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Is SAP NetWeaver a Good Basis for Enterprise Application Ecosystems?

White Paper

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1 Management Summary

In this report, we compare the technical features of the SAP NetWeaver and the IBM WebSphere middleware platforms. Today, each of them is intended to be a complete foundation for enterprise customers to host their business processes and to integrate their applications and data. However, NetWeaver was originally created to solve the many challenging integration tasks internal to the SAP world (and is now marketed beyond this scope), while WebSphere was designed from the start as a generic application platform.

On an architectural level, each platform has reasonably equivalent building blocks. On close inspection however, the principal NetWeaver constituents – the application server, portal software, messaging infrastructure and development environment – have serious deficiencies in areas such as standards compliance, scalability and ease-of-integration with non-SAP software. In contrast, each WebSphere component is typically among the three best products in its class - each offering very good integration support and standards compliance, allowing customers to leverage other standards-based software or even move between vendors if desired. Also worthy of note is that several open-source products have matured beyond the capabilities offered by SAP, for example in the area of Java application servers.

If you believe to be a pure-play SAP customer, you should thoroughly evaluate your application portfolio. In many cases, customers forget about the many non-SAP elements in their software environments. If it turns out that you really have an SAP-dominated IT landscape, you have no reasonable other choice but sticking to NetWeaver. Enjoy the integration benefits of a homogeneous IT landscape. Pressure SAP to increase NetWeaver's quality, ease-of-use and standards compliance. Periodically look over the fence and check whether the IT world has changed in order to re-affirm or change your policy.

But if you are a customer with a typical heterogeneous, i.e. non-SAP-centric environment, don't adopt NetWeaver outside the area mandated by SAP. Rather, enjoy your freedom to pick better products and services. Choose a highly rated commercial or open-source application server such as IBM WebSphere, BEA WebLogic, JBoss or Apache Geronimo. Choose a portal that is compliant to the JSR-168 and JSR-170 standards, again for example from IBM, or from open-source groups like Liferay. For development choose for example

the excellent open-source Eclipse, the free Oracle JDeveloper, IntelliJ Idea or IBM's Rational Application Developer. Integrate applications with Web Services and standardized messaging engines like IBM's ESB or the open-source ActiveMQ. For process integration, consider commercial toolsets such as IBM's mature process integration products.

If you are stuck in the middle, with a significant SAP infrastructure mixed with many other software deployments, evaluate your options very carefully. Some further adoptions of NetWeaver software may be unavoidable or even recommendable. But the road to permanent lock-in is risky. Therefore, on each decision that could lead to a deeper entanglement with the SAP as it stands today, consider the technical alternatives, such as the example tools mentioned above, or the strategic alternatives, such as switching to a software-as-a-service platform.

2 Introduction

This report is structured as follows:

- In this chapter, we present a short background section about the enterprise IT software market, introduce the players and discuss the huge transition that they face.
- In the third chapter, we present an overview of the ecosystems created by both SAP and IBM.
- In the fourth chapter, we conduct a high-level comparison between the general architecture and individual components of NetWeaver and WebSphere. We show which components of SAP correspond to counterparts of IBM.
- Based on chapter four, we conduct a deeper analysis in chapter five. Here, we also discuss additional aspects that influence the application ecosystem: How good is the developer support? Is vendor lock-in likely or can customers rely on standards?
- In chapter six, we present our conclusions.

2.1 Background

Middleware Stacks, Java and SOA

The enterprise IT software market is going through a rapid phase of consolidation and concentration. Major vendors provide "middleware software stacks" or "platforms", giving customers a single basis for mapping business processes to their IT landscape.

The *technical basis* of most – but not all[1] – modern middleware is the Java 2 Enterprise Edition (J2EE[2]) standard. As J2EE is built on top of the Java programming language, it is rather agnostic to the underlying operating system. Thus, a J2EE application server can be seen as a very refined and comprehensive abstraction layer on top of an ordinary Windows or UNIX operating system, or even as an operating system for enterprise applications in itself. All J2EE-compliant systems are – in theory – interchangeable. Thus, in contrast to previous integration solutions, the great prospect of J2EE is reduced vendor lock-in.

[1] In particular, Microsoft is offering the .NET-infrastructure.
[2] J2EE is currently rebranded by Sun as "*Java Platform, Enterprise Edition (Java EE)*". For simplicity, we stick to the traditional name.

The *architectural vision* for these integration efforts is the Service Oriented Architecture (SOA). Here, applications are decomposed into a set of re-usable, standards-based, vendor and technology agnostic services which can be assembled into flexible business processes. Vendor lock-in is reduced drastically, especially when combined with an underpinning J2EE platform.

As part of the transition to SOA, key ERP-vendors such as SAP and Oracle are taking the modernization opportunity to address integration deficits within their own convoluted architectures.

The Players

In particular, we compare:

- SAP, the premier player in the enterprise application market and creator of the NetWeaver middleware suite, with which SAP hopes to move into new market areas.
- IBM, the creator of WebSphere, a market-leading[3] J2EE middleware suite.

There are many other capable J2EE and middleware products, but WebSphere is among the top-rated. It was taken as representative for the market.

Three Perspectives of Evaluation

Middleware offerings can be evaluated from three different angles driven by user profile:

- The *Pure-play SAP-user* wants at least the same quality and speed of support for his SAP applications as he already gets. He is also interested in any simplifications and cost-of-ownership improvements he can realize without dramatic migration issues.
- The *SOA-minded SAP-user* will go beyond gradually improving his current operations. He also wants to benefit from SOA to tap the potential of collaborative business scenarios. The ability to integrate SOA-compliant applications of any kind is the key.

[3] According to the Gartner research note "Market Share: AIM and Portal Software, Worldwide, 2004, Preliminary (Executive Summary)" by J. Correia, F. Biscotti, L. Wurster and Y. Dharmasthira, cited on http://www-03.ibm.com/press/us/en/pressrelease/7610.wss

- The third perspective is the *generic middleware user* who takes NetWeaver as yet another middleware stack and compares it squarely against competitors such as WebSphere.

The Pure-play SAP-User

Users with this perspective will see that even though SAP is re-architecting its applications, this will not result in immediate simplifications and savings. SAP has to keep a balance between innovation and migration costs, which makes architectural revolutions hard. Rather, SAP wants users to go through a series of vendor-paced evolutionary steps. This is a lengthy and, summed up over all steps, expensive approach. However, once on this route, users have little choice. Their fate is in the hands of SAP, as only SAP can support its own ABAP legacy environment.

The SOA-minded SAP-User

These users have options. While bound to SAP when it comes to integrating SAP products, they need not stick to NetWeaver when implementing SOA outside their SAP confinement. They have to integrate non-SAP SOA constructs into their SAP environment in order to leverage the breadth of the world software market and to take part in the collaborative business paradigms.

The Generic Middleware User

From the third perspective, NetWeaver is just one middleware among many. Its support for SAP's own legacy applications doesn't matter. Instead, users want to know feature by feature how NetWeaver, the “new kid on the block”, is faring against middleware veterans having decades of experience.

2.2 The Importance of Enterprise IT Ecosystems

Continued Internet Impact

The Internet creates two important trends for enterprise application users:

1. It allows linkage to software operated outside the confinements of corporate IT.
2. It allows linking of business processes between multiple organizations.

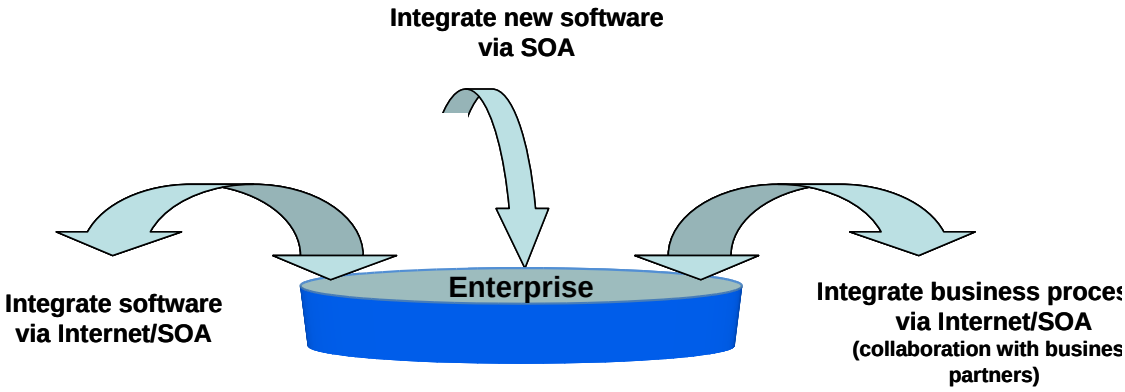


Figure 1: SOA and the Internet change the enterprise application scenario dramatically

Source: SPI

Conventional integrated business applications from SAP and its competitors have been created without these two trends in mind. Therefore, customers that want to follow the trends have to write their own applications, typically upon a middleware stack, and very soon, with a SOA. This is very dangerous for application vendors.

Vendor Reaction

The vendors know this and are conducting an enormous migration of their proven and widely adopted applications into fully Internet-aware systems. Given the many thousands of person years invested in the current applications, a rewrite from scratch is infeasible. The migration requires bringing proven legacy applications into the new environment.

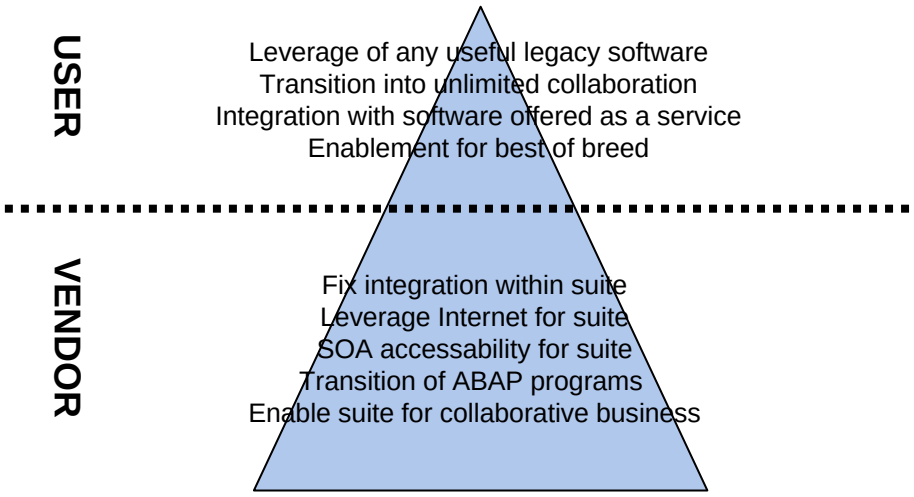


Figure 2: The middleware "iceberg" - users and application vendors pursue different agendas

Source: SPI

Vendors like SAP seem to believe it is enough to concentrate on their own legacy products and their own specific migration issues. They forget that customers have many other elements in their software environment to care about. At the same time, some of the most modern ideas like software-as-a-service seem beyond the old application vendors.

The Transformation Process

The strategic issues in the transformation process are:

- Providing a "technology stack" as a universal systems integration platform for all business applications.
- Conformance to open standards for interoperability between different vendors' applications and middleware stacks.
- Fostering an "ecosystem" of third party vendors, customer communities and developers to enhance an infrastructure's value.
- Vendors trying to lock their customers into proprietary technology.

In other research [Güm2005], we give a detailed view of how SAP is handling this strategically.

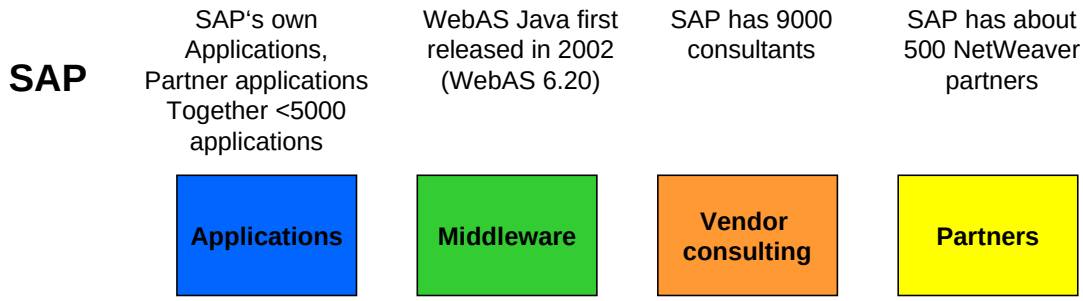
This transition into a new, different and more open application generation is a critical process where middleware plays a huge role. Hence, the temptation to control this transition by the usage of middleware proprietary to the application vendor is obvious.

3 Ecosystems Overview

In this chapter, we present an overview of the NetWeaver and WebSphere ecosystems.

Two Companies and their Positioning in the Market

SAP is redesigning the base of its entire product portfolio to fit under the NetWeaver label. We expect this process to take until 2010. As in the past, SAP is aiming to involve its partner network in helping to deploy the new generation of products. Differently from IBM, who sees its consulting business as an independent revenue source, SAP views its consultants primarily as a bridgehead into the market, prioritizing leverage over revenue.



