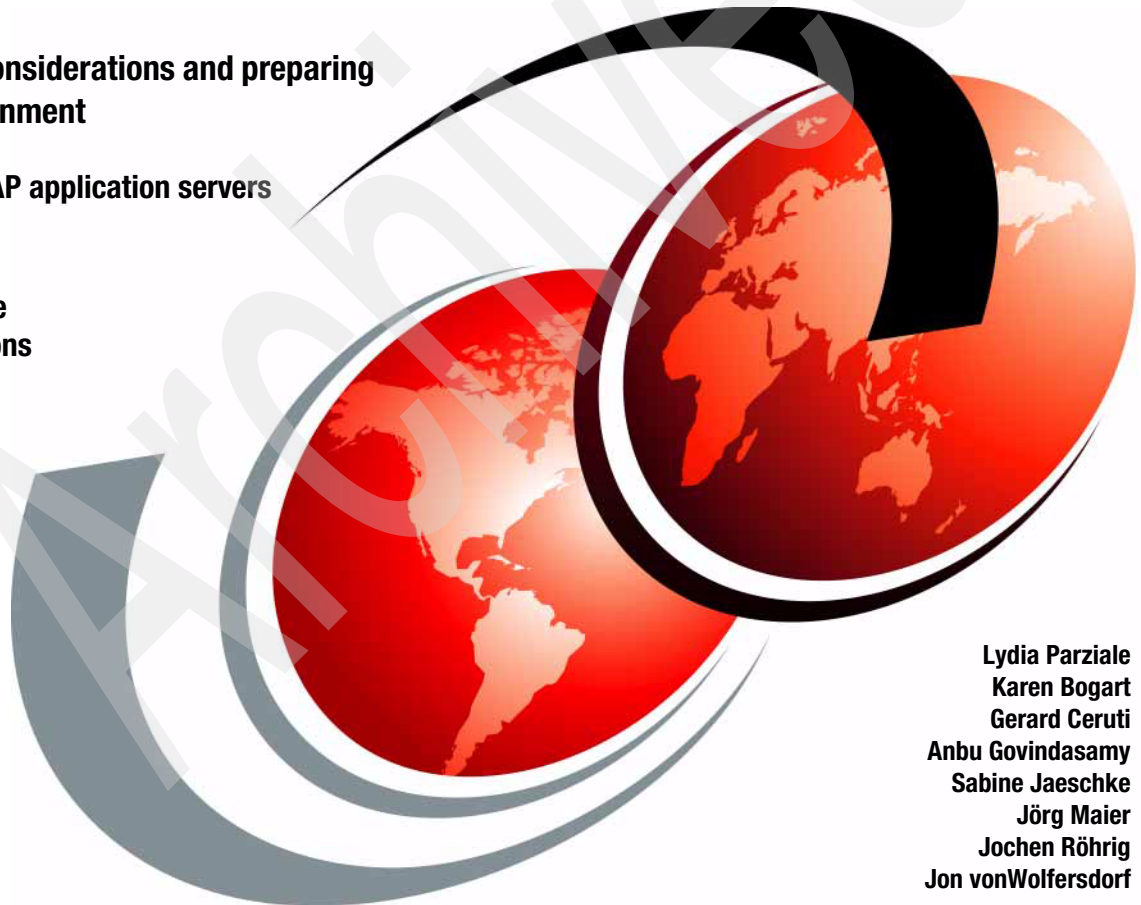


# **SAP on DB2 9 for z/OS: Implementing Application Servers on Linux for System z**

**Planning considerations and preparing  
your environment**

**Installing SAP application servers  
on Linux**

**Performance  
considerations**



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International Technical Support Organization

**SAP on DB2 9 for z/OS:  
Implementing Application Servers  
on Linux for System z**

March 2009

Archived

**Note:** Before using this information and the product it supports, read the information in “Notices” on page vii.

**Second Edition (March 2009)**

This edition applies to z/OS Version 1, Release 9, z/VM Version 5 Release 4, SLES 10 SP2, RHEL 5.1, SAP NetWeaver 7.00 SR3.

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# Preface

The power of the IBM® System z®, combined with the flexibility of Linux® on System z, provides the ideal platform on which to implement SAP® application servers. System z provides the benefits of continuous availability, high performance, scalability, and ease of management; these qualities support and complement mission-critical SAP business applications.

This IBM Redbooks® publication focuses on the implementation of SAP application servers on Linux on System z to leverage the synergy of this combination of products. It provides detailed information to guide you through the planning process, including resource sharing considerations, hardware and software requirements, support and maintenance.

This book takes you through the steps to prepare the system environment, describing system and network configurations, and demonstrates the procedures for installing and customizing your system. It describes in detail how to install SAP application servers in z/VM® Linux images, including the installation of SAP and Java™ and hipersockets. Finally, it provides guidance for performance tuning and introduces some useful monitoring tools.

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Figure 1 The project team, from left: Karen Bogart, Sabine Jaeschke, Jörg Maier, Gerard Ceruti, Anbu Govindasamy and Jochen Röhrig (Missing from photo: Jon vonWolffersdorf)

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# Summary of changes

This section describes the technical changes made in this edition of the book and in previous editions. This edition may also include minor corrections and editorial changes that are not identified.

Summary of Changes for SG24-6847-01 for SAP on DB2 9 for z/OS:  
Implementing Application Servers on Linux for System z as created or updated  
on March 29, 2009.

## March 2009, Second Edition

In addition to substantial changes to the existing information, this revision reflects the addition of new material and the removal of obsolete topics as outlined here.

### New information

- ▶ Java Instance
  - Setting up the Java instance
  - Some JDK™ recommendations - settings for Linux on System z and relevant SAP Notes
- ▶ Added new z/VM recommendations for tuning
- ▶ Hipersockets setup and patch levels
- ▶ A discussion on HA-readiness on Linux for System z
- ▶ Using SAP on Red Hat

### Deleted topics

- ▶ Installing the ICLI client and server
- ▶ Creating redadm and sapsys (this is now done by SAPinst, which is the recommended way to create the users)
- ▶ Heterogeneous environment considerations
- ▶ Dialog instance setup in a heterogeneous environment
- ▶ R3Setup output
- ▶ Cloning





# SAP and Linux overview

This chapter provides a brief overview of SAP NetWeaver architecture and its hardware and software implementations when DB2 9 for z/OS is used as the database server. We discuss the support for Linux application servers, how those Linux application servers help address business requirements, and the benefits they provide.

A more detailed look at the SAP NetWeaver architecture can be found in the following IBM Redbooks documents:

- *Enhancing SAP by Using DB2 9 for z/OS*, SG24-7239
- *SAP Solutions on IBM DB2 UDB V8.2.2 Handbook*, SG24-6765
- *SAP on DB2 for z/OS and OS/390: High Availability and Performance Monitoring with Data Sharing*, SG24-6950
- *DB2 UDB for z/OS V8: Through the Looking Glass and What SAP Found There*, SG24-7088

Detailed SAP documentation on the NetWeaver architecture is:

- Master Guide SAP NetWeaver 7.0
- SAP Planning Guide for SAP NetWeaver on IBM DB2 for z/OS

The starting URL for all SAP documentation is:

<http://service.sap.com/NW70doc>

## 1.1 SAP NetWeaver architecture

SAP NetWeaver provides a complete set of applications that combine all business activities into an integrated process. SAP NetWeaver provides an integrated database containing real-time business data. Business reporting and administration can be done on a departmental, divisional, or global level.

The SAP NetWeaver applications are designed around software services that are hardware independent. The SAP NetWeaver architecture has three logical tiers or layers, each providing a different category of services. The categories of services are:

- ▶ Presentation services

These are implemented by the SAP NetWeaver graphical user interface (GUI) that runs on Windows® (native), AIX® and Linux platforms (Java implementation).

- ▶ Application services

SAP NetWeaver application logic is executed on this layer. This layer provides services for online users, batch processes, and so on. SAP also provides monitoring utilities, which are executed on this layer.

- ▶ Database services

Vendor-provided database systems. SAP NetWeaver uses the database server to store data from various application servers. The SAP NetWeaver application code and statistical data is also stored in the database.

This design allows a more dynamic approach to managing workloads. It is possible to configure an SAP system in which two tiers reside on one physical machine, for example, the application server and the database server. When the workload grows to exceed the capacity of one physical machine, then the tiers can be split to run on different hardware. It is also possible to use multiple physical machines to support the application server tier.

Figure 1-1 on page 3 shows the currently supported application server configurations with DB2 9 for z/OS as the database server. This figure highlights the Linux application server for System z on which we concentrate in this book.

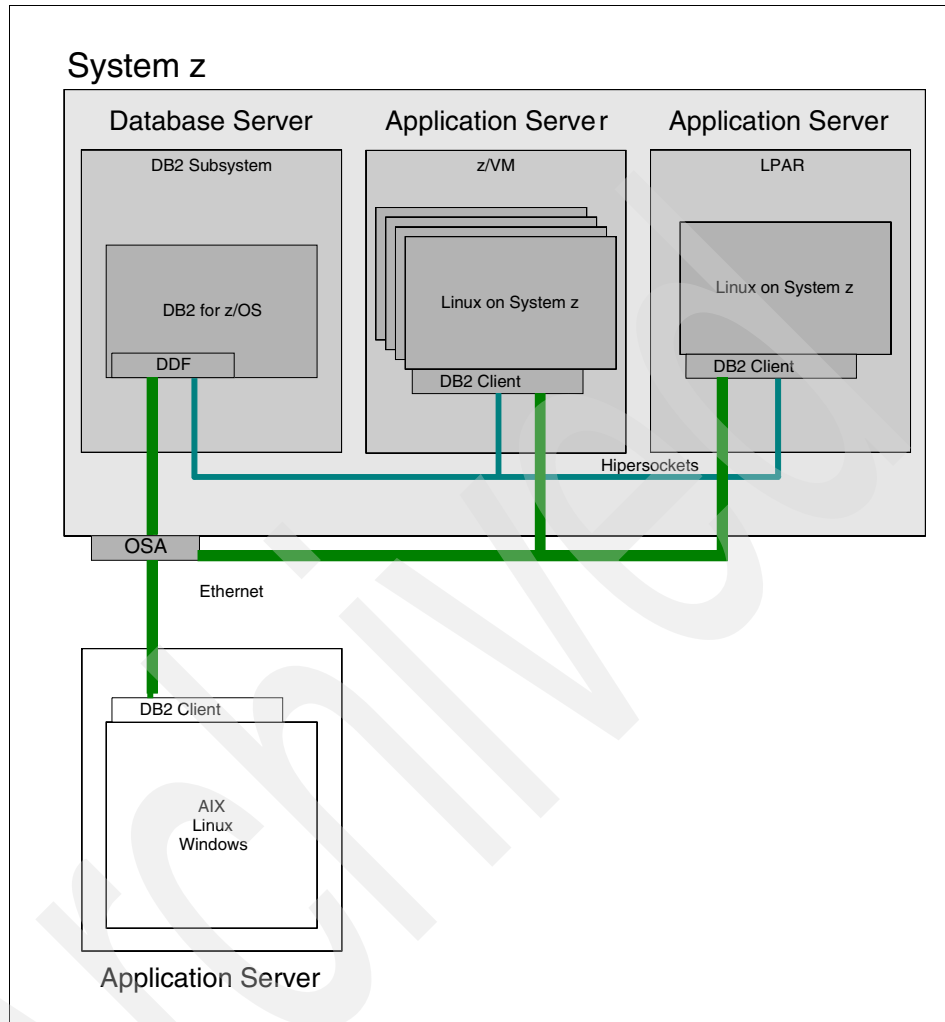


Figure 1-1 SAP application servers connecting to Linux on System z

## 1.2 How SAP and System z meet business requirements

A detailed discussion about the benefits of running SAP applications on IBM System z can be found in “Backbone for Business Success - The added value of running SAP applications on IBM System z”.

For all customers, the production SAP system provides mission-critical business applications. If the production SAP system becomes unavailable for any reason there is a potential business loss in revenue or reputation. In order to meet

business requirements, it is imperative to keep these systems available at all times, and this is especially true for global companies.

To achieve this, systems must be built to provide continuous availability, high performance, scalability, and easy management. In the current rapidly changing business environments, with workloads that are unpredictable, business systems must be able to respond to these demands and at the same time keep the total cost of ownership of IT systems within budget.

In the following sections we discuss how SAP application servers on Linux on System z can help to meet these business goals.

### 1.2.1 Continuous availability

Continuous availability is the design goal of many customer SAP production configurations. This is achieved by a combination of high availability and continuous operation.

#### High availability

High availability refers to the ability to avoid unplanned outages by eliminating single points of failure. This is a measure of the reliability of the hardware, operating system, and database manager software. Another measure of high availability is the ability to minimize the effect of an unplanned outage by masking the outage from the end users. This can be accomplished by quickly restarting failed components.

#### Continuous operation

Continuous operation refers to the ability to avoid planned outages. To achieve continuous operation there must be ways to perform administrative work, and hardware and software maintenance, while the application remains available to the end users. This is accomplished by providing multiple servers and switching the users to an available server at times when another server is made unavailable. Using DB2 data sharing with DB2 connection failover is an example of how this is accomplished in an SAP environment.

It is important to note that a system running in continuous operation is not necessarily operating with high availability because an excessive number of unplanned outages could compromise this.

High availability and continuous operation are documented in *Business Continuity for SAP on IBM System z*, SC33-8206. The SAP application servers on Linux on System z fully participate in the configurations described in this document.

## 1.2.2 Network

When the SAP application server is running on the same System z hardware as the DB2 database, one of the network connections to the database server will use HiperSockets – a sort of “network in a box.” HiperSockets eliminates the need for adapter cards for the application server to database server connection. HiperSockets server to server communication is performed by using the System z memory bus, thus reducing network latency significantly (with hardware latency close to zero), and also providing high-end security, because no network traffic flows outside the server. This improved network time can significantly improve the performance of long-running, database-intensive transactions.

Network cards are still required to connect the System z to the network infrastructure.

## 1.2.3 Scalability

The SAP architecture provides the ability to add application servers when the capacity of the application server hardware has been exceeded. Also, customers typically have multiple non-production SAP systems. Generally each SAP system or application server resides on its own hardware. For large installations, this means many physical servers are required.

An IBM System z10™ CEC can scale from one to sixty-four engines, and using PR/SM™ it can be partitioned into as many as sixty logical partitions (LPARs). LPARs can share CPU and I/O resources, but not memory. Each LPAR could support a Linux application server. System z z/VM provides the added capability of running multiple Linux application servers in a single System z z/VM LPAR. Using z/VM, the number of Linux application servers that could be run on one System z machine is limited only by the capacity of the System z machine.

Linux on System z application servers also fully support DB2 data sharing. With DB2 data sharing, database servers can be added to provide additional capacity beyond that of a physical System z machine. This means that you can add Linux application servers to an SAP system and maintain a physical two-tier configuration on System z. This provides scalability beyond a single System z machine.

## 1.2.4 Manageability

The management of Linux application servers on System z is simplified because of the outstanding scalability of the System z hardware. While the paradigm of others is “one application server per machine,” this is not true for System z. With System z, many application server instances can be put on one machine. By

reducing the number of physical systems and application instances from many to few, the effort for administration and maintenance can go down considerably.

With z/VM, many Linux application server instances can be run on System z. Another advantage of using z/VM is that the management procedures of the z/VM guest machines (Linux application servers) are common for all guest machines. This will further simplify the management of multiple Linux application servers running on System z.

### **1.2.5 Ease of deployment**

In today's world of fast-changing business volumes and acquisitions, the need to quickly deploy business applications is key to business success. The ability to clone guests within z/VM can make this easy and fast. The recommended way of cloning SAP instances is discussed in section 6.1, "Cloning of SAP dialog instances" on page 132.

### **1.2.6 Total cost of ownership**

The use of Linux on System z helps control the total cost of ownership (TCO) by allowing the consolidation of multiple application servers on a single System z machine. The incremental cost of adding an application server is less than that of traditional environments. The availability of the Integrated Facility for Linux (IFL) processor and its special pricing, covered in 1.4.6, "IFL engines" on page 11, also helps to lower the TCO for Linux on System z.

There are many aspects of the TCO that can justify using Linux on System z, including:

- ▶ Increased utilization of server hardware, software, and network
- ▶ Lower total cost for physical requirements such as floor space and energy
- ▶ Reduced employee requirements and cost
- ▶ Increased availability, lower downtime costs
- ▶ Faster deployment of servers, faster to market
- ▶ Lower total cost for administration and maintenance

A number of factors contribute to TCO. Among the items included in a TCO calculation are the following:

### ***Hardware***

- ▶ Servers
- ▶ Disk
- ▶ System management
- ▶ Racks (and cables)

Hardware components will vary greatly between architectures that are being compared for solving the same problem. Keep in mind that due to server differences in architecture and performance, it is important to correctly size the comparative workloads.

### ***Software***

- ▶ Operating system
- ▶ Linux software support
- ▶ System management
- ▶ Database

Software costs make up a very large component in the TCO model. In the distributed model, most of the ISV software cost is based on the number of processors (CPUs), independent of whether the machine is running at 3% or 100% capacity. Depending on the Linux on System z-based pricing used, there can often be savings in ISV software.

### ***People***

- ▶ Person days or full-time equivalents

People costs need to be examined carefully to make sure that the cost per person and the ratio of IT staff per server reflects the customer situation. This is frequently a very sensitive area.

### ***Occupancy***

- ▶ Area
- ▶ Utilities

There is a lot of variability in the cost of floor space and utility charges in different geographies. When looking at floor space costs, examine if there are any constraints. If there are, the acquisition of more space will probably have a very high initial cost. This large additional cost can often weigh heavily on the total cost analysis.

### ***Downtime***

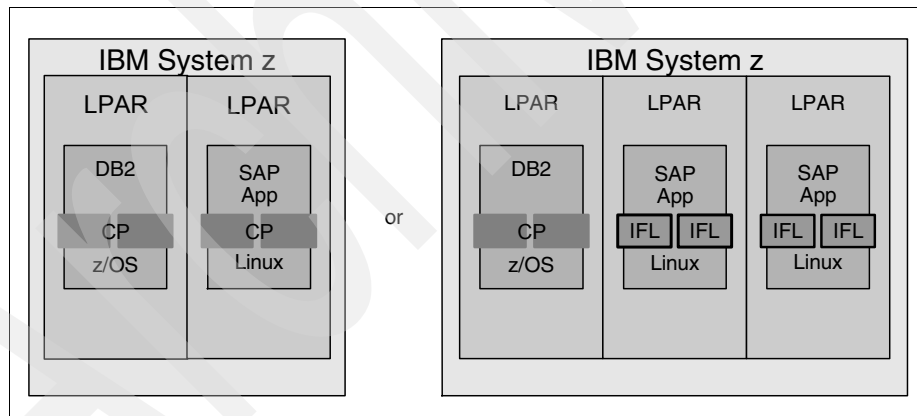
Downtime is an aggregated number based on expected downtime of each of the different architectures and on industry numbers for the cost of downtime. Cost of downtime numbers should be examined as a means of demonstrating the number of customer satisfaction issues that may occur within the different architectures. Downtime numbers are valuable for highlighting some of the hidden costs in an IT environment.

## **1.3 Linux on System z**

This section describes some possible configurations for the System z Central Electronic Complex (CEC) with Linux application servers. Note that these are not all the possible configurations, simply the more common ones.

### ***Possible configurations***

The configurations in Figure 1-2 show the Linux application servers running in native System z LPARs. The Linux application server on the left is using standard Central Processor (CP) engines. The Linux application servers on the right are using the Integrated Facility for Linux (IFL) engines.



*Figure 1-2 Configuration options - Examples (1)*

The configuration in Figure 1-3 on page 9 shows the Linux application servers running as guest machines under z/VM using IFL engines. It is also possible to run this configuration using standard engines.

We believe the configuration using standard engines for z/OS and DB2 with IFLs for z/VM, Linux, and SAP is the best for most environments.



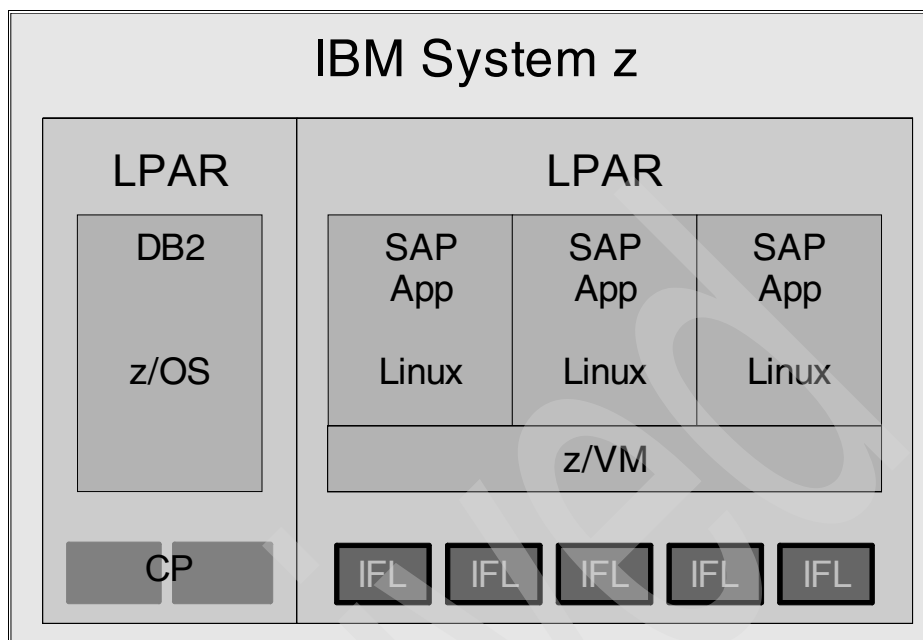


Figure 1-3 Configuration option - Example (2)

## 1.4 Benefits of Linux on System z for SAP

Linux on System z inherits all the reliability, availability, and serviceability of the System z server platform. This section discusses these and additional benefits of running Linux SAP application servers on System z.

### 1.4.1 Consolidation of operating system platforms

We believe that Linux is poised to become the most prominent operating system in the IT industry. Customers are looking for an industry standard operating system that is open, flexible, and can easily deploy new applications at reduced costs. As Linux becomes more widely used and supported, it makes sense to deploy business applications like SAP on Linux on System z. This would link the benefits of Linux with those of the System z hardware platform.

### 1.4.2 Server consolidation

Linux on System z enables you to combine multiple SAP application servers onto Linux application servers on a System z. The vertical scalability (from one to sixty-four processors) and horizontal scalability (from one to sixty LPARs) of a

System z server provides the capability to do this. Consolidation works best when the servers being considered are underutilized or have workloads that peak at different times. Reducing the number of servers from many to one reduces administration and maintenance efforts. Cost savings can be realized in the areas of lower operations cost, people costs, and improved disaster recovery.

The consolidated SAP application servers can share hardware resources. It is very possible that the CPU requirements for the System z server would be less than the aggregate CPU resource of the consolidated applications servers, especially when consolidating development systems and quality assurance systems. Administration and maintenance costs will be less because of the need to manage only one hardware platform.

Using z/VM for application server consolidation also addresses the requirement for easier management and better control of costs.

