthwhile results, IT and business managers should be enthusiastic about proceeded through this phase. To build upon pilot project ROI, team up with outside experts who can help re-engineer business processes, determine realistic metrics, and

accelerate implementation.

4. Enterprise-level adoption. At this point, the organization should be sold on SOA benefits. Repeat the activities of phase 3 across the enterprise and with trusted business partners. Make sure to recruit the business unit from the 3rd phase to help champion the more global effort.

SOA: Moving up and down the stack

When it comes to SOA and Web services, ESG sees a strong correlation . Companies that approach Web services as an application-centric activity report numerous problems while those that take a more architectural approach, by assessing the impact of Web services across the entire technology stack – from the network transport up to application logic to the overall business process – enjoy far greater success.

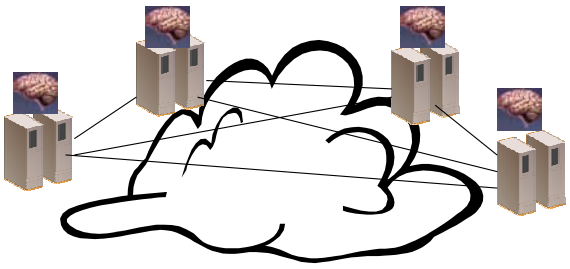
Why is this? Web services loosely coupled design results in increased traffic, dynamic distributed processing loads, and increased security road blocks across the network. Companies that focus their attention on application connectivity, business logic, and new development alone can miss these network-centric issues leading to performance, flexibility, and scalability problems.

ESG believes that this relationship is not a coincidence. Web services and SOA may be the first software architecture where the application infrastructure must be tightly coupled to the network. No longer can CIOs look at their IT infrastructure as a series of complimentary but independent technology layers. Rather Web services demand a systemic view that starts at the network and works its way up the OSI stack and beyond. In this model, application processing becomes a collective effort across network nodes allowing for rapid changes to accommodate traffic patterns, processing requirements, and business rules.
ESG calls this model Persistent Network Application processing (PNAP). Rather than separate network and application processing functionality, PNAP utilizes intelligent devices to consolidate specific processing and services on the network itself (see Figure 3).

Figure 3. Application-centric vs. PNAP Web services architecture

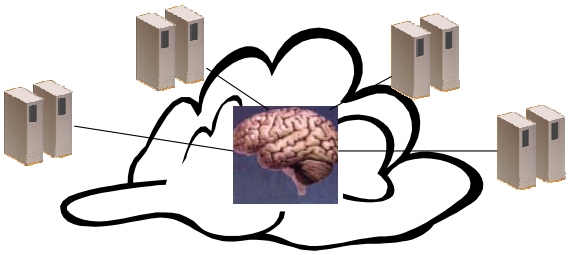
Application-centric web services deployment

- Services distributed across the network leading to:
  - Architectural complexity
  - Performance problems
  - Increased network traffic
  - Security issues
  - Inflexibility



PNAP web services deployment

- Services consolidated on the network:
  - Simplified architecture
  - Increased performance
  - Strong security
  - Flexibility and Agility



Source: ESG

In this way, a PNAP-based architecture uses the network to:

1. **Enable more efficient sharing of services.** Since the network "sees" all Web services traffic, it can perform specific services to enhance architectural efficiency across an SOA. For example, applications need security services like SSL termination, integrity checking and schema validation. Rather than place these functions on geographically displaced servers, it makes far more sense to consolidate them on common network segments where they can be collocated with – and shared by – application servers.

2. **Off-load specific operations.** Standard Intel servers may perform tasks like simple XML parsing but SOA performance can be dramatically enhanced by off-loading processor-intensive tasks to specialized SOA appliances. Since the network also offers a birds-eye of all transactions, it makes sense to consolidate logging functions on the network rather than monitoring activities by piecing together numerous server logs.