Sources: IBM: IBM and 10K SAP: SAP Annual Report 2004, p. 21 and p. 64, SDN

Figure 3: Comparing the ecosystems

Both NetWeaver and WebSphere benefit greatly from a large and powerful network of partners and partner products. Although SAP is adding partners to its ecosystem at record speed, SAP is still far behind IBM with respect to size, quality and maturity of the ecosystem. As SAP is currently focusing on speed of build-up at the expense of quality, we expect future quality measures to weed out poorly contributing partners and their products.

Both companies leverage synergies: IBM, who moved its focus from hardware to services, seeks to increase its service business with WebSphere. SAP, still a software company, hopes to sell more applications with NetWeaver. Internally however, both companies keep

their business lines quite separate – IBM even more so than SAP. Thus, the WebSphere part of IBM's software business is not measured on cross-selling, but on revenue and profit. It would be very interesting to see corresponding figures from SAP. Quite possibly for example, NetWeaver AS could be unprofitable.

3.1 NetWeaver Overview

According to SAP PRESS, "SAP NetWeaver is an infrastructure software that supports the integration and development of heterogeneous system landscapes as they are typically found in companies today" ([Kar2005], p.11).

NetWeaver Application Server (AS) History

The R/3 system was designed when the Internet was in its infancy. It couldn't anticipate today's Internet user access patterns. When the need for a web-centric infrastructure became urgent, SAP bought In-Q-My Technologies GmbH[4], who had developed a J2EE application server. This server was rechristened "SAP Web Application Server Java Stack" to align marketing to the existing ABAP-based Web AS. Thus, instead of committing to the J2EE standard and letting the rest of the world do the hard work of implementing it, SAP chose to commit upon a *particular implementation* of the standard. In the opinion of the authors of this report, this choice was a big and costly strategic mistake by SAP.

Unlike in the database sector, where SAP supports a sensible range of respected database vendors, SAP supported only one J2EE vendor – itself – and suddenly developed an interest to force out all other J2EE-implementations that SAP customers might have. The resulting conflicts have plagued the NetWeaver strategy ever since.

Recently, the ABAP/Java Web Application Server combination was renamed to NetWeaver AS. Although SAP is marketing it as a single integrated product, the J2EE and ABAP parts are clearly distinct. They are essentially two separate servers running on the same machine, not even sharing a single database. This implies a significant runtime overhead when accessing existing business data created with an ABAP application[5]. It also

[4] Interestingly, In-Q-My had been founded by former SAP employees aiming at reasonable Web support for R/3.

[5] The SDN FAQ on coexistence of ABAP and Java states the following: *"Of course, Java components can read or modify data in the ABAP schema. But rather than accessing table data directly, they are intended to go around: In the Java code, you apply the application-level APIs (like SAP Java Resource Adapter API, web services, Adaptive RFC for Web Dynpro UIs) and ask the ABAP component to do the work on the database.", Source* https://www.sdn.sap.com/irj/servlet/prt/portal/prtroot/docs/library/uuid/ad47eb90-0201-0010-7cb2-ddfa5ed879ec

implies that NetWeaver AS could be replaced by other commercial or open source J2EE servers with little effort.

SAP's Vision: Enterprise Service Architecture built on NetWeaver

SAP calls its SOA version "Enterprise Service Architecture" (ESA) and positions it as a form of value-added SOA. There is no clear technological definition of ESA; rather, it sounds more like a concept how future SAP-based enterprise systems are to be developed:

- SAP provides template structures that are oriented at common business processes[6] and consistent definitions of data objects.
- New services are developed using these structures and objects.
- Particular business processes are assembled by orchestrating services.

The stated final goal is to provide "Process Changes by the Click of a Mouse Button" ([Kar2005], p. 35).

SAP aims to move its overall application architecture to a NetWeaver-based ESA. However, some components of NetWeaver, particularly MDM and XI, are not yet mature. SAP itself is currently starting to port its existing applications on the NetWeaver stack, with full applications ("SAP All-in-One S") expected by the end of 2006 or later.

NetWeaver's Architecture

Conceptually, NetWeaver has a *layered architecture* with increasing levels of integration:

- The *application integration* forms the basic layer. It is responsible for seamless cooperation between applications and also between different platforms. NetWeaver supports the traditional ABAP and the J2EE platforms.
- The *process integration* layer aims at processes supporting work spanning applications and companies. Its main task is to provide an integration broker that delivers messages between applications.
- The *information integration* layer combines information independently of its source and structure. It contains all tasks that aggregate or consolidate data.

[6] However, the product status of these templates is unclear. They are usually provided without warranty and standard maintenance.

- The *people integration* layer is responsible for integrating all applications and information within a single portal visible to users. It enables collaboration between users and allows multi-channel access to enterprise data and applications.

Technically, the NetWeaver product family consists of six separate *software components*:

- The *Web Application Server (Web AS)* provides the application integration by abstracting from the operating system and database. Consequently, it is the basis of all other NetWeaver products.
- The *Exchange Infrastructure (XI)* is a messaging infrastructure that provides a central hub for communication between individual enterprise services. It also provides services for process orchestration, including third party applications. Thus, it offers the key facilities for the process integration layer.
- The *Master Data Management (MDM)* is a product for data unification and consolidation. By recognizing and reconciling duplicate data, it offers a foundation for information integration.
- The *Business Intelligence (BI)* is a system to create reports and analyses by combining existing data. It offers advanced functionality for the information integration layer.
- The *Enterprise Portal (EP)* offers portal functionality to integrate multiple applications in a single Web-based front-end. It includes also components to support collaboration between users and knowledge management. It is at the heart of the people integration layer.
- The *Mobile Infrastructure (MI)* offers facilities to connect mobile terminals such as PDAs or mobile computers to an enterprise IT system, providing the multi-channel access facility of the people integration layer.

Realistically, the general architecture of NetWeaver is a moving target.

- SAP is still working on the integration of previously separate components such as Business Warehouse or Master Data Management.
- Some components consist of multiple applications (e.g. Integration Broker is assembled from Integration Engine and Adapter Engine).

- Several additional applications such as the System Landscape Directory are necessary for a runtime system.

Thus, NetWeaver's simple conceptual architecture is an idealization[7].

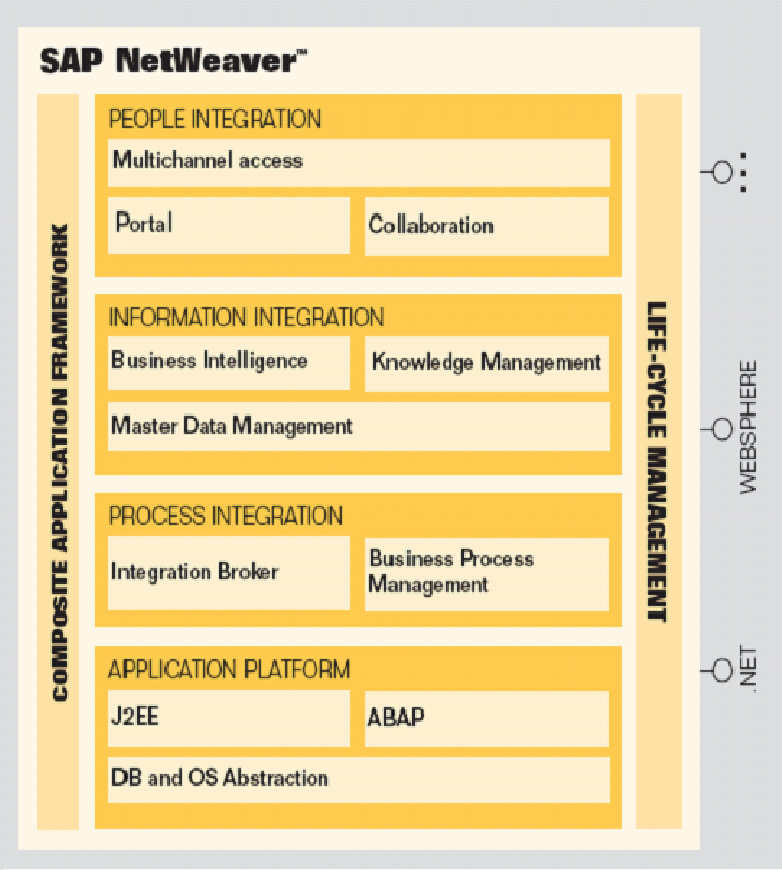


Figure 4: SAP NetWeaver conceptual components and layers

Source: SAP

Usage Types

With the release of NetWeaver 2004s, SAP shifted its view on NetWeaver from technical components to usage scenarios[8]. Instead of letting the users figure out which components depend on each other, the usage types give clear hints to the installation and administration of a several interoperating NetWeaver components. The current types are as follows:

- *Application Server ABAP (AS ABAP)*, which is the NetWeaver AS ABAP Stack.

[7] SAP tries to present its J2EE application server as a deeply integrated and thus irreplaceable part of the NetWeaver architecture. In reality, it could probably be replaced by any J2EE server with moderate effort.

[8] There is an interesting blog at https://weblogs.sdn.sap.com/pub/wlg/2940 about the shift from components to usage types.

- *Application Server Java (AS JAVA),* which is the NetWeaver AS Java Stack.
- *Enterprise Portal (EP)* contains the *Java Stack, Portal, Knowledge Management, Collaboration, Guided Procedures* (for model-based development of custom workflows) and *Universal Work list* (integrating notification mechanisms of the tools just mentioned).
- *Business Intelligence (BI)* packages the 2004s BI release. It contains *NetWeaver AS ABAP (& Java), Portal,* and *BI.*
- *Mobile Infrastructure (MI)* contains the *NetWeaver AS ABAP & Java* (configured for data exchange with mobile devices), the SAP Mobile Infrastructure Client and Software Deployment Manager.
- *Process Integration (PI)* covers XI and associated tools. It consists of the *System Landscape Directory (SLD),* the *Integration Builder,* the *Business Process Engine,* the *Integration Engine* and the *Adapter Engine.*
- *Development Infrastructure (DI)* contains all tools necessary for the SAP build process. It consists of the *NetWeaver Developer Studio,* the *Component Build Service (CBS),* the *Design Time Repository (DTR),* the *Change Management System (CMS)* and the *System Landscape Directory (SLD).*

SAP MDM is still missing from this new terminology. We expect it to reappear once SAP sorts out its future MDM strategy.

SAP's Ecosystem Support

Looking at NetWeaver, it becomes clear that the key beneficiary of the NetWeaver ecosystem is SAP itself – for the first time, a clear architecture allows to combine the vast amount of rather independent SAP applications (such as CRM, SCM, BW and EP). However, NetWeaver puts SAP into a new role as infrastructure provider. SAP has to supply infrastructure support for partner applications as well as for its own.

Currently, there are four main sources of information for NetWeaver developers:

- *SAP PRESS* offers various publications ([Kar2005], [Kes2005], [Stu2005]) giving overviews of NetWeaver components. Yet, these publications give a high-level business perspective and are not very helpful for developers.
- The *SAP Developer Network (SDN)*[9] is a community website hosted and controlled by SAP. After registration, anyone can set up a web log, take part in forum discussions or submit technical documentation and code examples. Although the submission process contains a review by SDN staff, SAP takes no liability for correctness. This makes it hard for SDN readers to determine the quality of a specific document at hand. Moreover, well-structured information is hard to find, and usable technical documentation about NetWeaver development has been added only recently with the release of NetWeaver 2004s[10]. The SDN offers also the opportunity to download free trial versions of some NetWeaver components. However, it appears to be impossible to get XI or MDM without further inquiry.
- The *SAP Help Portal*[11] has online documentation of all SAP products. The focus of the Help Portal is on administration of NetWeaver based systems rather than on development of new applications.
- The *SAP Service Marketplace* integrates several portals for collaboration between SAP customers and official service partners. It is only accessible after registration, and limited to customers and partner companies, not for prospective developers.

Developer support still follows the strategies suitable for SAP itself as an application provider, and is not yet adequate for an infrastructure provider. SAP has to give up this biased view to become successful in the infrastructure market. In summary, SAP needs to address these shortcomings.

As the NetWeaver ecosystem is young, SAP's is focusing on acquiring as many partners as possible. This is underlined by the "Powered by SAP NetWeaver" partner program, which has given free certification to ISVs for some time. As of now, the ecosystem's value is still rather limited – there are a large number of certified partners, but the significance of

[9] https://sdn.sap.com
[10] https://www.sdn.sap.com/irj/sdn/devguide2004s
[11] http://help.sap.com

certification is unclear. We expect SAP to need much time to consolidate its NetWeaver ecosystem.

