

# SAP on PowerLinux Reference Architecture



## Applies to:

SAP landscapes running on Linux® and IBM Power Systems™ hardware. For more information, visit the [SAP on Linux](#)

## Summary

This SAP on PowerLinux reference architecture document gives a short introduction to the SAP Business Suite and describes a sample SAP Enterprise Resource Planning (ERP) architecture on a PowerLinux server. The document shows all products and tools that are required to create a basic ERP landscape for small and medium customers.

This paper starts with information about SAP products available on PowerLinux servers, adding an introduction in SAP landscape architecture and design.

The next part describes an SAP on PowerLinux architecture scenario, followed by an overview of SAP on Linux and the IBM POWER® platform including virtualization on Power Systems.

As management and monitoring is an important topic today, focuses of this paper are the several capabilities to control an SAP landscape on PowerLinux hardware. In addition the paper provides information on database and storage usage with SAP, such as insight on database backups, preferred storage types and database monitoring.

The paper focuses on a general overview. The further topics section provides links to more technical and detailed information.

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

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## Author Bio



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Arnold Beilmann is a member of the joint development team for SAP on PowerLinux. He joined IBM in 2007 as a Software Developer focusing on the porting of SAP solutions to the PowerLinux platform. Arnold Beilmann worked in different projects related to SAP, PowerLinux servers, virtualization on IBM Power platforms and cloud computing. He can be reached at Arnold.Beilmann@sap.com.



Manfred Stein joined SAP in 1995, after having received his Ph.D. in Physics at TU Kaiserslautern. He has worked for SAP Advanced Global Support in the areas of MaxDB and SCM, later on he was Development Project Manager for SAP on Unix. In this role, he helped to establish PowerLinux servers as a certified SAP platform. He currently occupies the position as Product Manager for Virtualization & Cloud Management.



Helge Deller is Development Manager of the “SAP LinuxLab” and leads development and support of SAP products on Linux. Initially started as a Software Developer at Red Hat, he joined SAP in 2001 and heads the SAP LinuxLab since 2002. In this role, he was involved in the enablement of SAP solutions on the “Linux on Power” platform. He has a strong technical background in software development, UNIX and the Linux kernel and holds a degree in Mechanical Engineering from the University of Bochum, Germany.

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## Introduction

The requirements on today's business application landscapes in companies grow rapidly, leading to complex and large system and software clusters. New business areas and legal requirements lead to more and larger systems, which need to be maintained and kept up to date.

Especially for small and medium companies the increasing effort on IT maintenance and planning grows to a desirable factor that needs to be limited.

One option is to move to a system solution that integrates all required business functionalities. SAP ERP is one of the best known and most used Enterprise Resource Planning Systems worldwide and fits the needs of big corporations as well as small and medium size companies that are looking for a reliable application serving their needs and business requirements. It combines a wide variety of business functionality in one product, reduces maintenance and creates a clear and simple environment.

SAP ERP features several hardware platforms and operating systems of which Linux is often used by small and medium customers due to its openness, maintainability and also for economic reasons.

Running Linux on a reliable and high performance platform such as IBM Power Systems gives SAP customers a fast and secure system basis with high flexibility and maintainability.

This paper focuses on a small and efficient Enterprise Resource Planning solution based on SAP ERP, Linux and IBM Power servers. It highlights the required landscape and supporting tools to create a complete and easy to maintain environment for small and medium companies. The document gives the reader a first understanding of what an ERP landscape looks like and explains functionalities that are needed to manage it. It recommends a sample configuration for systems and software and explains its components. Additional software or hardware products can be added to this infrastructure if needed.

Probably no ERP landscape of a company looks like another. But certain requirements are always the same and the described architecture can be used as a blueprint and starting point for similar small ERP projects in a Linux and IBM Power Systems environment. It also contains references to further information and creates awareness for several topics that will come up during an ERP landscape setup.

## SAP Business Solutions

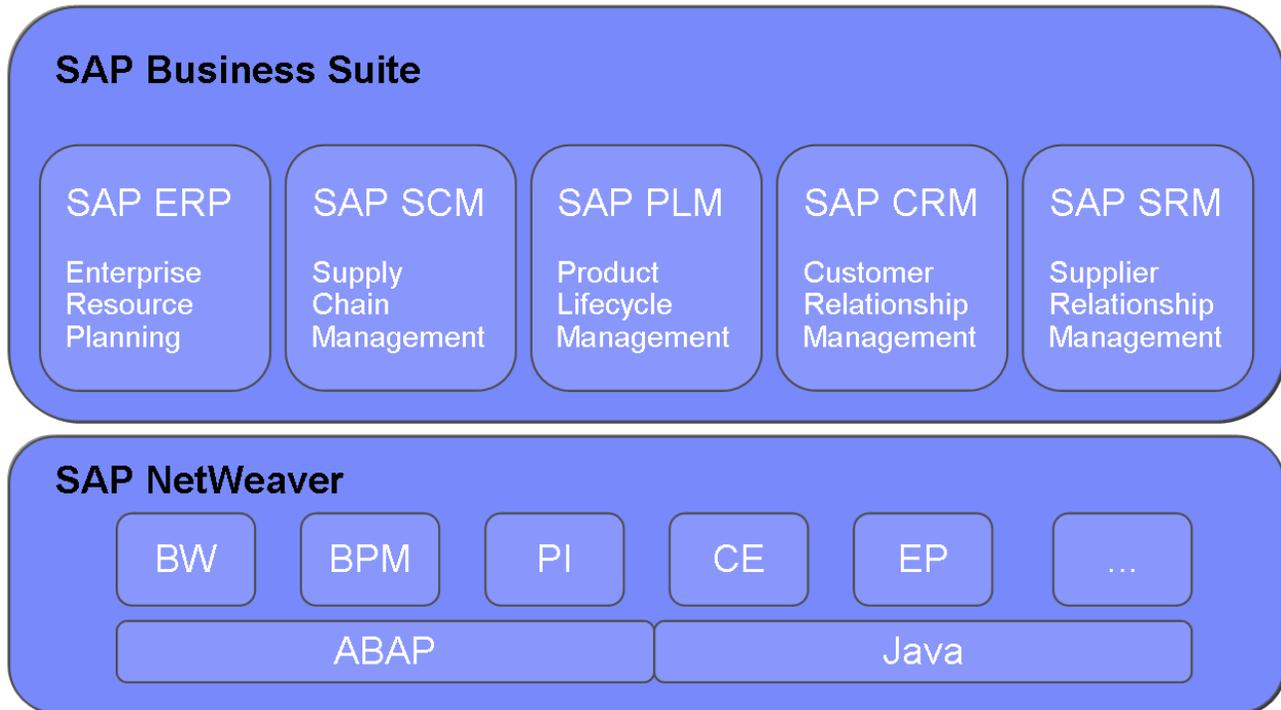
SAP is the leading provider of business solutions with functionalities covering the needs of modern companies. SAP software is used by companies of all sizes and in many different industry sectors. The official SAP Website <http://www.sap.com> gives fast access to the available solutions, in depth information can be found, e. g. on <http://www.sap.com/solutions/business-suite/brochures>.

### Business Suite

SAP Business Suite software is a comprehensive family of applications covering business requirements for finance, human resources, procurement, product development, marketing, sales, service, supply chain management, and asset management. SAP Business Suite provides integrated, comprehensive business processes across organizational, departmental and geographic boundaries. 25 Industry Solutions are available mostly as add-ons to SAP ERP. SAP Business Suite serves as the foundation for every solution portfolio SAP offers, and is based on the Service-Oriented Architecture (SOA) of the SAP NetWeaver technology platform.