### **1.4.3 Native LPAR**

When IFLs are used, capacity can be assigned to each of the Linux LPARs as needed, based on business requirements, using standard PR/SM functions. Multiple Linux LPARs that are sharing IFLs can take advantage of PR/SM features that dynamically share capacity while insuring that each LPAR receives the minimum capacity it needs.

### **1.4.4 64-bit addressing**

Linux application servers on System z support 64-bit addressing. The benefit of 64-bit addressing is the ability to address large amounts of storage. This increases the size of the SAP buffers and provides the ability to hold more data and programs in memory, thus avoiding database requests. If sufficient real storage is provided, then swapping and paging is also avoided – thus leading to performance improvements for systems with many users per application server.

### **1.4.5 z/VM Linux image cloning**

The ability to do image cloning with z/VM is key to the ability to easily and quickly deploy guest systems when there is a business need. The more quickly a business can respond to changing business needs, the more competitive it will be.

For more information on cloning Linux guests under z/VM see the redbooks publications *z/VM and Linux on IBM System z: The Virtualization Cookbook for*

*Red Hat Enterprise Linux 5.2, SG24-7492 and z/VM and Linux on IBM System z: The Virtualization Cookbook for SLES 10 SP2, SG24-7493.*

### **1.4.6 IFL engines**

The Integrated Facility for Linux (IFL) is a processor that is for use by z/VM and Linux guests and Linux on System z operating systems. IFLs are System z speciality engines and are priced at a lower rate than regular engines used for z/OS. Because IFLs are dedicated to Linux workloads, the added capacity does not increase software fees in the z/OS environment. (Note that this reflects the situation at the time of writing; consult your IBM server sales representative to obtain the most current pricing structure information.)

### **1.4.7 Business continuity**

Customers want business continuity or disaster recovery procedures for SAP application servers as well as for the SAP DB Server. All components of your SAP solution must be recoverable at the current site or at an alternate site in the event of a major outage. Advanced management and automation tools available for System z provide a full set of functions and features to achieve this. This includes the IBM service offering Geographically Dispersed Parallel Sysplex™ (GDPS®) and the IBM product group Tivoli® System Automation (TSA).

This is documented in “Business Continuity for SAP on IBM System z, SC33-8206-02.



# Planning for SAP on Linux on System z

This chapter discusses topics you need to consider before installing an SAP application server on Linux on System z, including the following:

- ▶ Designing the system
- ▶ Designing the network
- ▶ Resource sharing considerations
- ▶ Planning the software configuration
- ▶ Professional support

To prepare for the design phase, refer to the following Web pages for documentation:

- ▶ [http://www-03.ibm.com/servers/eserver/System\\_z/software/sap/sapesa/](http://www-03.ibm.com/servers/eserver/System_z/software/sap/sapesa/)
- ▶ <http://help.sap.com/nw70>
- ▶ <http://service.sap.com/instguides>
- ▶ <http://www.sdn.sap.com/irj/sdn/db2>

**Note:** Service.sap.com requires a valid SAP userid and password. Contact your SAP representative for these credentials.

## 2.1 Designing the system

The planning steps needed are dependent on your specific requirements and infrastructure, including both the current and the target configurations. Consider each of the following products, versions, and capabilities that can be incorporated into your design:

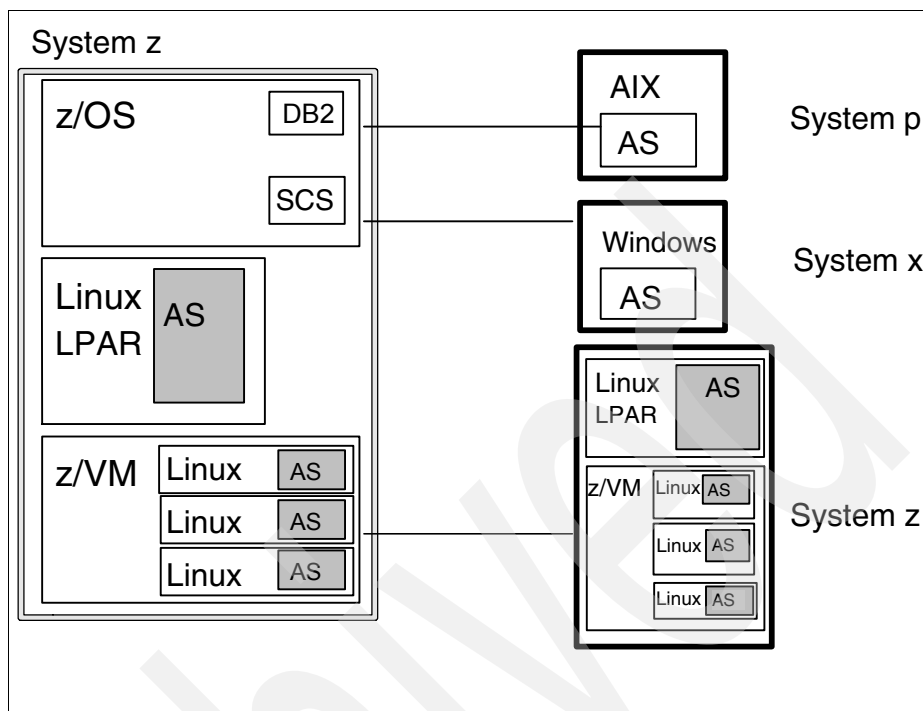
- SAP Kernel and SAP Release
- Linux Distribution
- DB2 version
- z/OS version
- Linux file system type
- Logical Volume use
- Backup and Recovery
- Job Scheduling
- Automation and High Availability
- Monitoring
- Archiving
- Printing
- Disaster Recovery
- Network Design

We cannot expand on all the possible configurations; instead, we discuss four typical system configuration scenarios here. One of these scenarios probably comes close to your own environment:

- ▶ Adding SAP Linux application servers to an existing SAP system
- ▶ Building new SAP systems from scratch
- ▶ Consolidating SAP systems
- ▶ A highly available configuration

### 2.1.1 Adding SAP Linux application servers to an existing SAP system

One possible scenario is that you might want to add SAP application servers running on Linux on System z to an existing SAP landscape that has DB2 already on z/OS. Figure 2-1 illustrates this configuration. Note the SAP Central Services (SCS).



*Figure 2-1 Scenario 1: Adding SAP application servers on Linux on System z (boxes shaded grey) to an existing SAP landscape*

There are a number of reasons you might want to add SAP application servers running on a Linux on System z environment, including:

- ▶ To use Linux as a strategic platform within the IT environment
- ▶ To replace z/OS application servers in order to leverage 64-bit addressing and reduce software costs, without sacrificing the advantages of the hardware platform
- ▶ To replace UNIX or Windows application servers with SAP Linux application servers running on the same CEC as the z/OS database subsystem, in order to reduce network latency and thus the response time of long-running transactions

Some basic decisions you must make regarding your configuration are:

- ▶ Will Linux run on the same hardware as the database server, or on a separate central electronic complex (CEC)?
- ▶ With your database system already running on a System z server:
  - Is there enough spare capacity?

- Can the CEC be easily upgraded with general purpose CPs or Linux speciality engines (IFLs)?
- Will deployment be in a Linux native LPAR, or as a virtual image within z/VM?

Once these decisions have been made and implemented you can relocate some of the application server workload onto the identified System z server.

Running SAP application servers under z/VM has numerous benefits with respect to sharing of resources, time to clone new images, backup and restore tools, high availability, and disaster recovery. If you are concerned about virtualization overhead with z/VM compared with running Linux for System z in native LPAR, see:

<http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP100722>

## 2.1.2 Building new SAP systems from scratch

If you decide to implement a new SAP system landscape with DB2 9 for z/OS and SAP application servers running under Linux on System z, you need to answer the following questions:

- ▶ Will Linux run on the same hardware as the database server, or on a separate CEC?
- ▶ Will I deploy Linux in an LPAR or in a z/VM guest?

Because you are using new hardware for both database and application servers, it makes sense to try to put them all together in the same CEC.

- ▶ Do I require a High Availability solution?

For a discussion on high availability, continuous operation, and continuous availability, see 2.1.4, “Highly available configuration” on page 19.

Figure 2-2 on page 17 illustrates SAP landscapes contained within one System z CEC.



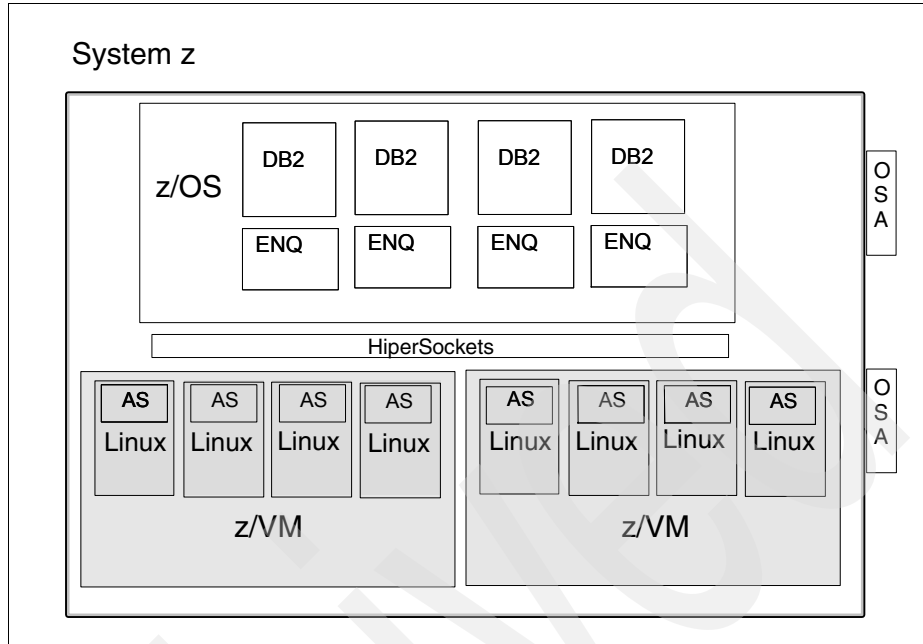


Figure 2-2 Scenario 2: New SAP systems with Linux application servers on System z

### 2.1.3 Consolidating SAP systems

Where System z really shows its strength is when it comes to server consolidation. In this scenario you already have a number of different SAP systems running with some UNIX or Windows database servers. As SAP systems over time increase in size and number, the number of installed hardware boxes will also increase for these environments.

Moving these systems to System z has the following advantages:

- ▶ It is good preparation for migrating the SAP landscape into a Highly Available configuration.
- ▶ Adding new SAP systems will, in most cases, result in setting up new LPARs and z/VM guests, not in adding more CECs.
- ▶ Increasing the number of servers does not necessarily require adding more capacity. Once you decide on the general system layout, you just add virtual servers. Only when the system workload grows do you increase your hardware capacity, and this increase might be just the addition of zIIP (special data processing) or IFL (special Linux processing) engines.

- ▶ Using several DB2 subsystems per z/OS image, Linux LPARs or Linux guests under z/VM allows for the sharing of resources between all the LPARs, thereby using the system hardware more efficiently.
- ▶ It enables you to utilize Parallel Sysplex to provide outstanding high availability features.

When planning for this consolidation scenario, you will have to decide on the following issues:

- ▶ Are Parallel Sysplex high availability features to be implemented? (If a highly available configuration is to be implemented, see 2.1.4, “Highly available configuration”.
- ▶ How many z/OS LPARs should be set up, and how many DB2 instances will run in each of them?
- ▶ Which Linux images cannot be z/VM guests?
- ▶ Will all application servers run on the same CEC as their primary database instance?
- ▶ To what degree do you want to separate production, quality assurance, development, test, and sandbox?

The answers to most of these questions depend on the size of the SAP systems being migrated.

Figure 2-3 on page 19 illustrates a setup with two System z servers, with DB2 in non-data-sharing mode. The separate CECs and LPARs are used for the different SAP landscapes: sandbox, development, quality assurance, pre-production, and production.

The non-production landscape can reside on one CEC in native LPARs or under z/VM. This consolidation process can then be staged and fully tested before going into production. In this example we included an IFL-only CEC running z/VM with Linux guests and a Linux native LPAR.

This consolidation configuration is the first step in the migration to a highly available configuration with DB2 data sharing.

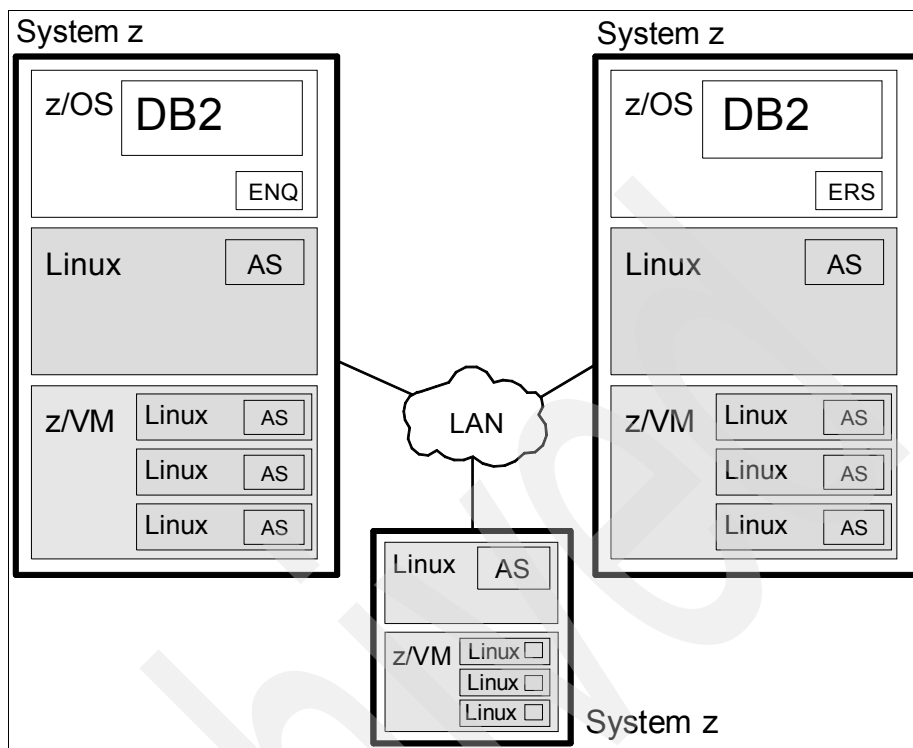


Figure 2-3 Scenario 3: Consolidating SAP systems on System z

## 2.1.4 Highly available configuration

As a reference for this section, see the IBM document *Business Continuity for SAP on IBM System z*, SC33-8206, which can be found at:

<http://www-03.ibm.com/servers/eserver/zseries/software/sap/documentation/docu.html>

In our experience, many customers who set up a new SAP landscape from scratch look especially for the Parallel Sysplex functions when they make a platform decision to use IBM System z.

A production SAP system is a critical business asset and therefore requires the highest level of availability. Continuous availability combines the characteristics of high availability (the ability to avoid unplanned outages by eliminating single points of failure) and continuous operation (the ability to avoid planned outages, such as for administrative or maintenance work) in order to keep the SAP system running as close to 24x365 as possible.

## Degrees of availability

The terms *high availability*, *continuous operation*, and *continuous availability* are generally used to express how available a system is. (These terms were defined previously; we repeat the definitions here because of their importance in configuration planning.)

### **High availability**

High availability refers to the ability to avoid unplanned outages by eliminating single points of failure. This is a measure of the reliability of the hardware, operating system, and database manager software. Another measure of high availability is the ability to minimize the effect of an unplanned outage by masking the outage from the end users. This can be accomplished by quickly restarting failed components using a tool such as Tivoli System Automation (TSA) on z/OS.

### **Continuous operation**

Continuous operation refers to the ability to avoid planned outages. For continuous operation there must be ways to perform administrative work and hardware and software maintenance while the application remains available to the end users. This is accomplished by providing multiple servers and switching end users to an available server at times when one server is made unavailable. Using DB2 data sharing with DB2 connection failover is an example of how this is accomplished in an SAP environment.

It is important to note that a system running in continuous operation is not necessarily operating with high availability because an excessive number of unplanned outages could compromise this.

### **Continuous availability**

Continuous availability combines the characteristics of high availability and continuous operation to provide the ability to keep the SAP system running as close to 24x365 as possible. This is what most customers want to achieve.

Figure 2-4 on page 21 illustrates a conceptual view of a possible solution:

- ▶ DB2 is in data-sharing mode via the ICFs, the z/VM Linux guests running the SAP application servers connect to the DB2 databases via HiperSocket, OSA, VIPA, OSPF, and VSWITCH network technology.
- ▶ The SAP stand-alone enqueue is running under z/OS and is replicated to the alternate z/OS via the enqueue replication server.
- ▶ The software tool to manage the infrastructure can be TSA on z/OS or TSA Multiplatform, which includes an end-to-end feature that spans multiple clusters or even platforms. This would allow for a single operational view of the infrastructure.

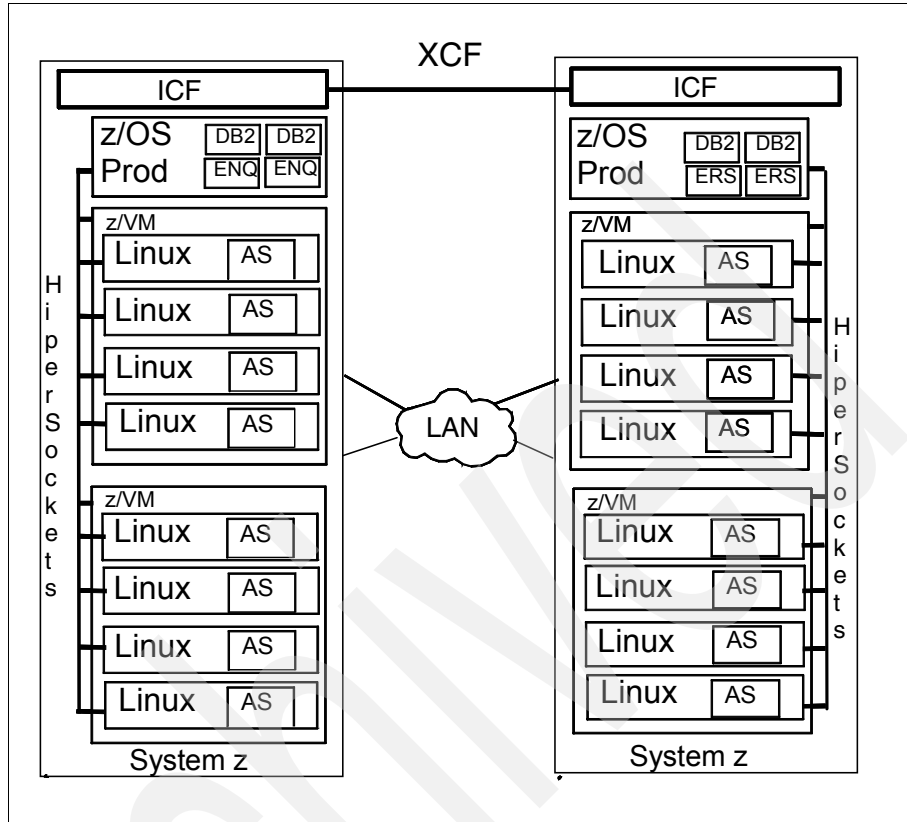


Figure 2-4 SAP Application servers on System z in a Highly Available configuration

## 2.2 Designing the network

After deciding on your system layout, it's time to think about the communications setup.

One advantage of setting up SAP application servers on Linux on System z is the ability to use HiperSockets™ to connect the application servers to the database instance on the same CEC.

HiperSockets supports:

- ▶ Up to sixteen independent HiperSockets.
- ▶ Up to 12288 I/O devices across all 16 HiperSockets.
- ▶ VLAN support, with a maximum four VLANs for each defined HiperSocket.

- ▶ Spanned channel support, which allows sharing of HiperSockets across multiple Logical Channel SubSystems (LCSS).
- ▶ Up to 4096 TCP/IP stack connections across all HiperSockets; for z/OS, z/VM, and Linux.
- ▶ Up to 16000 IP addresses across all 16 HiperSockets, which means that a total of 16000 IP addresses can be kept for the 16 possible IP address lookup tables. These IP addresses include the HiperSockets interface, and also Virtual IP addresses (VIPA) and dynamic Virtual IP Addresses (DVIPA) that are defined to the TCP/IP stack.

For further details refer to *HiperSockets Implementation Guide*, SG24-6816.

**Note:** HiperSockets are used within one CEC. If the SAP Application Server needs to connect to a DB2 subsystem on another CEC, normal connectivity via OSA cards is used.

Figure 2-5 illustrates a possible configuration.

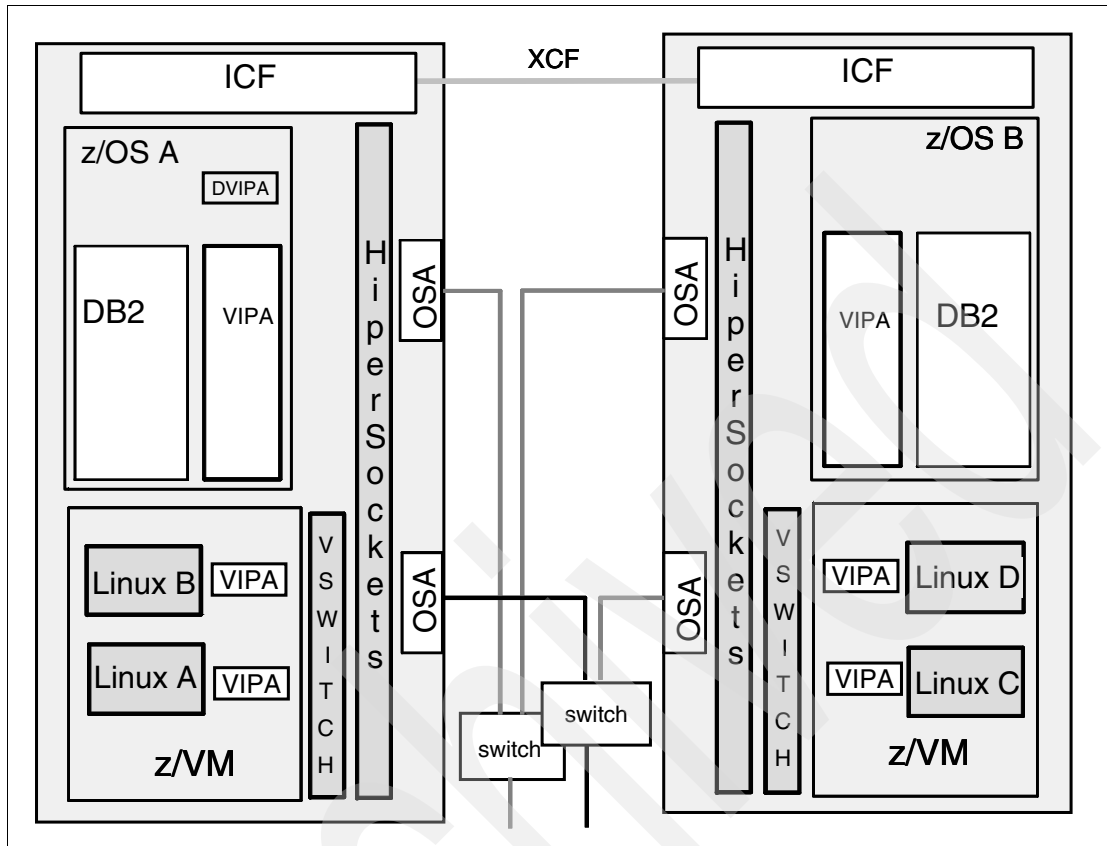


Figure 2-5 Example of TCP/IP configuration using OSA-Express and HiperSockets

The configuration depicted in Figure 2-5 has no Single Point of Failure (SPOF).