3.2 WebSphere Overview

The WebSphere product family [Sad2005] is at the center of IBM's "On Demand" Business strategy. Being a major player in the enterprise services market, IBM has a vital interest in innovations that foster the use of enterprise applications. Unlike NetWeaver, WebSphere does not aim at integrating a specific set of applications. Instead, it was designed from start as a general-purpose infrastructural abstraction and integration layer to hardware, databases, existing ERP systems and other enterprise applications.

WebSphere's Role within IBM's Product Portfolio

IBM aims at providing benefits to its customers by integrated solutions, marketed via a so-called *Business Integration Reference Architecture (BIRA)*[Gav2004]. As can be seen in Figure 5, the WebSphere product line is at the heart of IBM's integration efforts.

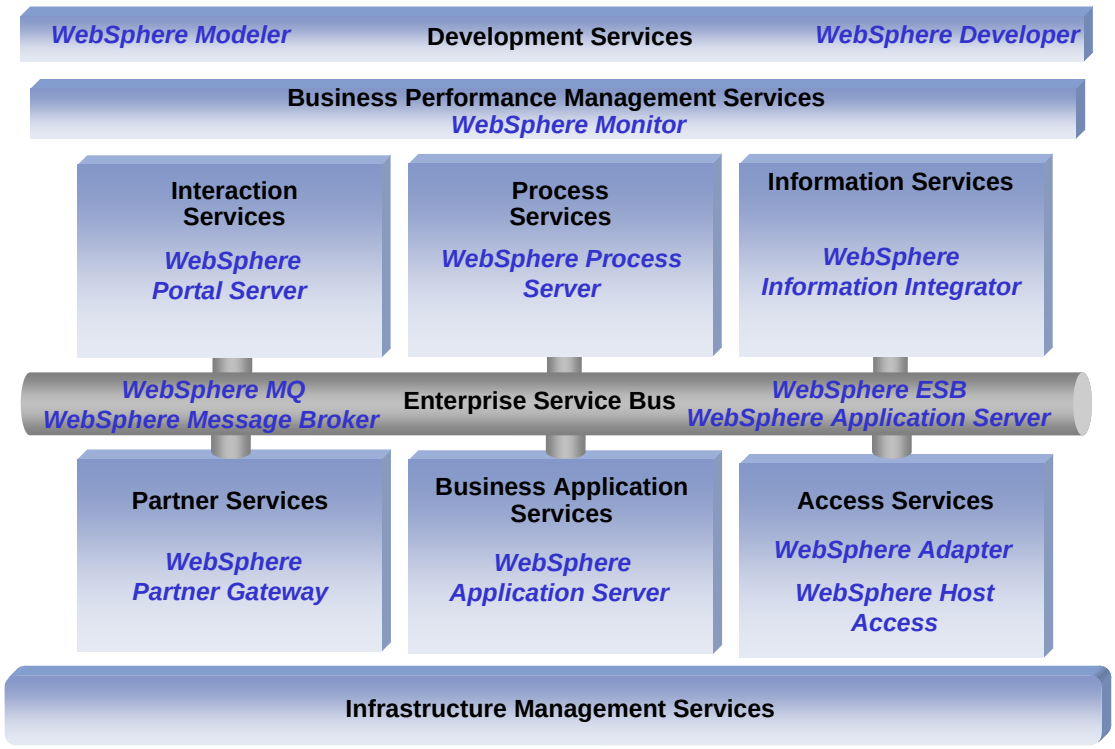


Figure 5: Product Mapping for IBM Business Integration Reference Architecture

Source: IBM

We will show below (Figure 7) that essentially all functionality of NetWeaver can be mapped to corresponding WebSphere components. Additionally, WebSphere contains

tools for process management and for runtime system monitoring and managing. Here, SAP relies on IDS Scheer's ARIS process modeler and its existing Solution Manager.

IBM's Vision: On Demand Business

Similar to SAP, IBM's marketing created a holistic vision to communicate the business possibilities emerging from its technology offerings. As defined by Sam Palmisano, IBM's CEO, an On Demand Business is "An enterprise whose business processes - integrated end-to-end across the company and with key partners, suppliers and customers - can respond with speed to any customer demand, market opportunity or external threat."[12]

Similarly to SAP, IBM's vision is heavily marketing-driven, too. Customers should take the vendor messages "with a grain of salt" and make up their own minds.

WebSphere's Architecture

In contrast to SAP, IBM does not promote a unified view onto all WebSphere product family members, although IBM's reference architecture is very similar to NetWeaver's. Instead, most products comply with open standards. This allows – at least theoretically – combining WebSphere with other standards-compliant products to create a custom best-of-breed platform for enterprise IT systems.

The WebSphere product family can be divided roughly into three areas:

- A SOA creates the technical foundation for more advanced applications.
- Applications make use of this infrastructure to offer advanced functionality for enterprise applications.
- Development and monitoring tools are used for the creation and runtime survey of applications based on the WebSphere infrastructure and applications.

Within the infrastructure area, WebSphere consists of two products that are available in multiple editions:

- The *Application Server* offers a scalable infrastructure for Web applications following the J2EE standard.

[12] http://www-5.ibm.com/e-business/za/about_ondemand/def.html

- The Enterprise Service Bus (*ESB)* is based on the application server and fits standard SOA integration needs based on XML messaging. The *Advanced ESB* (marketed as Message Broker) is based on the proven *MQ* messaging system and targets extended integration with very high performance and data transformation requirements.

These components are complemented by the following integration applications leveraging the core infrastructure:

- The *Process Server* builds on the application server and ESB to provide a runtime environment for business processes. Graphical tools such as the *Integration Developer* and *Business Modeler* allow both domain and technical experts to define, manage and execute business processes.
- Several products (the *Business Integration Adapters and Toolsets*, *Host Access*, *Partner Gateway*) support the integration of data from 3rd party applications both for administrative and development staff and of data from business partner.
- With the *Information Integrator*, federated queries from multiple enterprise databases become possible. The product does not keep its own data base and offers views on virtual databases aggregating multiple real databases.
- The *Portal for Multiplatforms* provides a single point of access to all kinds of applications in a corporate IT infrastructure. It also supports collaboration between people and allows for the integration of mobile devices. It has recently been improved by addition of Bowstreet Portlet factory to reduce development time and re-use of Portlets and improve integration with SAP.
- The *Product Center, Customer Center and Data Stage* are a set of products for master data management and integration.
- The *MQ Workflow* automates people-centric business processes. Most of its functionality is now handled by the process server.
- *Commerce* bundles functionality necessary for setting up e-commerce sites, both in B2B and B2C scenarios.

For developing custom applications and monitoring actual systems, IBM also has a range of products:

- The IBM software development platform consists of integrated tools and a set of development processes for designing and developing applications. Tool-based modeling support is emphasized. Development tools are provided from IBM's Rational software division.
- The *Business Modeler* allows the documentation of "As is" processes, graphical simulation and optimization of business processes.
- The *Business Monitor* offers real-time monitoring of processes supported by the Process Server system. It is accompanied by some members of the Tivoli product family that targets monitoring IT equipment. It can be integrated with Business Modeler to track key performance indicators.

Some products from IBM's DB2 software division complement WebSphere's functionality in the business intelligence sector. *DB2 Data Warehouse Edition* bundles them with the core DB2 database that is also a common basis for existing SAP ERP systems.

- *DB2 Cube Views* creates multidimensional datasets as a basis for analytical processing.
- *DB2 AlphaBlox* is a J2EE application framework that allows the creation of Web-based analytic applications that aggregate multiple and diverse enterprise data sources.

IBM recently followed market wishes for a clear picture of the complex infrastructure structure by branding essentially its entire middleware portfolio under the common WebSphere label. We expect IBM to further reduce the complexity by tightening the technical integration of these products.

IBM's Ecosystem Support

In contrast to SAP, IBM has fully realized that excellent developer support is a key to a large and lively ecosystem.

With IBM developerWorks[13], it offers a single portal to its developer resources similar to SDN. However, users are not required to register with developerWorks. The site is very

[13] http://www.ibm.com/developerworks

well structured and offers a wealth of information. Most information consists of official IBM documents that are of excellent technical quality. In particular, the Redbooks and Redpapers series give very detailed insight to all available WebSphere components.

The developerWorks website also offers free trial versions of most WebSphere products (260 different versions are listed, with the notable exception of all Master Data Management products), including some free online support. These versions allow thorough investigation of every WebSphere component before making an actual platform decision. It becomes also possible for prospective developers to gain expertise, eventually leading to a broader range of implementation partners for IBM WebSphere customers.

Additionally, IBM is supporting open source developments of basic technologies necessary for running enterprise IT infrastructure software. IBM primarily supports the Linux operating system and the Eclipse development environment platform, but is also active in multiple other open source projects. These efforts show the strong commitment of IBM to creating a large developer ecosystem.

In summary, IBM can be regarded as a role model for treating developers. In contrast to SAP, IBM is focusing on supporting its customers in finding best-of-breed solutions for enterprise IT challenges. The ecosystem provided by IBM not only helps IBM itself, but also the whole enterprise IT market.

3.3 Alternatives

Several alternatives exist to NetWeaver and WebSphere. Here we give a brief list.

J2EE-Compliant Application Servers

Today, thirteen officially certified implementations of the J2EE 1.4 standard exist[14]. Among them are several heavy-weight commercial ones from for example BEA, Oracle and Sun. There are even three 1.4-certified open-source implementations, from Apache, JBoss and ObjectWeb. Interestingly, NetWeaver AS is only J2EE 1.3-certified. It is surprising that SAP, given its enormous resources, is unwilling or unable to keep up.

[14] See: http://java.sun.com/j2ee/compatibility.html

The Competition: .NET

The .NET Framework is Microsoft's answer to J2EE. Currently, the full feature set of .NET is bound to Windows, whilst J2EE runs on any platform with a Java Virtual Machine.[15] However, Microsoft has released core parts of .NET, among them the C# programming language and the Common Language Infrastructure (CLI) virtual machine, as Ecma standards. The Mono project[16] aims at providing a true cross-platform development and runtime environment for .NET based on these standards.

[15] For a good conceptual overview of both frameworks and their suitability for Web Services, see [Vaw2001]. Multiple efforts have been made to integrate both enterprise infrastructure worlds. In 2004, SAP and Microsoft presented a roadmap to integrate NetWeaver and .NET (https://www.sdn.sap.com/irj/sdn/developerareas/dotnet), with interoperability ranging from the Web services level to integration of SAP content into Microsoft Office with a product called Mendocino (http://www.sap.com/solutions/mendocino/index.epx). IBM and Microsoft are both working on interoperability on the Web Service level (http://www.redbooks.ibm.com/abstracts/sg246395.html?Open and http://msdn.microsoft.com/vstudio/java/interop/websphereinterop/default.aspx).

[16] http://www.mono-project.com

4 High-Level Comparison

SAP tries to extend its scope from pure ERP systems to enterprise middleware. In this infrastructural market, IBM has been a major player for a long time, with a strong focus on the J2EE world. As ERP systems and middleware infrastructure are quite distinct domains with also quite distinct language, this chapter aims at giving a high-level view and comparison of NetWeaver and WebSphere. Additionally, we will define direct matches between individual components of both product families.

4.1 General Architecture – Layering versus Loose Coupling

As detailed before, SAP offers a unified view on all NetWeaver components. A clear separation in four layers building on top of each other gives a nice and simple structure. In contrast to that, the general architecture of IBM WebSphere is harder to understand. There is no clear layered approach, some components build on top of others, other components are rather independent.

Within SAP's vision of the NetWeaver architecture, NetWeaver AS is the basis of every single component. This makes a conceptually clear picture, but creates a strong dependency of the whole NetWeaver product family on a single component. If NetWeaver AS has problems, the whole NetWeaver stack will have problems. Similarly, every component except NetWeaver AS is based on SAP XI for communication facilities. Again, the concept is clear, but the strong dependency is dangerous: as all communication is relying on XI, this component may become a central bottleneck and a single point of failure. Also, a runtime NetWeaver system is not as simple as the conceptual architecture suggests – each NetWeaver Usage Type involves several interoperating software components.

IBM's peer-to-peer architectural approach, in contrast, is much more open, heterogeneous and complex. There is no strict layering, and consequently much fewer dependencies between components. There are much more possibilities to arrange components and direct communication shortcuts to match a company's current integration situation. After a rather steep learning curve, the flexibility of this loosely coupled components approach is much higher. Figure 6 visualizes the runtime benefit of a loosely coupled architectural approach.