3. **Use application content to increase networking productivity.** As XML, Web services, and SOA proliferate it makes sense to utilize the network for message routing – not just IP packet routing. Why? Message routing can look at specific XML content to make policy decisions on its next destination. To drive holiday volume on a certain product, a company may set up a program for large customers so they receive special payment terms or discounts. PNAP can help execute this by authenticating the customer, reading the XML message checking for product orders, and routing messages to the right back-end servers to services these special orders.

4. **Move business logic to the network.** The ultimate PNAP vision is that the network becomes integrated into application and business logic itself. For example, developers can write a business rule to the network stipulating that invoices over $5000 need CFO approval while those below $5000 can proceed directly to Accounts Payable. Rather than supersede traditional application development PNAP would simply increase flexibility and accelerate development.

PNAP: 2005

While PNAP may seem like blue sky vision, early innovation is already in place. For example, load balancing switches use the network to create virtual web server farms while SSL accelerators off-load SSL termination, key management, and encryption operations to the network. Over the past few years, several vendors developed more sophisticated PNAP appliances that perform specific Web services processing operations for security, content inspection, XML transformation and message routing.

ESG believes these appliances can offer short-term benefits while providing the foundation for a more strategic PNAP architecture. Even in this early stage however, appliance choices can be overwhelming and no company wants to bet its strategic SOA architecture on a flash-in-the-pan startup. How can a CIO be sure to make the right choice? To avoid a costly mistake, CIOs should:

- **Search for broad expertise not just one-trick ponies.** Many PNAP appliances are limited to one or two basic functions. This may work in early deployments but can lead to an operational challenge as new functions and appliances are added. Look for innovative vendors with deep XML/Web services knowledge and a strong lineup of products. These vendors have the smarts to react to Web services/SOA advancements thus protecting customer investment.

- **Focus on security**. While SOA architecture and development is evolving, few CIOs would debate the need for strong Web services security immediately. Fortunately, security is an area where PNAP appliances shine. Since most appliances do basic schema validation and meet WS-Security standards, weigh purchasing decisions on security features like hardened device security, common criteria certification, management, reporting, and auditing.

- **Place a lot of weight on performance.** As previously mentioned, PNAP appliances are responsible for a lot of heavy lifting that can slow lightning fast general purpose microprocessors to a crawl. Look at each appliance's processor architecture and network I/O capabilities. Is the device designed specifically for processor-intensive network tasks? Make sure to test PNAP appliances using real world data under heavy loads with all the features turned on. This will help weed out the slow pokes and clearly demonstrate which appliances have adequate headroom for future needs.

- **Look for appliances offering business agility.** A dynamic SOA architecture must be built with flexible piece parts. To fulfill this requirement, PNAP appliances must: 1) Provide seamless integration into existing legacy systems and management tools, 2) Supply programming options for network-layer business logic, 3) Focus on ease-of-use. Agility also depends upon implementation speed so PNAP device configuration can't be a bottleneck. Look for appliances that feature intuitive GUIs, policy engines, and support Extensible Stylesheet Language Transformations (XSLT) and XML Path Language (XPath). XSLT and XPath are especially useful as they can accelerate business logic changes through device scripting.

DataPower: A Leading PNAP Appliance Vendor

While many firms are developing PNAP products and services, DataPower, an IBM company, has been particularly innovative in this area. Since its inception, DataPower focused on XML-aware networking for XML applications, Web services and SOA. Unlike its competitors however, DataPower products are built with a "bottom up" design that adds application-layer functionality to SOA appliances rather than network-layer functionality to application servers. This distinction is important as it consolidates shared services on high-speed devices. DataPower bases all of its products on its own ASIC, the XG3 XML Engine, which provides near wire-speed performance for Web services operations.

ESG recently had a chance to speak with four DataPower customers to discuss their application environments, experiences, and DataPower implementations. Summaries of each of these case studies are described below. Note that customer case studies are presented anonymously here (see Figure 4).

