

Creating a scalable and efficient infrastructure for SOA and BPM

Smart work in the smart enterprise



Management summary

It is clear that service-oriented architecture (SOA) and business process management (BPM) are synergistic. BPM provides us the tools and techniques for understanding our business processes, the use of business resources in conducting those processes, automation of those processes to gain more efficiency and analysis for optimizing and gaining better insight into how our business is functioning within our marketplaces.

SOA, on the other hand, gives us the discipline to organize our information systems into composable building blocks. This, in turn helps us to rapidly construct information systems that support our business processes and more so enable us to quickly and reliably update those systems to respond to changes in our business processes.

Doing BPM and SOA together increases business agility. The separation of process logic and service logic increases cohesion and tolerance to change at a system level, while intelligent and policy controlled business services increase the flexibility and potential reuse of the enterprise service library.

However, both BPM and SOA are fundamentally dependent on a reliable and robust infrastructure upon which we can deliver solutions that ensure the integrity of the information, processes and tasks that serve the core of our business processes. Our mission-critical business activities require mission-critical information systems.

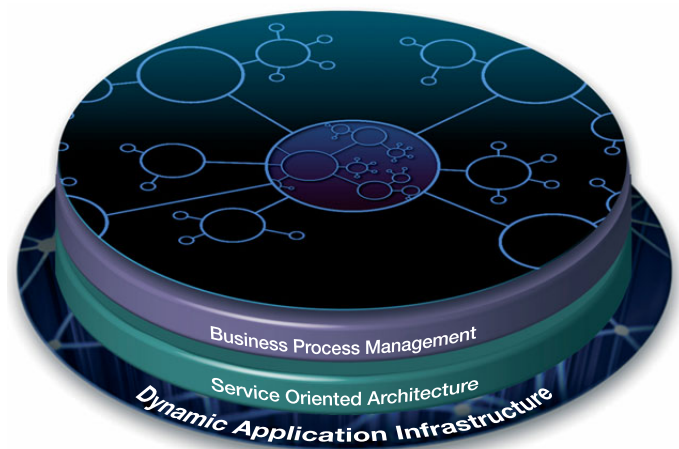
This paper outlines how IBM's software products are designed to create a mission-critical infrastructure that exhibits key transactional strengths in support of our BPM and SOA goals.

1. Creating a robust infrastructure for SOA and BPM

Business solutions are composed of three main elements: people, process and information. People are involved in driving the process, supplying information, conducting individual tasks within the process or benefiting from the outcomes. The process itself is generally defined as describing a sequence of activities along with the key metrics, policy conditions and business assumptions that profile the process. These activities may represent any variety of human tasks, automated procedures or even functions performed by other physical machines. Processes generally operate on critical information about customers, accounts, products, inventory, physical conditions and other entities that are relevant to the enterprise—information that then is a critical source for driving analytics that can be used to identify market inflections and optimize those business processes.

To reach higher levels of productivity, profitability and agility, businesses have been turning to more sophisticated use of information systems for automating business processes [BPM and SOA – why]. Using SOA techniques to enable flexibility in those systems helps the enterprise respond quickly to changes in the marketplace, exploit business opportunities and introduce new products and business innovations. Information systems are being used to build a whole new class of application that automates more and more of what we used to do manually or in an ad hoc manner and to achieve better consistency, efficiency and effectiveness in our business markets and with our customer relationships.

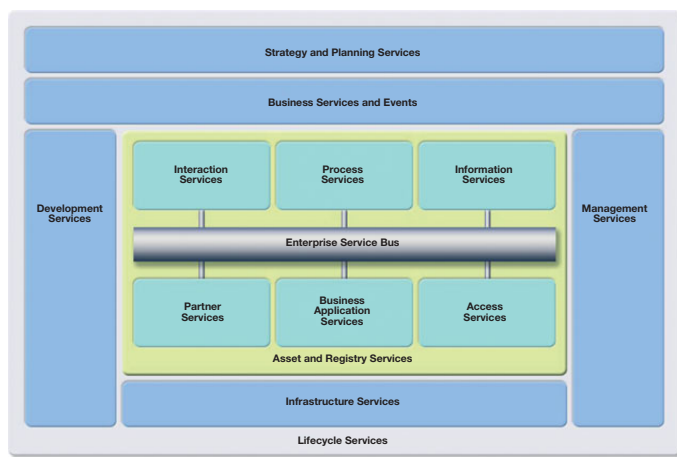
However, maintaining the integrity and robustness of our business processes has never been more important than it is today. And since more of the process is automated with information systems, more of the burden for ensuring the integrity of our business falls to the information system. Application developers are still responsible for ensuring they are correctly implementing the business logic of their processes, but we must leverage BPM and SOA techniques that exploit middleware and infrastructure that deliver transactional strength [BPM and SOA – what].