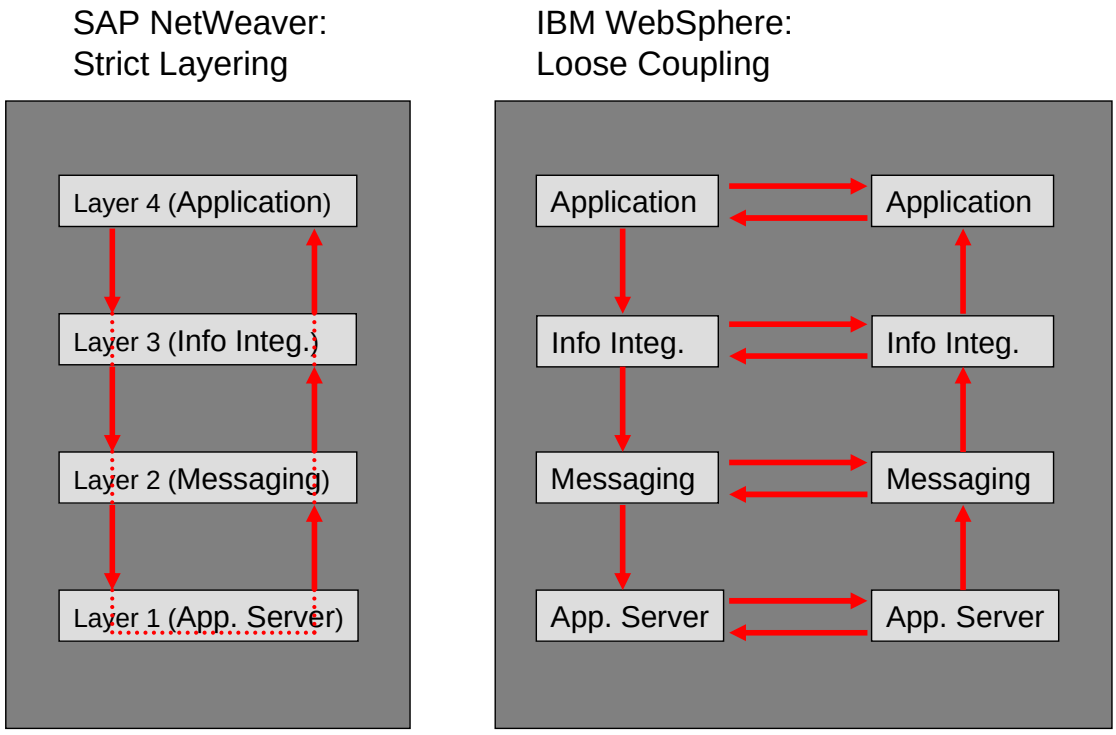


Figure 6: Comparison of the high-level communication architecture

Source: SPI

If we look at the effects of these general architectures on the key requirements for enterprise IT architectures, it becomes clear that loose coupling is a better approach. The strict layering of the NetWeaver approach leads to a scalability issue: all communication is forced through the single hub of SAP XI.

4.2 Components Side by Side

Building on the brief discussion of NetWeaver and WebSphere components in chapter 3, this section discusses which components correspond to each other. Figure 7 gives a high-level overview of the correspondences.

We distinguish primary and secondary components:

- Primary components are heavyweight, more important and/or may have more users and customers. They are the core of the middleware infrastructure.
- Secondary components are lighter, more specialized and/or may have fewer users and customers. They enhance the core infrastructure with high-level building blocks for specific applications.

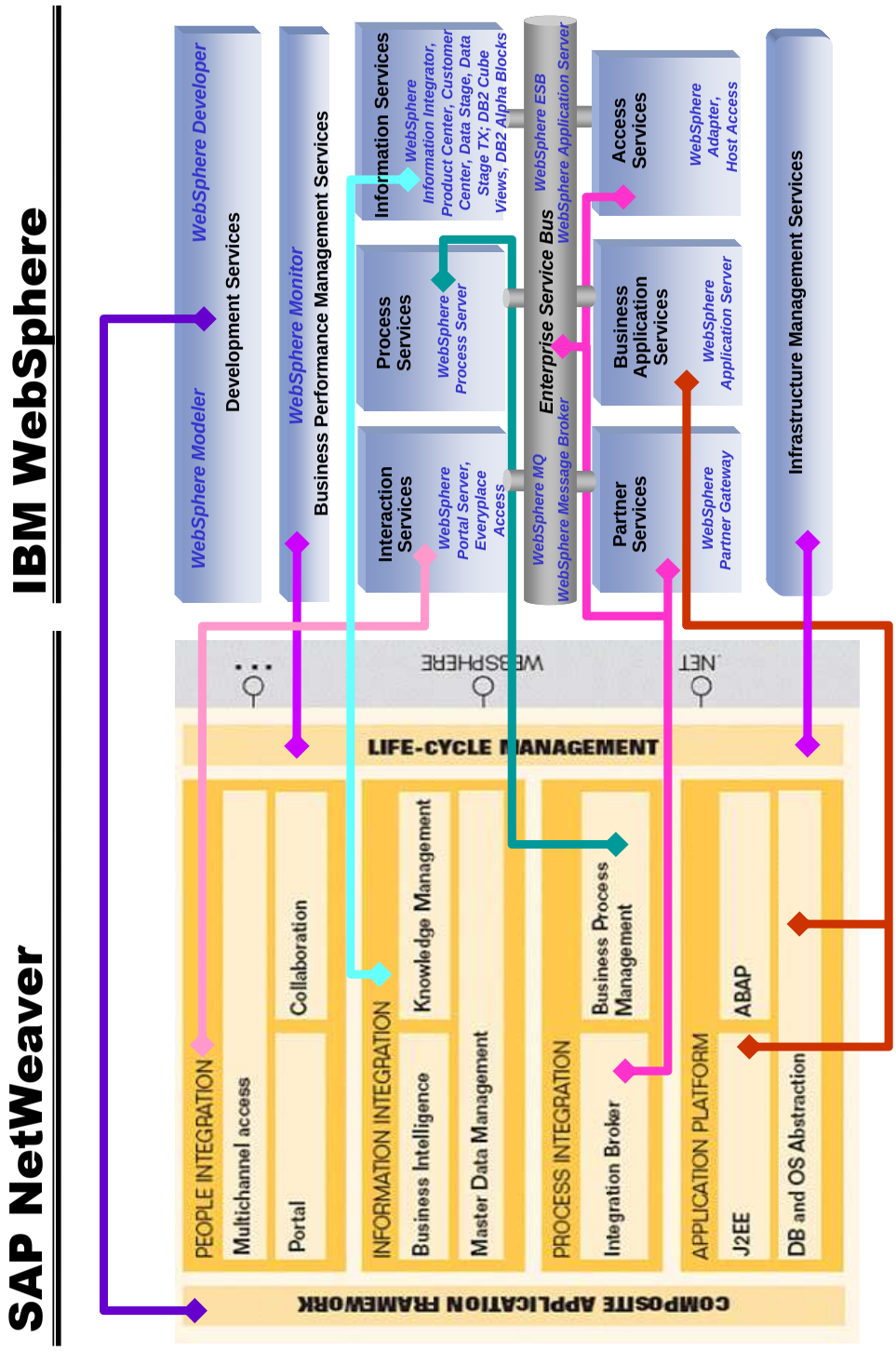


Figure 7: Corresponding components of SAP NetWeaver and IBM WebSphere.

Source: SPI

Note that the overall scope of all mentioned WebSphere products within the areas of Information and Interaction Services is beyond the scope of the corresponding NetWeaver components. Whenever we associate NetWeaver layers and WebSphere building blocks instead of components or products, no 100% product-level correspondence exists; instead, combinations of respective tools match each other.

Primary Components

- NetWeaver AS has an equivalent in WebSphere Application Server. In contrast to WebSphere, NetWeaver's application server not only supports J2EE, but also ABAP. Thus, it not only takes the role of the central middleware infrastructure component, but also that of the runtime infrastructure for existing SAP ERP systems. WebSphere's application server is a pure J2EE server. Existing SAP ERP systems have to be integrated via J2EE adapters.
- SAP XI corresponds to WebSphere ESB, WebSphere Message Broker and partially to WebSphere Process Server as a messaging and queuing platform. WebSphere Adapters handle necessary transformations to integrate third party applications. Adapters exist for applications, messaging frameworks (such as XI), mainframes (WebSphere Host Access), and also for basic communication technologies such as TCP/IP or CORBA.
- SAP Enterprise Portal is matched by IBM WebSphere Portal for Multiplatforms. WebSphere's Portal Extend edition also includes advanced collaboration features only partially available in SAP EP.

Component	SAP	IBM	Open Source Alternative
J2EE application server	SAP NetWeaver AS	WebSphere Application Server ND & XS	e.g. Apache Geronimo[17], JBoss
Portal	SAP Enterprise Portal	WebSphere Portal	e.g. LifeRay, eXoplatform
Messaging and Queuing Platform	SAP XI	WebSphere ESB/Message Broker, WebSphere Process Server	e.g. ActiveMQ

Figure 8: Primary SAP, IBM and OSS Components

Source: SPI

Technically, all these components should be freely interchangeable. There is no intrinsic technical reason which would prevent e.g. WebSphere portal and ActiveMQ to be deployed on NetWeaver AS or Web Dynpro applications be deployed on WebSphere Application Server. Yet, reality is different. The products just mentioned all rely on some

[17] Also marketed and supported by IBM as "WebSphere Application Server Community Edition"

proprietary extensions of infrastructure components to the J2EE standard that prevent them from running on some competing infrastructure.

Secondary Components

- SAP Master Data Management has a rather broad scope, with emphasis on SAP environments. IBM is taking a more specialized approach and offers a number of integrated products for master data management [IBM2005b]: WebSphere Product Center (handling primarily catalog data), WebSphere Customer Center (for customer data integration), WebSphere DataStage (recently acquired from Ascential, focuses on master data integration, transformation and cleansing rather than management) and WebSphere Information Integrator (for data transformation and integration).
- SAP Business Intelligence is essentially a repackaged version of SAP Business Warehouse. As such, it is not yet fully integrated into the NetWeaver stack. IBM offers Business Intelligence functionality via WebSphere Information Integrator, DB2 Cube Views and DB2 AlphaBlox. However, in contrast to SAP, IBM as a pure infrastructure provider focuses on frameworks for building analytic applications and not on predefined query templates.
- SAP Mobile Infrastructure is matched by the IBM WebSphere Everyplace Access product family. In particular, WebSphere Everyplace Mobile Portal Enable allows mobile access to portals created with IBM WebSphere Portal.
- SAP's development environment consists of NetWeaver Development Studio for creating Java-based applications, SAP Integration Builder for creating XI-based message flows and the SAP Visual Composer for facilitated model-based creation of Web Dynpros and of iViews for Enterprise Portal. The corresponding IBM products are IBM Rational Application Developer for WebSphere (for general UML modeling and Java development tasks), WebSphere Business Modeler and WebSphere Integration Developer (focusing on the creation of processes for Process Server and ESB). In contrast to SAP, all IBM tools integrate into a single Eclipse-based IDE and therefore look like a single tool.

Component	SAP	IBM	Open Source Alternative
Master Data Management[18]	SAP MDM	WebSphere Product Center, WebSphere Customer Center, WebSphere Data Stage, WebSphere Information Integrator	N/A
Business Intelligence	SAP Business Intelligence	WebSphere Information Integrator	Pentaho[19], Eclipse BIRT[20]
Mobile Infrastructure	SAP Mobile Infrastructure	WebSphere Everyplace Mobile Portal Enable	Funambol[21]
Development Environment	SAP NetWeaver Studio	Rational Application Developer for WebSphere, WebSphere Business Modeler, WebSphere Integration Developer	Eclipse

Figure 9: Secondary SAP, IBM and OSS Components

Source: SPI

The correspondence chart repeats the findings from the general architecture comparison: SAP provides a clear, unified view on its products. Yet, this clear view is accompanied by restricted choice for the customers and fewer options to exchange individual parts. Also, a NetWeaver runtime system is far more complex than suggested by the clear conceptual architecture. The discussion of usage types above shows that most NetWeaver functionality requires multiple applications to be combined, which frequently include software from SAP's OEM partners[22].

In contrast, IBM has a much more componentized product portfolio. For every particular need, an individual product exists that can be integrated with other products by several glue mechanisms. This architecture gives customers a much higher degree of freedom, but makes it somewhat more difficult to get a clear picture of the overall system.

From the SOA point of view, IBM's way of assembling products is much more service oriented than SAP's - SAP follows a monolithic take-all-or-nothing strategy, whilst IBM gives its customers the choice to assemble their own product portfolio.

[18] Successful MDM is a very hard organizational problem, which can only be supported, but not at all solved, with a software product.
[19] http://www.pentaho.org/

[20] http://www.eclipse.org/birt

[21] http://www.funambol.com/

[22] For example, from companies like Seeburger, IDS Scheer and Wily.

4.3 Conclusions

Contrary to SAP's marketing messages, NetWeaver is by no means a unique product, when it comes to general middleware qualities. The only unique area is, by design, the support for SAP's legacy environment. Otherwise, every NetWeaver component has an equivalent of equal or, in many areas such as the application server or the messaging system, better functionality and maturity in IBM's WebSphere stack.

