Companies need new and better ways to deploy end-to-end processes that streamline execution, automate workflow, reduce operational costs, and increase competitive advantage. But the IT landscapes of most organizations today are complex and difficult to integrate – especially when they include legacy systems. And they don’t provide a decentralized, distributed way to provide flexible, end-to-end processes. The SAP NetWeaver® Process Integration offering provides open integration technologies that enable process-centric collaboration among SAP® and non-SAP business applications, both within and beyond the enterprise.
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Businesses today increasingly need end-to-end processes that streamline execution, automate workflow, reduce operational costs, and give them competitive advantage. By integrating a variety of processes, businesses can gain timely access to accurate data, accelerate time to market for products and services, and improve their ability to respond and adapt to changing market conditions. At the same time, they can maximize partner business results through synchronized product catalogs and by automating business-to-business transactions for greater efficiency and value chain insight.

For some time now, organizations have been investing in ways to integrate business processes across the enterprise and extended value chain. In most cases, these efforts have included large expenditures on point solutions for enterprise application integration, business partner integration, or business process management. While these one-to-one communication links may provide a fast, easy way to integrate disparate systems, they often fail to provide a satisfactory return on investment. As the number of systems grows, the links begin to create complexity in the landscape that can drive up operational costs and decrease the stability of the entire IT environment. Even more importantly, point-to-point integration does not provide businesses with a way to integrate multiple, disparate systems as if they are a single, seamlessly integrated system. Ultimately, they want to operate processes independent of their IT landscape – and do so in a way that enables greater automation, monitoring, and control.

That’s why savvy organizations are seeking an advanced approach to end-to-end process integration. These companies are moving away from point solutions and toward broader communication infrastructures such as the SAP NetWeaver® technology platform that solve integration issues, while also serving as the architectural foundation for future application services. The SAP NetWeaver Process Integration (SAP NetWeaver PI) offering plays the lead role in end-to-end process integration. SAP NetWeaver PI provides open integration technologies that enable process-centric collaboration among SAP® and non-SAP business applications, both within and beyond the enterprise. By providing customers with seamless integration at sustainable costs, SAP NetWeaver PI removes the barriers associated with true integration.

EXECUTIVE SUMMARY

Evolving SAP NetWeaver® XI to SAP NetWeaver PI

On October 1, 2007, SAP announced the release of the SAP NetWeaver® Process Integration (SAP NetWeaver PI) offering – the next version of the SAP NetWeaver Exchange Infrastructure (SAP NetWeaver XI) component. SAP NetWeaver PI extends the integration functionality offered by SAP NetWeaver XI by delivering a standards-based service bus and a business event infrastructure around activity monitoring. Because the new functionality enables organizations to more effectively manage business processes, the name has been updated to reflect the enhancements.
The core tasks that SAP NetWeaver PI performs include properly routing and transforming messages and enabling end-to-end processes into a format that the receiving system understands. These tasks take processing time. As a result, the resource requirements for SAP NetWeaver PI grow with the number of systems that connect to it, and with the number and size of messages sent between communication partners. Businesses need to be confident that the end-to-end processes they enable through SAP NetWeaver PI offer exceptional performance and reliability – even under the heaviest loads.

In support of those needs, as well as to verify the performance of SAP NetWeaver PI on the Microsoft Windows operating system, SAP and HP have teamed up to conduct performance tests that demonstrate the processing power of SAP NetWeaver PI in the high-end server environments for which HP is well known. The tests involved typical integration scenarios that SAP customers are seeking to use and were run on standard HP servers designed for the processing needs of today’s demanding businesses. The configurations and settings reflected those commonly used by enterprises.

The overall result of the performance tests demonstrate that SAP NetWeaver PI works well in commonly deployed customer scenarios on standard hardware and is ready to serve as a service bus in a service-oriented architecture. Equally important, customers can use the latest service packs to significantly improve performance for the various scenarios – so they can grow their workload on the same hardware environment and ensure an affordable total cost of ownership (TCO).
Today’s IT landscapes are increasingly complex and difficult to integrate. Organizations need a solution that makes new levels of collaboration and connectivity possible among all the systems and applications within their enterprise and across their entire value chain. In addition to integrating these heterogeneous environments, companies want to leverage their existing legacy systems; in today’s environment, a “rip and replace” solution is not feasible. They also want to support the goal of standardizing on a services-based architecture, as the collaborative nature of business today requires a decentralized and distributed way to provide flexible end-to-end processes.