BPM and SOA must be built on a robust Dynamic Application Infrastructure

The IBM suite of middleware products enables the breadth of modern process automation. The WebSphere® Portal Server, Lotus® Forms, Expeditor, and related products can host the Interaction Services of our applications. The WebSphere Process Server can manage the process flow, human task management, rules and integration requirements of the business process. The InfoSphere™ Information Server and related Master Data Management products can handle our information federation, cleansing and transformation needs. And the WebSphere Enterprise Service Bus, WebSphere Message Broker and WebSphere DataPower® appliances, along with the WebSphere Service Registry and Repository, WebSphere Business Events and Tivoli® Composite Application Manager, are designed to manage connectivity and event processing requirements for ensuring strong coherency in composite applications.

All of these products fit within an SOA foundation architecture [SOA foundation].



SOA Foundation Reference Model

They adhere to open industry standards to ensure interoperability with other vendor heterogeneous products. This gives you the flexibility to mix and match IBM and non-IBM products as needed.

However, IBM products are also designed to work together to form the backbone of your service-oriented architecture and business process management infrastructure. And it is with this backbone of IBM products that we are able to provide high assurance of the integrity, scaling and robustness that you need to run your business.

2. Middleware as operating system

WebSphere Application Server (WAS) is IBM's Java™ Enterprise Edition (JavaEE, aka J2EE™) application hosting container and core SOA business application services platform. However, WAS is more than just a vanilla container; it defines the execution personality for many of the robust features you need to ensure the integrity and scaling of your SOA and BPM applications. WAS provides the core technology and extensibility framework for clustering, workload management, transaction management, failure detection, failover and recovery, security, internationalization, administration and systems management. Other elements of the IBM software portfolio heighten and extend this set of core technology to achieve the same levels of scaling and integrity within their own hosting containers.

WebSphere Process Server, WebSphere Portal, WebSphere Business Events, WebSphere Enterprise Service Bus, WebSphere ILOG Business Rules Management System, WebSphere Business Services Fabric, WebSphere Service Registry and Repository, WebSphere Business Monitor, InfoSphere Information Server, to name a few products all run

on top of and as an extension of WAS. These products gain their integrity and scaling characteristics by enhancing the resource management and extensibility features of the WAS middleware. Think of it as the *operating system* for our middleware portfolio.

2.1 Scaling

Scaling is critical to ensure that your applications can efficiently and reliably handle growth in demand—demand that may be driven by increasing consumption of your products, further automation of manual tasks or stronger adherence and compliance to regulations.

WAS provides near linear vertical and horizontal scaling throughout System z® Sysplex, symmetric multiprocessor (SMP) and multicore systems, in addition to massively distributed BladeCenter® and similar architectures. This is achieved in three ways:

- **Performance and throughput:** IBM maintains an aggressive focus on continuously improving the performance of its middleware products. This entails very close attention to details, including scrutiny of path length and resource contention in the code, as well careful tuning of threading, memory, cache and processing resources. The result has been best-of-class processing efficiency as demonstrated in both open benchmark comparisons such as [SPECjEnterprise™] as well as practical experiences in real production environments.
- **Clustering and workload distribution:** any given application can be configured to run on one or more WAS server processes (essentially a JVM™ execution environment running in a single Operating System process). WAS will then either work with your existing IP sprayer or augment that with a Web server plug-in to distribute workload throughout the cluster. If your work is stateful, WAS will also manage this workload distribution to maximize affinity of requests to those stateful services.
- **Resource management:** WAS also manages backend connections to shared resources—such as databases to ensure they are not becoming a bottleneck to systems throughput. This includes both connection virtualization as well resource monitoring and contention management.

WebSphere supports both 32-bit and 64-bit address spaces to enable larger applications and to support larger numbers of applications and users in a single installation.