NetWeaver's unique selling proposition is its integration of the ABAP stack into the application server NetWeaver AS. This allows for integration of existing SAP applications into the new world of SOA within the application ecosystem of a single vendor (SAP itself). Although existing SAP systems are very important in modern IT infrastructures, this integration capability should not dominate infrastructural decisions. Like all full-blown J2EE systems, IBM also offers an SAP adapter for the WebSphere product line[23]. In addition, SAP does not have a tight integration between its J2EE and ABAP worlds. Both stacks of NetWeaver AS do not even share a common database. As such, costly interprocess communication via XI, iDoc or JCo is necessary. The NetWeaver AS Java Stack therefore does not offer a performance gain compared to another vendor's J2EE stack. Decisions should be based on an overall comparison of the individual products necessary to fulfill the given requirements, not on a seemingly simple integration of existing SAP applications.

[23] http://www-306.ibm.com/software/integration/wbiadapters/mysap/

5 Detailed Comparison

Based on a survey of relevant literature and web sites ([Dav2005], [IBM2005b], [Kar2005], [MVi2005], [Rad2005], [Sad2005], [SAP2005b], [Stu2005], [Wan2003]), this chapter gives detailed comparisons between individual NetWeaver components and the corresponding products from the WebSphere product family. For each product category, we identify relevant assessment criteria and compare SAP's and IBM's offerings.

5.1 Application Server

Application servers are at the heart of both SAP's and IBM's enterprise infrastructure products. IBM is focusing on a pure J2EE application server; most of SAP's products depend on both its ABAP and J2EE application servers. In this section, we compare essential properties of the J2EE servers influencing the fulfillment of the key requirements for enterprise IT architectures above.

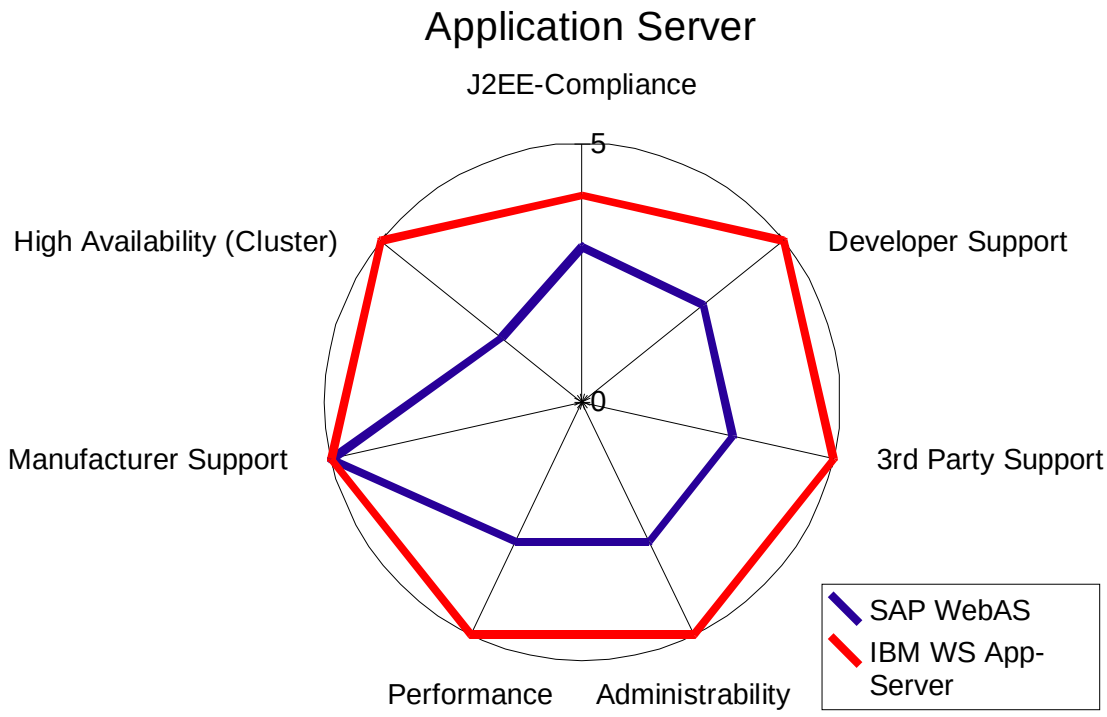


Figure 10: Comparison Chart of J2EE Application Servers. Higher values are better.

Source: SPI

Standards Compliance

Both servers adhere to the J2EE standard, albeit NetWeaver AS currently supports only J2EE 1.3 whilst WebSphere's application server is J2EE 1.4 certified. The key enhancements of J2EE 1.4 compared to its predecessor J2EE 1.3 are as follows:

- Support for Web services is assured by JAX-RPC 1.1 (the *Java API for XML Remote Procedure Call* for interoperability with Web services based on SOAP, the *Simple Object Access Protocol*, and WSDL, the *Web Services Description Language*), the Web services for J2EE specification JSR 921 (defining deployment requirements) and WS I – Basic Profile 1.0, a standard targeted at Web services platform interoperability. Thus, J2EE 1.4 enhances the suitability of a J2EE implementation for a Web-based SOA scenario with service interaction using Web services. Of these enhancements, NetWeaver only supports WS-I Basic Profile. Thus, WebSphere offers a more standard compliant way to deploy Web services and to access remote Web services. This makes it easier to interface to other standards compliant Web services and also keeps WebSphere customers an option to protect their investment in developing new services even if they decided at a later stage to move to another application server vendor.
- Runtime and deployment support of J2EE applications is assured by the J2EE Management 1.0 API (using Java Management Extensions API – JMX) and the J2EE Deployment 1.1 API. These APIs make sure that third party best-of-breed monitoring and development tools can be used to create and run applications on the servers. SAP provides its own proprietary means of deploying J2EE applications on NetWeaver AS, the *Software Deployment Manager* (SDM). Although this methodology is consistent with software lifecycle support in a SAP ABAP environment, it locks customers into proprietary technology that will be hard to get rid of. Also, SAP customers do not have a choice for the monitoring tools used in a heterogeneous runtime infrastructure that consists both of SAP and non-SAP components – they are forced into a proprietary SAP solution.

ABAP Support

The biggest difference from a functional point of view is NetWeaver's ABAP stack. It allows using a single application server hosting both J2EE- or ABAP-based Web services

and traditional ABAP ERP applications. However, the ABAP and J2EE worlds are too distinct to be really integrated. The two stacks of NetWeaver AS have to access different databases, as the transaction model of ABAP and J2EE is different (see footnote 15). Thus, the "two-stack" NetWeaver AS is essentially consisting of two distinct application servers that offer simplified JCo (SAP Java Connector) communication facilities between them. In a typical SAP ERP system, multiple NetWeaver AS instances are deployed. As such, the advantage of being able to use a single application server instance for all tasks is of a more theoretical nature.

Benchmark Results

Contrary to standard practice, SAP has not published any benchmark results on NetWeaver and is prohibiting benchmark publication by third parties. In contrast, SPEC benchmarks are readily available for BEA WebLogic, IBM WebSphere and Oracle AS 10g[24]. Among these, WebSphere application server ranked first in a study by the Edison Group[25].

The level of maturity indicated by the number of active users and number of years of development leads us to expect WebSphere's application server to be much better performing than the Java stack of NetWeaver AS.

The lack of NetWeaver benchmark results makes it more difficult to plan the hardware needs of NetWeaver-based applications.

Clustering Support

For a central component such as the application server, scalability and availability is a key requirement. Sooner or later, a single server will not be capable of either handling the whole messaging load or the high availability requirements of a large company. Thus, a clustering solution becomes necessary. Clustering can be done on the hardware or on the software level. On the hardware level, a virtual computer is assembled out of many underlying hardware boxes. On the software level, the application itself is tailored to be distributed over many hosts. Obviously, software clustering has a much higher potential for efficiency, as particular properties of a specific application can be used to parallelize tasks on multiple hosts.

[24] http://www.spec.org/jAppServer2004/results/jAppServer2004.html
[25] http://www.theedison.com/index.php/articles/82

Both application servers have clustering support. In NetWeaver AS, a star topology around a central messaging and locking component is implemented, following the traditional and proven ABAP application server clustering [SAP2005b]. The clustering system is extremely database centric. In our opinion, this does not well reflect the new requirements arising from service oriented architectures, with decentralized information processing and storage. The structure is easy to understand, but introduces several single points of failure:

- *A centralized messaging component* for small messages between cluster members. SAP claims that by restarting the lightweight messaging component, this single point of failure is virtually nonexistent. Yet, we consider even small outages during messaging restart to be harmful to mission critical environments.
- *A locking server* (called enqueue server) provides locking facilities to database items under work. SAP can only assure high availability of this component by physical replication of the enqueue server, necessitating an additional server.
- *A central database*. SAP relies on database vendors to provide reliability and scalability features for the persistency layer.

Although SAP is addressing all potential single points of failure, high extra effort becomes necessary. Multiple redundant servers have to be set up to assure both high availability and scalability in productive environments.

The clustering support has been tested by SAP with up to 50 machines with standard applications deployed [SAP2005b]. Yet, SAP does not make any statements about performance gains by clustering or about behavior under average application server load situations. The authors claim that “It is believed that if a productive system is capable of scaling more than 40 elements, this means it has practically unlimited scalability.” ([SAP2005b], p. 5). We do not follow this vague argumentation and strongly doubt the clustering performance of NetWeaver AS until proven otherwise by SAP.

The WebSphere product line has a strong standing in clustering support. Multiple products support clustering and fail over mechanisms on different levels, such as connection to the public Internet (WebSphere Edge Server), the HTTP Server, the EJB Container (WebSphere application server), and the database access layer [Wan2003]. The impression

of excellent clustering support of WebSphere is also supported by a comparative review article from Network Computing [MVi2005].

Database Integration

For database integration, both products provide the standardized JDBC (Java Database Connectivity) access layer and offer JDO (Java Data Objects) as an alternative. Yet, SAP discourages its customers from using these standard technologies and promotes a combination of the SAP-proprietary Open JDBC and Java Dictionary technologies ([Kes2005], chapter 4). The development environment for NetWeaver AS exclusively supports this technology, leading to a high probability of vendor lock-in if J2EE applications are developed for NetWeaver AS.

Operating System Support

NetWeaver AS is available for Microsoft Windows, Linux, IBM iSeries and UNIX platforms. WebSphere's application server is available on a multitude of platforms, from Windows to several UNIX platforms and to IBM's iSeries and z/OS platforms. Also, NetWeaver AS Java is available in a single configuration only, whilst WebSphere offers its application server in multiple packages, ranging from the express edition for small businesses to the Extended Deployment edition for advanced clustering.

Summary

In summary, NetWeaver AS complies with J2EE 1.3, but does not offer any advanced technology from the J2EE point of view. Its main advantage is its proprietary ABAP stack. WebSphere's application server supports J2EE 1.4, and offers superior performance, scalability and standards compliance compared to NetWeaver AS. Several awards won by WebSphere application server[26] show that it is also a best-of-breed product in the pure J2EE application server market. NetWeaver AS is suited for companies that almost exclusively use SAP ERP systems and want to develop very few J2EE based Web services. As soon as serious use of J2EE is required, WebSphere's application server is by far superior.

[26] http://www-306.ibm.com/software/info1/websphere/index.jsp?tab=awards/index

5.2 Messaging Infrastructure and Process Management

After the application server, the messaging infrastructure is the second most important component of each enterprise middleware. Its primary task is to route messages between the individual components involved, transparently performing all necessary transformation steps and network communication. It should be obvious that the messaging infrastructure is likely to become a bottleneck, as all information within the system and to and from external systems involves the messaging system.

The messaging infrastructure is the central communication facility required for SOA applications. It is of utmost importance to business processes mapped onto SOA applications. Processes are assembled via messages between process steps. Thus, business process management is tightly coupled with the messaging system. SAP XI contains both the messaging infrastructure and the process management functionalities; IBM WebSphere separates these technically distinct areas into ESB or Message Broker for messaging and Process Server for process management.