From a company’s point of view, its distributed, heterogeneous IT landscape should be invisible to end users. Business processes should support the technical linkage of the various applications and systems across the enterprise. With the help of SAP NetWeaver PI, companies can integrate different versions of both SAP and non-SAP systems based on different technologies to support cross-system business processes.

SAP NetWeaver PI is designed to protect technology investments by seamlessly integrating all existing components from both SAP and third-party vendors without any disruption. It runs on the SAP NetWeaver Application Server (SAP NetWeaver AS) component and uses different adapters to connect multiple business systems. Based on a native Web technology infrastructure, it leverages open standards such as XML, Web Services Description Language (WSDL), and simple object access protocol (SOAP), and supports multiple communication approaches, including central hubs and peer-to-peer connections.

SAP NetWeaver PI offers services that are essential in a heterogeneous and complex system landscape, such as a runtime infrastructure for message exchange, configuration options for managing business processes and message flow, and options for transforming message contents between the sender and receiver systems (mapping). At the same time, it provides a common, central repository for interfaces; support for integration-centric business process management based on the business process execution language (BPEL) standard; and an integrated tool set to help organizations build their own integration scenarios by defining the appropriate messaging interfaces, mappings, and routing rules.

Architecture of SAP NetWeaver PI

SAP NetWeaver PI includes the following core building blocks:

- **Enterprise Services Repository (ES Repository)** captures and stores all collaboration knowledge of software from SAP, partners, and third-party vendors. It stores integration definitions separately, away from functional application coding, so that organizations can upgrade functional coding without affecting repository definitions.

- **An integration server** contains a centrally configured integration engine that provides a runtime infrastructure for secure XML-based communication between the instances of the various components. In addition, it performs mapping and routing – activities that are dependent on integration information stored in the integration directory. It receives XML messages, determines the receiver, performs mappings, and routes the XML messages to the respective receiver systems.

- **An integration monitor** automatically monitors the exchange infrastructure from a technical and business process perspective.
Message Flow Within the Integration Engine
Through SAP NetWeaver PI, the SAP NetWeaver technology platform provides a very reliable, predictable, and efficient way of executing routing and transformation processes — the activities that require processing power and therefore can impact performance.

In contrast to traditional XSL Transformations (XSLT) methods for performing these tasks, which use an interpreted approach, SAP NetWeaver PI uses an executable transformation program that is faster and requires less processing power. Mapping definitions defined with XSLT can nevertheless be used and imported into the system.

Routing and transformation take place in the runtime environment of SAP NetWeaver PI and primarily involve the integration server and integration engine. The integration engine is a central “distribution engine” that processes XML messages, regardless of whether they are sent to the integration engine using an adapter or an application proxy. Services are included for determining receivers (logical and technical routing) and for the transformation of message contents between sender and receiver systems (mapping). Without these components, it would not be possible to exchange messages using SAP NetWeaver PI.
To illustrate: A single message can be transferred through the integration engine between two applications. Routing and physical address resolution is needed only for the request, as the response is transferred to an already-known sender. Different kinds of adapters are used to physically pass transformed data to business partners, third-party systems, and SAP solutions, each of which may use different interface technologies.

For any given message (which includes information about the sender and the message interface), the logical routing service determines receivers and required interfaces by evaluating the corresponding routing rules, whether those rules are XML Path Language expressions or Java code. This logical routing can have a significant influence on the overall performance of the integration engine.

The mapping service then determines the required transformations (which vary based on message, sender, and sender interface, as well as the receiver and receiver interface). In the case of synchronous communication, even the message direction is relevant to appropriately transform input, output, and fault messages. After retrieving the required mapping from the integration directory, the mapping service can then either execute XSLT mappings or Java code (or any combination in a given sequence) to the business content of the sender message. Mapping, like logical routing, signifies changes to the data structure and therefore can have an impact on performance.

Predefined Integration Content for SAP Applications
SAP NetWeaver is the best way to integrate processes for companies running one or more SAP applications. When the IT landscape includes application functionality from SAP, companies can take advantage of predefined content for integrating SAP software. This predefined integration content, which is available for all kinds of SAP products, shortens time to integration because it provides rules for how to transform data, as well as routing rules that define interactions between systems.