Figure 4. DataPower Case Studies Summary

	Business problem	Technical Requirements	Why DataPower?	Benefits
Fortune 100 Insurance Co.	Automate connections to customers and business partners	Integration with SSO and SAML. XML parsing flexibility and performance	Strong security. Integration with existing IT investments. Flexible architecture	Standardization. Lower IT costs. Seamless connectivity to external constituencies
International Wireless	Needed to Integrate	Strong authentication.	Far more secure and flexible than	Authentication and authorization

	distributed applications to save money and increase flexibility	Flexible XML transformation. SSL support	alternative software technology	by country and service. Flexibility for future needs.
Global Financial Services	Needed to Integrate distributed applications to save money and increase flexibility	High performance, Strong security. Flexible XML transformation. MQ integration.	DataPower fit security and connectivity needs. Saw 10x performance improvement with DataPower in place.	Saved failing project. Enterprise connectivity enables flexible development
Automotive Credit Company	Needed to support dealer and financial partner connections with security and performance	High performance, Strong security. Flexible XML transformation to connect to any customer system	Strong security, scaling, and support for XSLT	Provided ability to scale loan processing application

Case Study: Fortune 100 Insurance Co.

Fortune 100 Insurance is a U.S.-based financial services company with a broad customer base that includes large firms and business partners. Servicing these customers requires frequent and sometimes costly communication. F100 Insurance decided to automate this process by implementing Web services interfaces to open internal systems to its customer and partner base.

Fortune 100 Insurance understood that providing external access to mission-critical demanded strong security. For authentication purposes, the company needed a solution that could integrate into its existing SSO solution and it also needed support for SAML assertions to service one particularly large customer. Encryption operations were important as F100 Insurance planned to use its Web services application to communicate directly with customers and eliminate existing intermediaries. Finally, in order to accommodate SOAP messages with attachments F100 Insurance needed MIME and DIME support as well.

Fortune 100 Insurance was concerned about XML parsing and transformation because it had to support a number of message formats in use including XML, SOAP, SOAP with attachments, and a legacy XML format. The company also needed connectivity to MQ, Oracle, and an LDAP directory.

After evaluating a number of options, Fortune 100 Insurance selected DataPower because it met the company's need for ease-of-integration, high performance, and business flexibility. The IT professionals at F100 Insurance seemed especially pleased with the results of the DataPower selection:

> "We used DataPower style sheets and were able to boost performance by 2x"
>
> "We certainly achieved our goals! We were able to reduce IT cost and make it easier for our customers to do business with us. This all worked without the need for our customers to make a single change."
>
> "To test the DataPower appliance, we plugged it into the QA infrastructure and used real data. DataPower installed easily and certainly met our performance needs."

"Our SOA Director was comfortable with an isolated network box. DataPower had no measurable impact on our network."

"DataPower fit with our objectives of standardization and we've been able to decrease our IT staffing requirements."

Case Study: International Wireless

International Wireless is a global provider of wireless telecommunications services. Over the years, the company's decentralized IT operations helped localize services but also led to application redundancy and integration complexity. The company decided that an SOA based on Web services would help ease the integration burden, consolidate applications, and provide a better framework for future business needs.

The company realized it needed strong authentication so it divided its early time investigating two disparate technologies: PNAP appliances and Identity and Access Management software. After reviewing Web services standards, the company concluded that its real issue was securing XML messages, and that standards like WS-Security 1.0 would be sufficient to meet its authentication and authorization needs.

Some of International's legacy messages were in a format that the company described as "XML-like." As a result, it needed a flexible infrastructure that could understand these messages and do transformation "in the box." Similar to Fortune 100 Insurance, International wanted native SSL support so it could eliminate 3rd party connections over leased lines. As a carrier, the company also wanted to monitor the device at its operations center via appliance-based SNMP MIBs and traps.

Before selecting DataPower, International Wireless considered a software solution from Vordel but found it inflexible and lacking in security. The company selected DataPower as it met the requirements for authentication, SSL termination, message transformation, and SNMP management.

International said that DataPower had really met their expectations:

"We needed something that could provide authentication and authorization on a country-by-country and service-by-service basis. DataPower can do this and it's easy to configure."

"It just doesn't make sense to use a software package and off-the-shelf hardware! We need a hardened appliance."