The native scaling mechanisms of WAS are further augmented with the WebSphere Virtual Environment product that throttles workload, manages bandwidth and automatically adjusts the configuration of the target server environment to efficiently meet a set of service levels objectives for mission critical work.

2.2 Resilience

In today's global economy, the continuous and high availability of your applications is critical to maintaining an enterprise that is “always open for business.”

Server instances in a WAS cluster can be stopped and started at any time through an administrative action. When you stop a server, work is automatically redirected and distributed to the other running servers in the cluster. When you start a server, work is automatically routed and distributed over that server as well.

This automated workload distribution mechanism can be used to periodically *ripple* the application—to perform a rolling stop and start of each application or server in the cluster to perform maintenance, refresh the execution environment, or to roll in a new upgrade to the application. More so, since multiple versions of the application server runtime, or even multiple editions of the applications running on the application server runtime can be deployed in the same cluster, this

technique can also be used to perform an incremental upgrade of the production environment—all while maintaining the appearance of continuous operations.

WAS has built-in support for detecting failures in any server instance within the cluster. WAS will automatically respond to a server failure in three ways: initiating a restart process (including either notifying the administrator of the failure so that they can get involved in correcting the problem that caused the failure, automatically initiating restart, or both); selecting another server instance that is still running to recover any outstanding work on the failed server (including backing out in-flight transactions and releasing database locks); and redistributing work to the other running servers in the cluster. When combined with a storage area network (SAN), failure detection and recovery can be reduced to a matter of seconds in a peer recovery environment (where any of the available servers running on any machine within the SAN domain can serve to recover any failing server in the cluster).

2.3 Transactional and security integrity

Businesses rely on the information they depend on being accurate and consistent. Achieving this integrity begins with how information is created or updated in the first place.

The InfoSphere information management and DB2® database products provide a scalable and robust platform for maintaining and updating critical enterprise information. The InfoSphere Integration Server and Master Data Management platform enables information to be federated throughout multiple data sources (both relational and nonrelational), to

ensure the completeness and quality of the information and to control the flow of information as it traverses the enterprise. DB2 provides built-in support for transactional updates and being enlisted in external global transactions—thus ensuring not only the integrity of the data maintained in the database but also the integrity of relationships that data has to other information used in your business processes.

WAS has a built-in transaction manager for managing the integrity of information resources used in your application. The transaction manager is integral to each server instance and therefore will remain isolated from all other applications running in other server processes. The WAS transaction manager integrates with a large variety of external resource managers such as databases (for example, DB2, Oracle database, MySQL, etc.), message queues, adapters, etc. to coordinate updates. For example, if you want to ensure your “order complete” message is absolutely only sent when you have updated the order database, you can commit both of these actions in the same transaction. When you want to ensure supplies are taken out of inventory when added to the shipping manifest, you can commit the changes to the inventory and shipments databases in the same transaction.

The WebSphere transaction manager can coordinate both tightly coupled resources through a standard two-phase commit protocol, or through compensation for loosely coupled Web services and can be extended for other types of work activities. For example, if you want to coordinate orders from two different suppliers, you can place both loosely coupled

services in the same compensation scope and the transaction manager will coordinate those services. If the order for, say, balloons is accepted by one supplier but the order for party hats is rejected by a different supplier, the transaction manager will automatically issue an “undo” request to the first supplier, thus effectively cancelling the balloon order and rolling back the entire order.

The WebSphere Extreme Scale product can be used to support clustered, replicated partitioned and recoverable distribution of cached information to increase the availability and performance of high-intensity business data.

In today’s highly interconnected world it is also essential that your critical business information, services and processes are protected from malicious and accidental abuse.

WAS has built-in support for authentication, delegation, credential mapping, authorization, message protection and registry management. Any component hosted by the application server—including Servlets, Portlets, Enterprise JavaBeans™, Web services, etc. can be protected from unauthorized access and abuse. The security system provides basic security support, including support for major security standards.