Common Integration Scenarios
Using SAP NetWeaver PI, businesses can achieve their ultimate objective of automating end-to-end processes that span multiple applications and networks. Some of the most common integration scenarios include the following:
- Application-to-application process integration
- Business-to-business process integration
- Enterprise service-oriented architecture (enterprise SOA)

Application-to-Application Process Integration
One of the most common scenarios where companies use SAP NetWeaver PI is to integrate separate business applications within their IT landscape – a function that’s been necessary from the beginning of networked computing. For example, employee records need to move from HR to accounting, insurance policy information must travel from contracts management to claims processing, and loan data is transferred from a bank’s credit application into risk management and collateral realization systems.

Traditionally, this issue has been solved by batch processing. But batch processing can prove expensive, as separate extraction and loading programs must be built and maintained for each data exchange instance. Furthermore,
batch loading is not suitable for situations such as financial applications that require real-time data exchange. Another approach is to unify all enterprise data and store it in a single database accessible to all applications. Unfortunately, this method gravely limits the organization’s agility. Because people become reliant on access to this data, and accustomed to the way it is represented, changing the underlying data models poses a problem.

Today’s state-of-the-art approach to application-to-application integration combines the best of both worlds with the hub-and-spoke model. Through the spokes, the central message-processing hub is connected to all relevant applications, dramatically reducing the number of system connections required. The hub system then hosts all necessary information – such as document formats, transportation rules, and security requirements – to handle integration activities. This method provides a single point of management for all of the organization’s application-to-application integration requirements.

SAP NetWeaver incorporates a hub-and-spoke integration broker within its SAP NetWeaver PI offering. SAP NetWeaver PI contains predefined integration content for a growing number of SAP solutions, such as the SAP Supplier Relationship Management and SAP Supply Chain Management applications, helping you integrate these solutions with existing business systems. Because SAP NetWeaver PI provides an open, standards-based infrastructure and a wide selection of adapters for the most common business systems (IBM CICS Transaction Server, Oracle E-Business Suite, PeopleSoft Enterprise, JD Edwards OneWorld and World, Siebel Systems, and others), companies can also use it to integrate non-SAP systems into their environment. (The adapters are licensed separately from the SAP NetWeaver delivery.)

Business-to-Business Process Integration
Incorporating partners’ applications into business processes is becoming an increasingly important requirement for leading organizations. Large manufacturers already rely on electronic means to convey orders, manage shipments and inventory, receive invoices, and report quality of parts to their suppliers. Because these transactions involve the transfer of legally binding documents representing a high monetary value, organizations must address more stringent requirements for partner communication processes than for purely internal communications.

To transfer information to business partners, companies have traditionally relied on a batch process similar to that used for application-to-application integration. The initiating application produces the documents to be conveyed to a partner, while a specialized partner communication system – for example, an electronic data interchange (EDI) subsystem – receives the documents, transforms them into the required partner format, and deposits them in the partner’s mailbox on a value-added network (VAN). This process is both expensive and error-prone, as multiple systems are involved. In addition, VAN connectivity costs are prohibitive for all but the largest buyers and suppliers.

To overcome this problem, SAP NetWeaver – through SAP NetWeaver PI – uses the same hub-and-spoke infrastructure as for application integration. Specialized spoke adapters for partner communication support a variety of processes and connectivity requirements, including data and process security, reliability, and validity. By using these adapters, companies can migrate their traditional EDI system to the latest industry-standard partner exchange mechanisms – such as EDI over Internet (EDIINT), RINIF (RosettaNet, Chemical Industry Data Exchange, and Petroleum Industry Data Exchange), 1SYNC, SWIFT, and many others – or they can leverage secure HTTP for direct interaction over the Internet.
Enabling Enterprise Service-Oriented Architecture

Companies are increasingly using service-oriented architectures to provide open-ended access to any number of existing applications – often for more synchronous activities where users expect an immediate response. This requires that they use middleware to make all of the various application interfaces look the same and enable them to be exposed as Web services. These newly exposed services must be evident for discovery by application developers, retrieved and put into a central repository for reuse, and used to compose composite applications for end users.

SAP NetWeaver PI is the middleware that provides the connectivity and secure communications required to allow consumers to use the composite applications – which in turn use the exposed services to execute tasks (for example, information retrieval).

