SAP on IBM i Reference Architecture

Applies to:
SAP landscapes running on the IBM i database and operating system.

Summary
The SAP on IBM i Reference Architecture document gives an overview of how SAP landscapes are implemented on the IBM i platform. The document first provides an introduction to the SAP and IBM components that are used to build SAP landscapes. It shows SAP solution scenarios based on SAP Business Suite applications like SAP Enterprise Resource Planning and the SAP Business All-in-One solution. The implementation of the solution scenarios is then shown as three reference architectures. The architectures leverage the specific benefits of the IBM i platform and demonstrate different high availability options.

Based on the components described in the first part of the document, the second part describes extended SAP on IBM i scenarios. It explains the integration of further SAP components like Adobe Document Services and SAP BusinessObjects, as well as more virtualization scenarios. The Further Topics section contains links to more information about SAP on IBM i topics that are not described in detail in this document.

This document represents the current state of both IBM and SAP product availability as of August 2012. As this may change in the future when new components become available, this document will also be updated.

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Introduction to SAP on IBM i

Today almost any enterprise relies on information technology to run its business operations. SAP, the world market leader in business software offers software solutions that fit most company sizes in any kind of industry. The SAP Business Suite offers a set of applications that can be selectively installed to fit companies’ needs. In order to run SAP solutions, an SAP certified operating system and database is required. One of the operating systems certified by SAP is IBM i, formerly known as OS/400 and i5/OS, with its integrated DB2 for IBM i database. IBM i running on an IBM POWER Systems server offers a highly scalable and virus resistant architecture with a proven reputation for exceptional business resiliency. Running applications based on IBM i has helped companies over many years to focus on innovation and delivering new value to their business, not just on managing their data center operations.

IBM i integrates a trusted combination of relational database, security, Web services, networking and storage management capabilities. It provides a broad and highly stable database and middleware foundation for efficiently deploying business processing applications, like SAP. IBM develops, fully tests and preloads the core middleware components of IBM i. On other platforms, operating system, database and middleware integration is done in the data center. The pre-integration and testing of i is a key factor in enabling companies to deploy applications faster and maintain them with fewer staff. Virtualization and workload management are also built into i to enable running multiple SAP applications and components together on the same system, driving up system utilization and delivering a better return on IT investments for the SAP landscape.

In September 1995, SAP released its SAP R/3 Enterprise Resource Planning software for OS/400 for the first time. Since then IBM i has established itself as a proven and reliable platform for SAP. All new core SAP components, including SAP NetWeaver and its Java application server, have been released for the IBM i platform since then. All new IBM i releases since the original release of SAP on IBM i have been certified by SAP within a very short time period after their general availability. That is why SAP on IBM i customers can immediately benefit from new and improved functionalities of a new OS and DB release. Besides the short certification time, the long history of SAP BI MXL (Business Intelligence, Mixed Workload) benchmark leadership for SAP on IBM i is another demonstration of how beneficial the close collaboration between IBM and SAP is for the SAP on IBM i customers. A development team located at SAP Germany with members from both IBM and SAP is enabling and optimizing SAP applications on IBM i. Support functions from both IBM and SAP are tightly integrated with the development team, making SAP on IBM i a thoroughly integrated solution spanning hardware, software and support.

Like the SAP software, the IBM i platform is suitable for any size of business ranging from a dozen to thousands of users. The SAP on IBM i reference architectures shown in this document are not representing a system sizing guideline. More information about how to size systems for SAP applications can be obtained from the experts at the IBM SAP International Competence Center (ISICC).
SAP Components

This section provides an overview about solutions scenarios offered by SAP and then introduces the SAP components that are viewed as a precondition for a discussion of any implementation of SAP solutions.

SAP Solution Scenarios

This section provides a high level overview of SAP solution scenarios and their application components. More detailed information can be found in dedicated SAP publications for example at http://www.sap.com/solutions/business-suite/brochures.

The compilation of various solution scenarios reflects the fact that depending on their size and business companies have different requirements regarding solution completeness and flexibility on the one hand and different potential in terms of handling complexity on the other.

All presented scenarios can be viewed as subset of the complete SAP Business Suite. Therefore, this solution and its components will be described first and in some detail in order to serve as a reference for the simpler scenarios Basic SAP ERP and SAP Business All-in-One later on.

SAP Business Suite

SAP Business Suite software is a comprehensive family of applications that support industry-specific business requirements for finance, human resources, procurement, product development, marketing, sales, service, supply chain management, and asset management. SAP Business Suite supports integrated, comprehensive business processes that transcend organizational, departmental, and geographic boundaries for all industries. New SAP Business Suite applications can be added without expensive replacements or upgrades.

SAP Business Suite serves as the foundation for every solution portfolio SAP offers, serving the needs of customers in more than 25 major industries. The suite can be configured and deployed quickly to address specific industry requirements and processes.

SAP Business Suite is available in modular building blocks that combine software, support for best practices, and services to help your organization benefit from SAP business expertise. Each of the core applications within SAP Business Suite is based on the SAP NetWeaver technology platform.

Core applications building the SAP Business Suite

**SAP Enterprise Resource Planning:**

SAP ERP includes comprehensive functionality for accounting and financials, sales and service, procurement and logistics, inventory management, human capital management, product development and manufacturing, corporate services, and reporting and analytics.

**SAP Customer Relation Management:**

SAP CRM allows managing all aspects of customer relationships, from marketing to sales to service.

**SAP Product Lifecycle Management:**

SAP PLM provides customers with a 360-degree-support for all product-related processes – from the first product idea, through manufacturing to product service.