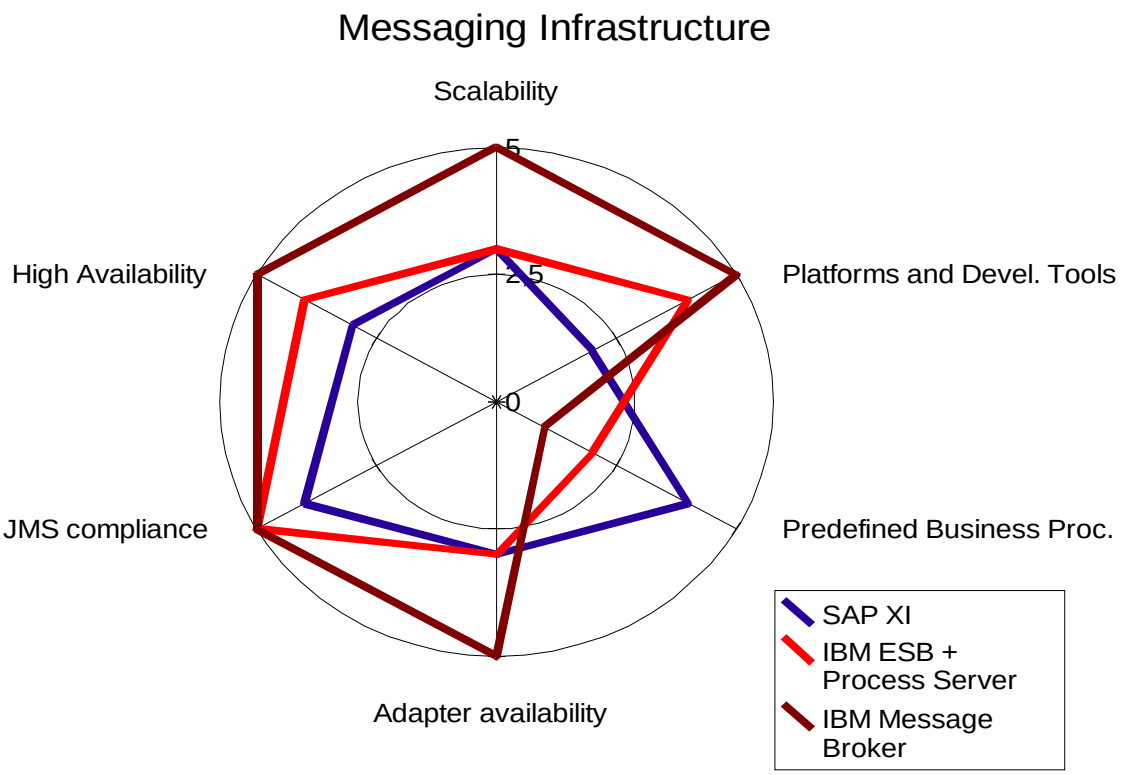


Figure 11: Comparison Chart of Messaging Infrastructure. Higher values are better.

Source: SPI

High-Level Messaging Architecture

The high-level messaging architectures of SAP XI and WebSphere ESB are rather different from WebSphere Message Broker's architecture. XI and ESB focus on a single central component that routes all messages within a system [Stu2005]. Both XI and ESB rely on an underlying application server and use its clustering capabilities for scalability and high availability. In contrast, Message Broker is independent of application servers and has a much more decentralized approach, with multiple message queues distributed over the network [IBM2005a].

Java Message Services (JMS) Support

Java Message Services (JMS) is a standard J2EE API that allows distributed components to create, send, receive and read messages. It enables asynchronous, reliable communication in distributed applications. A *JMS Provider* is a messaging system implementing the JMS API, consequently allowing client programs written in Java to send messages via JMS. JMS is by far the most important standard for messaging systems in the J2EE world.

WebSphere ESB and WebSphere Message Broker can act as JMS providers and thus interoperate with other standard-based messaging system. Yet, SAP XI requires an adapter for JMS, whilst WebSphere ESB and Message Broker are native JMS providers. Hence, we expect the JMS performance of the WebSphere products to be higher than that of XI.

NetWeaver AS is a JMS provider of its own, as JMS is a part of the J2EE 1.3 standard. Consequently, SAP is maintaining two distinct messaging systems simultaneously and puts special and unnecessary focus on its proprietary XI system rather than the standard-compliant JMS.

Other Integration Adapters

From a functional point of view, a messaging system's value is defined by its ability to integrate a variety of different applications by suitable protocol adapters.

If the integration need is primarily between existing SAP systems without any intentions to go beyond, XI should be considered. With SAP's own need to employ XI's capabilities for integrating its own applications, we expect XI to become the solution of choice for

messaging between SAP applications. XI supports iDoc and RFC with a proxy concept that does not need additional adapters. A limitation of XI in complex scenarios is its missing support for multi-command transactions due to a missing transactional context for multiple calls[27], leading to complex programming tasks and higher implementation cost. Also, the suitability of XI in RAS scenarios is not yet proven.

If external applications are to be integrated, the number of adapters supported by SAP[28] is significantly lower than that by IBM[29]. In addition, the WebSphere Business Integration Adapter[30] add-ons to WebSphere ESB and WebSphere Message Broker offer advanced SAP connection facilities that allow seamless integration of SAP systems [Dav2005]. They support bidirectional RFC (Remote Function Call to BAPI interfaces) and ALE (Application Link Enabling via IDOC messages) communication with SAP systems. Being independent from an application server, WebSphere Message Broker's base technology WebSphere MQ can also be deployed on a lightweight server without any J2EE infrastructure. This is advantageous for integrating legacy applications.

Clustering Support

The dominant non-functional property of a messaging system is its reliability and scalability, which can only be assured by clustering capabilities. SAP XI and WebSphere ESB offer limited clustering facilities. The major drawback is that there is only a single instance of the central integration engine, potentially becoming a bottleneck. To a limited degree, this situation can be remedied by clustering of the underlying NetWeaver AS instances. Still, the central database, messaging and enqueue servers of NetWeaver AS eventually become a limiting factor. Although its architectural approach is similar to XI, WebSphere ESB has an advantage, as clustering of the WebSphere Application Server is less complicated, involves fewer servers to be replicated, and is more proven than that of NetWeaver AS.

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[27] http://help.sap.com/saphelp_nw04/helpdata/en/6a/3f93404f673028e10000000a1550b0/content.htm (2nd item of constraints list: "Calls are stateless and sessions are not supported. There is no transactional context for more than one call.")

[28] see http://help.sap.com/saphelp_nw04/helpdata/en/0d/5ab43b274a960de10000000a114084/content.htm or [2], page 154 for a detailed list

[29] see http://www.ibm.com/software/integration/wbiadapters/apps/ for an overview

[30] http://www-306.ibm.com/software/integration/wbiadapters/mysap/

IBM WebSphere Message Broker offers an advanced clustering system for remote messaging. It supports setting up multiple message queues on multiple hosts. Message queues can be shared among hosts, leading to a round-robin processing scheme. In addition, WebSphere Message Broker provides mechanisms to avoid remote transmission of messages that can be processed locally. Also, handover in case of failure of individual hosts is handled transparently.

Thus, high requirements for high availability and/or scalability can be fulfilled easily with WebSphere Message Broker. Both SAP XI and WebSphere ESB also allow clustered setups, but rely on a single database for synchronization. The setup of an ESB system is less complex than that of an XI system, as fewer servers have to be clustered.

Predefined Business Processes

With the release of NetWeaver, SAP continues its tight collaboration with IDS Scheer and integrates the ARIS business process modeling tool set into NetWeaver. This integration has the big advantage that many existing predefined business processes can be reused with XI. SAP leverages its domain knowledge and can therefore provide business processes for integrating its own applications such as CRM or R/3.

Being a pure infrastructure platform, WebSphere does not come with any predefined processes. However, WebSphere Process Server supports both the BPEL standard and a state machine approach to processes. As such, definition of custom business processes is simpler than with SAP XI. Also, IDS Scheer and IBM announced a collaboration on importing processes modeled in ARIS into WebSphere Process Server[31]. This integration will allow current SAP customers to reuse their ARIS processes in a WebSphere environment.

Platforms and Development Tools

SAP XI is deployable on Windows, AIX, HP-UX, Solaris, Linux and OS/400 platforms. On z/OS, only High Availability solutions can be deployed. Being a pure J2EE application, WebSphere ESB runs on all platforms supported by WebSphere Application Server. Linux, multiple UNIX platforms, IBM's z/OS, i/OS and Windows are supported.

[31] http://www.ids-scheer.com/international/english/press/74094

WebSphere Message Broker is based on the long standing WebSphere MQ and consequently available on virtually any enterprise platform.

Configuration of XI is handled with the custom SAP Integration Builder. Both WebSphere products rely on WebSphere Integration Builder that is integrated with the Eclipse-based IDE used for application development. Thus, IBM offers an integrated tool chain for developing applications and configurations for the application server and the messaging infrastructure, whilst SAP customers have to use two different tools for these interrelated tasks. We will further discuss the issue of development environments below.

Summary

As with the application server, the messaging infrastructure component of NetWeaver can only be recommended for companies with a strong focus on SAP ERP applications and relaxed RAS requirements. If multiple diverse systems are to be integrated, WebSphere ESB is somewhat and WebSphere Message Broker is by far superior from a functional and performance point of view. If the expected message load is high, XI and ESB users might potentially run into problems due to the centralized architecture with limited scalability. Message Broker's clustering capabilities scale much better. In summary, WebSphere Message Broker offers a much higher degree of reliability, flexibility and scalability than SAP XI. WebSphere ESB is close to XI both in terms of architecture and functionality, but has a more convincing standards-based development and deployment process.

The process management part of XI has the advantage of several predefined processes for SAP ERP systems. WebSphere's Process Server offers a richer modeling capability.

5.3 Portal Server

In large corporate IT setups, employees, partners and B2B or B2C customers have to access a multitude of applications. Portal systems offer a unified Web-based view on all these applications, including facilities such as single sign-on (SSO), search over multiple applications and a unified user interface.

The key requirement for a portal product is the availability of portlets, front-ends for existing applications that snap into a portal's unified presentation. SAP and IBM follow different strategies: SAP has strong support for its proprietary iView technology, IBM is supporting open standards.

iView is a proprietary SAP standard for integrating applications into EP. More than 2000 iViews are currently available, mainly for SAP applications. iViews can be written with the SAP Portal Development Kit (part of NetWeaver Developer Studio) in multiple programming environments (ABAP, .NET, Java). WebSphere Portal can integrate iViews only via iFrames coming from SAP EP. However, Bowstreet Portlet Factory for WebSphere (Bowstreet Inc. was recently acquired by IBM) offers another option to access existing SAP applications via JSR 168 compliant or IBM proprietary portlets.

IBM's portal product supports the proprietary IBM portlet specification and two portlet standards: JSR 168[32] is a Java standard for portlets. WSRP[33] is an OASIS standard for Web services that are to be integrated to portlets. Both standards gained wide industry acceptance in recent years. If a portlet is developed according to one of these standards, it can be reused in other portal servers without problems. This does not hold true for proprietary portlets developed as SAP iViews or IBM portlet. Although SAP frequently talks about its participation in the definition of the JSR 168 and WSRP standards, we were unable to find any announcement about JSR 168 and WSRP compliance within EP or any roadmap towards it. A key impediment for SAP to accommodate the JSR168 standard is historical baggage: SAP instead prefers to support the proprietary Web Dynpro technology. We expect that SAP will continue its practice of discouraging developers from using standards within portals by providing integrated tool support only for iViews.

A key problem of JSR 168 and WSRP is the missing support for inter-portlet communication (IPC). As most major portal vendors, IBM offers an API (Click2Action) that allows sending messages between portlets. SAP offers similar functionality via its Enterprise Portal Client Framework (EPCF). The successor to JSR 168, JSR 286 (Portlet Specification 2.0), aims at providing IPC facilities. Both IBM and SAP are members of the JSR 286 expert group. It remains to be seen how much SAP can gain of JSR 286 without the support of JSR 168.

Within NetWeaver, support for collaboration and knowledge management is packaged with the portal product. However, both subsystems' functionalities are not yet very mature: collaboration provides repositories for online collaboration on documents called “virtual

[32] http://jcp.org/en/jsr/detail?id=168
[33] http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsrp

communities" and shared calendar functionality for "Ad-hoc Collaboration". Knowledge management is essentially limited to providing document repositories with search facilities.

WebSphere Portal is available in multiple platforms. The entry-level editions (Express and Enable) do not offer collaboration functionality. Yet, WebSphere Portal Extend for Multiplatforms product integrates a wide array of mature collaboration technology from IBM's Lotus product family ranging from instant messaging to web-based teleconferences. In addition, knowledge management is handled by the DB2 content management product family, offering by far more functionality than included within NetWeaver.

SAP Enterprise Portal administration and collaboration can only be accessed via Microsoft's Internet Explorer running on Windows, which is a severe limitation. IBM WebSphere Portal supports Microsoft Internet Explorer and Mozilla Firefox, and can thus be administrated from virtually all existing platforms.

To sum up our findings, SAP EP is suited for SAP-only shops which run mostly Internet Explorer. The availability of many iView portlets facilitates the creation of a unified view on multiple existing SAP applications. IBM's WebSphere portal solution is the better choice for enterprises with more diverse IT landscapes. It is also more extensible by IBM's large set of collaboration and knowledge management tools.

5.4 Other Components

We have now investigated the most important components of the NetWeaver and WebSphere ecosystems: application servers, messaging infrastructures and portals. In this section, we will have a brief look at the remaining parts of the NetWeaver technology stack: Master Data Management (MDM), Business Intelligence (BI), and Mobile Integration (MI).

Master Data Management

Master Data Management is hard to assess, as the documentation provided by both SAP and IBM about their respective products is rather sparse compared to the products discussed above. From a functionality point of view, the picture is similar to the portals: If master data only from SAP applications has to be managed, SAP MDM is maybe the better choice, as it contains specific schemata for SAP applications. If a more diverse set of data

sources (also including SAP applications) is to be integrated, IBM's solution should be considered.