Figure 2: SAP NetWeaver® – Delivering Technology for Enabling Enterprise SOA
It enables process integration using a standards-based SOA infrastructure by delivering the following:

- **ES Repository**: The repository is the central location in which enterprise services are modeled and where enterprise services metadata is stored. As an integral part of SAP NetWeaver, it consists of two key components:
  - A services repository that stores the definitions of enterprise services and business processes, stores the metadata of all services objects, and provides a central modeling and design environment.
  - A services registry that supports the publishing, classifying, and discovery of enterprise services. This registry, compliant with Universal Description, Discovery, and Integration (UDDI), also enables the management and governance of service-enabled applications.

- **Services bus**: The services bus enables direct communication between a provider application that implements an enterprise service and a consumer application that uses the enterprise service.

- **Support for Web services standards**: SAP NetWeaver PI includes support for SOAP including WSDL, XML, UDDI, Web Services Reliable Messaging, Web Services Policy, and Web Services Security.

Figure 2 shows how the enterprise services repository, registry, and bus work together to enable applications to provide and consume enterprise services.

By using SAP NetWeaver PI as a service bus, businesses can connect service consumers with service providers on a standardized and centrally managed and monitored infrastructure that provides very predictable response times. Only SAP NetWeaver PI offers an integrated platform approach with middleware that extends directly into all of the different applications being exposed as Web services (rather than having to rely on different, distant interfaces that may offer inconsistent response times). This not only ensures end-to-end predictability of response times, but also makes it easier and more cost effective to manage and monitor services on an ongoing basis.
For customers worldwide, choosing a modern enterprise platform is crucial to the continued success of their business. HP Integrity servers offer a powerful choice for enterprise applications and their associated high-end database servers by overcoming the addressing limitations of 32-bit systems, which most SAP applications have outgrown from a processing perspective. By eliminating platform and processing bottlenecks and providing RISC-level reliability, availability, and serviceability (RAS) features, the 64-bit HP Integrity server offers an increased – and affordable – level of scalability, reliability, and flexibility for Microsoft Windows-based SAP applications, so that today’s companies can keep pace with rapid business growth.

**Scalability**

HP Integrity servers are the ideal platform for large SAP installations because of their high performance and enterprise-class scalability. They feature industry-standard, 64-bit Intel Itanium 2 processors and scale from 1 to 128 processors.

HP Integrity systems running 64-bit Microsoft Windows (which were used to perform the tests summarized in this paper) meet the needs of organizations outgrowing their current 32-bit systems – and far exceed the AMD Opteron and Intel EM64T scalability sweet spot of 2-to-4 CPUs. Very large amounts of physical main memory become accessible so that each SAP application process can access virtually unlimited amounts of memory. Even large databases can be fully cached in memory. This reduces data access latencies and dramatically improves database query performance.

In addition to processor scalability, the HP Integrity line of servers provides huge options for additional I/O. The entry-level servers provide 8 PCI slots while on the highest end, the HP Integrity Superdome provides 192 I/O slots. This combination of expansion and performance creates a highly expandable landscape for customers implementing SAP solutions.

**Availability**

HP Integrity servers feature a number of availability features, including RAS features and clustering, to meet the needs of even the most demanding organizations.

**RAS Features**

HP Integrity servers running Microsoft Windows 2003 offer customers an industry-standard alternative to proprietary RISC systems by providing RISC-level RAS. Specifically, the servers have a powerful and thoughtfully designed error-handling infrastructure that is superior to the x86/x64 error handling. Integrity systems are packed with high-availability features such as hot-plug disks, failed-processor deallocation, chip spare technology, and redundant hot-swap fans and power supplies, all of which greatly reduce unplanned system downtime.

In addition, they offer the following:

- **Diagnosability of all hardware crashes:** If hardware errors occur, trusted firmware code immediately logs a “machine check abort” log with information on what failed and how it failed.

- **Error containment for errant hardware and software:** HP Integrity chipsets are explicitly designed to isolate and contain errant components immediately upon detection of an error.

- **Monitoring features for tracking corrected errors:** Corrected errors can occur periodically in healthy systems. The architecture of the processor enables online diagnostics that track trend data for predictive analysis.

**Clustering**

HP supports advanced server clustering that goes beyond Microsoft Windows Server 2003 clustering technologies by providing server clustering and network load balancing (NLB). Each of these technologies can be used to provide high availability for different types of services.