**SAP Supplier Relationship Management:**

SAP SRM automates, simplifies, and accelerates procure-to-pay processes for goods and services. With SAP SRM, customers can reduce procurement costs, build collaborative supplier relationships, better manage supply bases, and improve your bottom line with innovative offerings and a faster time to market.
**SAP Supply Chain Management:**

SAP SCM can help transform a linear, sequential supply chain into a responsive supply network – in which communities of customer-centric, demand-driven companies share knowledge, intelligently adapt to changing market conditions, and proactively respond to shorter, less predictable life cycles. SAP SCM provides broad functionality for enabling responsive supply networks and integrates seamlessly with both SAP and non-SAP software.

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**Technology Platform SAP NetWeaver**

Like all other SAP solutions, SAP Business Suite is powered by the technology platform SAP NetWeaver. It includes a comprehensive set of components and tools. With application servers for running ABAP and Java based applications, it provides a highly scalable and solid middleware foundation for SAP Business Suite applications such as SAP ERP. Other components provide advanced integration capabilities for business intelligence and collaboration. A few of the prominent components are:

- **The SAP NetWeaver Business Warehouse (SAP NetWeaver BW) component:**
  SAP NetWeaver BW enables a scalable enterprise data warehouse.

- **The SAP NetWeaver Process Integration (SAP NetWeaver PI) component:**
  SAP NetWeaver PI allows connecting applications and data sources to integrate processes.

- **The SAP NetWeaver Portal component:**
  SAP NetWeaver Portal allows providing role-based views that span the customer’s enterprise, enabling everyone to take full advantage of information resources.

- **The SAP NetWeaver Master Data Management (SAP NetWeaver MDM) component:**
  SAP NetWeaver MDM supports customer data integration, global spend analysis, global data synchronization, product content management, mergers, and acquisitions.
SAP Industry Solutions

SAP Business Suite serves as the foundation for every solution portfolio SAP offers, serving the needs of customers in more than 25 major industries. The suite can be configured and deployed quickly to address specific industry requirements and processes. Fully enabled by service-oriented architecture (SOA), the latest SAP Business Suite software provides more than 2,800 enterprise services to give greater flexibility to organizations in a wide range of industries.

Often SAP Industry Solutions are delivered as add-ons to general-purpose applications, particularly to SAP ERP. Some industry-specific applications may run stand-alone, and others require SAP ERP or other SAP Business Suite software.

SAP ERP

Although Enterprise Resource Planning (SAP ERP) is part of all scenarios described in this document it is treated separately. It is one of the core applications of the SAP Business Suite and can be viewed as de facto standard for business software. Consequently, SAP ERP can be found at many smaller companies without other SAP components installed.

SAP Business All-in-One

SAP Business All-in-One may be viewed as a subset of SAP Business Suite. It is a configurable and extensible business solution for midsize companies.

Components on top of SAP NetWeaver, which includes SAP NetWeaver BW, are SAP ERP and SAP CRM.

Part of the solution is the SAP Best Practices family of packages, which provides proven methods for implementing best practices in key functional areas and industries.

SAP Business All-in-One is available in industry specific flavors regarding functionality and services.

For more information regarding this solution, see [http://www.sap.com/businessallinone](http://www.sap.com/businessallinone)

Development, Test and Production System Landscapes

An SAP system consists of a logical database, one or more application server instances (ABAP and/or Java), central services (such as a message server and enqueue server), and in some cases, optional components. An SAP system is identified by its SAP system ID (SID), which consists of 3 letters or digits (e.g. PRD).

An SAP recommended landscape for a single component always includes three individual SAP systems: the development system (DEV), the quality assurance system (QAS) and the production system (PRD). This way, customizations to SAP delivered components, support packages, SAP kernel etc. can be implemented and tested in the DEV and QAS systems before they are deployed into the PRD system.

The separation of the development and test systems from the production system in terms of hardware and operating system enables implementation and test of OS and DB patches before doing this on the production server.

The three system SAP landscape is in principal then replicated for each SAP application.

![Figure 2 Production, quality assurance and development systems](image-url)
Technology Stacks ABAP, Java, MDM

A specific SAP system is identified by a System-ID (SID), whereas processes belonging to one particular SID are grouped into instances. Instances may be categorized into certain types according to their underlying technology and the corresponding characteristics in terms of resource consumption and workload.

SAP’s traditional workload runs on ABAP instances. Those are powered by a C based kernel that ensures abstraction from platform and database peculiarities at application level. At kernel level platform optimization is a permanent effort taking advantage of new features and capabilities of the underlying operating system and database.

In addition to the ABAP stack there are SAP products utilizing Java technology compliant with the Java EE standards. Similar abstraction standards and strong integration of the framework into the C kernel even allow for integrated instances with ABAP and Java processes. Systems of that kind are called dual stack systems in contrast to single stack systems with pure ABAP or Java instances.

Some products like MDM run on instances with complementary technology stacks. They are described as separate instance types, named by the product itself.

Proper isolation of systems with concurrent workload will be one basic requirement to ensure stability of each solution.

Two-tier, Three-tier Landscapes

Scalability is a key requirement for business applications. SAP systems can scale by increasing the number of work processes in an instance and by using the concept of three-tier landscapes.

In Figure 4, the left-most box shows a two-tier configuration where the central instance and database are both residing in one partition on a server. The right boxes show a three-tier architecture where the database and application server instance are on different partitions or even on different servers. As scaling requirements increase, additional partitions and/or servers can be added.

The capacity of an instance can be scaled by increasing the number of processes or additional instances on the same server. The maximum workload of a SAP system can be extended by instances on additional application servers. Every system owns a singular central instance, which also provides a set of unique services. In Java, and optionally in newer ABAP systems these services are externalized into one particular central services instance.

Because of platform and database abstraction an additional application server is not necessarily hosted on the same platform as the central instance. In the context of IBM i, Windows, Linux on POWER and IBM i application servers are supported. The IBM i application server is used in homogeneous environments, while in heterogeneous environments the Windows application server option is very commonly used.
SAP Solution Manager

The SAP Solution Manager was introduced by SAP as a central system to manage an SAP business landscape. Meanwhile SAP has made it mandatory for all customers hence it needs to be included in any SAP implementation.