SAP bought key parts of its current MDM solution as part of the acquisition of the software company A2i[34]. Although the current MDM version is already SAP's second full reimplementation since the introduction, there is still much work to do to integrate MDM fully into the NetWeaver stack. The key problem is bringing MDM to the J2EE stack, thus making it fully suitable for integration within SAP's ESA vision.

IBM's MDM products follow a best-of-breed approach: several tools complement one another. For example, IBM makes a sensible distinction between management of product data, management of customer data and data cleansing and transformation. However, IBM still has to put work in full seamless integration of these three tools that have all been recently obtained from acquired companies: WebSphere Product Center comes from Trigo Technologies, WebSphere Customer Center from DWL and DataStage from Ascential.

Business Intelligence

Business Intelligence (BI) is the aggregation of data out of a production system with the goal of extracting reporting and analytics information. Both NetWeaver and WebSphere provide BI solutions.

As with most components discussed in this report, SAP's solution is packaged under a single marketing umbrella. SAP BI is a renamed version of SAP Business Warehouse. As such, it offers predefined queries for common SAP applications. On the downside, similar to MDM, it still has to be fully integrated with NetWeaver and the ESA paradigm. Recently, SAP announced the BI Accelerator product as a package combining highly scalable hardware and software. However, the acceleration facility is only available for data sources already imported in a SAP BI system.

The WebSphere customer can combine multiple products to extract BI data, key components being WebSphere Information Integrator (for querying enterprise data sources), DB2 Cube Views (for multidimensional analysis) and DB2 AlphaBlox (a framework for creating custom reporting applications). These applications are almost

[34] A2i's product appears to have a product-only focus with some recently added extensions for customer-based object management.

independent of each other. As such, it is possible to use AlphaBlox to create reports from SAP BW data sources or to employ Cube Views to extract data from an R/3 system. A major advantage of the IBM product suite is its ability for integrating almost all available data sources. Integration of data from an existing SAP BW implementation is possible via BW's OLE DB for OLAP (ODBO) functionality.

The core feature set of both products is similar, with SAP BI clearly focusing on aggregating SAP-only data and IBM being more open to diverse data sets. The usefulness of a specific Business Intelligence application is mainly influenced by the nature of the existing IT infrastructure. As an application provider, SAP can include predefined query templates in its BI solution. These templates facilitate the creation of custom query and reporting applications. IBM, as a database provider, can leverage its DB2 database to enrich the functionality of DB2 Cube Views.

Mobile Infrastructure

With an increasing demand to integrate field workers in corporate IT infrastructures, mobile integration solutions are a key requirement for modern IT middleware solutions.

SAP offers its Mobile Infrastructure component as part of NetWeaver. This product is primarily targeted at accessing existing R/3 ERP applications with mobile devices. For this purpose, SAP follows a thick client approach: custom Java-based code on a mobile device communicates with a NetWeaver AS via the HTTPS protocol. The client software also supports advanced synchronization features for offline use. We hear concerns from the market about the speed of the overall solution. We attribute this to SAP MI using a full-blown but outdated Java Runtime Environment (version 1.1.8) that was originally designed for desktop applications instead of relying on Java 2 Micro Edition (J2ME), a special stripped-down variant of Java for low-power devices such as cell phones or PDAs.

In contrast to this rather simplistic approach, IBM's product WebSphere Everyplace Mobile Portal aims at making available all portal content on a mobile device. For this purpose, multi-device rendering and image conversion facilities are included. These allow defining how content of the main corporate portal based on WebSphere Enterprise Portal is to be displayed on mobile devices. If this thin-client approach is not sufficient, WebSphere Everyplace Micro Environment enables development of custom J2ME applications

integrated with the remaining enterprise infrastructure. J2ME applications are not only suited for rather powerful PDA devices, but also for standard cell phones. Moreover, IBM's Via Voice system can be integrated to allow for speech control on mobile devices.

IBM's solution offers by far more features necessary for mobile use. In addition, only IBM takes the concept of SOA to mobile devices and allows the development of Web Services on mobile devices, integrated into a full SOA architecture.

5.5 Development Environment

Recalling the discussion of ecosystems in chapter 3, this section discusses the most visible developer support of both product lines under examination: the development environment. Some details of them have been mentioned in this chapter already. This section gives a high-level view.

NetWeaver: Fragmented and Proprietary Tools

SAP appears to be new to the open J2EE world. The area where this becomes most obvious is how development tools support creating new applications. The SAP tools reflect the organization of large corporations: hierarchical roles, strict processes and proprietary technologies.

The main tool for development of J2EE applications is NetWeaver Developer Studio. This tool is based on the open source tool Eclipse[35]. However, NetWeaver sticks with the outdated version 2 of Eclipse, taking away many of the advanced capabilities like code assessments or multiple wizards. In addition, version 3 is much more stable and has higher performance. Perhaps the biggest problem with using the old Eclipse version is that the Eclipse plug-in interface was redesigned from scratch. Consequently, plug-in development on version 2 came to a standstill. This poses particular problems when new J2EE frameworks from the open source community are to be used – more often than not these frameworks rely heavily on development time support from Eclipse plug-ins. Also, when eventually moving to the current Eclipse version, all proprietary SAP extensions have to be redesigned. We expect major disruptions both for SAP's internal development and SAP's customers. As a further restriction, NetWeaver Developer Studio is only available for the Microsoft Windows platform.

[35] http://www.eclipse.org

SAP extensions of Eclipse include specific support for multi-developer projects and support for Web Dynpro, SAP's client-side user interface framework. Web Dynpro is the Web-based successor of Dynpro, SAP's GUI library. As such, Web Dynpro offers a simple migration path for SAP developers to Java-based applications. However, vendor lock-in occurs, as Web Dynpro is a proprietary SAP technology not available on other J2EE platforms.

For Business Process Modeling, SAP continues its tight cooperation with IDS Scheer. ARIS for SAP NetWeaver allows graphically modeling business processes implemented in NetWeaver. With the new integration capabilities of ARIS and WebSphere, these processing capabilities are also available for the WebSphere ecosystem.

Unfortunately, development for the XI messaging infrastructure requires a separate tool, the SAP Integration Builder, requiring higher training effort. In addition, when developing custom extensions for XI within the Java language, it is not possible to use a single tool for development and integration.

A last important issue is the recommended deployment process when creating J2EE applications for NetWeaver. Neither JAR (Java archive – a bundle containing all resources of an application) nor WAR (Web archive – a bundle containing resources of a Web application) can be deployed in NetWeaver AS[36]. Although it is possible to directly deploy EAR (Enterprise archive) files to NetWeaver AS, this J2EE standard way of deployment is not recommended by SAP and therefore not supported for production environments by the development environment. Instead, a development process similar to ABAP development is proposed. It involves an SAP-specific module concept (composite application framework – CAF) that is an extension of Java's package concept, a SAP-controlled name space concept instead of Java's URL-based name spaces, and a multi-stage deployment process. Although this process seems to be well designed and proven in ABAP practice, companies using this development and deployment process exclude themselves from many innovations developed within the J2EE world, primarily concerning agile methods such as refactoring, continuous integration and testing. SAP's commitments to its own ABAP

[36] http://media.sdn.sap.com/html/submitted_docs/sap_j2ee_migration_kit_webpages/migration/deploy_units.html

legacy make a lot of sense for traditional ABAP-programmers venturing into the J2EE-world. For J2EE thoroughbreds, they definitely are a lock-in.

WebSphere: Unified Modular Tools

As discussed previously, IBM offers particularly good support for developers. For the WebSphere product line, it also uses the Eclipse framework as a basis. However, as the founder and principal sponsor of the Eclipse project, IBM has much more experience in this tool and consequently uses many more of its features.

Rational Application Developer for WebSphere Software is based on Eclipse version 3, thus allowing developers to employ most existing plug-ins for the Eclipse platform. In addition, it includes unit testing facilities for Web services and portlets. Web front-end development is supporting the standard Struts and JSF frameworks, enabling developers to create code portable to other J2EE compliant environments. IBM integrated the Rational modeling tools with its Eclipse-based development environments. As such, support for UML-based modeling of Java applications is integrated in the WebSphere development environment.

A big plus of WebSphere's Eclipse-based development environment is that it gets used for all of the WebSphere products discussed in this report. This leverages efficiency gains in developer training and encourages development of applications employing multiple infrastructure components.

Business process modeling in WebSphere is possible via the WebSphere Business Modeler (that integrates with the Rational Application Developer IDE), but also using ARIS from IDS Scheer.

5.6 Standards Compliance

This section gives a brief comparison of how the respective products comply with J2EE-relevant standards. Figure 12 gives a summarizing quadrant perspective on how well the primary components of both NetWeaver and WebSphere perform in terms of standards compliance and feature richness going beyond standards.

Both application servers are compliant with J2EE. Yet, WebSphere already fulfills the new J2EE 1.4 standard; NetWeaver is still stuck with the older J2EE 1.3 standard.

For the portal products, only WebSphere Portal for Multiplatforms fulfills the JSR 168 standard for portlets. SAP has been claiming for some time that standard compliance is just around the corner, there is no clear date when this important standard will be fulfilled.

In general, SAP is rather vague on standards. It is an almost impossible task to find out which standards are actually implemented, as official documents mix up planned and realized standards (e.g. [SAP2005a]). Essentially every standard is planned, but there is no published roadmap for realized standard compliance and no credibility history of actively pushing open standards.

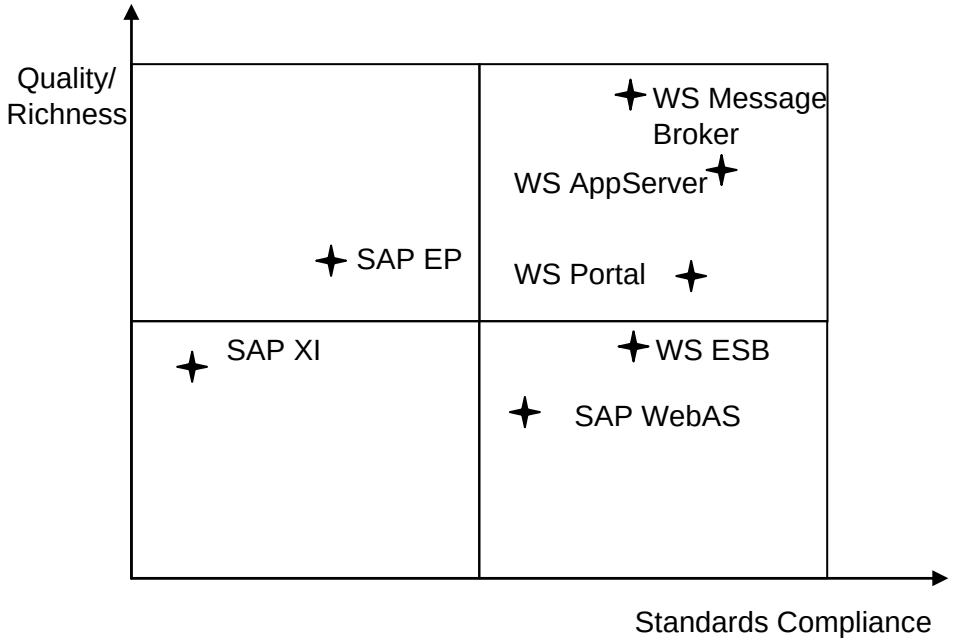

Figure 12: Standards Compliance Quadrant for NetWeaver and WebSphere.

Source: SPI

Contrary to that, IBM has high credibility in following open standards – its WebSphere product family has consistently been up to date with the newest standards, development tools offered by IBM support developers to create standards-based software, and finally IBM's commitment to open source software gives a strong hint that IBM understands the importance of openness in infrastructure software much better than SAP does.

In summary, SAP is performing quite poor on fulfilling the J2EE philosophy of standards-based software. A recurring theme in our discussion is that SAP is trying to guide developers into using proprietary technology, eventually leading to a lock-in by SAP. In

contrast, it is possible to develop fully J2EE compliant software using WebSphere – although some of the advanced WebSphere features may get lost.