Specifically, HP offers extended clusters with HP StorageWorks Cluster Extension XP and EVA (CLX) for intersite replication, management of site fail-over and fail-back, and geographical dispersion with automatic disaster tolerance. In addition to the Microsoft Cluster Service, HP provides multi-instance clustering and application stacking for SAP software with Microsoft Windows and HP Integrity servers via the HP Competent Cluster Service (HP CCS).
The HP CCS was developed for SAP software environments because the standard SAP method of providing failover support in a Microsoft Windows environment is a two-node cluster. This service is a modification to the standard SAP installation method that provides multinode cluster support, multiple instances of SAP applications within a single cluster, and clustering of consolidated SAP systems. Developed for Microsoft Windows and SAP environments only, it enables Microsoft Windows–based SAP clusters to support the same level of flexibility as UNIX-based cluster solutions for SAP environments. HP provides service and mission-critical SAP support for this offering.

With the RAS features and superior Microsoft Windows Integrity Cluster capabilities, customers gain an infrastructure that keeps SAP applications up and running—preventing business operations from being affected by IT outages, whatever the cause.

**Performance**

HP Integrity has the best-balanced performance for running a broad range of applications, as demonstrated by leading benchmarks for the following:

- Online transaction processing (OLTP)
- Analytical processing
- Enterprise resource planning
- Supply chain management
- Business intelligence
- Customer relationship management
- Java applications for middle tiers

Most significantly, a recent dual-core benchmark for the rx6600 delivered an outstanding new 4p/8c TPC-C benchmark of 345K tpmC, with a price-performance ratio of US$2.24. This result, achieved on the rx6600 with a dual-core Itanium 2 processor running Microsoft Windows Server 2003 and SQL Server 2005, holds the number one 4p/8c TPC-C performance benchmark across all CPU types and operating systems. This demonstrates superior transaction processing performance for demanding OLTP environments.

In addition, the HP Integrity Superdome, utilizing Dual-Core Intel Itanium 2 technology, achieved the number one overall result for two-tier 32-processor servers with 9,265 SAP software users (equivalent to a throughput of 2,783,000 fully processed dialog steps per hour), using the SAP standard benchmark for the sales and distribution (SD) software. It also produced the number one SD benchmark result for two-tier 16-processor servers with 5,600 SAP software users (equivalent to a throughput of 1,692,134 fully processed dialog steps per hour).

The record three-tier 64-processor HP Integrity Superdome benchmark with 93,000 SD benchmark users demonstrates that every SAP software system in the world can run on a Microsoft Windows–HP Integrity platform.

**Management**

Powerful, integrated management tools for HP Integrity servers—including HP Systems Insight Manager, HP OpenView, and Virtual Server Environment—simplify management of IT operations so that customers can focus on business, rather than IT.

HP OpenView and HP Systems Insight Manager lay a solid foundation for development of a broad IT service management solution. By delivering a consolidated and centralized management platform for the entire enterprise, they help reduce operating costs, increase availability, and ensure efficient management of critical business resources. With HP OpenView as the primary interface to manage the availability and performance of critical business services, integration with HP Systems Insight Manager enables administrators to correlate HP hardware status with the availability of business service levels and obtain in-depth data for more accurate root-cause analysis and faster problem resolution. In addition, HP OpenView provides enhancements to SAP environments to deliver compliance with SAP service-level agreements, integration of the SAP Solution Manager application management solution into OpenView, and SAP software–specific smart plug-ins (SPIs) to improve availability and enhance management of SAP environments.

Together, these powerful management tools reduce the number of people needed to maintain those stable systems. Equally important, they make it easier to set up and operate a virtualized environment.
Total Cost of Ownership

HP Integrity servers running Microsoft Windows Server 2003 bring the cost-of-ownership advantages of Microsoft Windows and standards-based servers, as well as an affordable level of reliability, to applications that previously required expensive, proprietary solutions. TCO analyses have consistently demonstrated that Microsoft Windows on HP Integrity servers provides higher performance and lower price. The fact that Itanium 2–based HP Integrity servers require fewer CPUs to perform a job means that companies benefit in the following ways:

- Less cluster complexity (improved scalability and availability)
- Fewer cabinets with smaller floor-space requirements (less physical and environmental cost)
- Reduced systems management complexity and cost (reduced manpower and training)
- Reduced software license fees (reduced budget impact)