The SAP Solution Manager basically is an SAP system with ABAP and Java stack. It has a connection to SAP as well as connections to all single systems existing in the local landscape.

Solution Manager fulfills different tasks such as:

- Central system repository (for example SLD – System Landscape Directory)
- Business process management
- Lifecycle Management – manage software updates, upgrades etc.
- Central monitoring system
- Entry point for SAP support
- Enablement of new additional SAP system installations

Standalone Engines (ADS, SAP NetWeaver Enterprise Search, SAP APO Live Cache, …)

For different reasons some SAP components are relying on third party services or on particular processor architectures. As a consequence, not every single component may be supported natively on every platform. Examples are Adobe Document Services (ADS), SAP NetWeaver Enterprise Search or the SAP Advanced Planning and Optimization (APO) Live Cache, which are described later in the context of the SAP Business Suite Reference architecture. These components can be integrated into an IBM i based solution as standalone engines. How this can be achieved is part of the Extended Scenarios section.
IBM i and POWER Systems Components

This section discusses the key features of IBM i and IBM POWER Systems which are often used within SAP environments.

PowerVM LPARs with Shared Processor Pool

The IBM PowerVM dynamic logical partition (LPAR) functionality enables the split of one physical machine into several logical systems. One LPAR is running a single operating system image. Hardware resources are then assigned to those partitions, either static or also dynamically shared with other partitions. Using LPARs is a very efficient way to maximize the utilization ratio of available hardware resources. The processors available in a system can be placed into a shared processor pool. Out of this pool the processing capacity can be assigned to the LPARs. One possibility is to assign a minimum processing capacity to each LPAR and let the remaining capacity be dynamically assigned to an LPAR when needed. To avoid that one LPAR is consuming all processor capacity it is also possible to restrict the maximum processing capacity for an LPAR. Using LPARs is an efficient way to achieve the separation of the development, test and the production workload. Even running only one LPAR provides greater flexibility and advanced management functions and is therefore recommended.

IBM i Work Management

The IBM i operating system provides flexible concepts for managing workload which are widely used by the SAP implementation.

The most obvious implication is that every instance of an SAP system is running in its own subsystem. Subsystems are an IBM i unique feature and provide advantages in terms of resource management and isolation when running multiple SAP systems within the same OS image.

SAP on i customers regularly take advantage of the benefits of sharing a single large memory pool within a partition for multiple SAP applications, where the OS is allowed to manage the usage of the pool by all the subsystems that are sharing it. In some cases, the concept of routing jobs of certain characteristics into dedicated memory pools may be used to address a condition resulting from the coexistence of C and Java stacks within SAP systems. Implied by the languages themselves, both stacks show significant differences in memory management. For example, protection from paging of shared resources as a result of Java garbage collection can be achieved by a dedicated memory pool for all or a selected set of Java processes.

Implementing the SAP landscape on IBM i therefore gives enterprises the full advantages of workload management and virtualization capabilities offered by the IBM i operating system and the IBM POWER Systems hardware.
IBM i Operating System Options

The IBM i operating system is available in three editions: The Standard, Enterprise and Express edition.

The IBM i Standard Edition is a fully enabled OS license which includes full entitlement to DB2 for IBM i. This should be used for the DB servers of most SAP systems.

The IBM i Enterprise Edition extends the Standard Edition with support for multiple interactive 5250 sessions. This edition can be used if there are 5250 legacy applications on the same server or partition as the SAP environment.

The IBM i Express Edition is a lower cost OS license meant for use by application server types of workloads as opposed to DB intensive workloads. This license can be used for partitions hosting SAP Solution Manager, SAP NetWeaver Enterprise Portal or SAP NetWeaver Process Integration. It can also be used for true three-tier application servers attached to a DB on a partition that is using a Standard Edition license.

IBM POWER Systems Server Options

The implementation of a SAP on IBM i solution can run on any IBM POWER model that is capable of running IBM i, including server and Blade configurations. The servers are capable of consolidating multiple workloads through their high scalability. With direct attached internal storage, the server models allow building an integrated and simple solution running in only one server, resulting in minimum administration efforts.

Capacity Backup models are available to reduce the cost of High Availability/Disaster Recovery solutions. These models are meant to be used as failover systems—usually idle, but fully enabled in case the primary system goes offline for any reason.

The IBM i support for POWER Blade servers opens the possibility to consolidate small SAP and non-SAP systems into a single BladeCenter. Together with x86 based blade servers, the BladeCenter is able to integrate heterogeneous landscapes. BladeCenter configurations may require external storage attachment and/or PowerVM Virtual I/O Server support.

IBM i Solution Edition for SAP

The IBM i Solution Edition for SAP is a special offer for optimizing IT costs when implementing a SAP on IBM i solution. The Solution Edition includes an IBM POWER Systems hardware model, operating system, database and maintenance. The IBM i Solution Edition for SAP is available for new hardware purchases in conjunction with a new or upgraded SAP license purchase. For the available options and more information, see the IBM website or an IBM sales representative.

IBM PureSystems

IBM PureSystems is an integration platform that allows consolidation of x86 and POWER based server architectures and storage systems. The PureSystems chassis provides space for up to 14 compute nodes. A V7000 based storage node is also available. With built-in network infrastructure and management appliance, PureSystems represents a data center in a box. Heterogeneous SAP landscapes that contain both POWER and x86 based components fit well into the PureSystems infrastructure. For more information about the deployment of SAP landscapes onto IBM PureSystems refer to the IBM Techdocs white paper “Efficiently Deploying SAP Landscapes on the IBM PureFlex System”: http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102087.
IBM System Storage Options

Traditionally IBM i based systems use direct attached internal storage. Internal storage provides advantages in terms of maximum integration and minimum administration.