There are two switches to connect the System z environment to the presentation layer in the client network. All servers implement Open Shortest Path First (OSPF) routing, with the HiperSockets connection having preference over the Gigabit connection for the network connections between z/VM and z/OS within the same CEC.

Multiple network interfaces are virtualized by the use of Virtual IP Address (VIPA) and Dynamic Virtual IP Address (DVIPA). The difference between VIPA and DVIPA is that DIPVA can be switched between the two CECs to support a Highly Available configuration. Also, DVIPA moves together with the application it belongs to.

Parallel Sysplex makes use of ICFs to facilitate DB2 data sharing.

## 2.3 Resource sharing considerations

The sharing of resources is one of the great strengths of Linux on System z. In this section, we briefly discuss the options available to you to share resources in a Linux on System z environment, such as processors, real memory, disk storage, swap space, and network.

### 2.3.1 Processors

The processing units (PUs) on a System z processor board come in different types, depending on the licensed internal code (LIC) that runs on the CEC. Two of these PU flavors can be used to run operating systems:

- ▶ All-purpose central processors (CPs) can be used for all kinds of System z operating systems: z/OS, z/VM, VSE, and Linux on System z (31-bit and 64-bit).
- ▶ Integrated Facilities for Linux (IFLs) can only be used for Linux on System z and z/VM V4 and higher. Adding an IFL to your traditional environment should not increase your z/OS software costs and will leave the machine type, model, and serial number the same.

Defining LPARs or z/VM guests on a System z gives you the opportunity to share either CPs or IFLs. For instance, if you have five physical CPs and three physical IFLs, you can define LPARs which each have either up to five logical CPs or three logical IFLs. Be aware, that there might be restrictions that limit the definition of IFLs and CPs to the same LPAR.

With z/VM, the type of PU (CP or IFL) that can be defined to guests is inherited by the type of PU that is defined to the LPAR that z/VM runs in. In contrast to LPARs, you can define more PUs to a z/VM guest than are available to the LPAR or even physically installed on the machine. For performance reasons, this feature should be used for testing purposes only.

**Note:** IBM has enhanced z/VM in release 5.4.0 to support the new System z10 EC capability to allow any combination of CP, zIIP, zAAP, IFL, and ICF processor types to reside in the same z/VM LPAR.



## 2.3.2 Real memory

You have to dedicate real memory to LPARs. If you want to increase the memory available to an LPAR, you have these options:

- ▶ If you have unused memory on your system, you can shut down your LPAR, add this memory in the hardware configuration definitions, and then reactivate the LPAR.
- ▶ Take memory away from another LPAR. For this, you have to deactivate both LPARs.
- ▶ Increase the amount of installed memory and give it to the LPAR.

Memory given to z/VM guests is normally virtual memory, which means that theoretically you can give each guest as much memory as you want, as long as you have enough paging space available.

How much you can overcommit the physically available memory without serious performance degradation depends on the kind of operating system and workload you are running. You can increase the amount of virtual storage available to a guest without affecting others, except perhaps in performance.

## 2.3.3 Disk storage

With z/VM, you have several possibilities to virtualize disk storage:

- ▶ Dedicated minidisks

To the operating system, these look like DASD ECKD-devices, except that they can be tailored in size. The maximum size is that of the physical disk they are carved from. Minidisks cannot span multiple physical disks.

- ▶ Shared minidisks

When you share minidisks between Linux images, they must be mounted read-only on every image. Any other approach could lead to damaging the file system, because Linux tries to cache large amounts of these file systems in its memory, and there is no way to achieve coherence of this cache between multiple Linux images.

- ▶ Virtual disks (VDISKs)

They live only in virtual memory, are created with logon to the z/VM guest, and are destructed on logoff. Therefore, they can only be used for temporarily used disks (for example, swap space).

z/VM also provides its own minidisk caching. It might be a good idea to use minidisk caching when you share minidisks between many Linux images. On the other hand, you should switch it off for minidisks Linux uses as swap devices.

For a standard setup, you might want to stick to dedicated minidisks, which will make the initial configuration simple and easy to understand.

When planning the DASD configuration of a Linux LPAR, we recommend that you make sure that Linux gets no access to volumes containing other production data or other non-Linux operating systems. This can be done in the hardware configuration definition (HCD) by either using the PARTITION parameter on the CHPID statement (which will dedicate all devices that are accessed by this CHPID to the Linux partition), or by using the PARTITION parameter on the IODEVICE statement and defining the CHPIDs as shared. In this case, you can select the devices that will be dedicated. The disadvantage is that Linux at IPL will still *sense* all devices that are accessible through the CHPIDs available to the LPAR, no matter which devices are dedicated.

Also look at the “cio\_ignore” option to have the Linux kernel ignore certain devices at Linux IPL time, especially if Linux is running a native LPAR. Follow this link for more information:

[http://www.ibm.com/developerworks/linux/linux390/perf/tuning\\_rec\\_cioignore.html](http://www.ibm.com/developerworks/linux/linux390/perf/tuning_rec_cioignore.html)

### 2.3.4 Swap space

There are several possibilities for setting up swap space in a z/VM Linux environment using DASD, minidisk, or Linux RAMdisk. You need to research the options and decide what is the correct configuration for your installation. For more information refer to 5.6, “Linux on System z swap space” on page 121.

### 2.3.5 Network adapters

There are several ways to share network adapters in an SAP Linux on System z environment. We recommend the following, in order of priority:

1. Share a HiperSockets LAN between all operating system images on the same box that participate in the SAP configuration. For more information about HiperSockets, refer to *HiperSockets Implementation Guide*, SG24-6816.
2. Define virtual LANs; the logically defined networks operate in a z/VM LPAR as though they are physically independent of each other. A VLAN can be extended to allow traffic flow over HiperSockets and OSA-Express.
3. Using OSA-Express adapters in QDIO mode as network devices, you can share one physical port over 80 TCP/IP stacks (operating systems). OSA adapters using QDIO mode also offer priority queueing, which allows you to

establish TCP/IP connections with different quality of service over the same port.

For more information about OSA-Express adapters, refer to *OSA-Express Implementation Guide*, SG24-5948.

4. Use z/OS HiperSockets accelerator as a router. This allows very efficient routing between a QDIO LAN connection and a HiperSockets LAN on the lowest possible data link control level. No higher level TCP/IP stack routing functions are involved.
5. Use HiperSockets Network Concentrator under z/VM to allow a Linux system to be configured as a connector server to transparently bridge network traffic between HiperSockets and OSA-Express networks.
6. Use the z/VM TCP/IP stack as a router between the outer world and an internal server network, or to connect the Linux images within z/VM to the database server.

**Note:** Whenever you use a TCP/IP stack in an LPAR as a router between an OSA adapter and an internal LAN (for example, HiperSockets, z/VM guest LAN), this stack must be defined as primary router (PRIRouter) to the OSA port. Only one PRIRouter can be defined to an OSA port.

Also, when planning a highly available configuration, ensure that the network router is not a single point of failure.

7. For all possible physical and virtualization technologies available on System z refer to the IBM Redpaper *Networking Overview for Linux on zSeries*, available at:

<http://www.redbooks.ibm.com/redpapers/pdfs/redp3901.pdf>

## 2.4 Hardware and software requirements

You have to meet certain hardware and software requirements to be able to run the SAP application server on Linux on System z in a certified environment.

### 2.4.1 Hardware requirements

Hardware needed for the application server on Linux on System z:

- 64-bit z/Architecture® hardware, which is available today with System z

## 2.4.2 Software requirements

The decision on which software levels of z/OS, DB2, z/VM, Linux, and SAP will be installed for your solution must be made in consultation with your IBM, SAP, and Linux distribution representatives.

We recommend using the latest version of SAP, IBM, and Linux documentation. Start with the *Master Guide SAP NetWeaver 7.0* available from:

<http://service.sap.com/instguides>.

For our specific installation we used *SAP NetWeaver 7.0 SR3 ABAP+Java on Linux: IBM DB2 for z/OS*. This and other relevant documentation is located at:

<http://service.sap.com/OperationsNW70>

**Note:** Before installing SAP on DB2 for z/OS and OS/390, or before you add application servers to Linux on System z within an existing environment, always verify that the PTF requirements mentioned in the most current “SAP Note 81737: DB2-z/OS APAR List” are fulfilled.

SAP assists by providing a tool called *PTF checker*. Information about how to download, install, and use this tool can be found in “SAP Note 183311: DB2/390: Automated PTF Check.”

### System Health Check

The IBM z/VM and Linux on System z Advanced Technical Support Team offers (where available) a System Health Check for new Linux on System z accounts.

The System Health Check evaluates the basic system configuration of an installed z/VM system and its Linux guests.

It also ensures that all recommended “Best Practices” are in place prior to running a “proof-of-concept” benchmark or production workload.

A System Health Check consists of the following steps:

1. The client team FTSS contacts the z/VM and Linux on System z ATS Team.
2. The FTSS is provided with data collection documentation.
3. The FTSS works with the customer to collect the data.
4. The FTSS forwards the data to ATS for evaluation.
5. ATS provides FTSS with a detailed analysis of the current system configuration along with any recommendations for changes and instructions for implementing the changes.

## 2.5 Professional support and maintenance

Linux on System z within a production environment is a landscape that must be included in your current support contracts covering hardware, software, infrastructure, environmental, and so forth. This support can be contracted from IBM, SAP, and your Linux distribution supplier.

The SAP application servers on Linux on System z must form part of your maintenance strategy. Maintenance strategies and schedules are customer-specific and cover all the hardware and software components of their IT infrastructure.

The checks performed to ensure that all levels of hardware and software are supported must be performed on a regular basis as part of a normal maintenance process. There are numerous tools and services available from IBM and SAP to assist in making this process highly automated.



## Preparing the System z environment

This chapter describes our system configuration and the preparation tasks we went through before installing an SAP application server on Linux on System z running under z/VM. Topics covered are:

- ▶ Prerequisites for our scenario
- ▶ HyperSockets setup (Linux on System z and z/OS)
- ▶ Preparing Linux guests for SAP
- ▶ Network accessibility, DNS, and ssh configuration
- ▶ Verification steps

### Note:

- ▶ We use the “#” prompt for commands that are issued as user root, for example:  

```
# chmod u+s /sapmnt/SU1/exe/saposcol
```
- ▶ We use the “>” prompt for commands that are issued as user <sid>adm, where <sid> is “su1” on our SLES systems and “rh1” on our Red Hat Enterprise Linux systems, for example:  

```
> startsap lnxsu1
```

## 3.1 Prerequisites

We required the following configuration:

- ▶ z/OS and DB2 installed in an LPAR, configuration and patch levels according to "SAP Note 81737: DB2-z/OS APAR List. We used one DB2 subsystem for our SLES setup and one DB2 subsystem for our Red Hat Enterprise Linux® setup.
- ▶ z/VM installed in an LPAR.

z/VM guest setup:

- General z/VM Support according to "SAP Note 1122387: Linux: SAP Support in virtualized environments".
- 3 installed SUSE Linux guests, SLES 10 SP2, and 3 Red Hat Linux guests, RHEL 5.1.

Linux installed with distribution-specific methods; no SAP Notes applied. The following applies for each guest:

- 4GByte memory (machine size)
  - One 3390 MOD-9 DASD for SWAP space
  - One 3390 MOD-9 DASD for the root filesystem
  - Three 3390 MOD-9 DASD set up with LVM and mounted on /SAP
- ▶ OSA network connection available between all OS images, including Linux guests, z/VM, and z/OS.
  - ▶ HiperSockets defined with IOCP on the CEC.

**Note:** Ensure that enough devices are defined on the HiperSockets CHPID to support connectivity between z/OS, z/VM, and all Linux guests. Each Linux guest requires three devices.

Our basic z/OS, z/VM, DB2 9 for z/OS, and Linux on System z setup is illustrated in Figure 3-1 on page 33.



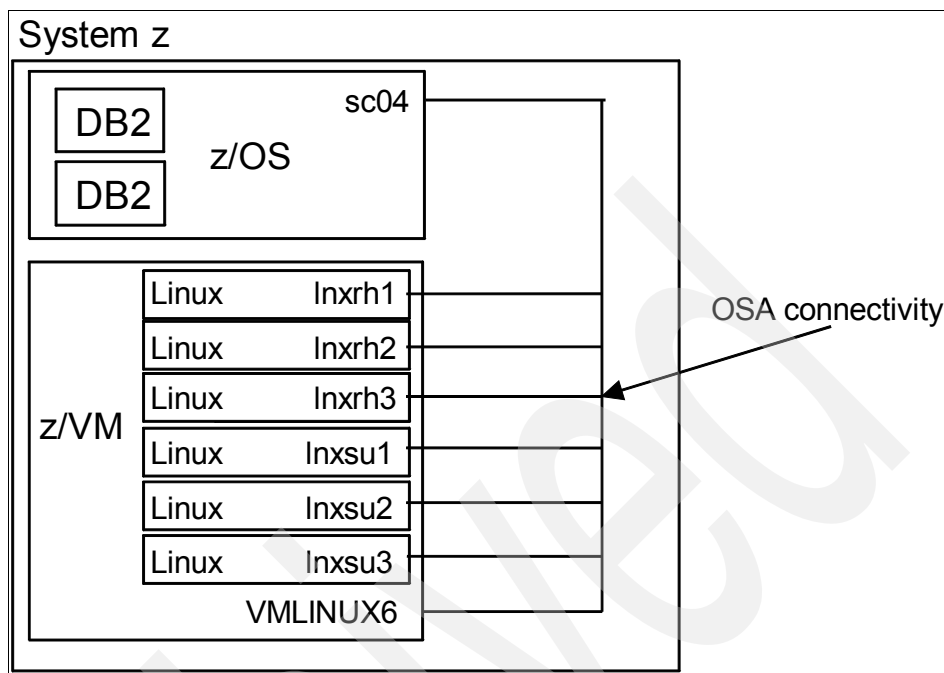


Figure 3-1 Basic network + operating system layout

## 3.2 HiperSockets

This section describes the steps we took to enable HiperSocket connectivity between all Linux guests and between all Linux guests and z/OS. HiperSockets installation with IOCP was done as a prerequisite. We tried a physical device layout where different CHPIDs are used by different Linux guests. We found out that a direct connection between two HiperSockets devices on different CHPIDs is not possible without setting up a VSWITCH. Because we did not want to try that scenario, we used one CHPID with enough physical devices available.

Table 3-1 on page 34 shows our network layout, including physical devices, virtual devices, and CHPIDs. Note that every Linux guest requires three physical devices for the HiperSockets connection.

Each of our systems has two static hostnames, one with an “h” at the end and one without. The hostname without the “h” resolves to an OSA IP address, the hostname with an “h” resolves to a HiperSockets IP address. If we refer to the Linux guest in general, we use the hostname without an “h” at the end.

Moreover, we defined two pairs of hostnames, one pair for the SLES guest (suscsch/suascsh), and one pair for the Red Hat Enterprise Linux guests (rhscsh/rhascsh). These hostnames resolve to HiperSockets IP addresses and are used for HA-readiness (see “Virtual host setup” on page 43).

**Note:** It is possible to share physical devices between different LPARs; devices 3E00, 3E01, and 3E02 are used as well by lnxrh1 and sc04h.

Table 3-1 IP configuration

NAME	OSA-IP	HIPER-IP	VIRTDEV	PHYSDEV	CHPID
sc04[h] (DB2-LPAR)	9.12.4.20	192.168.4.20		3E0[0-2]	F8
z/VM	9.12.4.89	192.168.4.89			F8
lnxrh1[h]	9.12.4.244	192.168.4.244	700[0-2]	3E0[0-2]	F8
lnxrh2[h]	9.12.4.245	192.168.4.245	700[0-2]	3E0[3-5]	F8
lnxrh3[h]	9.12.4.246	192.168.4.246	700[0-2]	3E0[6-8]	F8
lnxsu1[h]	9.12.4.241	192.168.4.241	700[0-2]	3E0[9-B]	F8
lnxsu2[h]	9.12.4.242	192.168.4.242	700[0-2]	3E0[C-E]	F8
lnxsu3[h]	9.12.4.243	192.168.4.243	700[0-2]	3E0F-3E11	F8
suscsch		192.168.4.100	HA-LINUX1-SCS		
suascsh		192.168.4.101	HA-LINUX1-ASCS		
rhscsh		192.168.4.103	HA-LINUX2-SCS		
rhascsh		192.168.4.104	HA-LINUX2-ASCS		

### 3.2.1 Installation and configuration on z/OS

z/OS implementation of HiperSockets consists of defining HiperSockets using HCD and then configuring Communications Server to support the HiperSockets configuration required. A HiperSockets connection requires you to specify all of the following configuration statements: DEVICE, LINK, HOME, BSDROUTINGPARMS, BEGINROUTES, and START. See *HiperSockets Implementation Guide*, SG24-6816 for detailed instructions.

The following steps summarize the tasks required to enable HiperSockets support:

1. Define the HiperSockets channel, control unit, and devices using HCD.

2. Generate an IOCDS for the hardware and IODF for the operating system.
3. Activate the hardware configuration (IOCDS) and software configuration (IODF) on the System z server.
4. Verify that the HiperSockets devices are online to the target logical partitions.
5. Configure the TCP/IP stacks for HiperSockets support.
6. Activate the TCP/IP configurations.
7. Verify the TCP/IP connections are working.

## Hardware definitions

All the required hardware definitions and activation were completed for us by the ITSO team. It is important to ensure that there are enough devices defined to the CHPID you will use for HiperSockets. In our case 64 devices were defined, so we were able to use the same CHPID for all systems connected via HiperSockets.

## Updating the TCP/IP profile dataset

The TCP/IP profile is pointed to by the PROFILE DD statement in the TCP/IP JCL procedure.

In our environment, the profile name resolves to TCPPROF in dataset TCP.SC04.TCPPARMS. The TCPIP start task is shown in Example 3-1

*Example 3-1 JCL for a TCPIP starter task*

---

```
//TCPIP   PROC P1='CTRACE(CTIEZB00)',TCPprof=TCPprof,TCPDATA=TCPDATA
//*
//TCPIP EXEC PGM=EZBTCPIP,REGION=0M,TIME=1440,
//   PARM=&P1
//*STEPLIB DD DSN=TCPIP.SEZATCP,DISP=SHR
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=VB,LRECL=137,BLKSIZE=0)
//SYSERR  DD SYSOUT=*,DCB=(RECFM=VB,LRECL=137,BLKSIZE=0)
//SYSERROR DD SYSOUT=*
//ALGPRINT DD SYSOUT=*,DCB=(RECFM=VB,LRECL=132,BLKSIZE=136)
//CFGPRINT DD SYSOUT=*,DCB=(RECFM=VB,LRECL=132,BLKSIZE=136)
//SYSOUT  DD SYSOUT=*,DCB=(RECFM=VB,LRECL=132,BLKSIZE=136)
//CEEDUMP DD SYSOUT=*,DCB=(RECFM=VB,LRECL=137,BLKSIZE=0)
//PROFILE DD DSN=TCP.&SYSNAME..TCPPARMS(&TCPprof),
//          DISP=SHR,FREE=CLOSE
//SYSTCPD DD DSN=TCP.&SYSNAME..TCPPARMS(&TCPDATA),DISP=SHR
//SYSABEND DD SYSOUT=*
```

---

### TCP/IP profile customization for HiperSockets

HiperSockets devices have to be defined in the TCP/IP profile with a `DEVICE` and `LINK` statement. Additionally, `HOME`, `BEGINROUTES`, and `START` statements should be specified. We updated the profile member for our TCP/IP stack following the configuration rules. Our customization for TCPIPF is shown in Example 3-2.

Example 3-2 TCPIP profile updates

---

TCPCONFIG	TCPCVBUFFRSIZE 65536	0
TCPCONFIG	TCPSENBFRSIZE 65536	
TCPCONFIG	DELAYACKS	
DEVICE	IUTIQDF8 MPCIPA	1
LINK	HIPERLF8 IPAQIDIO IUTIQDF8	2
HOME	192.168.4.20 HIPERLF8	3
BEGINROUTES		
ROUTE	192.168/0/24 = HIPERLF8 MTU 8192	4
ENDROUTES		
START	IUTIQDF8	5

---

The following notes apply to the TCPIP profile syntax:

**0** TCPIP settings according to “SAP Note 1263782: DB2 z/OS: Recommended settings for HiperSockets (Linux on System z)”.

**1** The `DEVICE` statement is in the form `DEVICE device_name MPCIPA`. The `device_name` must be in the form `IUTIQDxx`. The prefix `IUTIQD` must be specified. The `xx` indicates the hexadecimal value of the IQD CHPID that was defined in `HCD`. `MPCIPA` is required and specifies that the device belongs to the MPC family and uses the IPAssist-based interface.

Since the first six characters of the device name must be `IUTIQD` and the last two characters of the device name must be the CHPID number, for our example the device name must be `IUTIQDF8`. Based on this name, at TCP/IP device start time, a VTAM® Transport Resource List Element (TRLE) is dynamically built.

**2** The `LINK` statement is specified as `LINK link_name IPAQDIO device_name`. The `link_name` maximum length is 16 characters. `IPAQDIO` is required and indicates that the link uses the IPAssist-based interface, belongs to the QDIO family of interfaces, and uses the HiperSockets protocol. The `device_name` must be the same as the `device_name` specified on the `DEVICE` statement.

Since the `link_name` is user defined, we have used `HIPERLF8`. Because this `LINK` statement applies to our `HiperSockets` device, we use the device name specified on our `DEVICE` statement, `IUTIQDF8`.

3 The `HOME` statement is specified as `HOME internet_addr link_name`. The `internet_addr` should specify a valid IP address for the host in dotted decimal format. The `link_name` must match the `link_name` specified on the `LINK` statement for the associated `IPAQIDIO` link.

When a `TCP/IP` device is started, the IP address contained in the `TCP/IP` stack's `HOME` list is registered in the IP address lookup table. The `z/OS` `TCP/IP` stack becomes part of `HiperSockets` with the IP address `192.168.20.4`.

4 The `ROUTE` entry of the `BEGINROUTES` statement is specified as `ROUTE destination gateway_addr link_name MTU mtu_size`. The destination should specify a valid host, network, or subnetwork. Specifying “=” for the `gateway_addr` means packets are routed directly to destinations on that network or host. The `link_name` must match the `link_name` specified on the `LINK` statement.

Since we are using static routes in our environment, we have to define a `ROUTE` statement. If you are using dynamic routing (`RIP` or `OSPF`), omit this statement. Also note that we have specified an `MTU` size of 8 KB to accommodate the maximum frame size of the `IQD CHPID F8` which we defined in the `HCD` with the default value (16 KB).

5 The `START` statement is specified as: `START device_name`. The `START` statement is used to start a device. The `device_name` must match the `device_name` specified on the `DEVICE` statement for the `HiperSockets` `CHPID`.

Optionally, a `VARY TCPIP,tcpipproc,START,devicename` command can be issued or the `START` statement can be used in a `VARY TCPIP,tcpipproc,OBEYFILE,datasetname` command to start the desired device.