TCO is also improved because HP and Integrity deliver the industry’s only pay-per-use (PPU) option for Microsoft Windows. An option available only with HP Integrity servers, it gives companies a ready-to-use Microsoft Windows server solution that provides the capacity they need to meet daily business demands – even as they change. Customers pay only for the capacity that is actually used. In other words, with PPU, customers have access to reserve capacity, but don’t pay for that capacity when it’s not in use. This is very important to CIOs or CTOs who are responsible for reducing costs and increasing server utilization.
SAP and HP collaborated on the performance tests to demonstrate the ability of SAP NetWeaver PI running on HP Integrity servers to meet and exceed the processing requirements of common use. They include the following:

- **Enterprise SOA** to demonstrate synchronous execution of enterprise services
- **Batch data transfer** to demonstrate asynchronous intermediate document (IDoc) conversion and output
- **BPEL service orchestration** to demonstrate high-volume message correlation

All tests were performed using SAP NetWeaver PI 7.0 release with service pack (SP) 12 installed. The message-packaging feature from SP13 was also activated. Baselines for each test were based on pre-SP12 quick sizer estimates.

**Test Scenario: Enterprise SOA**

The test scenario for enterprise SOA involved a synchronous enterprise service, or Web service request, that calls a back-end SAP proxy interface to get information, such as product availability. In this scenario, a travel agent requests the number of available seats for a specific airline flight. The corresponding XML message is received on the integration server. The airline’s flight data system is searched for and found. The message is mapped to the interface format of the airline’s SAP back-end system. The request is sent via HTTP and SAP NetWeaver PI proxy communication to the back-end system.

In the back-end system, the inbound proxy calls the service, which returns the number of available seats and the total number of seats for the various seat classes. The return message is sent to the integration server and from there to the travel agent’s screen.

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**SAP NetWeaver® PI Offering: System Settings for Testing**

**Hardware Specifications**

**SAP NetWeaver® Process Integration**
- Rx8640
- Processor: 16 x 1.6 GHz Itanium 2 (Montecito)
- RAM: 256 GB
- Storage: 4 x 146 GB internal/28 x 72.8 GB external
- DB: SQL Server 2005, 64 bit
- ERP: SAP NetWeaver 7.0 SP12

**Sending and Receiving Business System**
- Rx7640
- Processor: 8 x 1.6 GHz Itanium 2 (Montecito)
- RAM: 128 GB
- Storage: 4 x 146 GB internal/14 x 72.8 GB external
- DB: SQL Server 2005, 64 bit
- ERP: SAP NetWeaver 7.0 SP11

**SAP® LoadRunner Application by HP**
- ProLiant ML370 GB
- Processor: 2 x 3.2 GHz Xeon DP
- RAM: 32 GB
- OS: Microsoft Windows Server 2003 Enterprise Edition, x64 bit

**General Settings**
- SAP NetWeaver PI tuning guide recommendations
- 86 DIA work processes
- 34 GB RAM ABAP®
- 7 Java EE Server nodes with 2 GB each

**SAP NetWeaver PI–Specific Configuration Parameters (Other than Default)**
- Message packaging switched on for ccBPM and SAP NetWeaver PI messaging
- Tuning: Number of parallel inbound queues set to 60
- Tuning: Number of parallel outbound queues set to 60
- Tuning: EO_INBOUND_TO_OUTBOUND set to 1
- IDoc: XML_CONVERSION set to 1
- Runtime: TRACE_LEVEL set to 0
Test Results

Runtime results from the test are based on a configuration that includes SP12 and message-packaging functionality via SP13. Testing was performed with mapping (which can increase the processing load considerably) and without mapping to demonstrate performance results in both conditions.

The following results reflect what customers can expect in scenarios similar to the one described above – when mapping is required because of integration with a third-party system or because data pulled from the server is rearranged.

- **Single message runtimes**: The shortest runtime between sending the request and receiving the answer was 89 milliseconds (including the time used by the back-end system) for a 3 KB XML message.
- **Parallel message runtimes**: The system processed 270 parallel messages per second with ease.

In the future, more and more SAP and partner software systems will be SOA-enabled, reducing the probability that mapping is required by the consuming application because the sender and receiver interface have the same structure. As demonstrated by the following test results, customers can achieve even higher throughput.