External attached storage offers additional flexibility when implementing more complex solutions.

Heterogeneous environments, some high availability options, solutions involving flash copy and highly virtualized configurations often depend on external storage. Some storage configurations may require a PowerVM Virtual I/O Server (VIOS) – usually for external storage or BladeCenter or some types of virtual devices. Use of all IBM i solutions related to external storage, including those requiring VIOS are compatible with SAP applications.

Solid State Disks

Solid State Disks (SSD) can be utilized to help improve the performance of data access by applications. With hierarchal storage management provided by IBM i, the most active data can be automatically placed on SSD making it easier to get the benefit from SSD’s fast I/O response times. The “SAP on IBM i Solid State Disk (SSD) Usage Recommendations” white paper, available on IBM Techdocs (http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101795), contains useful information about how to utilize SSDs in an SAP environment.

SSD drives can also be used to replace spinning disk drives to reduce space and energy requirements while maintaining or improving overall I/O performance. SSDs can be used for IBM i either internal or external disk configurations.

IBM Easy Tier

Available on several IBM external storage devices, IBM Easy Tier is a built-in function that automatically balances data between SSD and HDD drives based on the data access pattern. Data that is read frequently is placed on SSD drives to decrease read response times and improve I/O throughput, while infrequent accessed data is placed on the slower HDD drives.

Disk Compression with IBM Storwize V7000

The IBM Storwize V7000 external storage system provides a good storage option for many SAP on IBM i landscapes. The standard configuration holds up to 24 disk drives that can either be SSD or HDD drives, or a mixture of both. The system can be extended by further disk enclosures to grow in capacity.

Software version 6.4 of V7000 enables real time disk compression on a logical disk volume basis. Real time disk compression reduces the amount of required disk space without significant impact to the I/O response time for most workloads. Compression rate for a typical SAP ERP system is between 50 and 70 percent. The IBM Redpiece “Real-time Compression in SAN Volume Controller and Storwize V7000” available at http://www.redbooks.ibm.com/redbooks.nsf/RedpieceAbstracts/redp4859.html?Open contains more detailed information about the compression feature which is also available with the IBM SAN volume controller.
Business Continuity with High Availability

This section summarizes several options that are available to minimize any downtime scenarios which may occur in SAP environments.

Database Reload

Database reload is a method to establish a very basic level of high availability for the production system. The database of the production system is therefore copied on a regular basis to either the quality assurance system or a copy of the production system. The copied system can then serve as a backup system in case the production system fails. To protect the production system against hardware fails, the copied system should be placed on a separate server machine. The copy of the database can be easily performed with save/restore methods provided by IBM i.

SAN Boot

Storage Attached Network (SAN) Boot is a simple but efficient method to recover from a hardware failure. It requires that there is a second server system available and that the data resides on an external storage device. When the main system fails due to a hardware error, the external storage is attached to the backup system and the backup system is then booted with those disks. Using this solution the production system can be back online within half a day.
Logical Replication

The logical replication approach is based on IBM i object journaling technology. Changes and updates to objects are applied to the secondary server by replaying the journal entries from the source server. Logical replication does not require an iASP or external storage. Logical replication is best suited for systems running only a few databases due to the administration effort. For systems running many databases in one IBM i partition, an iASP based HA solution is preferable.

![Logical Replication Diagram](image.png)

**Figure 11** Shadow Database: journal entries are replayed on the backup system

IBM PowerHA iASP based High Availability Options

The hardware replication technologies within the PowerHA SystemMirror product are based on the independent auxiliary storage pool (iASP) technology provided by the IBM i operating system. The iASP is a set of disks than can be dynamically configured in and out of an IBM i system and therefore can be easily replicated or moved between systems. Most commonly, the iASP is replicated using the geographic mirroring, Metro Mirror, or Global Mirror technologies. When the iASP is configured on an external storage device, it can also be switched between physically separated systems, called LUN-level switching. The switched disk technology can also be used with an iASP on internal storage, but then it can only be switched between logical partitions of the same machine. SAP is fully enabled to make use of an iASP configuration. A new SAP system can be installed to an iASP directly, or an existing system can be moved into an iASP with tools delivered by SAP.

To enable automatic failover scenarios all PowerHA options also require a cluster configuration. The IBM i cluster technology provides the tools to create and manage a cluster of two or more IBM i systems. One system in the cluster is configured as the primary node running the production workload. All other systems in the cluster are secondary nodes. The cluster configuration is then monitored and if the primary cluster node fails, an automatic switchover to the next in line secondary system is initiated. The switchover moves the iASP to the secondary system which then can run the production workload.

The LUN-level switching and switched disk options allow recovery from a system hardware failure within a few hours but do not protect the system against data loss due to a storage failure. To prevent data loss the following mirroring solutions can be implemented on top of the iASP based cluster.
PowerHA Geographic Mirroring

Geographic Mirroring is creating a copied image of an iASP that is attached to a second server system. The connection between the primary and the secondary system is established over an IP network, which allows the geographically distant placement of the secondary system. The actual mirroring of the data is performed on data segment basis. Data segments from the primary server are sent to the secondary server either synchronously or asynchronously. In synchronous mode a writing job on the primary server has to wait for the secondary system to acknowledge the successful write of the data segment before it’s allowed to continue. Depending on the bandwidth and distance of the network connection this can cause a noticeable performance impact on the primary server. In asynchronous mode the writing job on the primary server is allowed to continue once the secondary server has received the data segment but has not necessarily written the segment to disk yet. This reduces the performance impact on the primary server. Since the replication is done by IBM i, geographic mirroring supports internal or external disk, either attached natively or virtually.