"Our primary need was security. After our testing phase, we were certain that DataPower provided authentication, message parsing, and content inspection with performance characteristics that could meet our needs into the future."

"We aren't ready to move application logic to the network but we are open to doing this in the future. DataPower provides this flexibility."

Case Study: Global Financial Services

Global Financial Services provides a variety of banking and investment services worldwide. The company has had substantial growth over the past 10 years as a function of geographic expansion and acquisitions. Over time, this strategy became unbearable for IT as it lead to an unending cycle of complex application integration and long development cycles. The company

decided to move to an SOA in order to integrate disparate systems, replace an existing message bus, increase security and performance, and meet business scaling needs.

Global built a prototype message broker based on a leading application server platform but ran into serious performance problems. The company tried working with the vendor, adding hardware, and tuning the system but still could not achieve production-level performance. While investigating alternative solutions, the company discovered PNAP appliances. IT managers decided that if these devices met their criteria, it would make sense to off-load security, message parsing, and auditing to the network.

Aside from these functions, the company also needed a solution that could plug into an MQ environment for mainframe connectivity. It also needed something that offered flexible message transformation to a number of server specific formats.

After evaluating Sarvega, Global Financial selected DataPower. The IT people that spoke to ESG seemed satisfied with this decision.

> "We tried tightening the code and XML parsing solutions but couldn't get system performance where we needed it. When we introduced the DataPower appliance into our architecture, we saw a 10x performance improvement!"
>
> "During our testing, we had no problem connecting DataPower with MQ. That was a big proof point."
>
> "We may add business logic to the device in the future but I really don't know at this point. It is certainly nice to have that option."
>
> "I was worried at one point that we'd have to scrap our entire project. I'd say that DataPower was a key factor in our eventual success."

Case Study: Automotive Credit

Automotive Credit provides credit and financial services for automobile dealers and customers. In this competitive field, Automotive believes it can use IT as a differentiator as it is linking to thousands of U.S. auto dealers and financial sources so it can exchange secure credit information in real-time. Automotive believes that these services can help the automotive industry accelerate purchases and cut costs.

Since Automotive Credit services are based upon the exchange of personal information, security was a primary concern. In addition, the company needed the capability to transform and route XML messages while providing easy connectivity for its dealer and financial networks. Performance was also important as the company uses the STAR (Standard for Technology in Automotive Retail) schema in its applications. STAR tends to create very large XML messages that could easily bog down standard processors.

Before examining DataPower, the company looked at other hardware-based as well as several software-based XML solutions but found performance and security to be lacking. Automotive Credit ultimately chose DataPower:

> "The software solutions were too slow for the volumes we were talking about."
>
> "We need to be as frictionless as possible, reliable and bulletproof in handling the credit apps that come from the dealers to the banks. Only DataPower delivers the performance and security needed for an application of this size and type."

"I think scaling is a huge issue. DataPower was the fastest we could find and it came well within the performance envelope to run this application."

Last Word

Web services and SOA have received more than their fair share of hype but for good reason. ESG believes they are the most promising technologies to date for streamlining application integration, standardizing software architectures and lower costs. Nevertheless, nothing is for free. Given that Web services and SOA continue to evolve, it is important that companies proceed carefully and continue to monitor innovation and technology progress.

Ultimately, Web services and SOA will open a new chapter in the annals of corporate computing. Picture new on-demand business relationships that can be supported with dynamic application integration and data exchange in real-time. Visualize a time when mainframe systems can be dynamically integrated with new applications to create a business process that reduces inventory carrying costs by 20% quarter over quarter. Imagine a time when you can easily add or replace existing software functionality with ease. This is where we are headed and it won't take as long as you think it will.

Finally, Web services and SOA will truly integrate the network and the computer. This is what ESG sees with PNAP. To get there, the network must become more intelligent, off-load processor-intensive services, and integrate seamlessly with the application stack. Again, this is a work-in-progress but there are many early proof-points already in existence.

DataPower is a visible PNAP success story. The company's founders were early visionaries in understanding the impact of XML networking and subsequently built the right products to help customers meet their security, processing, management and flexibility requirements.

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