- **Single message runtimes**: From request until delivery of response, the shortest runtime was 69 milliseconds for one round-trip.
- **Parallel message runtimes**: SAP NetWeaver PI managed 366 available-to-promise (ATP) requests in parallel per second on the HP Integrity server.

To return to the results above, this means that 366 travel agents can press “enter” at the same time and receive answers within one second.

**Test Scenario:**
Batch Data Transfer IDoc
→ SAP NetWeaver PI → Flat File

In the test, an IDoc is sent from an SAP application to a third-party system as a comma-separated file. Specifically, it was assumed that application data from an SAP ERP application is sent in IDoc format and must be transferred to a third-party system working with comma-separated values (CSV). The SAP ERP application sends the IDocs to the integration server as IDoc packages. The integration server sends a technical commit to the SAP ERP application and transforms the IDocs to SAP NetWeaver PI messages (IDoc-XML). A third-party business system is the receiver, and the message is therefore forwarded to the adapter engine, which drops the XML structure and puts the CSV into the file system. Further processing is done by the receiving business system.
Test Scenario: BPEL Service Orchestration

BPEL is used to correlate the message exchange between an SAP business system and a third-party warehouse management system. In this scenario, it was assumed that a warehouse application system creates a large number of small messages that have to be collected and combined. A certain number of messages (10, 50, and 100) were collected for the same order identification. As soon as this number of messages is reached, the BPEL engine merges the messages into a package and sends it to a receiving business system. There, the content of the message package is transferred to the application. The business benefit is that many small messages, which semantically belong together, are not processed one by one; instead they are together transferred to, and handled by, the application system.

Test Results

Runtime results from the test scenario are based on a configuration that includes SP12 and message packaging functionality via SP13. Testing was performed with mapping (which can increase the processing load considerably) and without mapping to demonstrate performance results in both conditions. Highlights include the following.

- **Maximum throughput of large messages (with mapping):** SAP NetWeaver PI running on HP Integrity servers achieved a maximum throughput of 78 GB per hour with large messages of 2.37 MB with 1,000 line items – even with mapping. This demonstrates that customers can use this configuration to transfer large amounts of data to a receiving system.

- **Increasing throughput with message packaging:** Customers can increase the throughput of large numbers of smaller messages when message packaging is used. When combined with packaging, the number of processed messages (11 KB) increased from 84 to 220 messages per second. Because this positive effect is achieved with smaller message sizes (in the test, 11 KB and 32 KB), it is ideal for batch processes.

While the benefits of message packaging diminish with large message sizes, SAP NetWeaver PI still achieves the best throughput in terms of byte volume of data, even with messages as large as 2.37 MB with 1,000 line items.

Test Results

Runtime results from the test are based on a configuration that includes SP12, message-packaging functionality from SP13, parallel queues (up to 25), and new BPEL transaction handling. This test assumed that the customer received countless small messages from its warehouse system and as a result, is having difficulty posting them to its back-end system individually. The customer needs to pack them together – 50 at a time – to create a larger message. These packages of 281 KB were sent to the receiving application. The results indicated the following:

- Without packaging, customers can send 3,000 messages of 281 KB per hour.
- With packaging, they can process 14,000 messages of 281 KB per hour.

Clearly the introduction of packaging functionality increases throughput dramatically and renders SAP NetWeaver PI ideal for business-to-business situations (for example, where many small individual requests from partners have to be combined into larger transactions) and bulk handling of real-time event messages from shop floor systems and radio frequency identification sensor systems.
Businesses must be confident that when they use SAP NetWeaver PI to enable end-to-end processes, they will have exceptional performance and reliability – even under the heaviest loads. As demonstrated by the performance tests of SAP NetWeaver PI on the Microsoft Windows operating system, the processing power of SAP NetWeaver PI in high-end server environments (such as HP Integrity systems) can support all usual customer scenarios (see Figure 3).

SAP NetWeaver PI is ready to serve as a service bus in service-oriented architecture, mediating between service consumers and providers. Equally important, customers can use different service packs to significantly improve performance for the various scenarios – so they can grow their workload on the same hardware environment and ensure an affordable total cost of ownership.

For more information about SAP NetWeaver PI, please visit www.sap.com/platform/netweaver/processintegration.epx.