- SAP Enterprise Resource Planning, Financial Management and Human Capital Management - SAP ERP includes comprehensive functionality for accounting and financials (SAP FI), sales and service, procurement and logistics, inventory management, human capital management (SAP HCM), product development and manufacturing, corporate services, and reporting and analytics.
- SAP Customer Relationship Management - SAP CRM allows managing all aspects of customer relationships, from marketing to sales to service.

- SAP Product Lifecycle Management - SAP PLM offers a 360-degree-support 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, build collaborative supplier relationships and manage supply bases.
- SAP Supply Chain Management - SAP SCM transforms linear, sequential supply chain into a responsive supply network where customer-centric, demand-driven companies share knowledge, intelligently adapt to changing market conditions, and proactively respond to shorter, less predictable life cycles.



*SAP Business Suite and SAP NetWeaver*

## SAP ERP

SAP Enterprise Resource Planning (SAP ERP) is the core application of the SAP Business Suite and one of the most popular business applications. It integrates the core business functionalities for a company in one product that can be customized to fit the needs of the enterprise. Consequently, SAP ERP can be found at many smaller companies without other SAP components installed.

SAP ERP groups its functionalities in modules that map the application functionalities to the functional units of the company e.g.

- Financials - Financial Accounting (FI)
- Financials - Controlling (CO)
- Human Capital Management (HCM)
- Logistics - Materials Management (MM)
- Logistics - Production Planning and Control (PP)
- Logistics - Sales and Distribution (SD)

## SAP NetWeaver

The SAP Business Suite is powered by the technology platform SAP NetWeaver. It includes a comprehensive set of components and tools. With the Application Servers ABAP and Java it provides a highly scalable and solid application server as a stable foundation for SAP Business Suite with advanced integration capabilities for business intelligence and collaboration. Key components are:

- SAP NetWeaver Process Integration (SAP NetWeaver PI)
- SAP NetWeaver Portal
- SAP NetWeaver Master Data Management (SAP NetWeaver MDM)

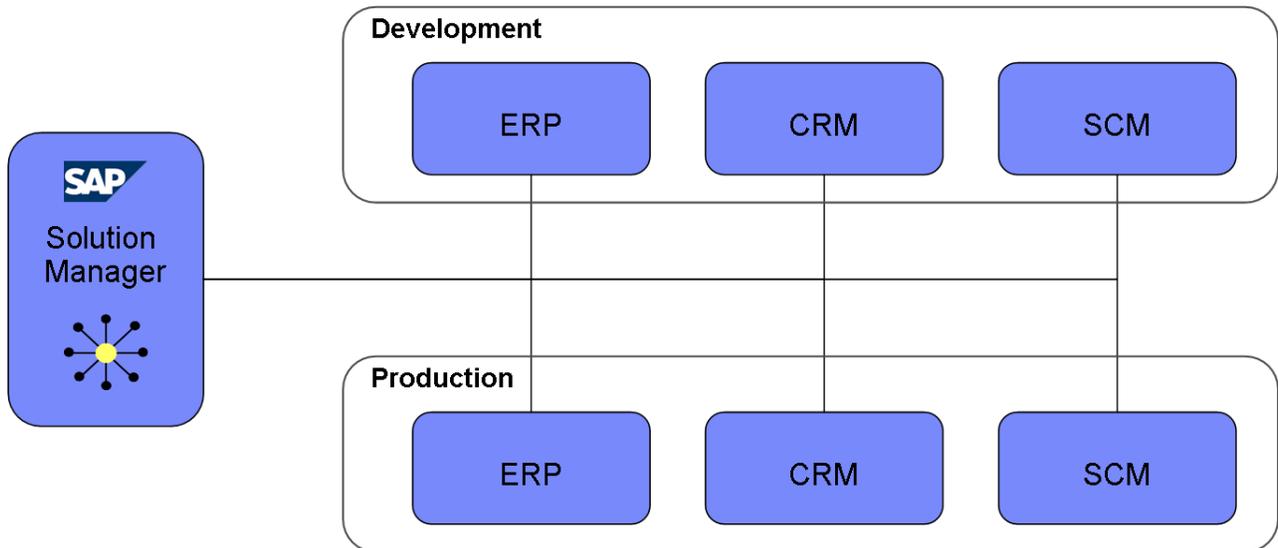
## SAP Solution Manager

The SAP Solution Manager is a strategic infrastructure component SAP introduced to manage SAP business landscapes. For new SAP implementations it is mandatory and must be installed as a prerequisite before other SAP products can be installed. It serves as a central entry point for tools, methods and information that help to implement new SAP products and to keep the existing infrastructure operational. An important part of the Solution Manager for example is the Maintenance Optimizer, a lifecycle management tool that provides patches for a SAP landscape.

Other application areas that are supported by the SAP Solution Manager:

- SAP Business Suite implementation and upgrades
- Change control management
- Testing
- IT and application support
- Root cause analysis
- Solution monitoring
- Service-level management and reporting
- Service processing
- Administration

The SAP Solution Manager is connected to all other systems in the SAP landscape. Technically it is based on a dual stack SAP Application Server with ABAP and Java.



SAP Solution Manager Schema

## Landscape and Architecture

This chapter provides some information on architecture and infrastructure settings that are commonly used in SAP landscapes. To create a stable and reliable SAP landscape some concepts should be applied.

### ABAP & Java Stack

SAP applications are based on different technologies. ABAP is the one that many of the traditional SAP products are based on. It is a programming language that has been developed by SAP and still is the basis of most core business functionalities. The SAP Application Server ABAP is the integral part of all SAP ABAP instances, single units that form together one SAP system and that may fail without the whole system being shut down. The SAP Application Server ABAP provides a basis for a large number of platform independent business applications written in SAP programming language.

Other SAP applications use the Java stack with the SAP Application Server Java. A combination of both ABAP and JAVA Application Server is referred to as Dual-Stack.

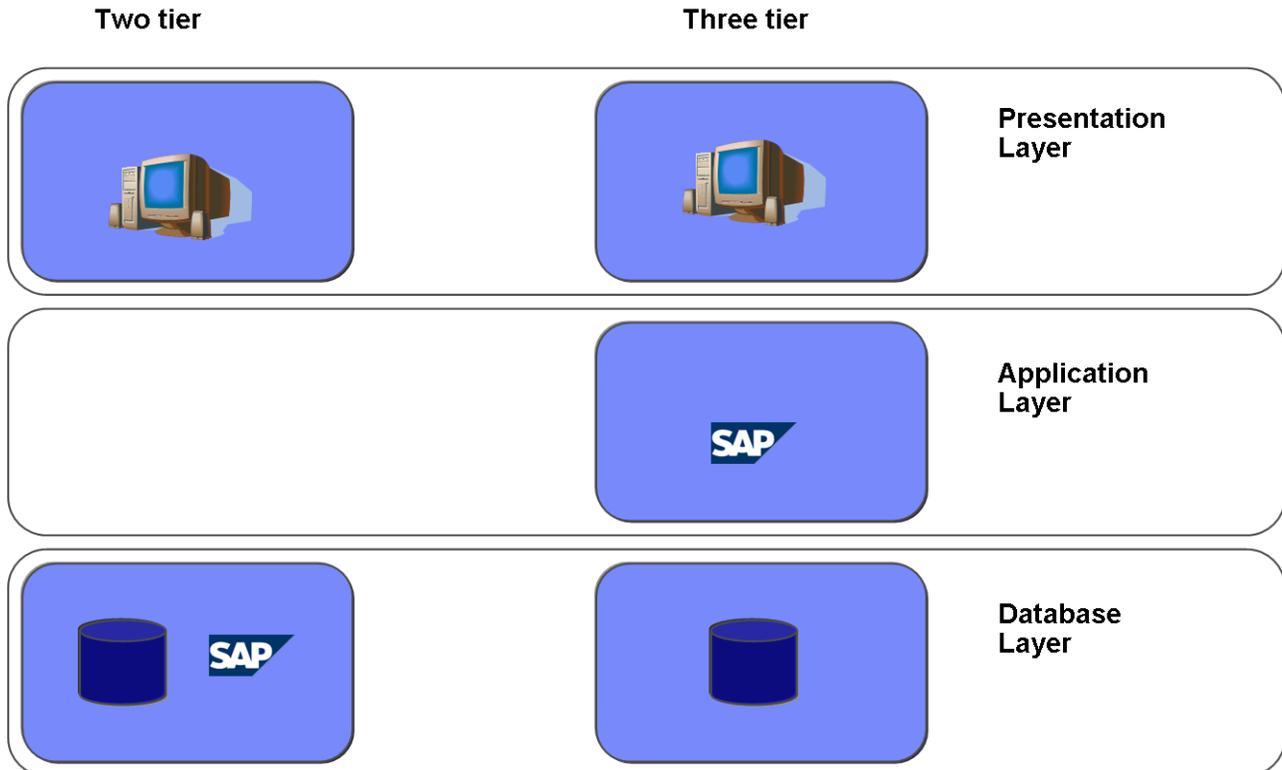
### Two-Tier and Three-Tier Architecture