### Verify TCP/IP device and link status

Successful initialization of the `HiperSockets` device can be verified by checking the `SYSLOG` messages when the IP stack is started; we obtained the following `TCPIP` startup message for the `HiperSocket` device:

```
EZZ4313I INITIALIZATION COMPLETE FOR DEVICE IUTIQDF8
```

To verify the status of devices and links defined to the `TCP/IP` stack, we used the `D TCPIP,procname,NETSTAT,DEVLINKS` command to request `NETSTAT` information. The output for our example is shown in Example 3-3 on page 38.

We verified that the device name and type match our tcp profile definitions and that the device is in a ready status **1**. We verified that the link name and type match our tcp profile definitions and that the link is in a ready status **2**. We also verified that the MTU definition matches what was defined in the tcp profile **3**.

Example 3-3 Verify device and link information of HiperSockets

---

DEVNAME: IUTIQDF8	DEVTYPE: MPCIPA	<b>1</b>
DEVSTATUS: READY	CFGROUTER: NON	ACTROUTER: NON
LNKNAME: HIPERLF8	LNKTYPE: IPAQIDIO	LNKSTATUS: READY <b>2</b>
NETNUM: N/A	QUESIZE: N/A	
IPBROADCASTCAPABILITY: NO		
ARPOFFLOAD: YES	ARPOFFLOADINFO: YES	
ACTMTU: 8192		
READSTORAGE: GLOBAL (2048K)		
SECCLASS: 255	MONSYSPLEX: NO	
IQDMULTIWRITE: DISABLED		
BSD ROUTING PARAMETERS:		
MTU SIZE: 8192 <b>3</b>	METRIC: 00	
DESTADDR: 0.0.0.0	SUBNETMASK: 255.255.255.0	
MULTICAST SPECIFIC:		
MULTICAST CAPABILITY: YES		
GROUP	REFCNT	SRCFLTMD
-----	-----	-----
224.0.0.1	0000000001	EXCLUDE
SRCADDR: NONE		
LINK STATISTICS:		
BYTESIN		= 0
INBOUND PACKETS		= 0
INBOUND PACKETS IN ERROR		= 0
INBOUND PACKETS DISCARDED		= 0
INBOUND PACKETS WITH NO PROTOCOL		= 0
BYTESOUT		= 0
OUTBOUND PACKETS		= 0
OUTBOUND PACKETS IN ERROR		= 0
OUTBOUND PACKETS DISCARDED		= 0

---

### 3.2.2 Configuring HiperSockets on z/VM for Linux guests

All steps performed for HiperSockets enablement are taken from the IBM Redbooks publication, *HiperSockets Implementation Guide*, SG24-6816, chapters 4 and 5.

1. Verify that the path to the HiperSockets devices is in an ONLINE status, using the CP QUERY CHPID command (Example 3-4 on page 39).

*Example 3-4 Results of CP QUERY CHPID command*

---

**q chpid f8**

```
Path F8 online to devices 3E00 3E01 3E02 3E03 3E04 3E05 3E06 3E07
Path F8 online to devices 3E08 3E09 3E0A 3E0B 3E0C 3E0D 3E0E 3E0F
Path F8 online to devices 3E10 3E11 3E12 3E13 3E14 3E15 3E16 3E17
Path F8 online to devices 3E18 3E19 3E1A 3E1B 3E1C 3E1D 3E1E 3E1F
Path F8 online to devices 3E20 3E21 3E22 3E23 3E24 3E25 3E26 3E27
Path F8 online to devices 3E28 3E29 3E2A 3E2B 3E2C 3E2D 3E2E 3E2F
Path F8 online to devices 3E30 3E31 3E32 3E33 3E34 3E35 3E36 3E37
Path F8 online to devices 3E38 3E39 3E3A 3E3B 3E3C 3E3D 3E3E 3E3F
Ready; T=0.01/0.01 15:33:23
```

---

2. Check whether all needed devices are FREE (Example 3-5, see also Table 3-1 on page 34).

*Example 3-5 Results of determining if devices are free*

---

**q 3e00-3e11**

```
OSA 3E00 FREE , OSA 3E01 FREE , OSA 3E02 FREE , OSA 3E03 FREE
OSA 3E04 FREE , OSA 3E05 FREE , OSA 3E06 FREE , OSA 3E07 FREE
OSA 3E08 FREE , OSA 3E09 FREE , OSA 3E0A FREE , OSA 3E0B FREE
OSA 3E0C FREE , OSA 3E0D FREE , OSA 3E0E FREE , OSA 3E0F FREE
OSA 3E10 FREE , OSA 3E11 FREE
Ready; T=0.01/0.01 17:37:37
```

---

3. Attach the devices dynamically with the attach command (Example 3-6).

*Example 3-6 Attaching the devices for Inxsu1 dynamically*

---

**attach 3E09 Inxsu1 7000**

**attach 3E0A Inxsu1 7001**

**attach 3E0B Inxsu1 7002**

---

4. Confirm the availability of the HiperSockets devices to the Linux guests (Example 3-7).

*Example 3-7 Confirming availability*

---

**q 3e00-3e11**

```
OSA 3E00 ATTACHED TO LNXRH1 7000 DEVTYP HPER CHPID F8 IQD
OSA 3E01 ATTACHED TO LNXRH1 7001 DEVTYP HPER CHPID F8 IQD
OSA 3E02 ATTACHED TO LNXRH1 7002 DEVTYP HPER CHPID F8 IQD
OSA 3E03 ATTACHED TO LNXRH2 7000 DEVTYP HPER CHPID F8 IQD
OSA 3E04 ATTACHED TO LNXRH2 7001 DEVTYP HPER CHPID F8 IQD
OSA 3E05 ATTACHED TO LNXRH2 7002 DEVTYP HPER CHPID F8 IQD
OSA 3E06 ATTACHED TO LNXRH3 7000 DEVTYP HPER CHPID F8 IQD
OSA 3E07 ATTACHED TO LNXRH3 7001 DEVTYP HPER CHPID F8 IQD
```

```

OSA 3E08 ATTACHED TO LNXRH3 7002 DEVTYPE HIPER CHPID F8 IQD
OSA 3E09 ATTACHED TO LNXSU1 7000 DEVTYPE HIPER CHPID F8 IQD
OSA 3E0A ATTACHED TO LNXSU1 7001 DEVTYPE HIPER CHPID F8 IQD
OSA 3E0B ATTACHED TO LNXSU1 7002 DEVTYPE HIPER CHPID F8 IQD
OSA 3E0C ATTACHED TO LNXSU2 7000 DEVTYPE HIPER CHPID F8 IQD
OSA 3E0D ATTACHED TO LNXSU2 7001 DEVTYPE HIPER CHPID F8 IQD
OSA 3E0E ATTACHED TO LNXSU2 7002 DEVTYPE HIPER CHPID F8 IQD
OSA 3E0F ATTACHED TO LNXSU3 7000 DEVTYPE HIPER CHPID F8 IQD
OSA 3E10 ATTACHED TO LNXSU3 7001 DEVTYPE HIPER CHPID F8 IQD
OSA 3E11 ATTACHED TO LNXSU3 7002 DEVTYPE HIPER CHPID F8 IQD
Ready; T=0.01/0.01 16:26:36

```

---

5. We permanently defined the allocation of the HiperSockets devices to the guest systems in the z/VM user directory **USER DIRECT** using **DEDICATE** statements. Example 3-8 shows a snippet of the **USER DIRECT** file for Linux guest **lnxsu1**.

*Example 3-8 A snippet of the USER DIRECT file*

---

```

02144 USER LNXSU1 LNXSU1 4G 12G G
02145     INCLUDE IBMDFLT
02146     IPL CMS
02147     MACHINE ESA 2
02148     OPTION QUICKDSP
02149     NICDEF C200 TYPE QDIO LAN SYSTEM VSWITCH1
02150     DEDICATE 7000 3E0C
02151     DEDICATE 7001 3E0D
02152     DEDICATE 7002 3E0E
02153     MDISK 0191 3390 101 50 LX6UR1 MR
02154     MDISK 0201 3390 0001 10016 LXC409 MR
02155     MDISK 0202 3390 0001 10016 LXC700 MR
02156     MDISK 0301 3390 0001 10016 LXC503 MR
02157     MDISK 0302 3390 0001 10016 LXD815 MR
02158     MDISK 0303 3390 0001 10016 LXDE15 MR
02159     MDISK 0304 3390 0001 10016 LXDF15 MR

```

---

6. We activated the **USER DIRECTORY** with the **directxa** command (Example 3-9).

*Example 3-9 Activate the USER DIRECTORY*

---

```

directxa
z/VM USER DIRECTORY CREATION PROGRAM - VERSION 5 RELEASE 4.0
EOJ DIRECTORY UPDATED AND ON LINE
HCPDIR494I User directory occupies 45 disk pages
Ready; T=0.01/0.01 09:18:07

```

---



### 3.2.3 Setting up HiperSockets on Linux on System z

We first activated the HiperSockets devices manually by following the steps in this section. Examples provided are as performed for host Inxrh1. We did this on all hosts and verified the HiperSockets connectivity by pinging the other Linux systems.

1. Verify the availability of the device (Example 3-10).

*Example 3-10 Availability of the devices in Linux on System z*

---

```
# lscss | grep 700
0.0.7000 0.0.0003 1732/05 1731/05 80 80 FF F8000000 00000000
0.0.7001 0.0.0004 1732/05 1731/05 80 80 FF F8000000 00000000
0.0.7002 0.0.0005 1732/05 1731/05 80 80 FF F8000000 00000000
```

---

2. Activate the devices through the sysfs filesystem:

```
# echo 0.0.7000,0.0.7001,0.0.7002 > \
    /sys/bus/ccwgroup/drivers/qeth/group
```

3. Bring the device online:

```
echo 1 > /sys/devices/qeth/0.0.7000/online
```

4. Check the device interface name:

```
# cat /sys/devices/qeth/0.0.7000/if_name
hsi0
```

5. Bring up the interface:

```
# ifconfig hsi0 192.168.4.244 netmask 255.255.255.0 up
```

#### **Activating devices on SLES Linux**

Activating the HiperSockets devices permanently is different for SLES and Red Hat Enterprise Linux. The following steps describe the SLES setup for Inxsu1.

1. Create a file for hardware definitions. The filename is `/etc/sysconfig/hardware/hwcfg-qeth-bus-ccw-0.0.7000`, content as shown in Example 3-11.

*Example 3-11 /etc/sysconfig/hardware/hwcfg-qeth-bus-ccw-0.0.7000*

---

```
STARTMODE='auto'
MODULE='qeth'
MODULE_OPTIONS=''
MODULE_UNLOAD='yes'
SCRIPTUP='hwup-ccw'
SCRIPTUP_ccw='hwup-ccw'
SCRIPTUP_ccwgroup='hwup-qeth'
```

---

```
SCRIPTDOWN='hwdow-down-ccw'  
CCW_CHAN_IDS='0.0.7000 0.0.7001 0.0.7002'  
CCW_CHAN_NUM='3'  
CCW_CHAN_MODE='any'  
QETH_LAYER2_SUPPORT='0'  
QETH_OPTIONS='buffer_count=128'
```

---

2. Create network definitions for SLES. The filename is `/etc/sysconfig/network/ifcfg-qeth-bus-ccw-0.0.7000`; content is shown in Example 3-12.

*Example 3-12 /etc/sysconfig/network/ifcfg-qeth-bus-ccw-0.0.7000*

---

```
BOOTPROTO='static'  
UNIQUE=''  
STARTMODE='auto'  
IPADDR='192.168.4.241'  
NETMASK='255.255.255.0'  
NETWORK=''  
BROADCAST=''  
ETHTOOL_OPTIONS=''  
LLADDR=''  
MTU=''  
NAME=''  
REMOTE_IPADDR=''  
USERCONTROL='no'  
STARTMODE='auto'  
PREFIXLEN=''
```

---

3. We rebooted the system to activate the hardware configuration.
4. After restart, the interface should be up and running because **STARTMODE** is set to **auto**. We verified this by running the following command:

```
# ifconfig hsi0
```

The output we received was:

```
hsi0      Link encap:Ethernet  HWaddr 00:00:00:00:00:00  
          inet addr:192.168.4.241  Bcast:192.168.4.255  Mask:255.255.255.0  
          inet6 addr: fe80::200:ff:fe00:0/64 Scope:Link  
          UP BROADCAST RUNNING NOARP MULTICAST  MTU:8192  Metric:1  
          RX packets:212571 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:169140 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:183209218 (174.7 Mb)  TX bytes:41340269 (39.4 Mb)
```

## Activating devices on Red Hat Enterprise Linux

To activate the HiperSockets interface on Red Hat Enterprise Linux permanently, we performed the following steps. Our example describes the setup on Inxrh1.

1. Create a file for hardware and network definitions, `/etc/sysconfig/network-scripts/ifcfg-hsi0`, with content as in Example 3-13.

*Example 3-13 /etc/sysconfig/network-scripts/ifcfg-hsi0*

---

```
# IBM QETH
DEVICE=hsi0
ARP=no
BOOTPROTO=static
IPADDR=192.168.4.244
NETMASK=255.255.255.0
NETTYPE=qeth
ONBOOT=yes
SUBCHANNELS=0.0.7000,0.0.7001,0.0.7002
OPTIONS='buffer_count=128'
```

---

2. After reboot, we used `ifconfig` to test whether the interface was up:

```
# ifconfig hsi0
```

The results were as follows:

```
hsi0      Link encap:Ethernet  HWaddr 00:00:00:00:00:00
          inet addr:192.168.4.244  Bcast:192.168.4.255  Mask:255.255.255.0
          inet6 addr: fe80::200:ff:fe00:0/64 Scope:Link
          UP BROADCAST RUNNING NOARP MULTICAST  MTU:8192  Metric:1
          RX packets:13 errors:0 dropped:0 overruns:0 frame:0
          TX packets:68 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:3666 (3.5 KiB)  TX bytes:10480 (10.2 KiB)
```

## 3.2.4 Additional configuration steps on Linux on System z

This section describes additional configuration changes. We implemented the following to adapt HiperSockets to our scenario and to SAP:

- ▶ Set up virtual hosts
- ▶ Implemented “SAP Note 1263782: DB2 z/OS: Recommended settings for HiperSockets (Linux on System z)”

### Virtual host setup

You must use virtual hostnames to implement HA-readiness. We describe the setup of virtual hostnames and IP aliases in this section. The IP addresses used

for the IP aliases are identified in Table 3-1 on page 34. Hostnames for our IP aliases are:

- ▶ `suascsh`: Alias for the ABAP™ SCS instance of SAP system SU1 on SLES
- ▶ `suscsh`: Alias for the Java SCS instance of SAP system SU1 on SLES
- ▶ `rhascs`: Alias for the ABAP SCS instance of SAP system RH1 on Red Hat Enterprise Linux
- ▶ `rhscs`: Alias for the Java SCS instance of SAP system RH1 on Red Hat Enterprise Linux

We tried to use distribution-specific configuration methods to add IP aliases to the HiperSockets interfaces. We encountered the following issues with SLES and Red Hat Enterprise Linux:

- ▶ On SLES 10 SP2, we were not able to start and stop specific aliases on one interface independent of one another with the distribution-specific tool `ifup`.
- ▶ On RHEL 5.1, the IP aliases were up after reboot although we specified `ONBOOT=no` in the networking script file `/etc/sysconfig/network-scripts/ifcfg-hsi0:1`.

**Note:** Installation using virtual host names is done to ensure that the SAP installation can be made highly available. Even if you do not intend to use HA for your SAP system at installation time, but might do so in the future, you should install your SAP system using virtual host name for the SCS and ASCS.

We implemented a small shell script that is able to start and stop the IP aliases independent of each other. As an example, the following command brings up IP alias 1:

```
# ./hsict1.sh up 1
```

The script is included in Appendix A, “Network configuration”, Example A-1 on page 140.

We decided to use the `ip` command, which is part of the `iproute2` package, instead of `ifconfig`. This package offers advanced routing options with Linux 2.4 and 2.6. Figure 3-2 on page 45 shows our new network layout with HiperSockets including IP aliases.

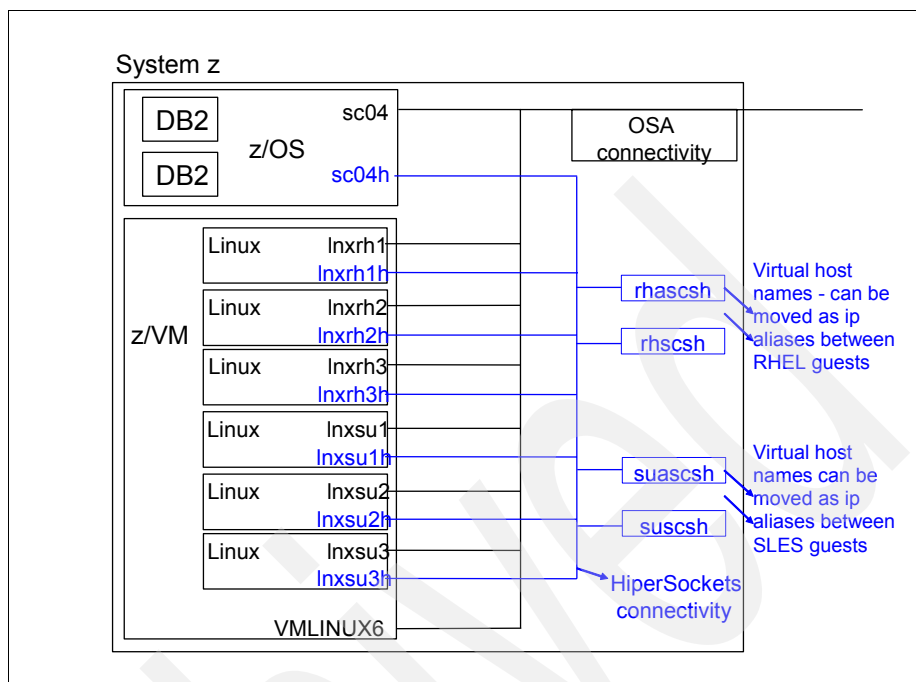


Figure 3-2 Network layout after HiperSockets implementation

## Implementation of SAP Note 1263782

As a last step for the HiperSockets setup we implemented “SAP Note 1263782: DB2 z/OS: Recommended settings for HiperSockets (Linux on System z)”:

- ▶ The SAP Note recommends an MTU size of 8k for the HiperSocket connection. According to the *HiperSockets Implementation Guide*, SG24-6816, section 2.1 *System configuration considerations*, this results in a maximum frame size of 16k for the used CHPID. Verify the maximum frame size settings with your z/OS administrator in the IQD definition. We did this for our CHPID F8.
- ▶ We verified the MTU size used for our system with the `ip` command:
 

```
# ip link show hsi0
4: hsi0: <BROADCAST,MULTICAST,NOARP,UP> mtu 8192 qdisc pfifo_fast qlen 1000
    link/ether 00:00:00:00:00:00 brd ff:ff:ff:ff:ff:ff
```
- ▶ Adjust the `tcp_wmem` value in `/etc/sysctl.conf`. See Example A-2 on page 142 and Example A-3 on page 143 for complete file listing.
 

```
# Added for Hipersocket tuning by JR on 2008-10-17
net.ipv4.tcp_wmem = 4096 65536 131072
```

- ▶ Increase the inbound buffer count from default 16 to 128:
  - On SLES, we added QETH\_OPTIONS='buffer\_count=128' to /etc/sysconfig/hardware/hwcfg-qeth-bus-ccw-0.0.7000
  - On Red Hat Enterprise Linux, we added OPTIONS='buffer\_count=128' to the file /etc/sysconfig/network-scripts/ifcfg-hsi0

We verified our buffer\_count settings after a reboot:

```
# cat /sys/devices/qeth/0.0.7000/buffer_count
128
```

- ▶ We added selinux=0 audit\_enable=0 audit=0 audit\_debug=0 to the parameters line in our bootloader configuration /etc/zipl.conf and ran the **zipl** command to make the changes effective. After the change this line reads on Inxsu1:
 

```
parameters = "root=/dev/dasdb1 TERM=dumb selinux=0 audit_enable=0\
audit=0 audit_debug=0"
```
- ▶ We removed unnecessary services as discussed in 5.11, “Linux on System z runlevels and unnecessary services” on page 125.
- ▶ We updated the SAP kernel version according to “SAP Note 1146808: Connection to standalone enqueue server is cancelled” after the SAP system installation; this is discussed in 4.5, “Problems while running SAPinst” on page 105.

### 3.2.5 Verification of the HiperSockets connectivity

We used the **ping** command on our z/OS system to verify the HiperSockets connection between our HiperSockets connected systems. If multiple stacks are active, you must route the **ping** command to the correct stack.

The results of the **ping** commands are shown in Example 3-14.

*Example 3-14 ping of HiperSocket IP addresses*

---

```
ping IP address
CS V1R9: Pinging host 192.168.4.244
Ping #1 response took 0.001 seconds.
CS V1R9: Pinging host 192.168.4.245
Ping #1 response took 0.000 seconds.
CS V1R9: Pinging host 192.168.4.246
Ping #1 response took 0.014 seconds.
CS V1R9: Pinging host 192.168.4.241
Ping #1 response took 0.000 seconds.
CS V1R9: Pinging host 192.168.4.242
Ping #1 response took 0.000 seconds.
```

```
CS V1R9: Pinging host 192.168.4.243
Ping #1 response took 0.000 seconds.
CS V1R9: Pinging host 192.168.4.100
Ping #1 response took 0.000 seconds.
CS V1R9: Pinging host 192.168.4.101
Ping #1 response took 0.000 seconds.
CS V1R9: Pinging host 192.168.4.103
Ping #1 response took 0.000 seconds.
CS V1R9: Pinging host 192.168.4.104
Ping #1 response took 0.000 seconds.
```

---

### 3.2.6 Switching from HiperSockets to OSA connectivity

Switching from HiperSockets to OSA connectivity only applies if no dynamic routing with OSPF is used. With OSPF and dynamic routing, this is automatically done if HiperSockets connectivity “breaks” for whatever reason. For further discussion, see the IBM document *Business Continuity for SAP on IBM System z*, SC33-8206-02, which can be found at:  
<http://www-03.ibm.com/servers/eserver/zseries/software/sap/documentation/docu.html>

That said, this section shows the necessary steps if you want to switch from a HiperSockets network to an OSA-connected network. Two possible solutions are:

- ▶ Change the DNS setup such that all hostnames that formerly resolved to HiperSockets IP addresses now resolve to OSA IP addresses.
- ▶ Add the HiperSockets IP addresses as aliases to the OSA adapters on Linux on System z.

After the installation of our SAP systems we implemented both solutions and successfully confirmed that the SAP system still functioned after the reconfiguration.

#### Undoing HiperSockets connectivity using DNS

In our example, we changed the connectivity from HiperSockets to OSA on our SAP system SU1, meaning that the following steps were performed on Inxsu1, Inxsu2, and Inxsu3:

1. We changed the hsi adapter startup mode to manual. We edited the file `/etc/sysconfig/network/ifcfg-qeth-bus-ccw-0.0.7000` and changed the parameter `STARTMODE="onboot"` to `STARTMODE="manual"`. This ensures that after reboot the HiperSockets interface is not up.