![Figure 12 Geographic Mirroring: storage segment based replication](image)

PowerHA Metro Mirror and Global Mirror

Metro Mirror and Global Mirror works in the same way as Geographic Mirroring, except the data copy is handled by an external storage device. Therefore, the system CPU is not occupied with the data copy process. The synchronous mode is called Metro Mirror, the asynchronous mode is called Global Mirror because the asynchronous mode allows greater distances between the storage devices. PowerHA currently supports the DS6000, DS8000, Storwize V7000, and San Volume Controller (SVC) storage devices.

![Figure 13 Metro Mirror / Global Mirror: replication handled by external storage device](image)
PowerHA with SAP Application Resiliency

The SAP application itself is also able to provide resiliency by using a configuration that does not have a single point of failure.


You can find a Configuration Guide for IBM i on the SAP Community Network under the following URL: http://scn.sap.com/docs/DOC-8541.

High Availability Options Summary

The following table gives an overview over the described high availability options in order to allow a quick assessment which option meets given requirements:

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<td>½ day</td>
<td>Hardware fail</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
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<td>Hardware fail</td>
<td>External</td>
</tr>
<tr>
<td>Logical Replication</td>
<td>½ - 2 hour</td>
<td>Hardware fail</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Storage fail</td>
<td>External</td>
</tr>
<tr>
<td>Geographic Mirroring</td>
<td>½ - 2 hour</td>
<td>Hardware fail</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Storage fail</td>
<td>External</td>
</tr>
<tr>
<td>Metro Mirroring</td>
<td>½ - 2 hour</td>
<td>Hardware fail</td>
<td>External</td>
</tr>
<tr>
<td>Global Mirroring</td>
<td>½ - 2 hour</td>
<td>Hardware fail</td>
<td>External</td>
</tr>
<tr>
<td>Power HA with SAP application resiliency</td>
<td>10 minutes for application failure 2 hours for DB failure</td>
<td>Hardware fail Storage fail Application fail</td>
<td>Internal External</td>
</tr>
</tbody>
</table>

* Recovery Times are depending on system configuration, size and type of failure and may vary
SAP on IBM i Implementation Options

This section describes the two commonly used ways to get started with an SAP environment.

Standard Installation with SAP Software Delivery Tool

The standard installation using the SAP Software Delivery Tool follows standardized rules and steps which are the same for all platforms. Some typical steps are:

- Determine the SAP products to install
- Determine and get the hardware and the sizing needed to run the SAP products
- Get the SAP Installation Documentation including SAP Notes
- Get the SAP Installation media
- Prepare and setup the hardware according to SAP Installation Documentation and SAP Notes
- Run SAPinst for every product to be installed
- Configure and update the SAP products using for example the latest software packages, fixes, kernels

SAPinst provides the necessary flexibility to install SAP products and to build up the desired SAP landscape.

IBM i Quick Install Option for SAP Business All-in-One

IBM i Quick Install Option for SAP Business All-in-One is a simplified turn-key offering for specific industries in the small and medium enterprise (SME) market segment. The concept complements IBM’s POWER Systems and is aimed at minimizing the initial setup/implementation time down to, ideally, as little as a single day. The IBM i Solution Edition for SAP delivers value and performance in a very attractive package that is targeted and optimized for SAP customers in the SME market.

IBM i Quick Install Option for SAP combines software, database and hardware into one package, with all components optimized to help midsized companies drive down the total cost of ownership while protecting their overall IT investment. Basic components may include:

- IBM POWER Systems - servers with simplified pricing, reduced energy and administration costs
- IBM i operating system - a highly scalable and virus-resistant OS.
- IBM DB2 database - industry-leading performance and seamless integration into SAP
- SAP ERP 6, SAP NetWeaver BW 7(in progress), SAP CRM 7(planned), SAP Solution Manager
- SAP Solution SAP Best Practices packages

The main idea is: “out-of-the-box”. Install, set-up, configure and validate a dedicated SAP landscape once at SAP, IBM, SAP Value Added Resellers, IBM Business Partners, save it to an IBM i tape and deploy this landscape at multiple customers within a single day.
SAP on IBM i Reference Architectures

SAP solution scenarios can be successful with IBM i at the center of the environment. IBM i runs the core SAP technology stacks (ABAP, Java, MDM) natively, providing the foundation for SAP NetWeaver and SAP Business Suite and all of the SAP Industry Solutions.

Most SAP on IBM i customers prefer two-tier architectures for their simplicity and because they scale very well without requiring a separate application server. Due to the efficiency of IBM i subsystems, it is very common for customers to run multiple SAP systems within a partition, especially for development, test and QA. It is also fairly common to see multiple production SAP systems within a partition. Customers also may take advantage of IBM i subsystems to run non-SAP applications either in the same IBM i partition with SAP systems. Nearly all customers take advantage of IBM Power VM partitioning technology to some degree, most often to separate non-production from production workloads.

Most SAP on IBM i customers implement some sort of High Availability and/or Disaster Recovery solution, either a third party logical replication solution or an IBM Power HA solution. Some of the Power HA solutions will take advantage of IBM i IASP technologies and/or external storage functionality. SAP applications can run equally well with either internal or external disk, and can often benefit from using SSD technology in either case.

Three-tier architectures are rarely necessary for scaling, however some SAP components that do not run natively on IBM i may require them. Other standalone SAP components that need to connect to core SAP technology stacks running on IBM i may do so via standard SAP APIs over the TCP/IP network. There are no SAP components that cannot be used in some way with an IBM i centered SAP implementation.

In addition to taking advantage of IBM i subsystems and IBM PowerVM, IBM HW and SW acquisition costs can be reduced by taking advantage of the IBM Solution Edition models, Capacity Backup models and/or the IBM i Express Edition license. Also, many of the components that do not run on IBM i can run in AIX, Windows or Linux environments that can be either hosted by IBM i or be on the same Power machine with the IBM i partitions.