A classical SAP installation consists of three parts, the SAP application server, the database and the graphical user interface (GUI). These three components together form the SAP system. They may all reside on the same hardware or run on different hosts.

The actual approach in the production system landscape is to place these system parts at least on two different machines. The SAP Application Server then runs on a server, while a client e.g. a local workstation is used to log on to this host to use its services. This workstation comprises the GUI, while the application processing is done on the remote server. The database is located on the same resource as the application server.

This arrangement is called a two-tier architecture because it consists of two separate tiers the presentation tier with the GUI and the application/database tier with the application server and database on a separate host.

Optionally that application server and database can also reside on separate hardware. The result is a three-tier architecture. The presentation layer is located on a local workstation, while the whole application logic and the database are placed on separate remote servers. The three-tier option is even more flexible and scalable than the two tier approach, but also more complex.



*Two-tier and three-tier landscape*

To enhance the capacity of the application layer the workload on the application server can be distributed by adding more application servers, so called dialog instances. These application servers can then run on several hosts or logical partitions and discharge the central instance.

Dialog instances are not system critical, they can be started and shut down as required. The blackout of a dialog instance does not lead to a complete system halt.

For small and medium SAP installations a two-tier approach with the database and central instance on one server is recommended and provides a sufficient environment. Additional application servers can then be placed on other hosts.

### Two-System and Three-System Landscape

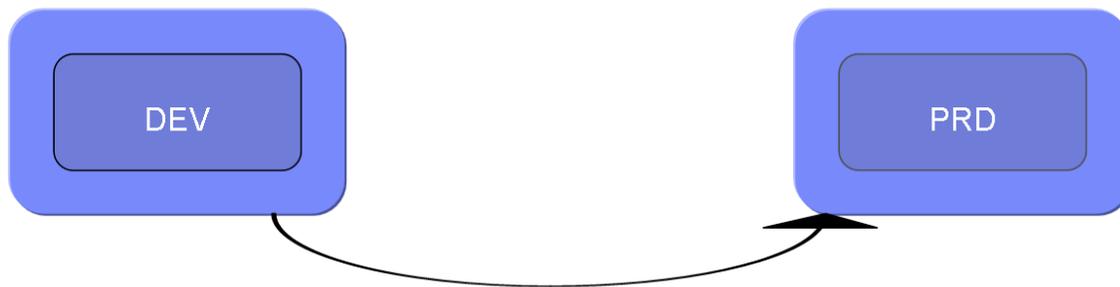
In order to secure your SAP landscape, development and test work must never be done on the production environment, which ensures the availability of the business processes. Therefore a minimum of two separate landscapes is needed – one for production use and the other for test and development purposes. This setup is called a two-system landscape.

SAP even recommends a three-system landscape with a production system (PRD), a test and quality system (QAS) and a development system (DEV).

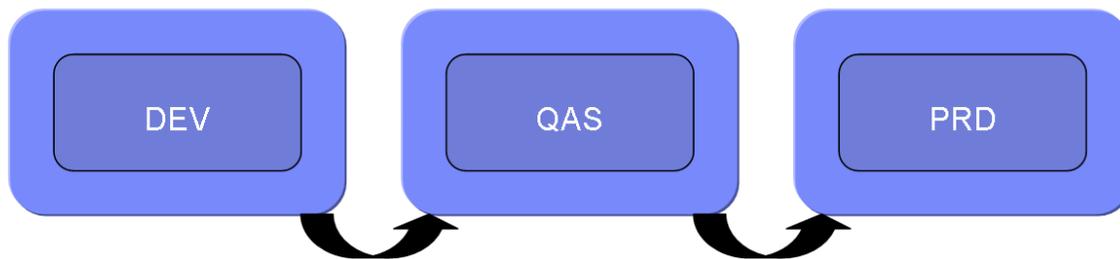
Application development, code fixes and customizing is done only on the DEV system. The stable changes are then transported into the QAS system – if a three-system landscape is used – to validate them in a production like environment. The QAS should be set up as copy of the production system. Possible problems can be found in this test environment and do not harm the PRD system. If a QAS system is not available, testing is also done in the DEV environment. Only after all changes are tested and it has been proofed that they run as required, they are transported into the PRD system.

A three-system landscape is very secure, but also a complex and difficult to maintain. The two-system landscape is a good compromise with adequate security level and only two maintained systems. The decision on the number of SAP systems depends very much on the size of the business and the required failure protection level. For a small or midsize installation a two-system landscape will be sufficient in most cases.

### SAP 2-System-Landscape



### SAP 3-System-Landscape



*SAP 2- and 3-System-Landscape*

## Reference Architecture for Small and Medium SAP Installations

The SAP on PowerLinux servers reference architecture is a basic SAP landscape that gears towards small ERP implementations with the flexibility to grow. It includes only two SAP products, SAP ERP and the SAP Solution Manager as an infrastructure component. These SAP products reside on an IBM Power server with several virtual machines (logical partitions).

The SAP Solution Manager is a single system, mandatory for every SAP landscape providing monitoring and other supporting functionalities. The SAP Solution Manager resides on its own logical partition in the landscape and needs to be installed first before further SAP products can be added to the landscape.