2. We changed the file `/etc/hosts`. The changed file configures all former HiperSockets hostnames to resolve to the OSA IP addresses. We only changed the HiperSockets hostnames for the SU1 application servers and the DB2 LPAR. The changed file is provided in “`/etc/hosts` without HiperSockets” on page 145.

**Note:** If you want to maintain HA-readiness for your SAP system you need an additional IP address in your OSA IP subnet for each of the virtual hostnames. This must be confirmed with your network administrator.

3. We deployed the new hosts file to all SU1 application servers and the NFS server `lnxsu3`. After this, network connections to the hosts `lnxsu1h`, `lnxsu2h`, `lnxsu3h`, and `sc04h` used OSA connectivity instead of HiperSockets.
4. We brought the z/OS HiperSockets interface down:  
**v tcpip,tcpip,stop,IUTIQDF8**
5. We confirmed the IP configuration on z/OS:  
**d tcpip,tcpip,netstat,dev1**
6. We restarted the SAP system and tried to log on with the SAP GUI on both the central instance and the dialog instance. We checked both J2EE™ engines (central and dialog) using the Web interface of the J2EE engine.

## Undoing HiperSockets using the HiperSockets IP addresses on the OSA interfaces

In the second approach we used all IP addresses that were bound to the HiperSockets interfaces as IP aliases on the OSA interface. We did this by performing the following steps:

1. We changed the hsi adapter startup mode to manual. We edited the file `/etc/sysconfig/network/ifcfg-qeth-bus-ccw-0.0.7000` and changed the parameter `STARTMODE="onboot"` to `STARTMODE="manual"`. This ensures that the HiperSockets interfaces are not up after reboot. We then rebooted the system.
2. On `lnxsu1` we configured the IP addresses associated with the hostnames `lnxsu1h`, `suscsh`, and `suascsh` as aliases on the OSA interface:  

```
# ip addr add 192.168.4.241/24 brd 192.168.4.255 label eth0:1 dev eth0
# ip addr add 192.168.4.100/24 brd 192.168.4.255 label eth0:1 dev eth0
# ip addr add 192.168.4.101/24 brd 192.168.4.255 label eth0:1 dev eth0
```
3. On `lnxsu2` we configured the IP addresses associated with the hostname `lnxsu2h` as alias on the OSA interface:  

```
# ip addr add 192.168.4.242/24 brd 192.168.4.255 label eth0:1 dev eth0
```



4. On Inxsu3 we configured the IP addresses associated with the hostname Inxsu3h as alias on the OSA interface:  

```
# ip addr add 192.168.4.243/24 brd 192.168.4.255 label eth0:1 dev eth0
```
5. On z/OS, we bound the z/OS HiperSockets IP address to an OSA link:
  - a. We made sure the HiperSockets IP address is not active:  

```
d tcpip,tcpip,netstat,dev1
```

If the link is active, bring the link down as described in the previous section “Undoing HiperSockets connectivity using DNS” on page 47.
  - b. We created a new “obeyfile” with the parameters to define the HiperSockets IP address to an OSA link. See the obeyfile in the appendix, “Obeyfile to move an IP address” on page 146.

**Note:** When using the OBEYFILE command, include all static routes that you want to define. The OBEYFILE command replaces the entire BEGINROUTES block.

- c. We issued the **obeyfile** command.
6. We started the link:  

```
v tcpip,tcpip,start,OSA30A0LNK
```
7. We tested the connectivity to all hosts with the **ping** command.
8. We restarted the SAP system.
9. We were able to connect via SAP GUI (sapgui) to both instances.
10. We checked, using the J2EE Web interface, whether both J2EE engines were up.

### 3.3 Network services setup

In this section we describe the configuration steps that we performed to configure the following network services:

- ▶ Domain Name System (DNS)
- ▶ Secure Shell (SSH)
- ▶ Network File System (NFS)
- ▶ Virtual Network Computing (VNC)

### 3.3.1 DNS

A synchronized `/etc/hosts` file can be used to address other hosts by their hostnames instead of using IP addresses. We added all necessary hostnames including HiperSockets interfaces and virtual hostnames. See the `/etc/hosts` content in Appendix A , “Network configuration” on page 139.

### 3.3.2 SSH

We used ssh keys to be able to log on from one Linux guest to another as root user without specifying a password. Confirm that this is within your security guidelines if you plan to implement this.

We created an ssh-key that was not locked by a password and added the public key to the `authorized_keys` file of all machines. We copied that ssh key to all machines. Example 3-15 shows the shell commands on `lnxsu1` to create and copy the keyfiles and the key authorizations to the other Linux guests.

*Example 3-15 Generating and copying ssh keys and key authorizations*

---

```
# ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/root/.ssh/id_rsa):
Created directory '/root/.ssh'.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /root/.ssh/id_rsa.
Your public key has been saved in /root/.ssh/id_rsa.pub.
The key fingerprint is:
b0:58:e1:69:96:1f:f0:dd:e5:8d:2f:aa:80:c9:09:f1 root@lnxsu1
# cd ~/.ssh
# cat id_rsa.pub >> authorized_keys
# chmod 600 authorized_keys
# for host in lnxsu2 lnxsu3 lnxxrh1 lnxxrh2 lnxxrh3; do
ssh root@$host "mkdir /root/.ssh && chmod 700 /root/.ssh";
scp /root/.ssh/id_rsa /root/.ssh/id_rsa.pub \
/root/.ssh/authorized_keys \
root@$host:/root/.ssh;
done
Password:
Password:
id_rsa                  100% 1675    1.6KB/s   00:00
id_rsa.pub              100% 393     0.4KB/s   00:00
authorized_keys         100% 797     0.8KB/s   00:00
Password:
Password:
id_rsa                  100% 1675    1.6KB/s   00:00
```

id_rsa.pub	100%	393	0.4KB/s	00:00
authorized_keys	100%	797	0.8KB/s	00:00
root@lnxrh1's password:				
root@lnxrh1's password:				
id_rsa	100%	1675	1.6KB/s	00:00
id_rsa.pub	100%	393	0.4KB/s	00:00
authorized_keys	100%	797	0.8KB/s	00:00
root@lnxrh2's password:				
root@lnxrh2's password:				
id_rsa	100%	1675	1.6KB/s	00:00
id_rsa.pub	100%	393	0.4KB/s	00:00
authorized_keys	100%	797	0.8KB/s	00:00
root@lnxrh3's password:				
root@lnxrh3's password:				
id_rsa	100%	1675	1.6KB/s	00:00
id_rsa.pub	100%	393	0.4KB/s	00:00
authorized_keys	100%	797	0.8KB/s	00:00

---

### 3.3.3 NFS

In this section we show how we set up our NFS (Network File System) servers to export file systems to be accessed from all our Linux systems via the network. We mounted the SAP installation media required by the SAP installation using NFS. The reason for using NFS was to share file systems between different instances of our SAP systems (see Chapter 4, “Installing SAP NetWeaver on Linux for System z” on page 71).

**Note:** If you plan to install a highly available SAP system, you need to provide a highly available NFS configuration. Our configuration is not highly available. Refer to Business Continuity for SAP on IBM System z, SC33-8206-02 for further discussion.

#### Setting up an NFS server on SLES

Setting up an NFS server on SLES can be done either from the command line or using graphical tools.

We used Inxsu3 as NFS server to export the SAP installation media and the shared filesystems for the SU1 SAP system.

#### NFS server setup from the command line

##### *Defining the directories to export*

We defined the directories on Inxsu3 to be exported by adding the line shown in Example 3-16 on page 52 to the /etc/exports file.

---

```
/SAP    lnrxrh1h(rw,no_root_squash,sync) lnrxrh2h(rw,no_root_squash,sync) \
lnrxrh3h(rw,no_root_squash,sync)lnxsu1h(rw,no_root_squash,sync)lnxsu2h(rw,no_root_squash,sync) \
/SAP/sapmnt.SU1 lnxsu1h(rw,no_root_squash,async) \
lnxsu2h(rw,no_root_squash,sync)
```

---

### **Activating the NFS server**

To activate the NFS server and make the activation persistent we carried out the following steps:

1. We checked whether the NFS server is activated:

```
# chkconfig --list nfsserver
nfsserver      0:off 1:off 2:off 3:off 4:off :off 6:off
```

As you see, the nfssserver was not activated for any runlevel.

2. We activated the NFS server:

```
# chkconfig nfsserver on
```

3. We checked whether the NFS server was activated:

```
# chkconfig --list nfsserver
nfsserver      0:off 1:off 2:off 3:on  4:off 5:on  6:off
```

After we completed these steps, the NFS server started automatically at the next reboot of the Linux system. To start the NFS server immediately without rebooting, we issued the following commands:

4. We checked whether the NFS server was running:

```
# service nfsserver status
Checking for kernel based NFS server:                unused
```

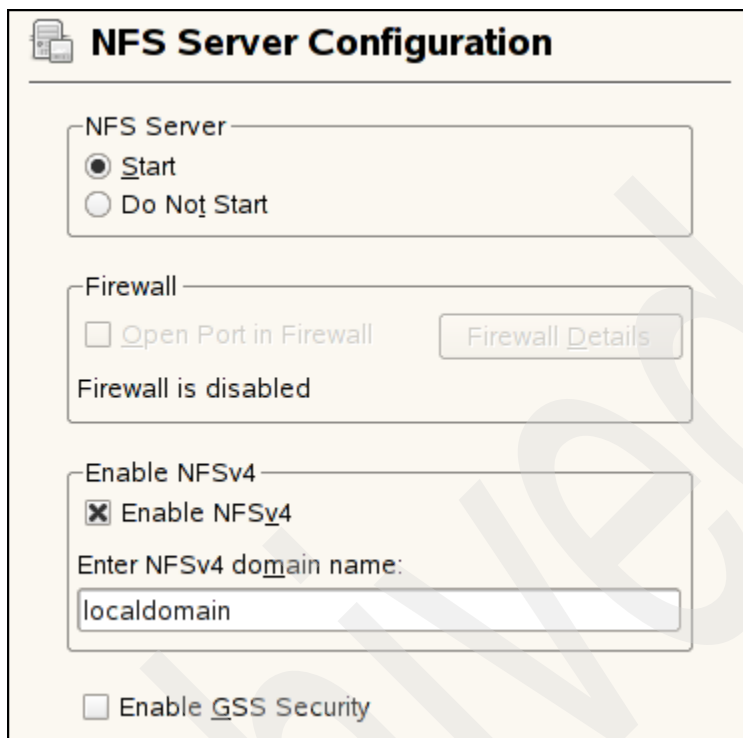
5. We started the NFS server:

```
# service nfsserver start
Starting kernel based NFS server                      done
```

### **NFS server setup using YaST2**

To set up an NFS server on SLES 10 SP2 with YaST2, navigate to **Network Services** → **NFS Server**.

In the NFS Server section of the NFS Server Configuration dialogue check the **Start** option. Do not change the other settings (see Figure 3-3).



The image shows a window titled "NFS Server Configuration" with a document icon. It contains three main sections: "NFS Server" with radio buttons for "Start" (selected) and "Do Not Start"; "Firewall" with a checkbox for "Open Port in Firewall" (unchecked) and a "Firewall Details" button, with the text "Firewall is disabled" below; and "Enable NFSv4" with a checked checkbox for "Enable NFSv4", a text field for "Enter NFSv4 domain name:" containing "localdomain", and an unchecked checkbox for "Enable GSS Security" at the bottom.

Figure 3-3 NFS server configuration in SLES 10 SP2

Click **Next**. In the “Directories to Export” dialogue add the directory that is to be exported and the hosts that should be allowed to mount the exported file system. Figure 3-4 on page 54 shows our setup.

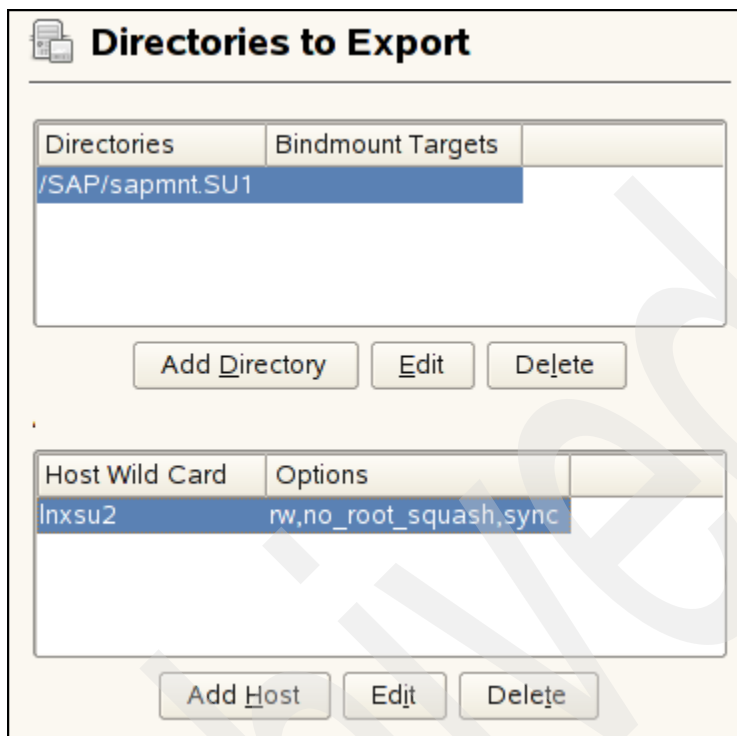


Figure 3-4 Selecting directories to export in SLES 10 SP2

Click **Finish** to activate the NFS server.

## Setting up an NFS server on Red Hat Enterprise Linux

Setting up an NFS server on Red Hat Enterprise Linux can be done either from the command line or using graphical tools.

We used lnxxrh3 as NFS server to export the shared filesystems for the RH1 SAP system.

### Defining the directories to export

To set up an NFS server on RHEL 5.1, we first defined the directories to be exported by adding the following line to the `/etc/exports` file:

```
/SAP/sapmnt.RH1 lnxxrh1(rw,no_root_squash,sync) \
lnxxrh2(rw,no_root_squash,sync)
```

### ***Activating the NFS server from the command line***

To activate the NFS server and make the activation persistent we carried out the following steps:

1. We checked whether the NFS server is activated:

```
# chkconfig --list nfs
nfs          0:off  1:off  2:off  3:off  4:off  5:off  6:off
```

You can see that the nfssserver is not activated for any runlevel.

2. We activated the NFS server:

```
# chkconfig nfs on
```

3. We checked whether the NFS server was activated:

```
# chkconfig --list nfs
nfs          0:off  1:off  2:on   3:on   4:on   5:on   6:off
```

After we carried out these steps, the NFS server started automatically at the next reboot of the Linux system. To start the NFS server immediately without rebooting, we performed the following steps:

4. We checked whether the NFS server was running:

```
# service nfs status
rpc.mountd is stopped
nfsd is stopped
rpc.rquotad is stopped
```

5. We start the NFS server:

```
# service nfs start
Starting NFS services: [ OK ]
Starting NFS quotas: [ OK ]
Starting NFS daemon: [ OK ]
Starting NFS mountd: [ OK ]
```

### ***Activating the NFS server using a GUI***

In order to activate an NFS server on RHEL 5.1 by means of a GUI, issue the command:

```
system-config-services
```

Set the editing runlevel to the default runlevel (in our case: runlevel 3). This is shown in Figure 3-5 on page 56.

Scroll down to the nfs check box and click it to select nfs for activation. Click **Start** to start the nfs server (Figure 3-6 on page 56).

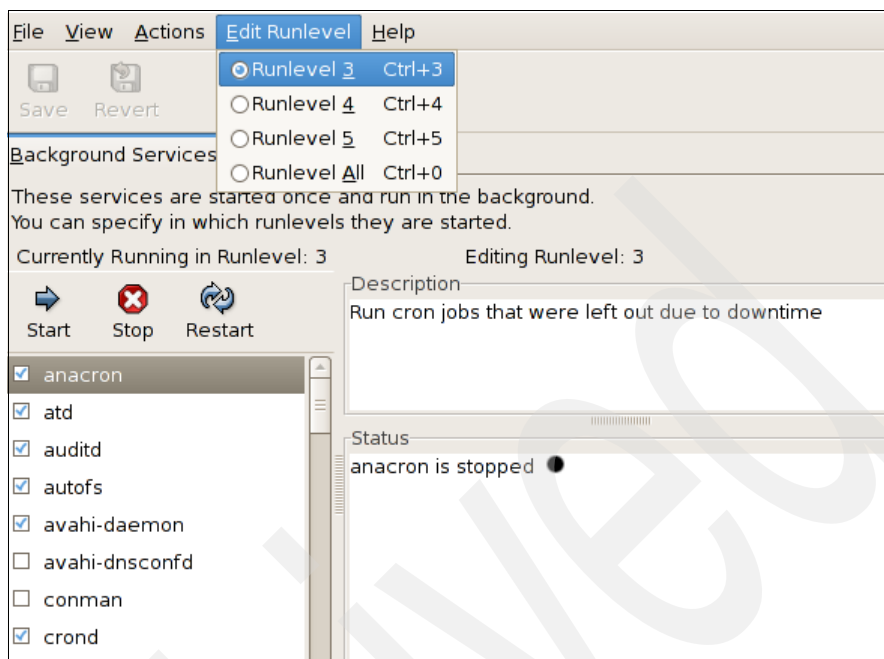


Figure 3-5 Setting the editing runlevel in RHEL 5.1 service configuration

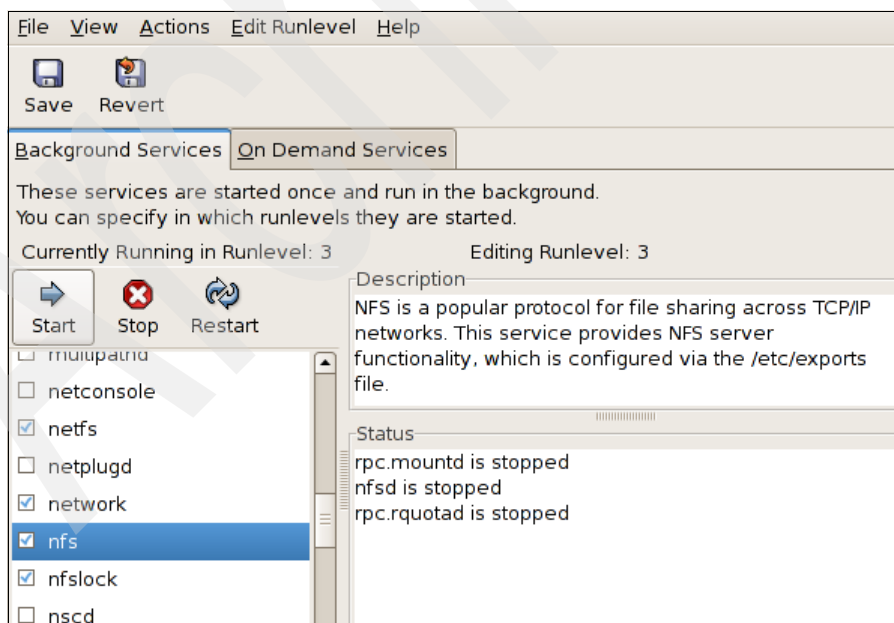


Figure 3-6 Selecting and starting the NFS service in RHEL 5.1



Click **Save** to make the activation of the NFS server persistent (Figure 3-7).

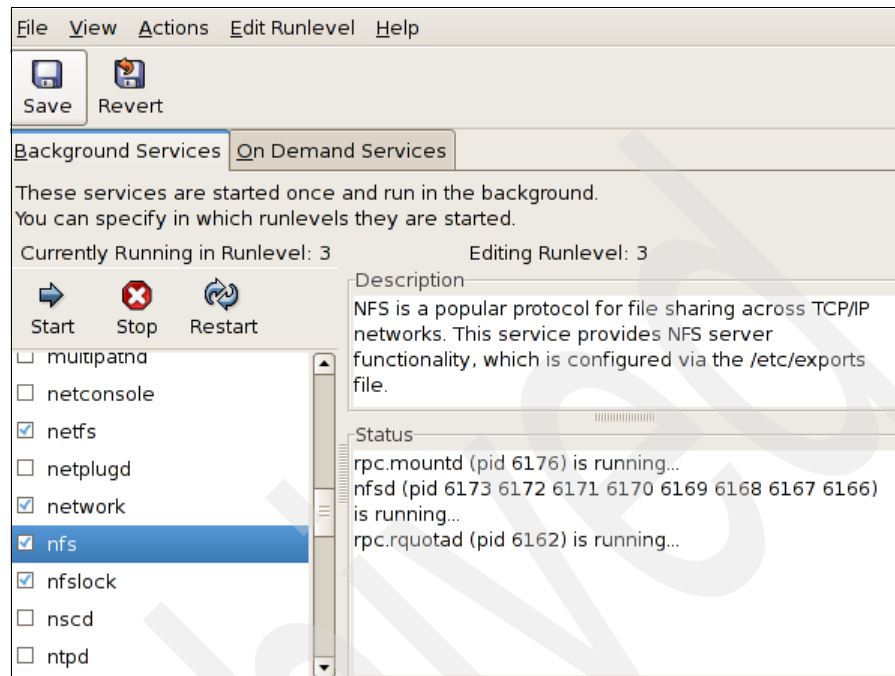


Figure 3-7 Making the NFS service activation persistent in RHEL 5.1

### 3.3.4 VNC

An SAP installation involves using a graphical installer and may take several hours. When installing SAP on Linux, this means that during the whole process of installation you need an open X11 session in which the graphical installer can run. If the X11 session is closed during installation, the installation will fail – a certainly unwanted situation. In particular this could happen in the following scenario: You connect from a personal computer to the machine on which SAP is to be installed. The X11 server that displays the SAP install GUI runs on this personal computer. If that computer is shut down or disconnected from the network during the SAP installation the installation will fail.

A method to avoid such a situation is running the installation completely on the machine on which SAP is to be installed – including the graphical installer.<sup>1</sup> This can be done by starting the installer on an X11 server that is running on the

<sup>1</sup> The SAP installer offers the option to detach the installer GUI from an installer session without interrupting the installer. You can then reconnect from another machine, provided that you have the necessary files needed for running the installer GUI on this machine.

machine on which SAP is to be installed and connecting from the personal computer to the X11 server via a remote desktop connection.

VNC clients are freely available in different flavors for Linux, UNIX, and Windows. In the following section we describe how to start the SAP installation using TightVNC.

## Starting the VNC server

As user *root*, start the VNC server on SLES as shown in Example 3-17, or on Red Hat Enterprise Linux as shown in Example 3-18.

*Example 3-17 Starting the VNC server for the first time on SLES*

---

```
# vncserver
```

You will require a password to access your desktops.

Password:

Verify:

Would you like to enter a view-only password (y/n)? n

New 'X' desktop is lnxsu3:2

Creating default startup script /root/.vnc/xstartup

Starting applications specified in /root/.vnc/xstartup

Log file is /root/.vnc/lnxsu3:2.log

---

*Example 3-18 Starting the VNC server for the first time on Red Hat Enterprise Linux*

---

```
# vncserver
```

You will require a password to access your desktops.

Password:

Verify:

New 'lnxrh3:1 (root)' desktop is lnxrh3:1

Creating default startup script /root/.vnc/xstartup

Starting applications specified in /root/.vnc/xstartup

Log file is /root/.vnc/lnxrh3:1.log

---

Note the lines reading:

New 'X' desktop is <hostname>:<display number>

Use this information to connect to the VNC server from the VNC client.