5.7 Comparison Matrix

Category	NetWeaver Component	WebSphere Component
Application Server	✓ complies with J2EE 1.3 and WS-I Basic Profile 1.0 standards ✓ integrated ABAP stack ✓ simple integration of SAP-only ERP systems × poor integration of ABAP and J2EE stacks × clustering support is in initial state of maturity × few published performance data, no SPEC benchmarks × support for non-SAP ERP systems virtually nonexistent × proprietary database access layer	✓ complies with J2EE 1.4 standard (includes WS-I, deployment and management standards) ✓ proven clustering supporting ✓ proven best-of-breed performance ✓ convincing support of open standards for SOA ✓ allows to integrate ERP systems from multiple vendors × integration of existing SAP ERP systems more complex
Messaging Infrastructure & Process Management	✓ integrated iDoc and RFC support ✓ simple star-shaped communication topology ✓ availability of predefined business processes × JMS support requires extra adapter × unproven scalability × dependency on SAP application server × development environment distinct from application server's	✓ proven high performance ✓ proven clustering support ✓ very large number of adapters for integrating most existing enterprise systems ✓ development environment integrated with application server's ✓ import of ARIS process models announced × potentially complex configuration
Portal	✓ excellent support for SAP proprietary iView portlets ✓ simple integration of collaboration and knowledge management tools × no support for JSR 168 portlet and WSRP standards × limited collaboration support	✓ excellent support of JSR 168 portlet and WSRP standards ✓ wide range of collaboration tools are integrated in Extend edition ✓ full-blown content management solution can be integrated easily × integration of SAP ERP content mainly via Bowstreet Portlet Factory
Master Data Management	✓ predefined data consolidation templates for existing SAP applications × not yet integrated with remaining NetWeaver stack × limited customer data integration support	✓ Best-of-breed MDM approach ✓ Complete approach addressing multiple master data management issues including cleansing and heterogeneous support × multiple tools (depending on integration scenario) with potentially complex configuration

Category	NetWeaver Component	WebSphere Component
Business Intelligence	✓ interesting high-performance accelerator technology ✓ predefined query templates for SAP applications × strong support only for SAP data sources × not yet integrated with remaining NetWeaver stack	✓ complete data integration product suite ✓ equally good support of all data sources ✓ leverages custom functionality of DB2 database (even within SAP systems) × multiple tools with potentially complex configuration
Mobile Infrastructure	✓ focus on synchronization issues with mobile devices × targeted at accessing R/3 applications, no explicit SOA support × relies on outdated and resource-hungry Java runtime for mobile devices	✓ full-blown mobile access solution ✓ incorporates voice control on mobile devices ✓ SOA support ✓ J2ME support × multiple tools with potentially complex configuration
Developer Tools	✓ partially based on open source Eclipse framework ✓ development process matches with existing ABAP processes × outdated Eclipse version 2 × strong focus on proprietary SAP technologies × multitude of tools for individual NetWeaver components × only available on Windows platform	✓ based on open source Eclipse framework ✓ integrated environment for all infrastructure components ✓ based on new Eclipse version with large set of available plug-ins ✓ available on Windows and Unix ✓ integration of Rational modeling tools
Standards Compliance[37]	✓ application server fulfills J2EE and Web Services standards × base technology (e.g. ABAP, iView, System Landscape Directory) is SAP proprietary × vague communication policy of SAP regarding standards compliance × development tools lure users into proprietary SAP technology	✓ all relevant standards implemented in timely fashion ✓ credible standards policy due to open source commitment by IBM ✓ developer tools support standards-compliant development

Figure 13: Detailed Comparison Matrix

[37] Due to SAP's communication policy, it is difficult to find out the true standard compliance of NetWeaver.

6 Strategic Conclusions

Summarizing our findings, we conclude that SAP has a proprietary understanding of the SOA philosophy. The primary goal of interoperable components that are independent of a specific vendor's infrastructure platform will typically be hard to reach when using the NetWeaver technology stack. Instead, developers are lured into using a large set of proprietary SAP technologies, eventually leading to yet another pure SAP system, this time implemented in the Java programming language instead of ABAP. SAP still has to prove its claims of openness and functionality at par with the leading competitors.

IBM and other vendors offer a convincing SOA infrastructure. IBM does not only support current versions of open standards, but also actively supports developers in adhering to these standards and gives them the freedom to choose competing applications. On the downside, IBM's customers sometimes have a hard job finding the right overall solution out of the vast number of possible combinations of the large number of interoperable WebSphere and third party products.

6.1 Recommendations for SAP

SAP has never been a general infrastructure provider and is still doing a mediocre job trying to become one. The business goals of an application provider are too different from those of an infrastructure provider to fit easily within a single company. Instead of further pursuing its current strategy, SAP should focus on its strength within the enterprise application market and transform its current solutions to fit into an open SOA world. Within this new enterprise IT vision, interoperability and standards adherence are a must for vendors of best-of-breed applications. SAP has a deserved best-of-breed position in the ERP application market and should take this market as a basis to explore new opportunities in application markets partially covered by NetWeaver, such as business intelligence and software-as-a-service.

SAP and the J2EE Application Server Market

J2EE application servers are part of the SOA infrastructure and not of custom enterprise applications. Therefore, SAP should treat the J2EE application server market like the database market: A mature commodity market in which sufficiently many vendors provide

products that comply with a common standard. Thus, SAP should be vendor-agnostic. Like it does with the leading database vendors, SAP should offer a certification program that allows J2EE servers to be certified as SAP-compliant. This certification should cover commercial and open source servers.

SAP's own J2EE product, the NetWeaver AS Java Stack, has never been in the J2EE top tier since its inception. Moreover, it looks unlikely that it ever will, as the consistent and embarrassing delays in NetWeaver AS's standard compliance painfully show. Therefore, SAP should discontinue it or divest it into a separate company, as SAP has done before with its in-house database (now MaxDB). It is not in the interest of SAP to maintain the costly development of a mediocre product that alienates the SAP customers that want to run on a best-of-breed J2EE server, be it commercial or open-source.

SAP and Developer Support

Currently, SAP supports primarily developers of large corporations, being organized in a hierarchical and bureaucratic fashion. However, agile development methods become increasingly important. SAP could profit a lot from supporting independent software developers. They should not be regarded as competition to SAP business, but rather as an untapped resource that can help to increase the usefulness and therefore the importance of systems using SAP technology.

Such an open standards strategy should also be followed for the development environment. Currently, SAP is stuck with an outdated fork of the Eclipse framework. Instead, it should take an up-to-date version of the framework and develop all of its extensions as interoperable plug-ins, making sure that developers can integrate their custom favorite tools, potentially supporting non-SAP technologies. Otherwise, locking developers into proprietary old technology will discourage innovations and lead to a low performing and frustrated developer community.

6.2 Recommendations for IBM

With hardware, operating systems and databases, IBM has always been an infrastructure provider. With enterprise infrastructure as the foundation of a SOA-based corporate IT world, IBM has been correct in putting great efforts in transforming its infrastructure

offerings to comply with the SOA paradigm. Nevertheless, there are some points that warrant improvement.

Product Fragmentation

IBM has an extremely broad product range that got extended massively by a large number of acquisitions. Several business tasks such as business intelligence or a portal with collaboration support require a combination of multiple IBM products. Although this approach allows customers to specifically tailor their product range, which is an advantage, we see two problems:

- High marketing and consulting efforts are necessary to show the possibilities that arise from all possible combinations of products. SAP could act as a role model for clear marketing: "There is NetWeaver, it consists of six components, and each component has a clear purpose". In contrast to that, an IBM customer is faced with dozens of products with partially overlapping functionality, where several products like the application server are available in several different configurations[38].
- Once a customer selects a combination of products, configuration becomes complex. The products not only have to be adapted individually to the customer's IT structure, but also the interrelations of these products have to be configured. As there is a high probability that a specific product combination is unique for a single customer, help from the community becomes much harder to obtain.

In the long run, we recommend reducing the number of different products and product variants significantly. IBM appears to have identified this and is simplifying its core middleware structure with its SOA message and SOA Foundation platform efforts. The recent shift to the V6 WebSphere product line is a large step into the right direction.

Communication

The product fragmentation just discussed makes communication a hard job. It is not clear which set of IBM products are targeted at SOA, which ones are for virtualization or which products support collaboration. Instead, everything is put under the somewhat mystic label

[38] In reality, both SAP and IBM runtime systems require a similar amount of interoperating components.

of “on demand business”. SAP's strategy of communicating a clearly layered architecture gives a much clearer picture of each product's role within the company's portfolio than IBM's perhaps technically more accurate picture of Business Integration Accelerators ([Sad2005], p. 4).

6.3 Recommendations for Customers

In principle, all of NetWeaver's functionality can be substituted by WebSphere products. From a functional SOA point of view, there is no killer feature in either NetWeaver or WebSphere. However, non-functional properties such as standards compliance, ease of integration with existing systems or scalability vary significantly and will impact customers. For all infrastructure aspects, NetWeaver is behind best-of-breed products from competitors, whilst WebSphere often ranks among the best products available.

Risks and Opportunities

In our opinion, SAP currently tries to lock its customers into proprietary technology when making the transition to SOA. This is highly dangerous for two reasons: scalability and ecosystem support.

When introducing a SOA, initial load on the system can be rather low. However, as more business processes are implemented within the new paradigm, infrastructure load will significantly increase. At some point, overall system performance will suddenly not suffice any more. Especially XI, NetWeaver's messaging component, is not convincingly scalable. The probability of future problems is high if a customer opts for introducing NetWeaver in its current version as the basis for a future SOA infrastructure.

The current NetWeaver developer ecosystem is restricted to SAP partner companies. This excludes the large J2EE ecosystem that will be essential for creating successful SOA systems. If SAP continues its restricted information policy, its ecosystem is likely to stagnate. Thus, developer resources will remain largely with standards-based J2EE systems and not be applicable for SAP specific technologies.

Recommendations for Existing NetWeaver Customers

To reduce the danger of vendor lock-in, existing NetWeaver customers should aim at closely following open standards and not make use of proprietary SAP technology such as

Web Dynpro or Open JDBC. Also, there is no technical necessity to use all NetWeaver components – for example, if a company already uses NetWeaver BI, there is still the possibility to aggregate its data in WebSphere Portal via DB2 AlphaBlox.

Recommendations for Customers Considering NetWeaver adoption

Reconsidering the different perspectives on NetWeaver discussed at the beginning of this report, we again differentiate between pure-play SAP users, SOA-minded SAP users and users looking for a SOA infrastructure.

Pure-play SAP users not interested at all in SOA do not have any urgent technical reason to migrate to NetWeaver. They should save money and delay adoption until they are forced by SAP.

We recommend migrating to NetWeaver only for SOA-minded SAP users with an almost exclusive use of existing SAP applications. The advantages of NetWeaver lie in integration capabilities with SAP applications; integration with third party systems is poor compared to competing products such as IBM WebSphere. If customers now decide to use NetWeaver as SOA platform, it is very likely that they will be stuck with a SAP-only system and be in trouble whenever they want to integrate third party applications. Instead, the path to SOA should be taken in a completely standards-compliant way and be based on products that implement an up-to-date set of relevant standards. This also leaves the possibility to make a transition to upcoming best-of-breed products for parts of the enterprise IT system.

We strongly discourage generic middleware users looking for a J2EE-based SOA infrastructure from selecting NetWeaver. Although NetWeaver fulfills the core J2EE standards in outdated versions, none of its infrastructure components is among the best-of-breed products, from a performance or an administrative point of view. Also, SAP's ecosystem support rewards developers adhering to proprietary SAP methodologies. Thus, we expect NetWeaver's ecosystem standard compliance to be reduced even more in the future.

While SAP's superior marketing makes it easy for users to quickly come to grips with SAP's vision, we encourage users strongly to go one step beyond and scrutinize features,

quality and maturity. This is where IBM excels although it may be a little more difficult to consume technical details than easy-to-read marketing material.

7 Glossary

ALE – *Application Link Enabling* is a proprietary SAP standard for configuration, operation and synchronization of distributed applications. ALE employs asynchronous communication for synchronization and synchronous communication for reading data items.

BPEL – The *Business Process Execution Language* provides a means to formally specify business processes and interaction protocols. It employs Web Services as its communication protocol.

EJB – The *Enterprise Java Beans* standard defines a component model for enterprise IT applications.

ETL – Short for *extract, transform, load*. Data is extracted from one data source, transformed in some other format and loaded into another database. ETL functionality is a prerequisite for every enterprise integration system, particularly data warehouses.

JEE – the currently rebranded J2EE.

J2EE – *Java 2 Enterprise Edition* is a collection of standards defined by Sun Microsystems helping to create enterprise applications with the Java programming language.

J2ME – *Java 2 Micro Edition* is a stripped-down variant of Java for low-power devices such as cell phones or PDAs.

JCo – SAP *Java Connector* is a proprietary SAP standard for accessing ABAP programs from Java programs.

JDBC – *Java Database Connectivity* is a technology that abstracts from concrete database implementations in J2EE. As strings with SQL statements are used with JDBC calls, it is still possible that dependencies on concrete database systems are introduced.

JDO – *Java Data Objects* is a standard for abstraction from databases within the Java language.

Open JDBC – *Open JDBC* is a proprietary SAP standard building on top of JDBC. It uses SAP's proprietary OpenSQL for communication with databases.

OpenSQL – *OpenSQL* is a subset of SQL specified by SAP for vendor-agnostic access of R/3 and NetWeaver systems to database systems

RAS – *Reliability, Availability and Serviceability* are the key requirements for high availability clustering solutions.

SOAP – *Simple Object Access Protocol* is an XML-based protocol for exchanging data and remote procedure calls. It is relevant for Web services communication.

WSDL – *Web Services Description Language* is a platform-, language- and protocol-independent standard for the description of Web services that exchange data.

8 List of Figures

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