Covering the major business processes SAP ERP is the core SAP product and the integral component of every business landscape. The SAP ERP landscape needs to be split in a two-system landscape to ensure

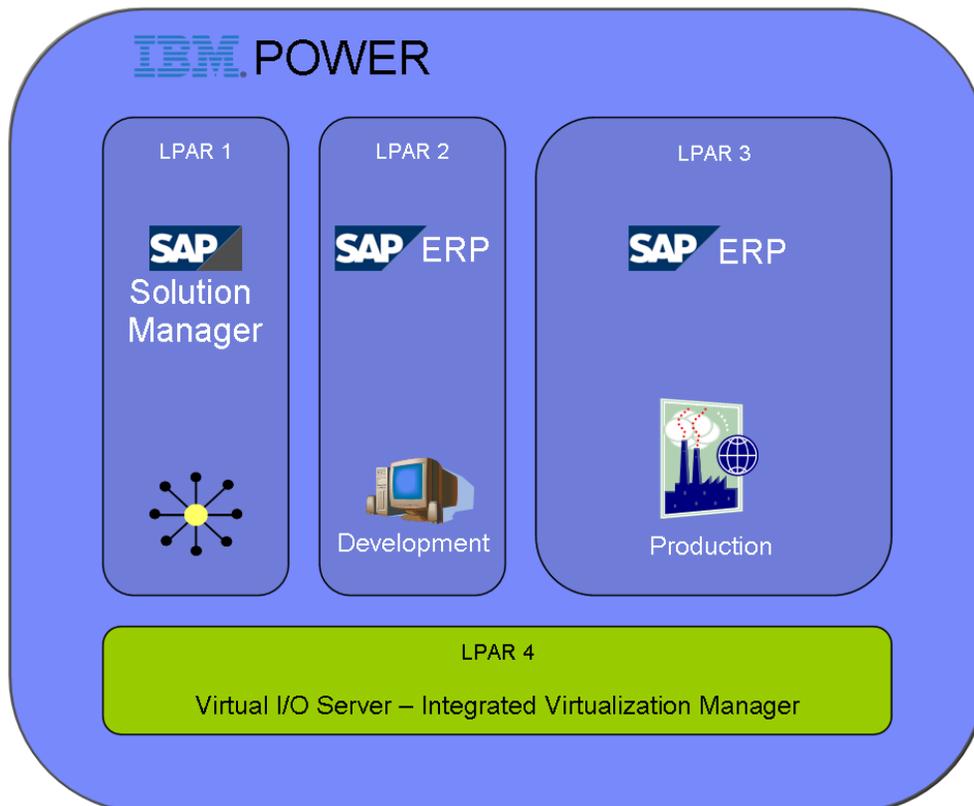
development/test and production are separated. As SAP ERP needs to be customized individually for every company, development and customizing need to be validated in depth to prevent impacts on the execution of the business processes by defective changes.

The development and production SAP ERP systems are set up as two-tier systems with the database and SAP ERP residing on the same logical partition. This ensures an easy to maintain and compact ERP landscape.

Management and monitoring tools for the hardware and partition setup are available via Integrated Virtualization Manager (IVM). The IVM resides on a Virtual I/O Server (VIOS), which is a separate logical partition on the same IBM Power hardware. The Virtual I/O Server provides an unrestricted set of virtual Ethernet and disk adapters to the other logical partitions on the server which makes them independent from a limited number of physical adapters. An option is also to install two Virtual I/O Servers to keep the Ethernet and storage connection redundant.

Further partitions with additional dialog instances, other SAP products or third party software could be added to this basic SAP landscape solution as needed. Segmenting the involved products and functions on several logical partitions offers better resource differentiation and guarantees a better utilization of the system as resources can be assigned based on system priorities and resource shortage for production systems can be prevented.

Power machines offer internal disk space and the basic SAP setup could be done on internal disks. Nevertheless for such complex and data intensive workloads as an SAP environment an external storage device is highly recommended. External storage devices offer more space and better reliability in comparison to internal disks. Various external storage solutions for small and medium size installations are available and can be used in combination with Power hardware and this reference architecture.



*SAP on PowerLinux servers reference architecture*

## SAP on Linux

SAP announced the support for “SAP on Linux” in 1999 at the CeBIT fair in Hannover, Germany. Since this initial announcement 13 years ago – which consisted of the SAP R/3 4.0B release on a 32bit processor – Linux has become an important operating system for SAP customers. New installation numbers for 64bit Linux installations show that Linux is becoming the second-most used operating system by customers to run their database servers and one of the most chosen operating system for running SAP Application Servers. Today customers can chose between these three enterprise-class Linux distributions to run their SAP workloads:

- SUSE® Linux Enterprise Server (SLES),
- Red Hat® Enterprise Linux (RHEL) and
- Oracle® Linux (OL)

Prior to a certification, all those Linux distributions are jointly tested and validated by SAP and the operating system vendors to ensure the best quality and performance which is expected by SAP customers for their mission-critical installations. In addition, SAP hardware partners (IBM®, HP®, DELL®, Fujitsu®, BULL®, NEC®, Hitachi® and others) test and certify their hardware for SAP on Linux. Due to Linux being an open-source operating system, the further development of Linux is growing very quickly with contributions by the hardware and software partners, as well as the open source community.

In the last few years, the SAP LinuxLab and the Linux distribution vendors for example developed, tested or integrated numerous important features into the Linux distributions. This includes full-integrated High-Availability solutions, Virtualization- and Virtualization-administration-support, SAP-related monitoring support, SAP-specific support options, fast-installation tools for SAP and support for all major databases.

With the combination of SAP software, Linux operating system and reliable hardware, customers get an unbeatable price-per-performance ratio compared to other combinations. Even on short term this often pays back any investments necessary for the migration to Linux.

## Hardware

The described SAP reference architecture on Power requires several hardware and infrastructure components. Core component is the IBM Power Systems hardware with Linux operating system. Additionally matching external storage can be used to extend the available disk space and enable more flexibility.

### IBM Power Systems and Linux

IBM Power Systems are available in different sizes, supporting business from small installations up to complex landscapes with multiple huge systems and options from one up to 256 cores.

While the POWER5 and POWER6 processor generations are based on a two core architecture, the newest generation of Power Systems with the POWER7 processor offers up to 8 cores per processor chip.

IBM Power hardware offers very good scalability and can be used to consolidate multiple workloads such as several SAP products or landscape components on one machine.

SAP Sales and Distribution (SD) Benchmarks prove the performance of Power Systems in combination with SAP workload. For many years Power has also been known as a secure platform that keeps your SAP system running with minimal downtime requirements.



With its compact enterprise systems it offers small and medium business a very flexible and reliable platform to run SAP workloads.

The internally available disk space of Power Systems can be extended by using external SAN space which can be attached to Power servers.

Power specific monitoring and administration tools provide a high standard of maintainability and reliability. Resource sharing allows high utilization rates and minimum of hardware consumption.

SAP on PowerLinux servers is available as 64bit platform only. It is certified and supported starting with POWER4+ processors and above up to the newest POWER7 generation for both server and blade configurations. Due to SAP on Linux certification rules every processor generation is certified separately to ensure permanent quality and reliability.

SAP on Power Systems features both SUSE Linux Enterprise Server (SLES) and Red Hat Enterprise Linux (RHEL) as Linux distributions. SUSE Linux Enterprise Server for Power Systems has been supported since SLES 9 and Red Hat Enterprise Linux for POWER from RHEL 4 onward.

Running SAP on PowerLinux servers combines the benefits of a flexible and open operating system with those of a powerful and strong hardware platform.

## Storage

An SAP system requires a considerable amount of storage, depending especially on the size and complexity of the landscape and the number of business operations.

Internal disks could be used but offer some disadvantages compared to external storage. Firstly the number of internal disks is very limited and may not fit business requirements. Additionally external storage offers better reliability and flexibility.

Therefore it is recommended to use external storage e.g. a Storage Area Network (SAN). External storage can easily be extended and provide its own management tools. It is also required if you want to use Live Partition Mobility – migrating partitions from one machine to another without interruption of running processes. In case of a hardware failure external storage enables you to relocate your logical partitions to other Power Systems and continue work while the broken hardware is repaired.

## Virtualization

Virtualization is an integral and intrinsic part of the IBM Power Systems Family which allows you to use the infrastructure flexibly and to reduce the total costs of ownership. The combination of Power Systems hardware and IBM PowerVM™ virtualization enables you to achieve a near 100 % utilization of CPU and memory resources and to share storage and network connections between several virtual machines. This chapter describes the main components and some interesting features of virtualization used by IBM Power Systems.