**Figure 3: Summary of Performance Tests for Different Scenarios**

<table>
<thead>
<tr>
<th>Business process management – BPEL message correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMS: Warehouse management system</td>
</tr>
<tr>
<td>PI: SAP NetWeaver® Process Integration</td>
</tr>
<tr>
<td>R*: 1.2:n: Requestors (multiple)</td>
</tr>
<tr>
<td>CSV: Comma-separated value files</td>
</tr>
<tr>
<td>Outbound messages per hour</td>
</tr>
<tr>
<td>pre-SP12:</td>
</tr>
<tr>
<td>SP12:</td>
</tr>
<tr>
<td>15,000</td>
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<tr>
<td>10,000</td>
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<tr>
<td>5,000</td>
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<tr>
<td>0</td>
</tr>
<tr>
<td>Warehouse pick events</td>
</tr>
<tr>
<td>Large number of small messages</td>
</tr>
<tr>
<td>Correlation per customer (50:1)</td>
</tr>
<tr>
<td>4.7 x</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enterprise SOA – synchronous proxy</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI:</td>
</tr>
<tr>
<td>R2</td>
</tr>
<tr>
<td>R1</td>
</tr>
<tr>
<td>Rn</td>
</tr>
<tr>
<td>Availability check</td>
</tr>
<tr>
<td>HTTP front end</td>
</tr>
<tr>
<td>Proxy back end</td>
</tr>
<tr>
<td>Single request: 69 ms round-trip</td>
</tr>
<tr>
<td>Parallel requests: 366 per second</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IDoc→XML→CSV messaging (async)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSV:</td>
</tr>
<tr>
<td>PI:</td>
</tr>
<tr>
<td>SAP:</td>
</tr>
<tr>
<td>Batch document exchange</td>
</tr>
<tr>
<td>XML and CSV conversion</td>
</tr>
<tr>
<td>File storage</td>
</tr>
<tr>
<td>Throughput: 220 message/s (2.6 x pre-SP12) and 78 GB/h</td>
</tr>
<tr>
<td>Usage of “message packaging”</td>
</tr>
</tbody>
</table>

WMS: Warehouse management system
PI: SAP NetWeaver® Process Integration
R*: 1.2:n: Requestors (multiple)
CSV: Comma-separated value files
Summary
The SAP NetWeaver® Process Integration (SAP NetWeaver PI) offering provides open integration technologies that enable process-centric collaboration among SAP® and non-SAP business applications, both within and beyond the enterprise. By providing customers with seamless integration at sustainable costs, SAP NetWeaver PI removes the barriers associated with true integration.

Challenges
- Heterogeneous IT landscapes increasingly complex and difficult to integrate
- Traditional point-to-point integration not adequate for today's business needs
- Need to standardize on a services-based architecture to support collaborative nature of business today

Performance Test Results (SAP NetWeaver PI on HP Integrity Servers)¹
- **Enterprise service-oriented architecture (enterprise SOA) test scenario (with mapping)** – Achieved single-message runtimes of 89 milliseconds and processed 270 parallel messages
- **Enterprise SOA test scenario (without mapping)** – Achieved single-message runtimes of 69 milliseconds and processed 366 parallel messages
- **Batch data transfer scenario (with mapping)** – Achieved maximum throughput of 78 GB per hour with large messages of 1,000 lines
- **Batch data transfer scenario (without mapping)** – With message packaging, increased number of processed small messages (11 KB) from 84 to 220 messages per second
- **BPEL (service orchestration)** – While merging related messages into packages for faster back-end posting, processed 3,000 messages at 281 KB per hour (without packaging) and 14,000 messages at 281 KB per hour (with packaging)

Business Benefits
- **Exceptional performance and reliability** – Be confident, even under the heaviest loads
- **Investment reuse** – Use one product for application-to-application, business-to-business, and SOA-based integrations
- **Flexibility to serve as a service bus** – Roll out service-oriented architectures with a service bus ready to mediate between service consumers and providers
- **Affordable total cost of ownership** – Grow workloads on the same hardware environment by using service packs that significantly improve performance for different uses

For More Information
For more information about SAP NetWeaver PI, please visit www.sap.com/platform/netweaver/processintegration.epx.

¹. All tests were performed using SAP NetWeaver PI 7.0 release with service pack (SP) 12 installed. In some cases, the message-packaging feature from SP13 was also installed. BPEL test configurations also included use of parallel queues (up to 25) and new BPEL transaction handling.