The following reference architectures are reflecting the considerations above and show examples how to implement SAP Business Suite application based landscapes on IBM i.
Basic SAP ERP

The reference architecture for an SAP ERP solution on IBM i is implemented as a simple integrated single server configuration. The server runs two partitions, one for the production, one for the development and test workload. This setup ensures that the production system can run undisturbed from the development and test activities. Using multiple LPARs also allows flexible and dedicated resource assignments, ensuring the production system is not constrained by resources used from DEV and QAS systems.

The SAP Solution Manager is not resource demanding and therefore also installed into the development and test partition. The availability of the SAP Solution Manager is usually not critical for the production systems.

Of course, variations of this setup are feasible. It is also possible to install development and test instances of the SAP Solution Manager when required. It is certainly also possible to run all the SAP systems in one LPAR only if the resource requirements allow that.

Figure 16 Basic SAP ERP reference architecture on two LPARs including SAP Solution Manager

A very easy approach to create a stand-by backup production system for this configuration is to use the database reload method. Adding a second server machine and external storage allows implementing a SAN boot based recovery solution as well. Both options are described in more detail in the HA section.
SAP Business All-in-One

The SAP Business All-in-One solution consists of three SAP Business Suite applications: SAP Enterprise Resource Planning (SAP ERP), SAP NetWeaver Business Warehouse (SAP NetWeaver BW) and SAP Customer Relationship Management (SAP CRM) applications. The SAP ERP application covers the essential functionality an enterprise requires to run its business including financial, human resources and sales and distribution modules. To optimize business decisions an enterprise requires the capability to analyze data that is stored within the IT systems and applications it’s running. This functionality is provided by a business intelligence solution like SAP NetWeaver BW. SAP NetWeaver BW integrates information from internal and external sources and transforms it into valuable business information for decision making. Increasing the efficiency of communication with its customers is another requirement an enterprise is facing. The SAP CRM application is offering solutions to manage all aspects of customer relations like marketing, customer interaction, distribution and service.

![Diagram of SAP Business All-in-One reference architecture](image)

Figure 17 SAP Business All-in-One reference architecture with an iASP based mirroring solution

The reference architecture for a SAP Business All-in-One solution on IBM i implements an iASP based high availability concept to ensure high availability of the SAP ERP and SAP CRM applications. The SAP ERP and SAP CRM applications run in one partition on the production server. With dedicated memory pools defined for the subsystems, the ABAP and Java workloads can safely run in the same LPAR.

The decision which of the available iASP based mirroring solutions to use depends on the individual needs of the enterprise. To learn more about the available options, see the High Availability section.

The backup server system is not only used for providing a partition for the stand-by SAP ERP and SAP CRM applications. It is also used to run partitions for the BW production system and the development and test systems for all SAP applications. Development and test systems have usually a different workload distribution and are not as resource demanding as production systems. That is why multiple DEV and QAS systems can easily share resources and run in the same LPAR.

The SAP Solution Manager is also installed into the development and test partition, because it is not resource demanding as well. Running the SAP NetWeaver BW production system in its own partition allows flexible resources provisioning and ensures that there will be no performance issue during peak usage of the SAP NetWeaver BW application.
SAP Business Suite

The SAP Enterprise Resource Planning (SAP ERP), SAP Customer Relationship Management (SAP CRM), SAP Supply Chain Management (SAP SCM) and SAP Product Lifecycle Management (SAP PLM) components are building the base of the SAP Business Suite reference architecture for IBM i. SAP Supplier Relationship Management (SAP SRM) is not shown in the picture, it would be added the same way as the other components though.

The production systems of the SAP Business Suite components are located in an iASP of one partition. This enables the mirroring of the production systems to a backup server with one of the options described in the High Availability section.

The SAP NetWeaver Portal (EP) and SAP NetWeaver Process Integration (SAP NetWeaver PI) components are installed in a separate partition. Due to the workload characteristics of those components the partition can be run with an IBM i Express Edition operating system version. If one or both of these components are business critical, for instance when the portal is running an online-shop, the EP and SAP NetWeaver PI systems should also be mirrored to the backup server like the core SAP Business Suite components.

The SAP SCM Business Suite component is extended with the SAP SCM LiveCache module to boost the performance of supply chain planning. The SAP SCM LiveCache server can be run on a Linux on POWER or AIX partition running on the same server machine as the other production systems. Alternatively the SAP SCM LiveCache server can run on a separate x86 based server also.

The backup server machine holds the stand-by partition for the core SAP applications, the SAP NetWeaver Business Warehouse (SAP NetWeaver BW) production system and the development and test systems for all SAP applications in their own LPARs. The SAP Solution Manager is installed to the development and test LPAR.

Figure 18 SAP Business Suite reference architecture implements business continuity of a complete solution portfolio leveraging integration capabilities of IBM i
Extended Scenarios

This section describes selected IBM and/or SAP technologies which may be of interest. They are not always required, but appear often enough or are unique enough to justify mentioning where they may fit in an IBM i centered SAP solution landscape.

SAP Landscape Optimization with IBM i Express Edition

The IBM i Express Edition license is meant for use by applications that generate only minimal database workloads. Therefore this license can be used for partitions hosting SAP Solution Manager, SAP NetWeaver Enterprise Portal (EP), SAP NetWeaver Process Integration (PI) and SAP NetWeaver Composition Environment (CE) systems. It can also be used for three-tier application servers attached to a DB on a partition that is using a Standard Edition license.

The Express Edition license cost is lower compared to a Standard or Enterprise Edition license. Running Solution Manager, EP, PI or CE systems on an Express Edition can therefore optimize OS license costs for a SAP landscape. In three-tier landscapes, license costs for additional application servers can also be optimized by using the Express Edition.

Furthermore SAP EP, PI and CE license costs are based on the CPU usage of these systems. The license fee is depending on the maximum number of CPUs the SAP system can make use of. That is why it is recommended to run those SAP systems in their own LPAR with dedicated CPU resources.