### IBM PowerVM

Over the past years, IBM has introduced a number of virtualization technologies, capabilities and offerings. Many of the virtualization features were originally available through an offering known as Advanced POWER Virtualization (APV). As of early 2008, these and many subsequent technologies and offerings have been collectively grouped under the new name PowerVM. PowerVM comprises several virtualization features that improve the management of your Power Systems landscape.

Key benefits of IBM PowerVM are:

- Server utilization is improved by sharing I/O resources, RAM and CPU resources
- Resources can dynamically be re-allocated to better match business needs
- Workload can be made independent of hardware resources, logical partitions can be moved between different servers without application downtime

Some of the virtualization technologies are also part of the described reference architecture, e.g. the Virtual I/O Server. Depending on the required virtualization level of a system landscape there are three PowerVM Editions available: Express, Standard and Enterprise.

See also <http://www-03.ibm.com/systems/power/software/virtualization/editions/>

### Virtual I/O Server (VIOS)

The Virtual I/O Server (VIOS) acts as an intermediate layer between hardware (physical storage and network adapters) and logical client partitions. The VIOS virtualizes the physical hardware and provides virtual adapters for the clients. Clients do not need to know the details about the underlying hardware and do not need to run hardware specific driver software. Thus, the VIOS facilitates both on demand computing and server consolidation.

In this Reference Architecture, the one LPAR (logical partition) acts as VIOS. Physical resources like network adapters and I/O controllers are associated to this LPAR. All other LPARs access these resources by virtual adapters provided by the VIOS. The VIOS also acts as Integrated Virtualization Manager (IVM). The IVM is described later in this document.

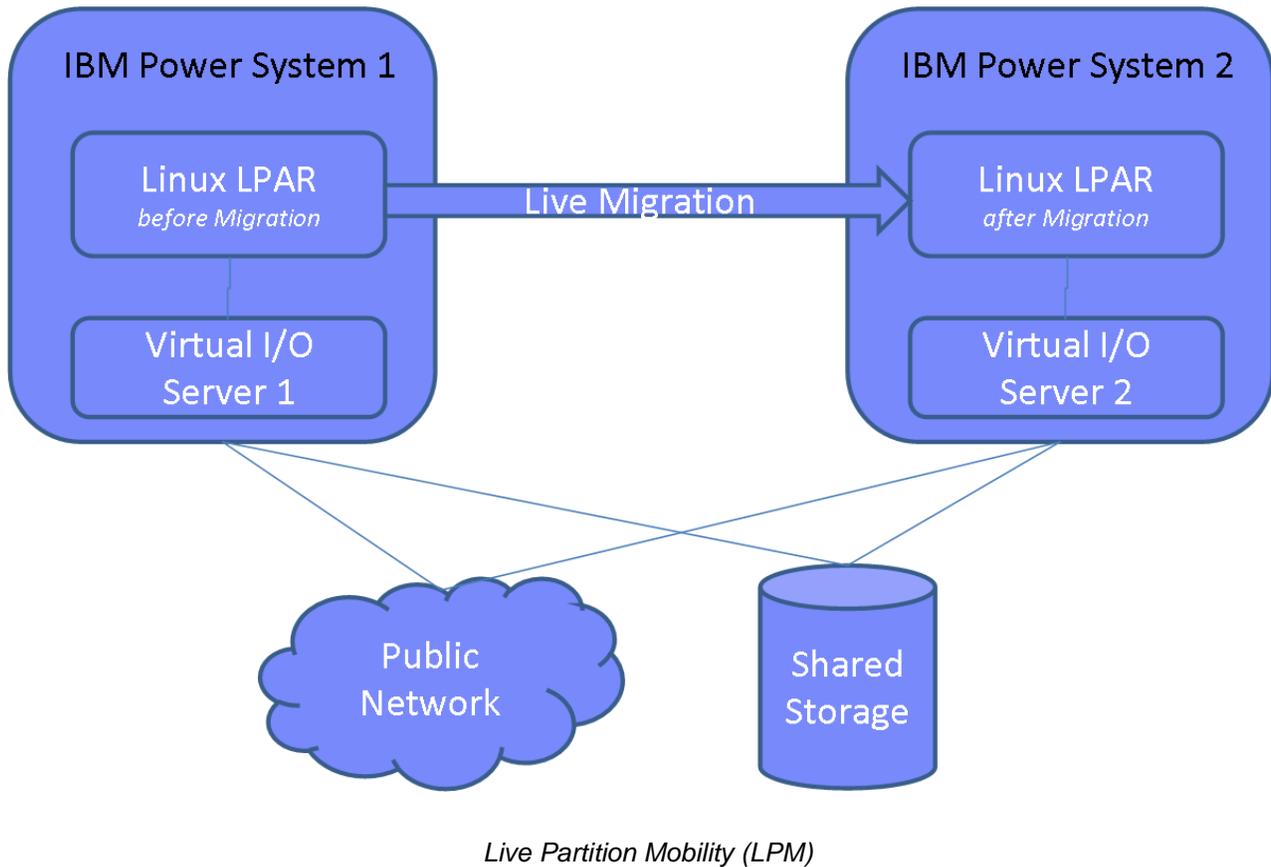
Refer to the following IBM Redbooks for a detailed description of the IBM PowerVM features:

- IBM Redbook "SAP Applications on IBM PowerVM"  
<http://www.redbooks.ibm.com/abstracts/sg247564.html>
- IBM Redbook "IBM PowerVM Virtualization Introduction and Configuration"  
<http://www.redbooks.ibm.com/abstracts/sg247940.html>

### Live Partition Mobility (LPM)

Using Live Partition Mobility (LPM), active Linux partitions can be moved from one physical Power System to another without application downtime. LPM allows server maintenance without interrupting running applications by moving partitions to different servers. With LPM, workload rebalancing and server consolidation can be performed without downtime and completely transparent to end users.

LPM is available since POWER6 and enables you to relocate an LPAR with a running SAP system without downtime. This can be very useful in case of a hardware replacement or if you system landscape comprises more than one Power system.



Even without using LPM, LPARs can easily be moved from one system to another, if all storage devices associated to the LPAR are located on an external Storage Area Network (SAN) device.

In order to manually relocate LPARs, shut down the LPAR on the source hardware system, create a new LPAR on the destination hardware and assign the SAN storage to it. Now the LPAR can be booted on the destination hardware without further changes. A manual migration like this can be processed in minutes by an experienced administrator.

### Shared Processing Mode

In dedicated mode, whole physical processors are assigned to logical partitions, no matter if the partition currently uses the CPU resources or not.

To increase system utilization, POWER technology allows the definition of logical partitions in shared processing mode, a feature of IBM PowerVM. For LPARs running in shared processor mode, the POWER Hypervisor dispatches CPU resources to the LPARs according to their current need. Each logical partition does not use the CPU cycles exclusively but shares them with other partitions. So the number of unused cycles is minimized. A partition can have a guaranteed amount of CPU resources (entitlement) as well as a maximum amount. With sharing priority the priority sequence in which logical partitions will get CPU cycles gets defined. LPARs running business critical workload can be assigned a higher priority for CPU resources than less critical LPARs.

An option would be to differentiate between production and non-production SAP systems. It could be defined that production systems will get a higher priority and shared CPU cycles whenever they request them.

## Managing Virtualization Features

To manage and configure the PowerVM virtualization features Power Systems offer different kinds of management consoles depending on the landscape size and number of machines. This chapter describes the provided management tools and their usage.

### Integrated Virtualization Manager (IVM)

In order to manage virtualization on IBM Power Systems IBM provides an easy-to-use and browser-based Integrated Virtualization Manager (IVM). The IVM is included in PowerVM and is packaged in the Virtual I/O Server software.