WAS security is also extensible to other resource types and can be integrated with many external security systems such as IBM® Tivoli Access Manager for e-Business, IBM Tivoli Identity Manager, Tivoli Security Policy Manager, common

Lightweight Directory Access Protocol products and cryptographic frameworks. WAS has built-in support for most common security protocols, including Hypertext Transfer Protocol (HTTP) Basic-Auth, Secure Sockets Layer (SSL), Transport Layer Security (TLS), Kerberos and Security Assertion Markup Language (SAML) assertions and will pass credentials through to the underlying application database, messaging system or adaptors—providing for a layered defense to guard against intrusion and other malicious software.

WAS can also be combined with an IBM WebSphere DataPower appliance in a bastion host to provide a very robust and secure firewall, prevent denial-of-service attacks and to offload processing of large Extensible Markup Language (XML) documents that could otherwise undermine the integrity of the rest of the information system.

2.4 Management and policy enforcement

An important aspect of ensuring the scaling, resilience and integrity of your business applications, and therefore the operations of your business itself, is the ability to monitor, diagnose and manage the systems on which your business depends. WebSphere is instrumented with literally hundreds of performance monitors—enabling you to observe everything from trace points to thread counts, connections to object pools, and access attempts to process completions. You can enable or disable independent instruments as needed and access the monitor information through standard programmatic interfaces or as visual information through the IBM Tivoli Performance Monitor.

Problem determination tools are built into the runtimes. The IBM Support Assistant can be used to analyze problems or to gather problem information used in working with IBM product support services.

The IBM Tivoli Composite Application Manager can also be used to monitor overall systems performance, to recognize and resolve bottlenecks and to manage server deployment. When combined with other Tivoli offerings, such as IBM Tivoli Performance Analyzer, IBM Tivoli Web Response Monitor, IBM Tivoli Change and Configuration Management Database, you can proactively manage your application infrastructure to avoid or quickly reconcile problems that could disrupt your business.

In addition to enforcing security policies, you will have other policies that you want enforced: business policies, architectural policies and operational policies. The IBM WebSphere Message Broker, IBM WebSphere ESB and IBM WebSphere DataPower, in addition to the IBM WebSphere Application Server and Process Server products, are designed to enforce policies either in the interaction between services or in the service hosting environment itself.

3. Building automated business processes from SOA foundations

A complete solution based on BPM that automates your key business processes will involve several parts. Presentation logic may be constructed using Lotus Expeditor, Lotus Forms or WebSphere Portal. Business application services may be built

to run in WebSphere Application Server. Process choreography, business state machines and microflows may be developed in Business Process Execution Language (BPEL) running in WebSphere Process Server. Rules may be evaluated to condition business logic in the WebSphere ILOG JRules decision services.

Business events may be filtered, correlated or used to initiate other business processes through WebSphere Business Events server. Information may be delivered through InfoSphere Information Server or master data management (MDM) products. Dashboards for business key performance indicators (KPIs) and alerts based on information gathered during process execution can be made available through WebSphere Business Monitor and WebSphere Business Compass. Services used throughout the business process may be interconnected through WebSphere Message Broker, WebSphere ESB or WebSphere DataPower appliances—all of which implement the enterprise service bus connectivity pattern to mediate potential incoherency in loosely coupled systems.

All of these elements of composite application hosting infrastructure need to work together seamlessly to maintain the integrity and scaling of your business process solution. The process itself will execute in a distributed fashion throughout all of these elements. Any weakness in the integrity and scaling of any one component will compromise the overall integrity of the entire solution. Each of the components must be equally available, recoverable, secure and manageable.

Products such as Lotus Forms, WebSphere Portal, WebSphere Process Server (WPS), WebSphere Business Events, WebSphere ILOG JRules engine and InfoSphere Information Server are built on top of the WebSphere Application Server—inheriting all of the robustness characteristics of the underlying WAS operating system.

WPS microflow support is integrated into the WAS transaction manager for automated recovery. WPS extends this support with Failed Events Support to enable recovery with asynchronous requestors and provides compensation support for long-running macroflows. WPS also builds on WAS support for workload management and availability throughout a server cluster. On the zSeries® platform, this support is extended throughout WebSphere with an additional layer of recovery isolation—an architecture heavily modeled after IBM's Information Management System (IMS™)—and advanced heterogeneous workload classification that can be used to control service level objectives for both WebSphere and non-WebSphere workloads.

IBM's BPM suite also includes widgets for monitoring the health of business processes for inclusion in the Web 2.0-enabled business spaces. The failed event manager can be used along with the business process choreographer explorer to monitor failed service requests, message delivery or any other business process instance problem that may be preventing your business from operating correctly.