![Figure 19 Example for License Cost Optimization](image)

Figure 19 above on the left shows a landscape running a PI and EP systems in the same LPAR as an ERP system. In this case, even though the available CPUs will be mostly occupied by the ERP workload, all CPUs need to be licensed for the PI and EP systems. As shown on the right in Figure 19 above, placing the PI and EP systems in their own LPAR allows licensing only the CPUs really needed for these systems. The two extra LPARs required are running an IBM i Express Edition license, keeping the OS license costs for those low.
PowerVM IBM i Hosted Disks

IBM i has the ability to host disk storage for other platforms within an IBM i partition using IBM i objects called network server storage spaces (NWSSTG). Hosting the disk of other platforms allows a very tight integration of SAP components that are not running on IBM i directly, like Adobe Document Services or SAP Business Objects components; and also offers some interesting options since an i partition can host the disk for a different i partition.

IBM i network server storage spaces can be thought of as virtual disk drives. That IBM i makes available to other partitions or servers - either AIX or Linux partitions, or Windows environments on an IBM BladeCenter or System x server. These storage spaces can be allocated on the hosting IBM i partition from its system storage pool (ASP), a user storage pool or an independent user storage pool.

IBM i commands can be used to backup entire hosted environments by simply backing up the virtual disk drives (storage spaces). This provides a disaster recovery backup of the server, since the entire image of the hosted server can be recovered quickly by simply restoring the server’s virtual disk drive objects to the host partition.

Even other IBM i partitions can be hosted by an IBM i. This can be useful for multiple sandbox, training or testing scenarios. For example, it’s possible to set up an SAP system on a network server storage space, then save the image. After the system was used, it can be easily restored to its original state in one simple step by restoring the image.

Figure 20 Integration of heterogeneous components utilizing hosted disks

There is no restriction to what type of application can be run in a hosted environment. For SAP on IBM i the most suitable applications are the standalone engines that do not natively run on IBM i. Some of which are described in more details in the following section.

PowerVM Live Partition Mobility for IBM i

With technology refresh four (TR4) of IBM i 7.1, IBM i is enabled to perform LPAR migrations from one physical POWER7 server to another without interruption. SAP states support for Live Partition Mobility (LPM) in SAP note 1102760, meaning that LPM can be performed with running SAP systems. Prerequisites for LPM are POWER7 servers with PowerVM Enterprise Edition and a fully virtualized system setup using Virtual I/O Server and external storage.
SAP Standalone Engine Scenarios

Standalone engine scenarios refer to a set of SAP components that run as specialty appliances. For various reasons these components do not run on all SAP NetWeaver platforms, or may only run on one platform. It is always the case that there is a way to incorporate these components into an IBM i-centric SAP solution because they are integrated within SAP landscapes using standard industry or SAP protocols.

SAP Adobe Document Services

The SAP Adobe Document Services (ADS) enhance the document handling capabilities of the SAP applications. The main idea is to replace the cost-intensive manual document handling by a complete digital document handling which is fully integrated into the SAP processes. Especially globally acting companies with locations all over the world handling documents in different languages appreciate the ability to reduce the amount of costly paper-based processes. This applies also to national companies which have a lot of remote branches and/or consultants with only loose contact to the headquarter. ADS enables all SAP applications (either ABAP or Java) to use the full range of the Adobe Acrobat document software. This functionality is provided by the so-called SAP INTERACTIVE FORMS by Adobe which are saved in the file format PDF (Portable Document Format). The main functions are:

- Derive dynamic PDFs from data within an SAP system
- Readout data from forms and put it directly into an SAP system
- Enable users to sign PDFs digitally
- Provide interactive forms that look exactly the same as paper versions
- Use forms in offline and online scenarios
- Attach files of different formats to a PDF inside
- Put remarks on PDF documents and collaborate on PDF reviews

Although SAP ADS is running in a SAP NetWeaver Java system the services itself are not completely implemented in Java. ADS still use a proprietary coding which is not implemented on all platforms. To close this gap SAP recommends installing an additional stand-alone Application Server Java on a platform supported by ADS. For IBM i it’s recommended to install ADS on a Windows server. In general one SAP ADS server can serve all SAP systems in the SAP landscape.

Figure 21 Adobe Document Services integration into an IBM i based landscape
SAP BusinessObjects

SAP BusinessObjects offers a broad portfolio of tools and applications designed to help customers to optimize business performance by connecting people, information, and businesses across business networks.

One central component of SAP BusinessObjects is the SAP BusinessObjects Enterprise server. The Enterprise server offers an integrated suite for reporting and analysis of data from various sources. It also serves as an information delivery hub, making reports available to end users via a variety of web based interfaces. Other BusinessObjects frontend applications connect to the Enterprise server.

While the Enterprise server is a self-contained system that runs on either a Windows, Linux or UNIX system, it can make use of IBM i as a data source. Data sources can be any SAP system running on IBM i, like ERP and BW systems, as well as any database running on IBM i. To integrate the Enterprise server more tightly to the IBM i landscape, the server could also take advantage of the IBM i hosted virtual disks. See section PowerVM IBM i Hosted Disks for more details.

SAP BusinessObjects provides various means to connect to data sources. More details about how to connect data sources running on IBM i are described in the white paper “SAP BusinessObjects and IBM i” which can be found on the IBM Techdocs webpage.

Figure 22 SAP BusinessObjects components utilize IBM i as data source
SAP HANA

SAP HANA is a specialized standalone in-memory database that can aggregate very large data sets in a short period of time. For SAP systems running on IBM i, HANA is not required, but can be used to accelerate certain SAP Business Suite applications.