**View/Modify Partitions**

To perform an action on a partition, first select the partition or partitions, and then select the task.

**System Overview**

Total system memory:	128 GB	Total processing units:	12
Memory available:	64 GB	Processing units available:	7
Reserved firmware memory:	3 GB	Processor pool utilization:	0.26 (2.2%)
System attention LED:	Inactive		

**Partition Details**

\* Create Partition...
Activate
Shutdown
--- More Tasks ---

Select	ID ^	Name	State	Uptime	Memory	Processors	Entitled Processing Units	Utilized Processing Units	Reference Code
<input type="checkbox"/>	1	<a href="#">VIO-Server</a>	Running	47.84 Days	5 GB	2	1.0	0.02	
<input type="checkbox"/>	2	<a href="#">LPAR1_SLM</a>	Running	1.98 Days	12 GB	4	1.0	0.08	<a href="#">SUSE Linux</a>
<input type="checkbox"/>	3	<a href="#">LPAR2_DEV</a>	Running	2.11 Days	8 GB	4	1.0	0.09	<a href="#">SUSE Linux</a>
<input type="checkbox"/>	4	<a href="#">LPAR3_DB</a>	Running	37.05 Days	18 GB	4	1.0	0.02	<a href="#">SUSE Linux</a>
<input type="checkbox"/>	5	<a href="#">LPAR4_PRD</a>	Running	1.97 Days	18 GB	4	1.0	0.05	<a href="#">SUSE Linux</a>

### *Integrated Virtualization Manager*

It covers all the administration tasks that are typically performed by a server administrator. In the case of IBM PowerVM based solutions, the administrator may perform all of them using the IVM as a central entry point.

Typical usage of the IVM would be the configuration of logical partitions and their preparation after the completion of the PowerLinux server installation. In this case the IVM can be used in order to create the partition configuration, to assign storage and network connections using Virtual I/O Server, to assign memory and CPU shares and sharing priority.

It also provides tasks for managing the full life cycle of logical partitions running on IBM Power machines. This includes the monitoring of available hardware resources, starting and stopping of logical partitions and the “hot-plug” reassignment of resources to certain partitions.

The last mentioned feature also known as Dynamic Logical Partitioning (DLPAR) allows the administrator to dynamically increase or reduce the number of resources used by partitions. E.g. additional memory can be added without stopping the running SAP workloads.

Another benefit is the advanced IBM PowerVM feature IBM Live Partition Mobility. This feature allows you to relocate partitions by running SAP workload from one physical IBM Power server to another in a non-disruptive way.

The following list shows the most important tasks that you may perform on your IBM Power machines using the IVM:

- Create and manage logical partitions
- Configure the virtual Ethernet networks
- Manage storage in the Virtual I/O Server
- Perform advanced tasks like Live Partition Mobility, Active Memory Sharing and Dynamic Logical Partitioning (DLPAR)
- Create and manage serviceable events through Service Focal Point
- Download and install updates to device microcode and to Virtual I/O Server software
- Backup and restore logical partition configuration information
- View application logs and the device inventory

Refer to the following documents for a detailed description of the IBM IVM:

- IBM Whitepaper "IBM Integrated Virtualization Manager"  
<http://www-03.ibm.com/systems/power/hardware/whitepapers/ivm.html>

### Hardware Management Console (HMC)

In case you need a management solution which could become a central management point for a number of IBM Power machines, IBM provides an appliance named Hardware Management Console (HMC). The HMC is an independent hardware appliance. It connects to IBM Power machines via private or public networks. With a HMC you may perform all the operations available in the IVM. While the IVM supports IBM Power machines up to IBM Power® 750, with the HMC you may manage all your IBM Power Systems of any types. In addition you get an external central management point which allows you to access your IBM Power Systems also in case of hardware defects.

Refer to the following documents for a detailed description of the IBM HMC:

- IBM Redbook "Hardware Management Console V7 Handbook"  
<http://www.redbooks.ibm.com/abstracts/sg247491.html>

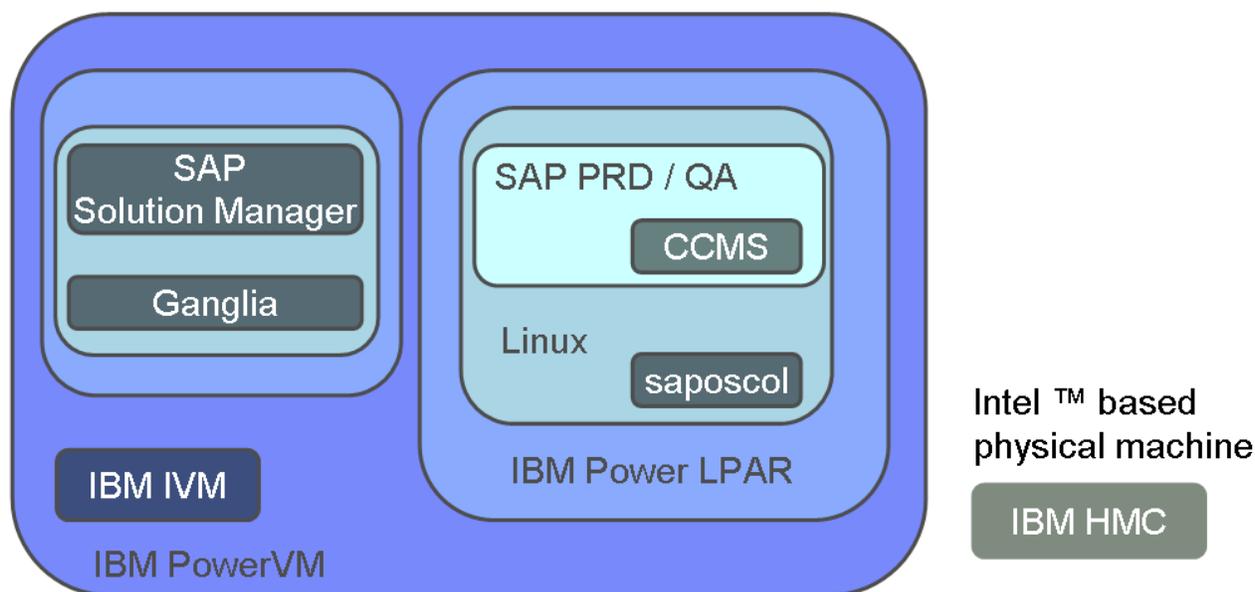
### Monitoring and Automation

IBM and SAP provide a set of different applications for monitoring, management and process automation of SAP systems running on PowerLinux servers. These applications cover all the virtualization layers beginning from the hardware, through the firmware and software up to the management of the logical relations of your SAP systems.

This document describes several important applications, which are:

- IBM Integrated Virtualization Manager (IVM) and IBM Hardware Management Console (HMC) are the applications for monitoring and management of hardware and logical partitions (LPARs)
- CCMS - the SAP Computing Centre Management System provides monitoring and alerting of all SAP specific metrics and workflows
- saposcol is part of the SAP CCMS, it provides OS specific metrics. On Power hardware saposcol also provides POWER® specific metrics
- SAP Solution Manager provides a platform for monitoring and managing a whole SAP landscape, including business process monitoring, lifecycle management etc.
- Ganglia is an open-source monitoring framework which is able to monitor POWER specific metrics

## IBM Power physical machine



### *Monitoring and Management of Applications*

#### CCMS and saposcol

The SAP Computing Center Management System (CCMS) allows monitoring of the SAP landscape with all associated components. Several kinds of monitors provide information to identify and resolve performance problems and bottlenecks.

The CCMS also allows monitoring of the resource usage of the associated hardware e.g. CPU and RAM usage. This is especially important in virtualized environments, where several logical systems share physical resources.