When you start the VNC server for the first time you are asked to enter a password to access your desktops. You need to specify this password when you connect to the VNC server from a VNC client. On SLES 10 SP2 you can also choose to set a view-only password, which allows you to connect to the VNC server in read-only mode. However, for an SAP installation you do not need this option. The encrypted password is stored in the `.vnc/` directory of user root and will be valid for all subsequent `vncserver` sessions. Therefore, you will not be asked for a password on subsequent starts of the VNC server.

As default, on both SLES and Red Hat Enterprise Linux the VNC server starts an X11 session with a simple `twm` window manager. If you want to change this behavior, for example, to start KDE instead of `twm`, you can edit the `xstartup` file in the `.vnc/` directory of user root (this file is automatically created by the VNC server when it is started for the first time).

Simply change the line:

```
twm &
```

to:

```
startkde &
```

When the SAP installation is finished you should shut down the VNC server as shown in Example 3-19 for SLES or in Example 3-20 for Red Hat Enterprise Linux. Here, the number specified after the colon is the `<display number>` that is displayed when starting the VNC server, in the line reading:

New 'X' desktop is `<hostname>:<display number>`

*Example 3-19 Shutting down the VNC server on SLES*

---

```
# vncserver -kill :2  
Killing Xvnc process ID 15843
```

---

*Example 3-20 Shutting down the VNC server on Red Hat Enterprise Linux*

---

```
# vncserver -kill :1  
Killing Xvnc process ID 2389
```

---

## 3.4 Implementing the SAP Notes for SLES and Red Hat Enterprise Linux

After the standard Linux installation on the SLES and Red Hat Enterprise Linux systems was finished, we implemented “SAP Note 958253: SUSE LINUX Enterprise Server 10: Installation notes” and “SAP Note 1048303: Red Hat Enterprise Linux 5.x: Installation and Upgrade” to prepare our Linux systems for the SAP installation. In the following sections we describe the steps we carried out to implement the two notes.

### 3.4.1 Preparing for SAP installation on SLES

To prepare our SLES systems for SAP installation we implemented “SAP Note 958253: SUSE LINUX Enterprise Server 10: Installation notes” on our SLES systems.

#### Setting up the sapinit package

To use SAP on SLES, installation of the sapinit RPM™ package is necessary. This should normally be done during the base SLES installation. We checked that this was the case on our systems:

```
# rpm -q sapinit
sapinit-3.0-1.4
```

If you get the answer “package sapinit is not installed” you need to install the sapinit RPM package manually. You can do this by running YaST as user root. Choose **Software** → **Software Management** and select the sapinit package for installation.

During the installation of sapinit, some Linux kernel parameters (**kernel.shmmax**, **kernel.sem**, **kernel.shmall**, and **vm.max\_map\_count**) are adapted in file `/etc/sysctl.conf`. We did not make any changes to these parameters.

#### Adapting the `/etc/hosts` file

We adapted the `/etc/hosts` file as described in 3.3, “Network services setup” on page 49.

#### Using a time server

In an SAP system landscape all systems must have a synchronized system time. For all systems running on the same System z CEC, time synchronization is guaranteed by the System z hardware.

In a heterogenous environment time synchronization between the different systems may be achieved by numerous methods, for example, by setting up an NTP time server on z/OS.

## Checking the swap space

We checked the swap space set up during base installation as follows:

```
# free -m
```

	total	used	free	shared	buffers	cached
Mem:	4009	3855	154	0	73	1681
-/+ buffers/cache:		2100	1909			
Swap:	7042	0	7042			

We used 7042 MB swap space, which is about twice the amount of RAM (4009MB). This corresponds to the recommendation in the SAP note. See 5.6, “Linux on System z swap space” on page 121 for a discussion about swap space on Linux on System z.

## Adapt the sshd environment

As described in SAP Note 958253 we commented out the following lines in /etc/ssh/sshd\_config to avoid propagation of certain environment settings:

```
#AcceptEnv LANG LC_CTYPE LC_NUMERIC LC_TIME LC_COLLATE LC_MONETARY LC_MESSAGES
#AcceptEnv LC_PAPER LC_NAME LC_ADDRESS LC_TELEPHONE LC_MEASUREMENT
#AcceptEnv LC_IDENTIFICATION LC_ALL
```

## Setting up the saplocales package

To use non Unicode SAP Systems on SLES, the installation of the saplocales RPM package is necessary. This package is provided by SAP and is not installed during the SLES base installation. We downloaded the package as described in “SAP Note 171356: SAP software on Linux: Essential information” and installed it:

```
# unzip saplocales_sles10_s390x_version-3.zip
Archive:  saplocales_sles10_s390x_version-3.zip
  inflating: saplocales-2.4-3.s390x.rpm
# rpm -i saplocales-2.4-3.s390x.rpm
```

Please read SAP Note 910707 for changes regarding the ja\_JP.SJIS locale and SAP Note 187864 for required changes in SAP table TCP0C.

## UTF8 autodetection

As stated in SAP Note 958253, UTF8 autodetection must be switched off when starting the SAP system by means of **sapstartsrv**. We checked this as follows:

```
# grep AUTO_DETECT_UTF8 /etc/sysconfig/language
AUTO_DETECT_UTF8="no"
```

## Adjusting the number of file descriptors

We did not change the possible number of open file descriptors that is set by the **sapinit** script to the limits recommended by SAP. However, in certain situations and with certain SAP applications this might be necessary. If you encounter problems related to the number of open file descriptors follow the instructions in SAP Note 958253 to adjust the limits.

### 3.4.2 Preparing for SAP installation on Red Hat Enterprise Linux

To prepare our Red Hat Enterprise Linux systems for SAP installation we implemented “SAP Note 1048303: Red Hat Enterprise Linux 5.x: Installation and Upgrade” on our Red Hat Enterprise Linux systems.

#### Checking whether the libXp package is installed

To use SAP on Red Hat Enterprise Linux, installation of the libXp RPM package is necessary. This package is provided by Red Hat but is not installed during the base Red Hat Enterprise Linux installation.

We downloaded the RPM package from our internal ftp server that held the Red Hat Enterprise Linux install media and installed the package as follows:

```
# rpm -i \
ftp://lncode.:/code/rhe15.1-s390x/Server/libXp-1.0.0-8.1.e15.s390x.rpm
```

```
warning: libXp-1.0.0-8.1.e15.s390x.rpm: Header V3 DSA signature: NOKEY, key ID
37017186
```

#### Configuring the firewall

We did not enable the firewall on our Red Hat Enterprise Linux systems. Therefore we did not need to open any ports for SAP. If you use a firewall on your Red Hat Enterprise Linux system follow the instructions in SAP Note 1048303 to configure your firewall properly.

#### Configuring SELinux

Since we did not have to consider security issues, we disabled SELinux on our Red Hat Enterprise Linux systems by setting, in file `/etc/selinux/config`:

```
SELINUX=disabled
```

SAP Note 1048303 suggests using the setting **permissive** instead of **disabled** which might be more appropriate for a production environment. However, one of the two settings must be used since the third option **enforcing** will not work with certain SAP components.

## Using a time server

In an SAP system landscape all systems must have a synchronized system time. For all systems running on the same System z CEC, time synchronization is guaranteed by the System z hardware.

In a heterogenous environment time synchronization between the different systems can be achieved by numerous methods, for example, by setting up an NTP time server on z/OS.

## Adapting the /etc/hosts file

We adapted the /etc/hosts file as described in 3.3, “Network services setup” on page 49.

## Setting up the saplocales package

To use non Unicode SAP Systems on Red Hat Enterprise Linux, the installation of the saplocales RPM package is necessary. This package is provided by SAP and is not installed during the Red Hat Enterprise Linux base installation. We downloaded the package as described in “SAP Note 171356: SAP software on Linux: Essential information” and installed it:

```
# unzip saplocales_rhel5_s390x_version-1.zip
Archive:  saplocales_rhel5_s390x_version-1.zip
  inflating: saplocales-32bit-2.5-1.s390.rpm
  inflating: saplocales-2.5-1.s390x.rpm
# rpm -i saplocales-2.5-1.s390x.rpm
Adding /usr/lib/locale/tr_TR.ISO-8859-9
Adding /usr/lib/locale/lv_LV.ISO-8859-4
Adding /usr/lib/locale/lt_LT.ISO-8859-4
Adding /usr/lib/locale/et_EE.ISO-8859-4
character map `SHIFT_JISX0213' is not ASCII compatible, locale not ISO C
compliant
Adding /usr/lib/locale/ja_JP.SHIFT_JISX0213
Adding /usr/lib/locale/de_DE.SAP
```

Note that the zip file contains two RPM packages. On Linux on System z the second package, named saplocales-2.5-1.s390x.rpm, is the one that should be installed.

## Adjusting Linux kernel parameters

We appended the following lines to the /etc/sysctl.conf file in order to adjust some of the Linux kernel parameters as required by SAP:

```
# ADDED BY JCM 20081017 SAP NOTE 1048303
kernel.msgmni=1024
kernel.sem=1250 256000 100 1024
vm.max_map_count=300000
```

## Adjusting process resource limits

In order to meet the requirements of some SAP components related to the number of possible open files, we added the following lines to the `/etc/security/limits.conf` file:

```
# ADDED BY JR 20081017 SAP NOTE 1048303

@sapsys hard nfile 32800
@sapsys soft nfile 32800
@dba    hard nfile 32800
@dba    soft nfile 32800
```

## Installing missing libraries

When we tried to start the SAP installer on Red Hat Enterprise Linux we got the following error:

```
./sapinst: error while loading shared libraries: libstdc++.so.5:
cannot open shared object file: no such file or directoryDASD, lvm,
and file system setup
```

This problem could be resolved by installing `compat-libstdc++-33-3.2.3-61` which comes on the Red Hat Enterprise Linux installation media. (See also 4.5, “Problems while running SAPinst” on page 105.)

## 3.5 Providing Java for SAP

In this section we describe how to set up Java for SAP. The following description is valid for both SLES and Red Hat Enterprise Linux.

### 3.5.1 Getting the required IBM Java version

For the installation of the SAP Java instances we need to provide a Java installation on our Linux systems. When we prepared our system for the installation of the SAP Java instance, according to “SAP Note 746299: Recommended Settings for the Linux for zSeries JVM”, the required IBM JDK was IBM SDK 1.4.2, service release 11. We did not have any IBM JDK installed on our systems. If you already have a Java JDK installed on your system, you can check the version by running:

```
# java -fullversion
```



For the correct java version this returns the string:

```
java full version "J2RE 1.4.2 IBM build cxz64142-<build_date> (<sr_num>)"
```

Here <sr\_num> is the required service release number as indicated in “SAP Note 746299: Recommended Settings for the Linux for zSeries JVM”.

**Note:** Beginning with NetWeaver 7.1 the SAP JVM™ should be used. While this book is about NetWeaver 7.0, some SAP components on NetWeaver 7.1 ((for example, PI 7.1) are already available and require the SAP JVM. See 6.3.3, “SAP JVM” for more details.

The required Java version was not provided with the installation media of SLES and Red Hat Enterprise Linux. We therefore followed the instructions in SAP Note 746299 and downloaded the RPM package containing the required JDK: Java2-142-z64-SDK-1.4.2-11.0.s390x.rpm

We obtained this package from:

```
https://www14.software.ibm.com/webapp/iwm/web/preLogin.do?lang=en_US&source=swg-ibmjaisv
```

## 3.5.2 Installing Java

### Installing the JDK

We want to be able to switch easily between different JDK versions for the SAP Java instance. This can be done by using a symbolic link to access Java. The symbolic link always points to the installation directory of the IBM JDK which will be used by SAP. However, there are some considerations before installing the JDK and creating the symbolic link.

When installing the IBM JDK RPM package using **rpm -i <package name>** the package contents is installed under directory /opt/IBMJava2-s390x-142. Installing a new version of the IBM JDK RPM at a later time using **rpm -u <package name>** will overwrite a previously installed IBM JDK by replacing all files under /opt/IBMJava2-s390x-142 with the files of the new JDK version. We circumvented this problem by using the **--relocate** option of the **rpm** command during installation of the IBM JDK. This option allows for the installation of multiple JDK versions.

We installed the IBM JDK under path /opt/IBMJava2-s390x-142-<sr\_num> where <sr\_num> is the number of the service release of the IBM JDK. To install the IBM JDK RPM we issued the following command on each of our Linux systems:

```
# rpm -ihv --relocate /opt/IBMJava2-s390x-142=/opt/IBMJava2-s390x-142-11\
IBMJava2-142-z64-SDK-1.4.2-11.0.s390x.rpm
```

This installs the IBM JDK under directory /opt/IBMJava2-s390x-142-11.

We then created the symbolic link /opt/sapjdk which is used by the SAP Java instance:

```
# cd /opt
# ln -s IBMJava2-s390x-142-11 sapjdk
# ls -l sapjdk
lrwxrwxrwx 1 root root 18 Nov  4 13:55 sapjdk -> IBMJava2-s390x-142-11
```

We verified successful installation of the JDK and setup of the symbolic link by running the following command on all Linux systems:

```
# /opt/sapjdk/bin/java -fullversion
java full version "J2RE 1.4.2 IBM build cxz64142-20080515 (SR11)"
```

During the installation of the SAP Java instance the path /opt/sapjdk was used to access Java independent of the real location of the JDK (see 4.1.2, “Linux on System z prerequisites for running SAPinst” on page 73).

## Post installation steps

### *Checking for missing libraries*

After you have installed the IBM JDK RPM and set up the symbolic link you might still be missing a compatibility library. You can check this by running the **java** command with the **-version** option:

```
# /opt/sapjdk/bin/java -version
Warning: JIT compiler "jitc" not found. Will use interpreter.
java version "1.4.2"
Java(TM) 2 Runtime Environment, Standard Edition (build 1.4.2)
Classic VM (build 1.4.2, J2RE 1.4.2 IBM build cxz64142-20080515
(SR11) (JIT disabled))
```

This warning means that you will run into severe performance issues since the just-in-time compiler (JIT) cannot be used and thus all Java byte code will be interpreted instead of being executed directly on the CPU.

**Note:** We specified the **-version** option when running the **java** command. You don't get the warning if you use the **-fullversion** option.

We got the warning on our systems. We did some investigations using the **strace** command:

```
# strace -eopen /opt/sapjdk/bin/java -version
```

This gave the output (among others) on Red Hat Enterprise Linux<sup>2</sup>:

```
...
open("/lib64/tls/libstdc++-libc6.2-2.so.3", 0_RDONLY) = -1 ENOENT
(No such file or directory)
open("/lib64/libstdc++-libc6.2-2.so.3", 0_RDONLY) = -1 ENOENT (No
such file or directory)
open("/usr/lib64/tls/libstdc++-libc6.2-2.so.3", 0_RDONLY) = -1
ENOENT (No such file or directory)
open("/usr/lib64/libstdc++-libc6.2-2.so.3", 0_RDONLY) = -1 ENOENT
(No such file or directory)
...
```

This indicates that we were missing the library `libstdc++-libc6.2-2.so.3`.

The library is provided in the following RPM packages on the SLES and Red Hat Enterprise Linux installation media:

- ▶ SLES: `compat-2006.1.25-11.2.s390x.rpm`
- ▶ Red Hat Enterprise Linux: `compat-libstdc++-295-2.95.3-85.s390x.rpm`

After we installed the appropriate packages on our SLES and Red Hat Enterprise Linux systems, we could successfully run the **java** command without getting the warning about the JIT compiler:

```
# /opt/sapjdk/bin/java -version
java version "1.4.2"
Java(TM) 2 Runtime Environment, Standard Edition (build 1.4.2)
Classic VM (build 1.4.2, J2RE 1.4.2 IBM build cxz64142-20080515
(SR11) (JIT enabled: jitc))
```

Note the “JIT enabled” message at the end of the output of the **java** command, meaning that just in time compilation now will be used.

### ***Setting the Java Virtual Machine parameters***

Some adaptations must be made to the JVM parameters to obtain proper functioning of the SAP Java instance. This is done using the **configtool**, which is installed during SAP installation. See 4.6, “Performing the post installation steps” on page 106 for more details concerning modifying the JVM parameters.

---

<sup>2</sup> On SLES the output is slightly different but all **open** systems calls involving `libstdc++-libc6.2-2.so.3` equally fail.

### 3.5.3 Switching to another Java version

After we installed our SAP Java instances (see section 4.2.5, “Installing the Java central services instance (SCS)” on page 89), SAP Note 746229 was updated. The updated SAP Note stated that IBM JDK version SDK 1.4.2, *service release 12* should be used. To install and switch to the new JDK version we carried out the following steps, which apply to both SLES and Red Hat Enterprise Linux.

#### Downloading and installing the RPM package

We downloaded the RPM package containing the required JDK  
IBMJava2-142-z64-SDK-1.4.2-12.0.s390x.rpm

We obtained this package from:

[https://www14.software.ibm.com/webapp/iwm/web/preLogin.do?lang=en\\_US  
&source=swg-ibmjava1sv](https://www14.software.ibm.com/webapp/iwm/web/preLogin.do?lang=en_US&source=swg-ibmjava1sv)

We installed the RPM package by running, on each of our Linux guests:

```
# rpm -ihv --relocate /opt/IBMJava2-s390x-142=/opt/IBMJava2-s390x-142-12\  
IBMJava2-142-z64-SDK-1.4.2-12.0.s390x.rpm
```

We changed the symbolic link to the location of the new JDK:

```
# cd /opt  
# rm sapjdk  
# ln -s IBMJava2-s390x-142-12 sapjdk  
# ls -l sapjdk  
lrwxrwxrwx 1 root root 18 Nov  4 13:55 sapjdk -> IBMJava2-s390x-142-12
```

#### Installing the latest JCE policy files

According to SAP Note 746299 we also need to install the latest version of the JCE policy files. We downloaded the file `unrestricted.zip` from:

<https://www14.software.ibm.com/webapp/iwm/web/preLogin.do?source=jcesdk>

We unpacked it in directory `/opt/IBMJava2-s390x-142-12/jre/lib/security/`:

```
# cd /opt/sapjdk/jre/lib/security/  
# unzip /tmp/unrestricted.zip  
Archive:  /tmp/unrestricted.zip  
replace US_export_policy.jar? [y]es, [n]o, [A]ll, [N]one, [r]ename: y  
  inflating: US_export_policy.jar  
replace local_policy.jar? [y]es, [n]o, [A]ll, [N]one, [r]ename: y  
  inflating: local_policy.jar  
  inflating: Readme.txt
```

## Cleaning up the SAP J2EE settings

To make sure that the SAP Java instance will use the new JDK on the next restart, we removed the following two files before restarting the SAP Java instance:

```
# rm /usr/sap/<SID>/<INSTANCE>/j2ee/cluster/instance.properties.vmpprop
# rm /usr/sap/<SID>/<INSTANCE>/SDM/program/config/sdm_jstartup.properties.vmpprop
```

Here <SID> is SU1 for our SLES SAP system and RH1 for our Red Hat Enterprise Linux SAP system and <INSTANCE> is DVEBMGS02 for both our Red Hat Enterprise Linux and our SLES system.

The removed files will be recreated on the next restart of the engine (see “SAP Note 718901: How to Change the JDK of the J2EE Engine” for more details).



# Installing SAP NetWeaver on Linux for System z

This chapter describes how to install an SAP system on Linux for System z. It includes the following topics:

- ▶ Preparing the database and the Linux system for the installation
- ▶ Installing the SAP services
- ▶ Installing the Enqueue Replication Server (ERS)
- ▶ Performing the post installation steps

## 4.1 Preparing database and Linux on System z system for the installation

This section describes the steps for preparing Linux on System z before installing an SAP system. To complete these steps you need to have DB2 for z/OS installed. For this IBM Redbooks publication, we installed DB2 9 for z/OS. For more information refer to SAP Database Administration Guide for SAP NetWeaver on IBM DB2 for z/OS SAP NetWeaver 7.0 SR3.

### 4.1.1 Recommended documentation

The following documents will assist you in the preparation and installation of your SAP system:

- ▶ Master Guide SAP NetWeaver 7.0
- ▶ Technical Infrastructure Guide - SAP NetWeaver
- ▶ SAP Planning Guide for SAP NetWeaver on IBM DB2 for z/OS SAP NetWeaver 7.0 SR3
- ▶ SAP Database Administration Guide for SAP NetWeaver on IBM DB2 for z/OS SAP NetWeaver 7.0 SR3
- ▶ SAP Security Guide: IBM DB2 for z/OS
- ▶ SAP NetWeaver 7.0 SR3 ABAP+Java on Linux: IBM DB2 for z/OS

**Note:** This documentation can be found at:

<http://service.sap.com/instguides>

We used the following OSS notes:

- |         |                                                                              |
|---------|------------------------------------------------------------------------------|
| 1100775 | SAP Note 1100775: SAP NetWeaver 7.0 (2004s) SR3 Installation IBM DB2 on z/OS |
| 81737   | SAP Note 81737: DB2-z/OS APAR List                                           |

### Userids and groups required on z/OS

The userids and groups shown in Table 4-1 on page 73 must be created prior to running SAPinst; they are not be created automatically by SAPinst. For details about authorities for these IDs and groups see the SAP Security Guide: IBM DB2 for z/OS.



Table 4-1 z/OS userids and groups

Type	Name	Description	Our value
Groups	ABAP Schema	Group is creator of all ABAP objects in the DB2 subsystem, corresponds to a RACF® group	SAPR3
	Java Schema	Same as above but for Java objects	SAPJ1
Userids	DB Administrator User ID	TSO userid used only for the installation, must have DB2 SYSADM authority	KAREN B
	DB Connect User ID	TSO userid used to connect to DB2, must be a member of the ABAP Schema group	R3USER
	Java Connect User ID	Same as above but must be a member of the Java Schema group	SAPJAVA

### 4.1.2 Linux on System z prerequisites for running SAPinst

This section describes all prerequisites needed to install an SAP system. SAP provides a tool to install SAP systems, called SAPinst.

#### Access as root

You must be logged on with a userid having root permissions to run SAPinst.

#### Java installation

To run SAPinst you need a Java JDK installed on your Linux on System z system. For more information about our Java installation, refer to section 3.5, “Providing Java for SAP” on page 64.

#### Download the JCE policy file

With NetWeaver 7.0 SR3 it is mandatory to have strong encryption for the J2EE engine. Before you can start the SAP system installation, you have to download it from this location:

<http://www6.software.ibm.com/dl/jcesdk/jcesdk-p>

SAPinst asks you for the location of the JCE policy archive file during the installation. It extracts it into your Java directory. Make sure that you specify the archive file with its complete path.

## Get the DVDs from SAP

We used the guide Media List for SAP NetWeaver 7.0 SR3 to get a list of the media needed for the installation. To obtain this guide, go to:

<http://service.sap.com/installNW70>

Select **Media List** → **SAP NetWeaver 7.0**.

The DVDs used for our installation are listed in Table 4-2.

Table 4-2 DVDs used for our installations

DVD Label	DVD Number
Installation master	51033511_7
Unicode kernel	51033507_15
Export	51033493_1, 51033493_2
CLI Driver:9.1	51033060
Java	51033513_1,2,3,4

We used SAP Note 1039640: Unpacking RAR archives to decompress the software. We also used the Linux on System z unzip utility for zipped files.

The DVDs were placed on our file system Inxsu3:/mnt/sapcds and exported and mounted to the other servers using NFS.