In this so called side-by-side scenario, the SAP systems are running on the IBM i operating system and DB2 for i relational database, SAP HANA is used for specific data processing tasks. Certain SAP Business Suite applications can make use of SAP HANA to accelerate query processing. The SAP Landscape Transformation (SLT) replication server can then be used to provide almost real-time data replication sourcing from SAP applications running on IBM i to SAP HANA. Communication between the SAP HANA appliance and the SAP system on IBM i is done via standard SAP APIs and TCP/IP network interfaces.
SAP Supply Chain Management Extensions

SCM LiveCache and SCM Optimizer

SAP SCM (Supply-Chain-Management) is part of the SAP Business Suite. It offers the ability to collaborate cross company and to plan, execute and coordinate corporately on the entire supply network.

A former additional product for SCM called APO (Advanced Planner & Optimizer) is meanwhile integrated into the SCM. Optional features of the APO were the APO LiveCache and the APO Optimizer, now called SCM LiveCache and SCM Optimizer.

The SCM LiveCache is a server which keeps all planning relevant data in the main storage to speed up the data processing. The persistence layer of the SCM LiveCache server is always a MaxDB database.

The SCM Optimizer is an enhanced optimizer to support planning by mathematical methods or a heuristic.

Currently these optional SCM features are running only on Windows, Linux and AIX. To run the solution on IBM i these SCM programs have to be installed on a different dedicated server. The SCM LiveCache and the SCM Optimizer may be used as a single feature or they may be used in parallel. This depends on the needs of the customer. To integrate the additional servers more tightly to the IBM i landscape, the server could also take advantage of the IBM i hosted virtual disks. See section PowerVM IBM i Hosted Disks for more details.

To communicate with the remote SCM LiveCache server an SCM LiveCache client has to be installed on IBM i, which is done automatically since SCM 2007.

Figure 24 SAP SCM optional software integration on AIX

Figure 25 SAP SCM optional software integration on Linux/Windows
SAP Forecast and Replenishment (F&R)

This optional solution for retail is dependent on a 3rd party piece of software that is not currently available natively on IBM i. Customers should request a native solution from SAP if this is desired. Otherwise it is possible to run F&R in a separate partition or server on either Windows or AIX – and it is possible that this separate partition could take advantage of the capability of IBM i to host the disk in virtual storage.

SAP Internet Pricing and Configuration (IPC)

The SAP Internet Pricing Configuration module is part of the SAP Customer Relationship Management (CRM) application. It allows users to configure products online and compare prices across different catalogs and marketplaces, and also includes shopping basket functions. For IBM i there are two options to integrate IPC.

1. The first option is to run IPC natively on IBM i in an ABAP application server. IPC uses a Virtual Machine Container (VMC) which is a Java runtime environment embedded into the ABAP work processes. It is recommended to run IPC on its own application server rather than together with the standard CRM workload. The VMC has higher demands for memory and CPU resources than the standard ABAP work processes and therefore running the VMC on a separate application server allows better control over the required resources. Using the IBM i workload management and virtualization capabilities the additional application server can still run within the same IBM i partition as the standard CRM application server.

2. The second option is to run IPC on a dedicated server. This server can be either installed as a 3-tier application server or a standalone server running IBM i or Windows. To integrate the additional server more tightly to the IBM i landscape, the server could also take advantage of the IBM i hosted virtual disks. See section PowerVM IBM i Hosted Disks for more details.

IBM i Application Integration with SAP

IBM i is a proven business software platform capable to run many different applications available from IBM and other software vendors. Those applications can be integrated with an SAP system in several ways, where the most common are:

- SAP NetWeaver Process Integration to integrate external data sources
- SAP NetWeaver Business Warehouse to integrate non SAP databases
- ABAP reports, JAVA programs for custom integration of external data
- Access to SAP from external applications utilizing RFC, JDBC, JCo

The decision where to run the IBM i applications depends on their type of usage. Applications that require an interactive 5250 access are usually not run in the same partition as the SAP systems. The main reason for that is that the 5250 access requires the IBM i Enterprise Edition operating system version, while the SAP systems requires either the IBM i Standard Edition or Express Edition only.
Further Topics and References

For the topics covered in this document there is more information available on the following websites:


The following topics show and exploit specific features of the platform and are viewed as important. However, they are not part of a reference architecture. Therefore, they are not covered in detail in this document. To learn more about these topics, see referred documentation:

- Monitoring as one part of technical operations: [http://scn.sap.com/docs/DOC-8335](http://scn.sap.com/docs/DOC-8335)
- Out of the SAP Services portfolio of service offerings, the SAP EarlyWatch Check is essential. It analyzes the components of SAP software, including the operating system and database. Information can be found at [http://www.sap.com/services](http://www.sap.com/services)

Find more information of interest here:

- The SAP developer community network (SAP SCN) offers a SAP on IBM i space with discussion form, blog articles and other featured content for SAP on IBM i: [http://scn.sap.com/community/ibm-i](http://scn.sap.com/community/ibm-i)
- The IBM information page for SAP on IBM i contains latest news and links to the current info APAR for SAP on IBM i: [http://www.ibm.com/developerworks/ibmi/sap](http://www.ibm.com/developerworks/ibmi/sap)
- The IBM Techdocs website is another good source of documentation about IBM i in general and also SAP on IBM i specific topics: [http://www.ibm.com/support/techdocs](http://www.ibm.com/support/techdocs)
- An IBM Redbook providing a technical deep dive into all aspects of a SAP on IBM i installation is available from the IBM Redbooks website at [http://www.redbooks.ibm.com/abstracts/sg247166.html](http://www.redbooks.ibm.com/abstracts/sg247166.html)
- To get in touch with the experts from the International IBM SAP Competence Center (ISICC) in Walldorf, Germany, visit the ISICC website at [http://www.ibm.com/de/worktogether/customer/isicc.html](http://www.ibm.com/de/worktogether/customer/isicc.html)
SAP together with IBM offers a comprehensive class that covers all basis administration topics of SAP on IBM i. The class code is ADM525. Training services can be looked up at http://www.ibm.com/E-Learning