Saposcol is a CCMS component that collects specific information for the operating system. It runs as a separate process, independent from the SAP instances. In non-virtualized environments it collects data about the usage of CPU, physical/virtual RAM, file systems and processes.

In virtualized environments like IBM PowerVM it collects also information about the physical resources used by the logical partitions (LPARs). If several LPARs share the same physical CPUs, saposcol collects the information on which LPAR uses which amount of the available CPU resources.

Additionally, saposcol reports the configuration parameters of the virtualized environment which helps to optimize the setup for an optimal throughput of the whole SAP landscape.

The SAP monitoring infrastructure has been enhanced to display the virtualization metrics collected by saposcol running in virtualized environments. All data collected by saposcol is available and visible in standard SAP monitoring transactions like OS07.

**SLM Is3835\_SLM\_00 Linux Is3835 2.6.32.12-0.7-ppc64 #1 SMP 2010-05-20**

Snapshot Overview Tue Sep 20 13:25:53 2011 Interval 60 sec.

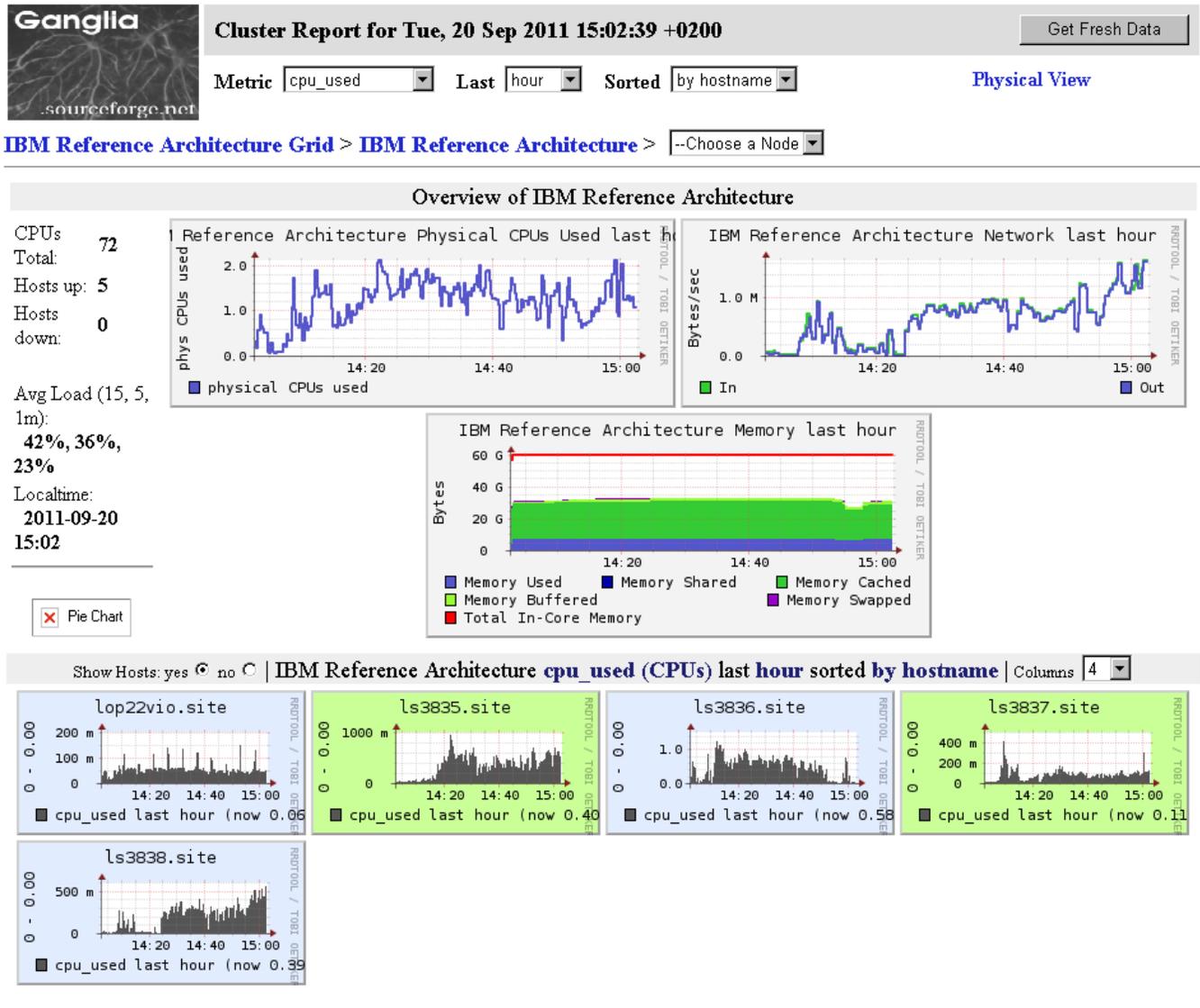
Monitoring Category	Description	Value	Unit	
CPU Virtualization Host	Model	IBM,8246-L2B		
	Hardware Id	IBM,030600C2A		
	Pool Id	0		
	Pool Utilization Authority	Granted		
	Processor	POWER7		
	Pool CPUs Idle	11,91	CPU	
CPU Virtualization Virtual System	Partition Type	Shared Processor LPAR		
	Partition Name	Is3835		
	Capped	Off		
	SMT Mode	On		
	Entitlement	1,00	CPU	
	Entitlement Consumed	3,6	%	
	Weight	128		
	Virtual CPUs	4		
	Threads	4		
	Capacity Consumed	0,03	CPU	
	Available Capacity	4,00	CPU	
	Available Capacity Consumed	0,9	%	
	Current Processor Frequency	3.720	MHz	
	Memory	Physical memory	31.050.496	KB
		Configured swap size	2.104.384	KB
		Free swap size	2.104.384	KB
Maximum swap size		2.104.384	KB	
Actual swap size		2.104.384	KB	
Free		1	%	
Pages In		0	Pg/	
Pages Out		0	Pg/	
Page In		0	KB/	
Page Out		0	KB/	
Disk with highest response time	Name	sda		
	Utilization	0	%	
	Operations	7	/s	
	Transfer rate	248	KB/s	

SAP Operating System Monitor showing IBM LPAR configuration

In the Reference Architecture, every Linux LPAR runs a `saposcol`. The `saposcol` process is installed automatically during the installation of the SAP solutions. Optionally, a `saposcol` can be installed on the VIOS instance to be able to monitor the resource usage on the VIOS using SAP monitoring tools. See Redbook “SAP Applications on IBM PowerVM” for a detailed description of the `saposcol` installation inside the VIOS.

## Ganglia

Ganglia is an open-source distributed monitoring system which is available on several operating systems and hardware platforms. Unlike other open-source monitoring tools, Ganglia is aware of the virtualized Power environment and can be used for additional monitoring tasks of an SAP landscape running on IBM Power Systems. Ganglia offers an easy-to-use web interface to access the monitoring data.



### Ganglia Web Fronted

The Ganglia source code and precompiled binaries for different platforms are available at the Ganglia project home page: <http://ganglia.info>

You can download precompiled binary packages for PowerLinux servers with the Power Ganglia extensions from: <http://www.perzl.org/ganglia/>

In this Reference Architecture all LPARs are running a Ganglia client daemon (gmond) which collects data from the operating system.

Please be aware that Ganglia is open-source software, functional limitations on single distributions or Service Packs may exist.