## Directory setup

We used the previously defined volume group and file system, described in 3.1, “Prerequisites” on page 32, to create directories as shown in Figure 4-1.

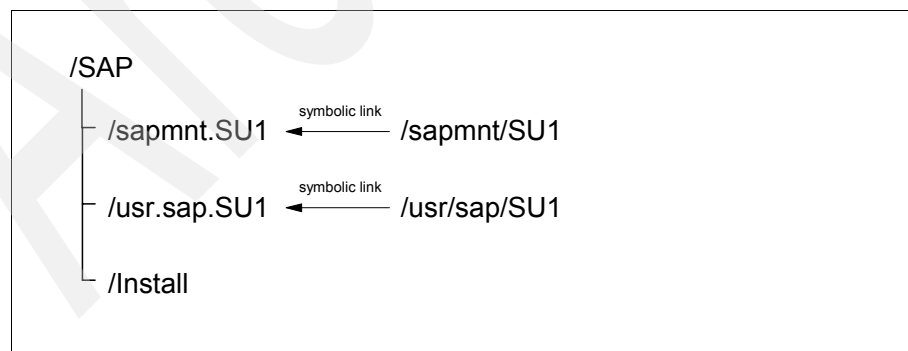


Figure 4-1 Directory setup

We set up our file system using the commands shown in Example 4-1.

*Example 4-1 Commands used to create directories on Inxsu1h*

---

```
# Create the directories
mkdir /mnt/sapcds
mkdir /SAP/sapmnt.SU1
mkdir /SAP/usr.sap.SU1

# Create directories needed to make the softlinks
mkdir /sapmnt
mkdir /usr/sap

# Create the softlinks
ln -s /SAP/sapmnt.SU1 /sapmnt/SU1
ln -s /SAP/usr.sap.SU1 /usr/sap/SU1

# Create the installation directory
mkdir /SAP/install
chmod 777 /SAP/install

# NFS-Mounts
# add following lines to /etc/fstab on Inxsu1h
Inxsu3h:/SAP /mnt/sapcds nfs sync 0 0
Inxsu3h:/SAP/sapmnt.SU1 /SAP/sapmnt.SU1 nfs sync 0 0

mount /mnt/sapcds
mount /SAP/sapmnt.SU1
```

---

Make sure that the volume group and file system sizes meet the requirements in the SAP NetWeaver 7.0 SR3 ABAP+Java on Linux: IBM DB2 for z/OS guide.

The /SAP/install directory holds all the files generated by SAPinst. If you do not specify your own installation directory, SAPinst uses /tmp to save all installation information. This may lead to a problem if the /tmp directory is cleaned up by your Linux on System z administrator.

## **Setting up the file system for installing dialog instances**

We set up local directories on Inxsu2h and exported directories from Inxsu1h as shown in Example 4-2.

*Example 4-2 Commands used to create directories on Inxsu2h*

---

```
# Create the directories
mkdir /mnt/sapcds
```

```

mkdir /SAP/sapmnt.SU1
mkdir /SAP/usr.sap.SU1

# Create directories needed to make the softlinks
mkdir /sapmnt
mkdir /usr/sap

# Create the softlinks
ln -s /SAP/sapmnt.SU1 /sapmnt/SU1
ln -s /SAP/usr.sap.SU1 /usr/sap/SU1

# Create the installation directory
mkdir /SAP/install
chmod 777 /SAP/install

# NFS-Mounts
# add following lines to /etc/fstab on lnxsu2h
lnxsu3h:/SAP /mnt/sapcds nfs sync 0 0
lnxsu3h:/SAP/sapmnt.SU1 /SAP/sapmnt.SU1 nfs sync 0 0

mount /mnt/sapcds
mount /SAP/sapmnt.SU1

```

---

## Environment variables

Before running SAPinst we used the commands shown in Example 4-3 to set the environment variables and limits. We set these parameters every time before starting SAPinst.

### *Example 4-3 Environment variables for running SAPinst*

---

```

# Set the environment for SAPinst.
export TMP=/SAP/install
export JAVA_HOME=/opt/sapjdk
export SAPINST_JRE_HOME=/opt/sapjdk
# Set the ulimits.
ulimit -t unlimited
ulimit -d 2097148
ulimit -f unlimited
ulimit -s 8192
ulimit -m unlimited
ulimit -n 8192
ulimit -c unlimited

```

---

## Linux on System z userids

You do not need to create any userids or groups on Linux on System z. This is done automatically by SAPinst.

**Caution:** The userids (UID) and groups (GID) of the operating system users and groups must be identical on any application server used for one SAP system.

## Database connectivity

The ABAP stack of the SAP application servers connects to DB2 using the IBM Data Server Driver for ODBC and CLI (also referred to as the *CLI Driver*). The J2EE stack is connected to DB2 with the IBM Data Server Driver for JDBC™ and SQLJ. We refer to them in this book as the CLI and JDBC drivers.

**Note:** In SAP documentation, you may find the new database connectivity named “thin client” or CLI driver.

The CLI and JDBC drivers are automatically installed by SAPinst. SAPinst builds the file system structure as shown in Figure 4-2. An installed DB2 Connect™ is no longer needed. Learn more about DB2 connectivity with SAP by reading *Streamlining DB2 Connect for SAP*, which can be found at: <https://www.sdn.sap.com/irj/scn/go/portal/prtroot/docs/library/uuid/207c5c32-51ea-2a10-c7bc-bcfca74552d5>

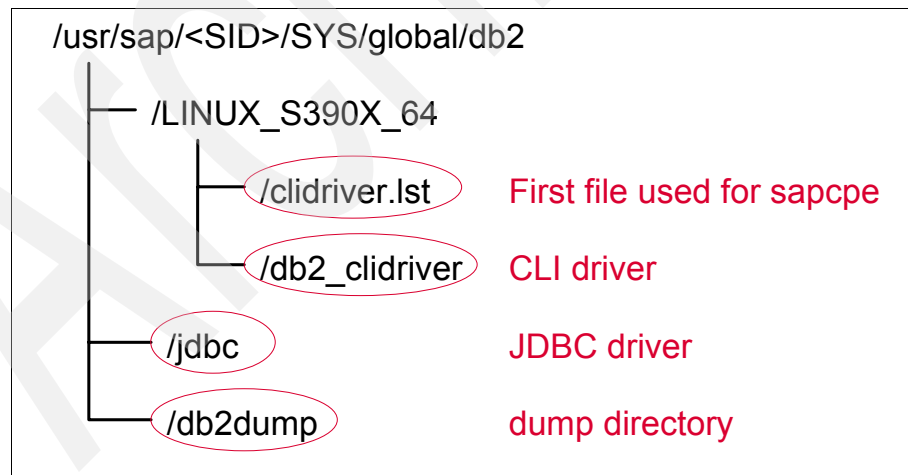


Figure 4-2 File system structure of the CLI driver

The program **sapcpe** mentioned in Figure 4-2 is used during the start process of an SAP instance. This is covered in more detail in the next section.

All connectivity data used to connect to the database is stored in the file `connect.ini`, which is located in `/usr/sap/<SID>/SYS/global`. An initial `connect.ini` file is written by `SAPinst` during the installation process. For more information about maintaining the `connect.ini` file, refer to the *SAP Database Administration Guide for SAP NetWeaver on IBM DB2 for z/OS SAP NetWeaver 7.0 SR3*.

The SAP installation is performed with a *try and buy license* of the CLI driver. This license is temporary and must be replaced by a valid license as soon as possible. If it is not replaced, the system will stop working after 90 days.

If you are an OEM customer, you can download the license at:

<http://service.sap.com/swdc>

Select **Download** → **Database Patches (from other vendors)** → **DB2 for z/OS** → **Download IBM DB2 Drivers for ODBC, CLI and JDBC,<version>**

If you are an IBM customer, contact your IBM representative.

As soon as you get your license, copy it to:

`/usr/sap/<SAPSID>/<INSTANCE>/exe/db2_clidriver/license`

## Setting up local executables on UNIX SAP instances

During the installation all executables needed to run the SAP system are extracted to your central executables directory. This executable directory is located in `/usr/sap/<SAPSID>/SYS/exe/run`.

`SAPinst` configures the start profiles of all instances to let the **sapcpe** program replicate the kernel automatically from the central executables directory to your instance executable directory, which is `/usr/sap/<SAPSID>/<INSTANCE>/exe`.

**Note:** Setting up the *instance profiles* for using **sapcpe** is done automatically by `SAPinst`.

For more information on how the replication of the executables works, refer to:

[http://help.sap.com/saphelp\\_nw04/helpdata/en/4f/37783021fc11d288cd0000e83539c3/frameset.htm](http://help.sap.com/saphelp_nw04/helpdata/en/4f/37783021fc11d288cd0000e83539c3/frameset.htm)

## SAPinst

SAPinst resides on the installation master DVD. It can be started using various parameters. To see a list of all parameters, issue **sapinst -p**.

We used the `SAPINST_USE_HOSTNAME` parameter to set the virtual host names to prepare for HA readiness, which is described in 3.2.4, “Additional configuration steps on Linux on System z” on page 43.

The file path to the **sapinst** executable can be found as shown in Figure 4-3.



Figure 4-3 Path to SAPinst on the installation master DVD

Another useful parameter is

`SAPINST_JSLIB_TRACE=NWdb2DBParameter,NWdb2DBAccess`.

You might use this parameter if you encounter an issue during the installation. This will give further trace information in the log files.

The installation process is divided into the parameter input and the execution phase. After finishing the parameter input phase, SAPinst shows the summary of all parameters set. On this panel you can see all parameters you entered during the parameter input phase. If you want to change one or more values, select the appropriate check box and click **Revise**. SAPinst will then display all necessary dialogs and you will be able to change the values.

For more information about starting SAPinst, refer to *SAP NetWeaver 7.0 SR3 ABAP+Java on Linux: IBM DB2 for z/OS*.

The parameters we used are shown in Appendix B, “Parameter input” on page 147.

## Check OS requirements

We ran an optional prerequisite checker provided by SAPinst in standalone mode to make sure that all hardware and software requirements were met. SAPinst will also rerun this during the installation.

**Note:** The prerequisites checker is not able to test the connection to the database, the database subsystem itself, nor the database system parameters.

We also downloaded the latest PREREQUISITE\_CHECK\_DATA\_700.SAR from *SAP Note 855498: Installation Prerequisite Checker* and extracted it to PREREQUISITE\_CHECK\_DATA.XML.

The prerequisites checker was started by launching SAPinst and making the following selections from the SAPinst Welcome screen (Figure 4-4):

**SAP Netweaver 7.0 SR3 → Software Life-Cycle Options → Additional Preparation Options → Prerequisites Check.**

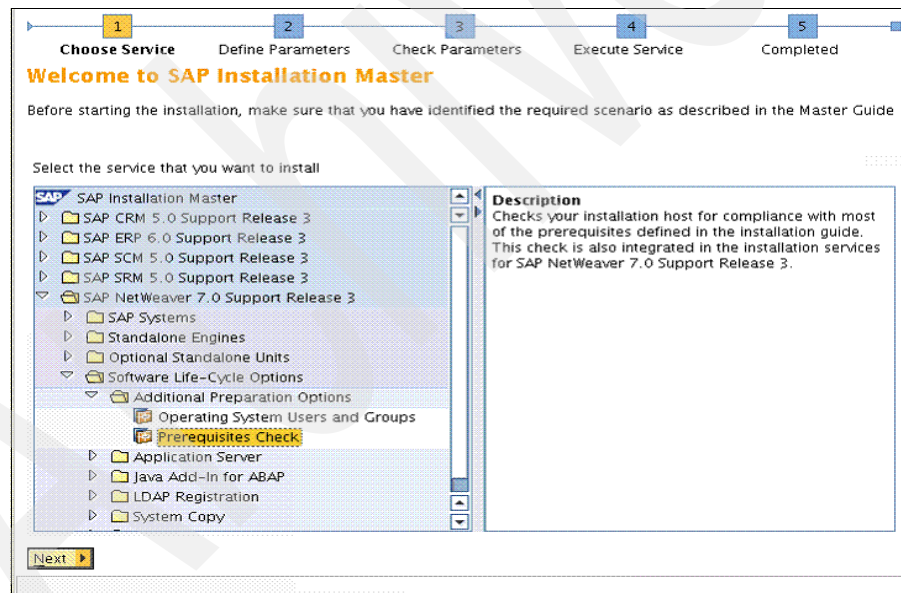


Figure 4-4 SAPinst Prerequisites Check



We selected the tasks shown with check marks in Figure 4-5 and clicked **Next**.

12345

Choose ServiceDefine ParametersCheck ParametersExecute ServiceCompleted

Prerequisites Checker > Services

Select the tasks for which you want to check specific prerequisites

Services for Check

If you do not choose any task, only the essential prerequisites for an installation are checked. If you plan to install a SAP system with usage types based on *AS ABAP* and *AS Java*, choose the instances for both.

Check Prerequisites	Task
<input type="checkbox"/>	Java EE Engine Update
<input type="checkbox"/>	Developer Workplace
<input type="checkbox"/>	Database Instance (AS ABAP)
<input checked="" type="checkbox"/>	Primary Application Server Instance (AS ABAP)
<input checked="" type="checkbox"/>	Central Services Instance for ABAP (AS ABAP)
<input checked="" type="checkbox"/>	Dialog Instance (AS ABAP)
<input type="checkbox"/>	Database Instance (AS Java)
<input checked="" type="checkbox"/>	Primary Application Server Instance (AS Java)
<input checked="" type="checkbox"/>	Application Server Instance (AS Java)
<input checked="" type="checkbox"/>	Central Services Instance (AS Java)
<input type="checkbox"/>	PI Usage Type

Back

Next

Figure 4-5 Tasks

The results are shown in Figure 4-6.

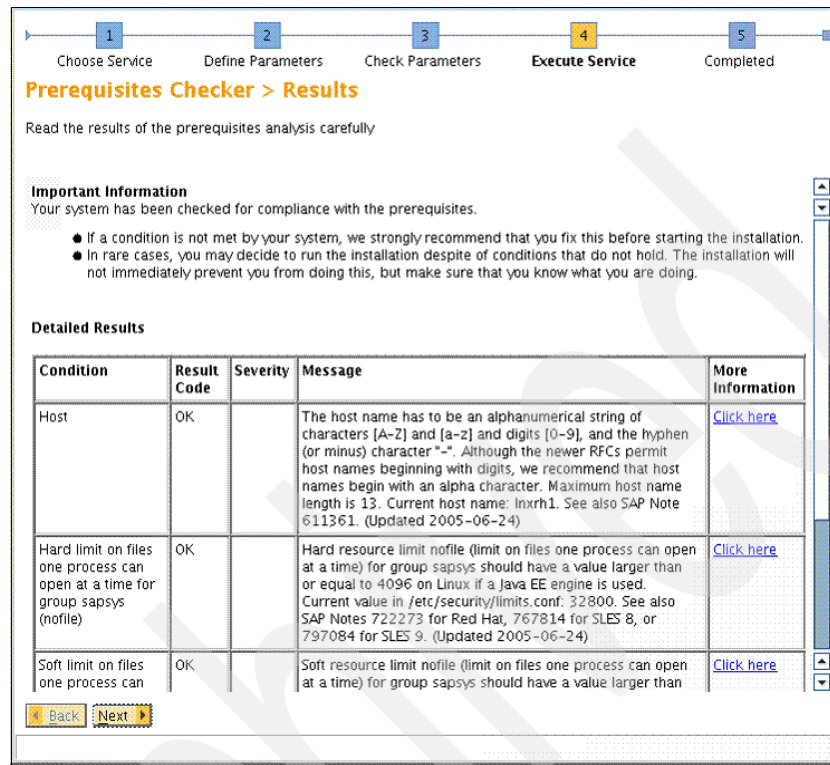


Figure 4-6 Results of the Prerequisites Check

### 4.1.3 Dual stack versus single stack

You can install three types of SAP systems with NetWeaver 7.0 SR3:

- ▶ SAP system with ABAP stack
- ▶ SAP system with Java stack
- ▶ SAP system with both ABAP and Java stack (dual stack)

We decided to install our SAP systems with both ABAP and Java stacks. This is a typical type of installation and we wanted to show you the possibility of running dual stacks on Linux on System z with HA-readiness.

## 4.1.4 High availability and virtual hosts

SAPinst provides two ways to install SAP systems:

- ▶ Central system installation

When you choose this option, all SAP system services (ASCS, SCS, DB, and CI) are installed on one application server. This is an easy way to install a complete SAP system starting SAPinst only once. But if you decide to make this SAP system highly available later on, it takes a lot of effort to split the single system services.

- ▶ High availability system installation

When you choose this option, each SAP system service has to be installed separately by calling SAPinst for every service. The services are:

- Central services instance for ABAP (ASCS)
- Central services instance for Java (SCS)
- Database instance (DB)
- Central instance (CI)

We installed our SAP systems using the high availability system installation. This gives you the opportunity to make these systems highly available if there is a need to do so later on.

For the purposes of the book, we call this type of installation an *HA-ready* installation. We recommend using the HA-ready installation.

Both the ASCS and the SCS contain the following standalone components:

- ▶ Standalone enqueue server
- ▶ Message server
- ▶ SAP gateway (optional for ASCS)
- ▶ Syslog collector (optional for ASCS)

There is no need to have database access to install ASCS and SCS.

### Standalone enqueue server

In former SAP versions, the enqueue server was part of the central instance and was running inside an SAP work process. If the enqueue server was not running, the target SAP system would not work because most transactions would fail. Therefore, the enqueue server was redesigned as a standalone component. All application server instances connect directly to the enqueue server and therefore to ASCS and SCS.

If you want to make your system HA-ready, you must be able to switch your ASCS and SCS over to another host. Therefore, you have to use virtual host

names when installing the ASCS and SCS services. These virtual host names enable you to easily move your ASCS and SCS services to another application server or failover server. The virtual host name is specified as a parameter when calling SAPinst.

For more information about virtual host names, refer to, “Virtual host setup” on page 43.

### **Enqueue replication server**

Like the enqueue server, the enqueue replication server (ERS) is a standalone component. It is not part of the ASCS or SCS; it is run on a failover application server. The standalone enqueue server (ASCS or SCS) is connected to the enqueue replication server (ERS). It transmits replication information to the ERS, which holds this data in shared memory. If the enqueue server encounters a problem, the replication data is used to rebuild the data structures and tables after the failover.

**Note:** The ERS is not mandatory for running SAP systems, but it is recommended for a continuous availability configuration. You need one ERS for ASCS and, additionally, one ERS for SCS (which means 2 ERSs).

## **4.1.5 Solution Manager Key**

To perform a NetWeaver 7.0 SR3 installation you need a Solution Manager Key. This key is generated using a Solution Manager System. For more information about the Solution Manager, refer to *SAP Note 805390: SAP Solution Manager is required for SAP Software*.

## **4.2 Installing the SAP services**

For our SAP systems we used both the SLES and the Red Hat Enterprise Linux distribution. All installation steps described below ran on our SLES Linux on System z application server.

### **4.2.1 Differences between the SLES and the Red Hat Enterprise Linux installation**

We did not discover any differences between the SLES (the SU1 SAP system) and the Red Hat Enterprise Linux (the RH1 SAP system) installation.

The SAPinst GUI requires an X11 server on which it can be displayed. We ran the SLES installation on an X11 server that was locally installed on a personal computer with MS® Windows installed.

We ran the Red Hat Enterprise Linux installation on a VNC X11 server that was started on the installation target machine (Linux on System z) and remotely connected to the VNC server from a VNC client running locally on our PC.

## How to use the VNC Client for installing an SAP system

For our Red Hat Enterprise Linux installation, we used the VNC client (VNC meaning Virtual Network Computing) from TightVNC, which can be downloaded for free from <http://www.tightvnc.com/>.

You need both the VNC server (which runs on Linux on System z) and the VNC client (which runs on your local machine). For more information about the VNC server refer to 3.3.4, “VNC” on page 57.

If you use VNC for your installation, you can run SAPinst unattended, which means you can disconnect your VNC client from the server, for example, when you want to shut down your local machine. Later on you can connect to the VNC server again without losing the connection to your installation process.

Follow these steps to use VNC for your installation:

1. Start the VNC Server using the **vncserver** command on the installation target machine (Linux in System z).
2. To start the VNC Client on Windows select:

**Start → All Programs → TightVNC → TightVNC Viewer**

The dialog shown in Figure 4-7 appears.

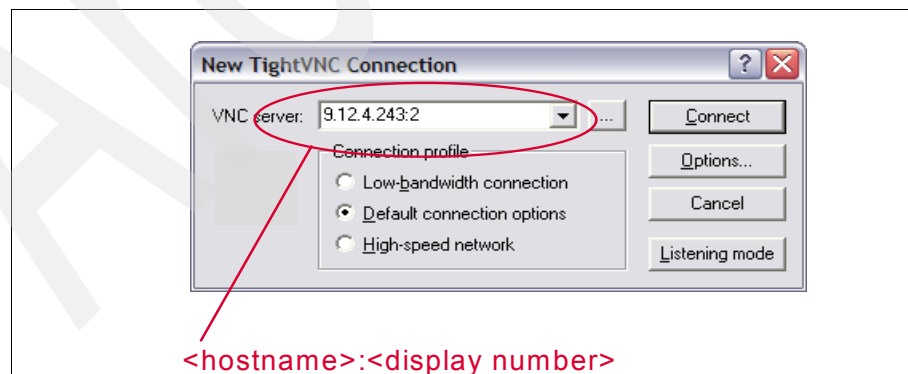


Figure 4-7 TightVNC: host name and display name

Specify the host name of the Linux on System z to which you want to connect followed by a “:” and the display number. Click **Connect**.