When you build business processes that are automated in the WebSphere Process Server, along with the other middleware products offered by IBM that build on the WebSphere operating system, you increase the combined transactional strength of BPM and SOA.

4. Process analysis

It is important to remember that analyzing your business processes is also critical to achieving overall business integrity. For some, the task of simply documenting what you do now will reveal tremendous insights into how people spend their time, how resources are being consumed, the degree to which business policies are being applied throughout different products and channels, and simply whether your business processes are doing what you thought they were. Once you have your processes captured, you can begin to analyze how to optimize them, conduct what-if scenarios, instrument them with your critical KPIs, and simulate the impact that changes could have in benefiting your business. And, finally, the business process design will serve as input to practitioners responsible for implementing your new and changed processes in the information system and operational environment.

The IBM WebSphere Business Modeler (WBM) tool is ideal for capturing business processes. You can define your process flow (irrespective of whether you've automated that flow or the tasks conducted in the process). You can define your organizational model, business and financial resources, KPIs and assumptions. WBM can be used to run simulations—applying your assumptions to the flows and resource consumption to estimate the impact and benefit you should realize from the process design. You can use the process design to assess what things should be done to ensure the integrity of your business. And subsequently you can use that as a source of input to your development processes.

Processes specifications documented in WBM can be imported into other development tools, such as WebSphere Integration Developer, Rational® System Architect and

Rational Software Architect to accelerate the development process or to support portfolio management and other enterprise architecture activities. Further, the resulting process specification can be used as a source of input to WebSphere Business Monitor or other monitoring solutions to put some structure and context around your KPI dashboards.

Finally, IBM has tested techniques, skilled resources and prepackaged content—both industry models based on vertical standards—in addition to common process and service implementations. These assets can be employed to help accelerate solutions delivery and increase the reliability of your solutions. Maximizing these capabilities can take some of the guesswork out of ensuring the integrity of your systems, your business processes and the relationships you have with your partners.

5. Conclusion

IBM has been producing middleware products for decades—most notably including the introduction of the Customer Information Control System (CICS®) in 1968 and IBM Information Management System (IMS) before that in 1966. The experiences that we have gained in the years that followed have been incorporated into our latest middleware offerings such as WebSphere and InfoSphere. We know how important it is to provide a robust infrastructure for today's

most important business processes. To that end we have been utterly uncompromising in ensuring these middleware components offer rock-solid integrity, resilience and scalability. It is these features that lend your application transactional strength—the strength to run your largest and most important workloads.

IBM believes that BPM and SOA are synergistic—in part, as discussed in [\[BPM and SOA – why\]](#)—because BPM provides the business context, understanding and metrics and SOA provides a governed library of well-architected service and information building blocks. Designing a robust infrastructure to enable the principles of SOA and BPM will ensure a higher degree of flexibility and cohesion, whilst drawing a clear distinction between your process logic, and service logic will maintain a stronger separation of concerns and operational excellence [\[BPM and SOA – what\]](#).

However, just as important, the very characteristics that were critical to ensuring the robustness of your SOA solutions are just as important to BPM-based solutions. Building your automated processes on top of SOA helps you to inherit all of the properties of integrity, resilience and scalability of our SOA middleware.

References

[BPM and SOA – why]: IBM white paper, *Achieving business agility with BPM and SOA together: Smart work in the smart enterprise*, Claus T Jensen, 2009

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[SOA Foundation]: IBM white paper, *IBM's SOA Foundation—An Architectural Introduction and Overview*, Rob High, Jr., Stephen Kinder, Steve Graham

[SPEC]Enterprise]: <http://www.spec.org/jEnterprise2010/results/jEnterprise2010.html>

[Smart SOA™]: IBM white paper, *Smart SOA: Best practices for agile innovation and optimization*, 2007

If you read this document, you will learn the following:

This white paper describes the principles for the convergence of BPM and SOA. The primary audiences are leaders and architects that need to understand how to effectively combine BPM and SOA as a key differentiator for successful enterprises in their drive toward business agility.

For more information

To learn more about BPM and SOA, please contact your IBM marketing representative or IBM Business Partner, or visit the following Web site: ibm.com/soa.

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