## SAP Solution Manager Monitoring

As described earlier in this document the SAP Solution Manager provides supporting functionalities for an SAP landscape. As a central tool it is connected to all other systems in the SAP landscape and therefore able to provide an overall view on the system conditions. It collects monitoring data from the attached systems to offer a diagnostic service that checks several system parameters such as system configuration, performance, response time, utilization and many more.

Based on the measured values potential system problems can be identified at an early stage and arrangements to prevent bottlenecks or outages can be made. This Early Watch functionality can be configured to provide regular reports on the health of your SAP system and components.

## DB2® UDB

Starting with DB2® LUW version 8.2.2, IBM offers a version of IBM's DB2 Universal Database which has been developed jointly between IBM and SAP. As a result of this development, DB2 LUW is optimized for SAP's suite of applications and the SAP NetWeaver platform. This optimization includes features like:

- automatic statistics collection
- DB2 workload optimization for SAP environments
- simplified storage layout
- performance enhancements optimized for the SAP workload

## DB2 Cockpit and Monitoring

With the SAP DBA Cockpit, SAP offers an integrated tool with an extensive collection of administration functionalities. The DBA Cockpit can monitor both local and remote systems. Remote DB2 systems are not required to run in conjunction with an SAP system but can also be connected as standalone database system. All essential administration tasks can be executed and monitored using the DBA Cockpit.

Using the monitoring functions of the DBA Cockpit, all relevant database activity metrics can be supervised. This includes buffer pools, caches, asynchronous I/O, direct I/O, extended storage, locks and deadlocks, logging, calls and sorts.

The administration tasks supported by the DBA Cockpit include backup management, log file management, space management and configuration.

Diagnostic functions of the DBA Cockpit allow the administrator to perform system checks, turn on/off traces, investigate and explain plans for query statements and view database diagnostic/notification logs.

The DBA Cockpit offers an alert monitor and pre-configured importing elements for DB2 LUW database system monitoring in these categories:

- space
- health
- performance
- backup

An e-mail notification function allows getting alert messages by e-mail.

**Performance: Database Snapshot**

DB Name: SLM | DB Server: ls3835 | Started: 13.09.2011 08:52:34  
 DB Release: 09.07.0002 | Last Reset: | Current Selection: Since DBM Start

**Buffer Pools**

Number	1
Total Size	5.713.040 KB

**Average Time**

Physical Reads	9,78 ms
Physical Writes	14,91 ms

**Buffer Quality**

Overall Buffer Quality	99,84 %
Data Hit Ratio	99,81 %
Index Hit Ratio	99,88 %
No Victim Buffers	101.095

**Data**

Logical Reads	133.851.622
Physical Reads	304.021
Physical Writes	105.962
Synchronous Reads	85.936
Synchronous Writes	1.297
Temporary Logical Reads	29.288.912
Temporary Physical Reads	0

**Index**

Logical Reads	140.093.609
Physical Reads	174.110
Physical Writes	306.078
Synchronous Reads	112.709
Synchronous Writes	971
Temporary Logical Reads	0
Temporary Physical Reads	0

Sample Screenshot of the SAP DBA Cockpit

## Backup in the SAP Environment

In the SAP environment, at a minimum the following data needs a regular backup:

- Operating system => needs backup on a regular basis, e.g. monthly or after applying changes/patches.
- SAP and database software => needs backup on a regular basis, e.g. monthly or after applying changes/patches.
- Database contents => needs a continuous backup (database contents and change logs) to be able to always restore the current state or a reasonable point of time in the past.

The easiest way to set up regular backups is to use the DBA Planning Calendar, a part of the SAP DBA Cockpit (SAP transaction code DBACOCKPIT). The DBA Planning Calendar allows you to plan all necessary backup and maintenance jobs easily using predefined pattern setup. Most commonly, a tape device attached

to the Power hardware can be used as backup device. If you need a more specialized setup, e.g. to reduce backup and recovery times, you can integrate Tivoli Storage Manager (TSM) or other third party backup software into the SAP DBA Cockpit. The picture below shows the DBA Planning Calendar as part of the DBA Cockpit.

The screenshot displays the DBA Planning Calendar in the SAP DBA Cockpit. The interface is divided into several sections:

- DBA Planning Calendar:** Shows the system 'PRD' and a calendar for 2011/11 and 2011/12. The calendar grid highlights the current week (Week 48) starting on Monday, December 28th. The category is set to 'All Actions'.
- Action Pad:** A list of actions on the right side, including 'Archive Logfiles to Tape', 'Automatic REORG', 'CLP Script', 'Database Backup into TSM', 'Database Backup to Device', 'Database Backup with Vendor Library', 'REORG and RUNSTATS for Set of Tabl...', and 'REORG and RUNSTATS of Planned Ta'.
- Toolbar:** Contains icons for 'Action Details', 'Edit', 'Delete', 'Add', 'Execute', 'Pattern Setup', and 'Cleanup'.
- Calendar View:** A detailed view of 'December 2011, Calendar Week 48'. The grid shows the following actions:
 

Time	Monday, 28	Tuesday, 29	Wednesday, 30	Thursday, 1	Friday, 2	Saturday, 3	Sunday, 4
02:00							
03:00							
04:00	Backup_Dev	Backup_Dev	Backup_Dev	Backup_Dev	Backup_Dev		
05:00							
06:00							
07:00							
08:00							
09:00							
10:00							
11:00							
12:00							
13:00							
14:00							
15:00							
16:00							
17:00							
18:00							
19:00							
20:00							
21:00							
22:00							Reorgck_All =>

*DBA Cockpit Planning Calendar*

## Outlook

The described reference architecture is based on a one server model with only two SAP products. As the requirements of a company might change with new challenges, new business segments or growing employee numbers the landscape is flexible to grow and adapt to the changing needs of the business.

One requirement is the scalability, the possibility to grow the existing products to enable a higher user number, data size or better performance. As a single Application Server might reach its maximum size, additional application servers – known as SAP dialog instances – can be added. These application servers connect to the central database and enhance the existing capacity. The SAP dialog instances can be started on request and could also reside on further hardware boxes that might be added if one single box is not sufficient anymore.

Adding further physical machines to the scenario also enables migration of partitions during production work e.g. balancing the load on several machines or maintaining a single physical server in production without downtime. During the maintenance time the LPARs are moved to other physical machines using Live Partition Mobility while the maintained IBM Power server goes offline. This scenario requires external disk space on a SAN, as the location of the data needs to be independent from the physical server.

Not only the resource requirements may increase but also new business areas may increase, that demand introducing new SAP products to the existing infrastructure. At any time additional SAP products that are certified on PowerLinux servers can be added to the landscape to interact with the existing installations.

## Related Content

### SAP Service Marketplace (SMP) Notes

[Note 171356 - SAP software on Linux: Essential information](#)

[Note 765424 - Linux: Released IBM Hardware - Power based servers](#)

[Note 773544 - Linux: SuSE Distributions on IBM Power based servers](#)

[Note 994025 - Virtualized OS environments in the operating system](#)

[Note 1102760 - PowerVM Live Partition Mobility](#)

[Note 1122387 - Linux: SAP Support in virtualized environments](#)

### SAP Developer Network (SDN)

[SAP on Linux](#)

[SAP on PowerLinux servers](#)

[Virtualization on SAP](#)

[SAP on DB2 for Linux](#)

[SAP on IBM I reference architecture](#)

### IBM Documentation

[IBM Whitepaper "IBM Integrated Virtualization Manager"](#)

[IBM Redbook "Hardware Management Console V7 Handbook"](#)

[IBM Redbook "SAP Applications on IBM PowerVM"](#)

[IBM Redbook "IBM PowerVM Virtualization Introduction and Configuration"](#)

[IBM Whitepaper "Live Migration of Power Partitions Running SAP Applications"](#)

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