3. Specify the password set when you started the VNC server and press Enter (Figure 4-8).

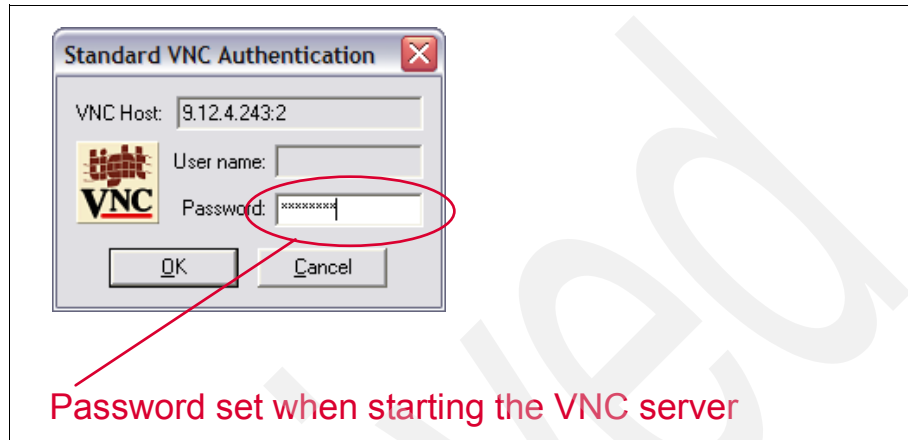


Figure 4-8 TightVNC: Password to identify to the VNC server

4. Now you are logged on via VNC to your Linux on System z. The panel shown in Figure 4-9 appears.

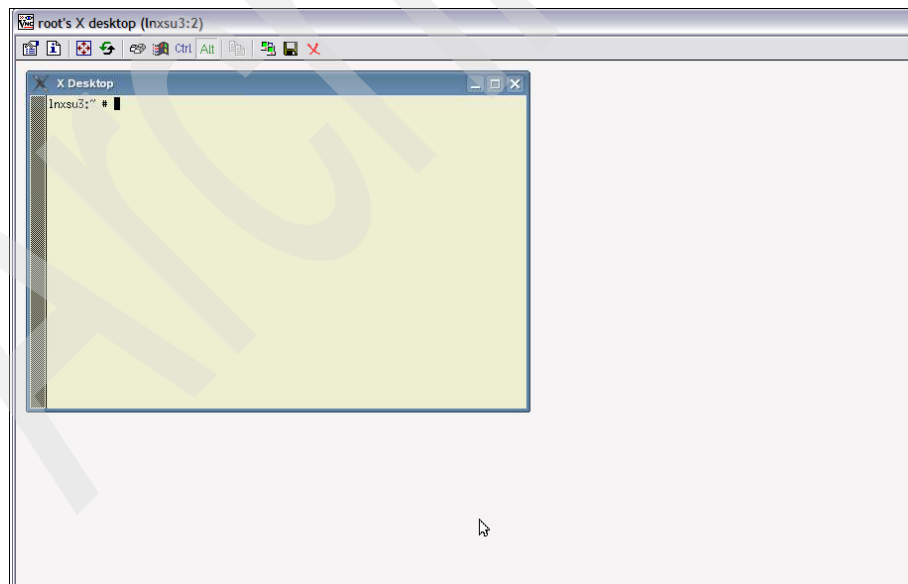


Figure 4-9 VNC client

## 4.2.2 The system landscape we used

For our SAP system we used the system landscape shown in Figure 4-10.

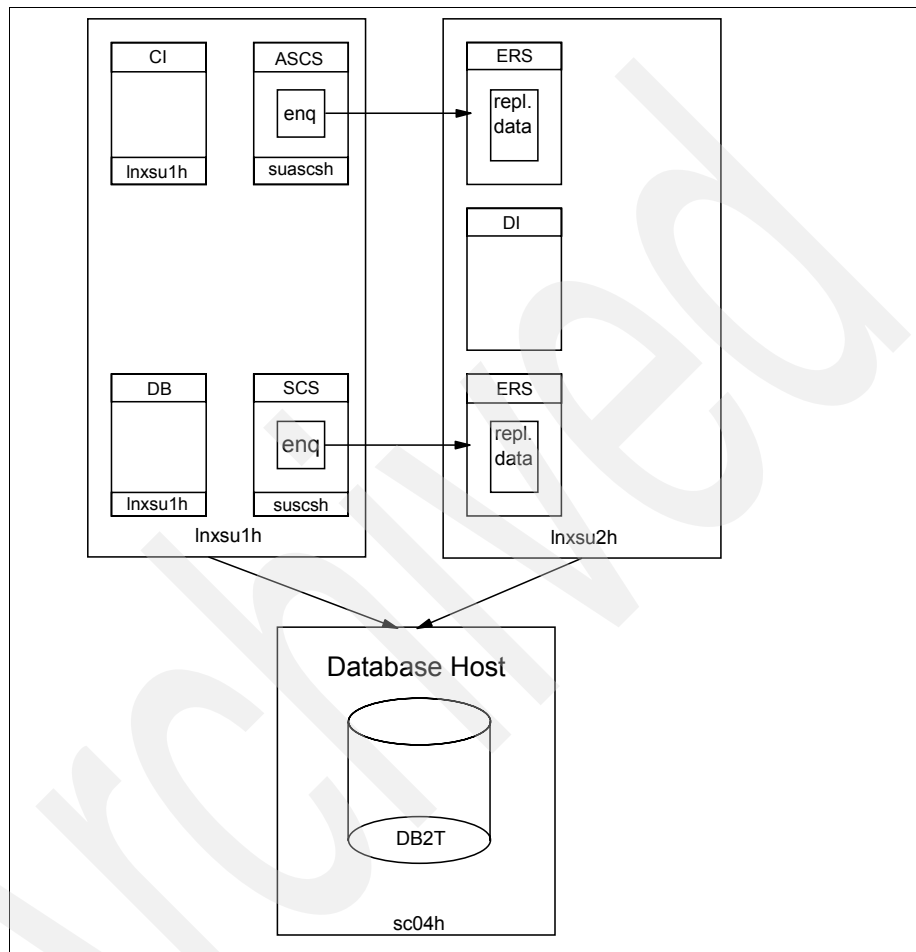


Figure 4-10 System setup for the SU1 SAP System

### Connectivity

We used the HiperSockets connections for all SAP installations. For more information about HiperSockets refer to 3.2, “HiperSockets” on page 33.

### 4.2.3 SAP services installation order

When installing an HA-ready SAP system, you must perform the installation in the following order:

1. ABAP central services instance (ASCS)
2. Java central services instance (SCS)
3. Database instance (DB)
4. Central instance (CI)
5. Dialog instances (DI) if required

### 4.2.4 Installing the ABAP central services instance (ASCS)

ASCS provides the message and the enqueue server on the SAP global host. The SAP file system resides on the global host. If you install the ASCS using a virtual host name, this host name will be used as global host. In case of system failure, it can be moved to another host.

In our environment we installed the ASCS instance using the virtual host name, suascsh.

We started SAPinst using the commands shown in Example 4-4.

*Example 4-4 Starting SAPinst with virtual host name for ASCS installation*

---

```
cd /mnt/sapcds/51033511_7/BS_2005_SR3_SAP_Installation_Master/IM_LINUX_S390X_64/  
./sapinst SAPINST_USE_HOSTNAME=suascsh
```

---

To start the NetWeaver ASCS instance installation, select the following path:

**SAP NetWeaver 7.0 Support Release 3 → SAP Systems → IBM DB2 for z/OS → High Availability System → Based on AS ABAP and AS Java → Central Services Instance for ABAP (ASCS)**

The path to start the ASCS instance installation is shown in Figure 4-11 on page 89.



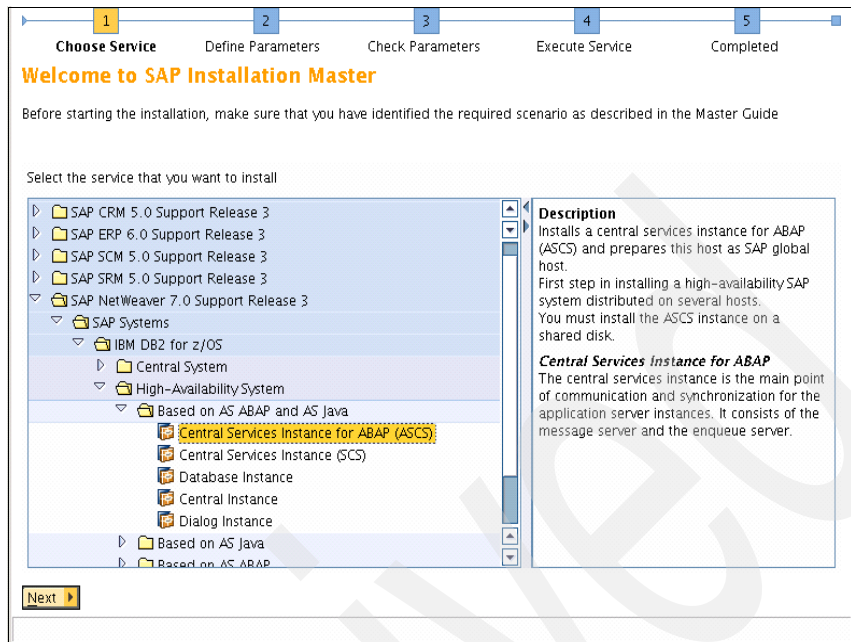


Figure 4-11 Starting the ASCS installation

For more information about the parameters we used for the ASCS instance installation refer Appendix B, “Parameter input” on page 147.

## 4.2.5 Installing the Java central services instance (SCS)

We started SAPinst using the commands shown in Example 4-5.

*Example 4-5 Starting SAPinst with virtual host name for SCS installation*

---

```
cd /mnt/sapcds/51033511_7/BS_2005_SR3_SAP_Installation_Master/IM_LINUX_S390X_64/
./sapinst SAPINST_USE_HOSTNAME=suscsh
```

---

To start the NetWeaver SCS instance installation, select the following path:

**SAP NetWeaver 7.0 Support Release 3 → SAP Systems → IBM DB2 for z/OS → High Availability System → Based on AS ABAP and AS Java → Central Services Instance for Java (SCS)**

The path to start the SCS instance installation is shown in Figure 4-12 on page 90.

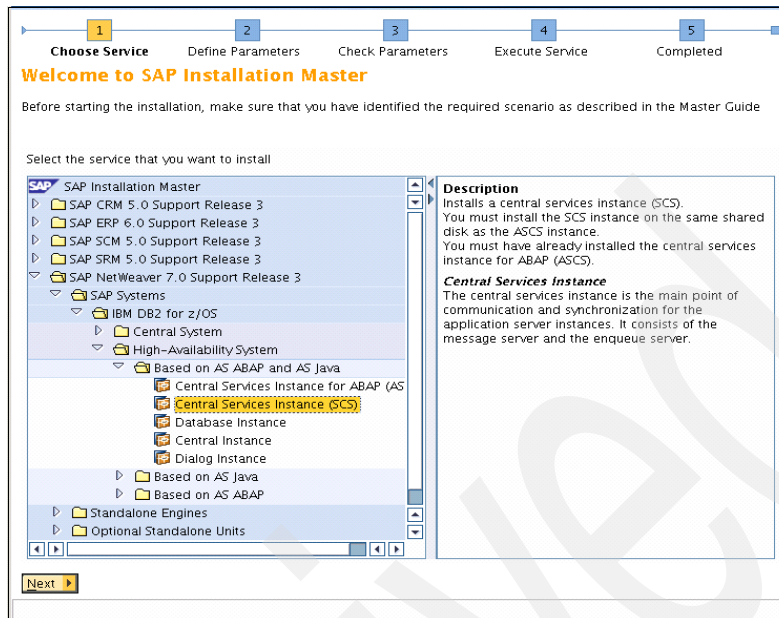


Figure 4-12 Starting the SCS installation

For more information about the parameters we used for the SCS instance installation refer to Appendix B, “Parameter input” on page 147.

## 4.2.6 Installing the database instance (DB)

During the database instance installation the database content is loaded. SAPinst uses one schema (ABAP schema) for the ABAP content and a different one (Java Schema) for the Java content. Both schemas reside in the same database subsystem.

We started SAPinst using the commands shown in Example 4-6. You do not have to specify the SAPINST\_USE\_HOSTNAME parameter when starting SAPinst for installing this instance type. In our case we specified the *real* host name to clarify on which Linux on System z this installation is running.

*Example 4-6 Starting SAPinst with the real host name for DB Instance installation*

---

```
cd /mnt/sapcds/51033511_7/BS_2005_SR3_SAP_Installation_Master/IM_LINUX_S390X_64/
./sapinst SAPINST_USE_HOSTNAME=lnxsulh
```

---

To start the NetWeaver Database instance installation, select the following path:

**SAP NetWeaver 7.0 Support Release 3 → SAP Systems → IBM DB2 for z/OS → High Availability System → Based on AS ABAP and AS Java → Database Instance**

The path to start the DB instance installation is shown in Figure 4-13.

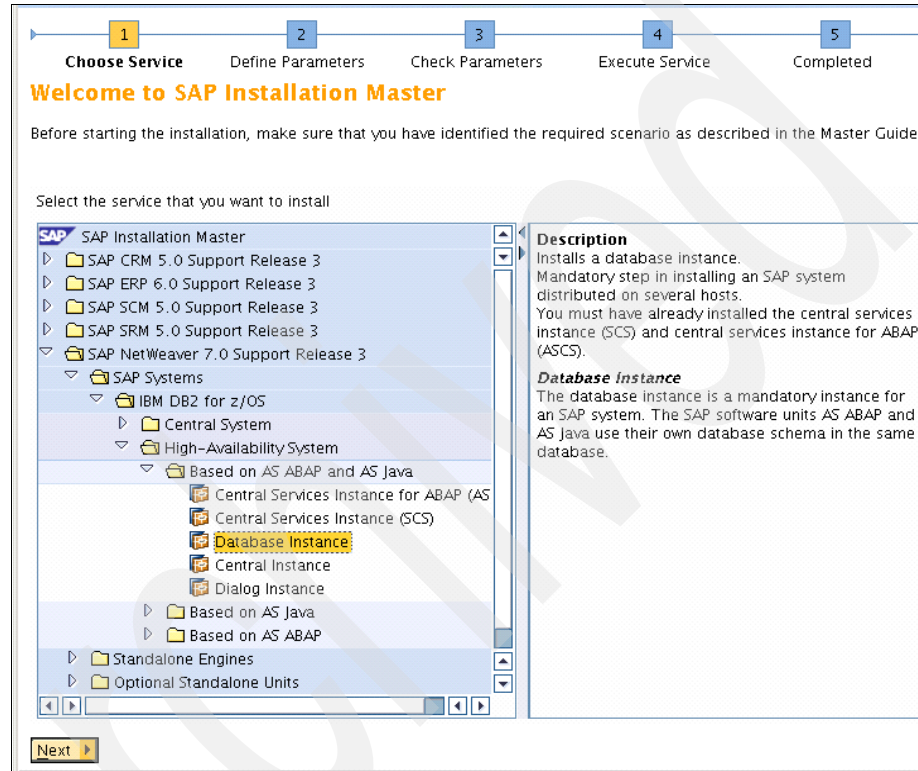


Figure 4-13 Starting the database instance installation

Figure 4-14 on page 92 shows the DB2-specific parameters and values for the ABAP stack we used in our SLES installation.

1 Choose Service 2 **Define Parameters** 3 Check Parameters 4 Execute Service 5 Completed

**IBM DB2 UDB for z/OS > Database Connectivity**

Enter the DB2 connect parameters

**Database Connectivity**

Database Subsystem ID (SSID) DB2T

Database Host sc04h

Location Name of DB2 Subsystem (DDF) DB2T

Port (DDF) 38300

Volumes Catalog Identifier (VCAT) DB2TU

ABAP Schema SAPR3

DB Administrator User ID KARENB

Password of DB Administrator \*\*\*\*\*

DB Connect User ID R3USER

Password of DB Connect User \*\*\*\*\*

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Figure 4-14 DB2 specific parameters for ABAP stack

Figure 4-15 shows the DB2-specific parameters and values for the Java stack we used in our SLES installation.

1 Choose Service 2 **Define Parameters** 3 Check Parameters 4 Execute Service 5 Completed

**IBM DB2 UDB for z/OS > Database Schema for Java**

Enter the Java schema, the connect User and corresponding password

**J2EE Schema and Connect User Parameters**

Java Schema SAPJ1

Java Connect User ID SAPJAVA

Password of Java Connect User \*\*\*\*\*

**Additional Information**

The Java Schema is used for the database content.

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Figure 4-15 DB2 specific parameters for Java stack

For more information about the parameters we used for the database instance installation refer to Table B-3 in Appendix B, “Parameter input” on page 147.

## 4.2.7 Installing the central instance (CI)

The central instance consists of the following work processes:

- ▶ Dialog
- ▶ Update
- ▶ Batch
- ▶ Spool
- ▶ Gateway

We started SAPinst using the commands shown in Example 4-7. You do not have to specify the `SAPINST_USE_HOSTNAME` parameter when starting SAPinst for installing this instance type. In our case we specified the *real* host name to clarify on which Linux on System z this installation is running.

*Example 4-7 Starting SAPinst with the real host name for central instance installation*

---

```
cd /mnt/sapcds/51033511_7/BS_2005_SR3_SAP_Installation_Master/IM_LINUX_S390X_64/  
./sapinst SAPINST_USE_HOSTNAME=lnxsulh
```

---

To start the NetWeaver central instance installation, select the following path:

**SAP NetWeaver 7.0 Support Release 3 → SAP Systems → IBM DB2 for z/OS → High Availability System → Based on AS ABAP and AS Java → Central Instance**

The path to start the CI installation is shown in Figure 4-16 on page 94.

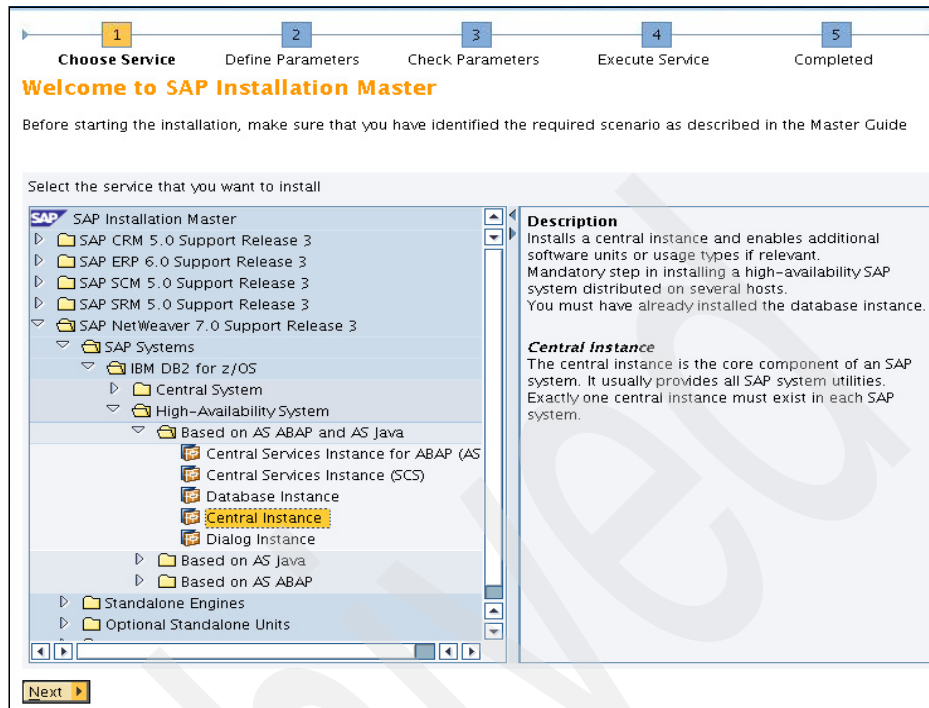


Figure 4-16 Starting the central instance installation

For more information about the parameters we used for the central instance installation refer to Table B-4 in Appendix B, “Parameter input” on page 147.

## 4.2.8 Installing additional dialog instances (DI)

Dialog instances are used to split the workload of your SAP system between different Linux on System z guests.

We started SAPinst using the commands shown in Example 4-8. You do not have to specify the `SAPINST_USE_HOSTNAME` parameter when starting SAPinst for installing this instance type. In our case we specified the *real* host name to clarify on which Linux on System z this installation is running.

*Example 4-8 Starting SAPinst with the real host name for dialog instance installation.*

---

```
cd /mnt/sapcds/51033511_7/BS_2005_SR3_SAP_Installation_Master/IM_LINUX_S390X_64/
./sapinst SAPINST_USE_HOSTNAME=lnxsu2h
```

---

To start the dialog instance installation, select the following path:

**SAP NetWeaver 7.0 Support Release 3 → SAP Systems → IBM DB2 for z/OS → High Availability System → Based on AS ABAP and AS Java → Dialog Instance**

The path to start the DI installation is shown in Figure 4-17.

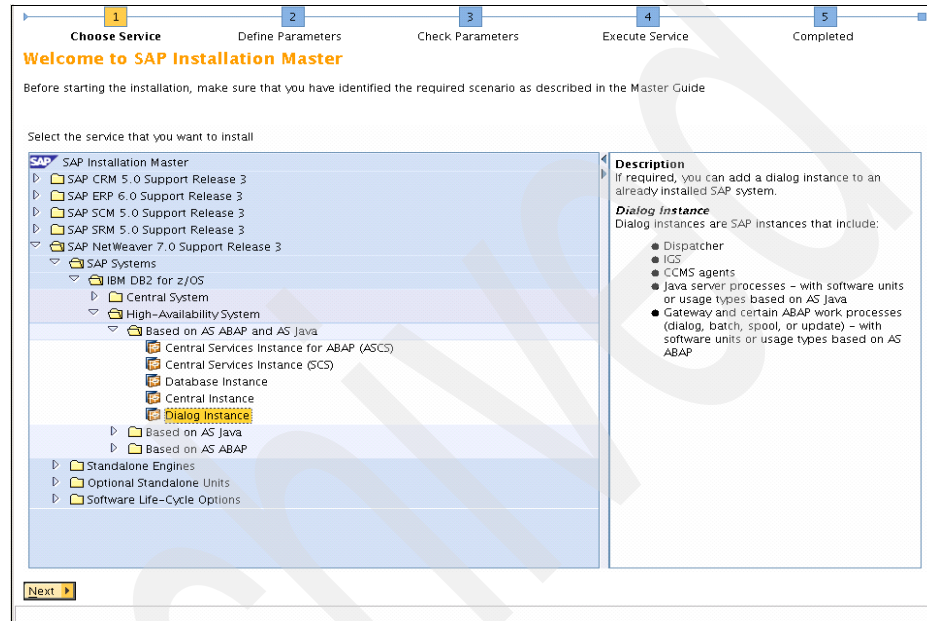


Figure 4-17 Starting the dialog instance installation

**Note:** Be very careful choosing the instance numbers. If you plan to use one of the application servers to bring up the ASCS and the SCS in case of an error, you must not choose the same SAP instance number that you used for the ASCS and SCS installation.

## 4.3 Preparing the Linux on System z guest for failover

In this section we discuss how to set up your second Linux on System z guest to use it as a failover system. On your failover Linux on System z guest, you need copies of both ASCS and SCS and an ERS for each of them.

### 4.3.1 Copying the ASCS and SCS directories

In case of failover, you have to start the ASCS and SCS instances on your second Linux on System z guest. You must be <sapsid>adm to execute the following steps.

1. We issued the commands shown in Example 4-9 on our first Linux on System z to pack the ASCS and SCS.

*Example 4-9 Packing ASCS and SCS*

---

```
cd /usr/sap/SU1
tar -cvf ASCS00.tar ASCS00
tar -cvf SCS01.tar SCS01
```

---

2. We used `ftp` to move both the `ASCS00.tar` and `SCS01.tar` file to our second Linux on System z guest. We copied both files to `/usr/sap/SU1`.
3. To extract the files, we used the commands shown in Example 4-10.

*Example 4-10 Extracting the ASCS and SCS*

---

```
cd /usr/sap/SU1
tar -xvf ASCS00.tar ASCS00
rm ASCS00.tar
tar -xvf SCS01.tar SCS01
rm SCS01.tar
```

---

## 4.4 Installing the enqueue replication server (ERS)

With NetWeaver 7.0 SR3 SAPinst does not offer the possibility to install an ERS. There are several steps you have to perform manually.

We installed two ERSs, one for each standalone enqueue server (ASCS and SCS).



To take advantage of the replication process you have to install the ERS on a different server than the standalone enqueue server (ASCS/SCS).

We used the naming conventions for the enqueue replication servers as shown in Table 4-3.

Table 4-3 Naming conventions for ERS instance names

Central Services Instance	Instance Number	Instance Name for ERS
ASCS	00	ERS10
SCS	01	ERS11

All steps described must be done as user <sapsid>adm. We followed the steps identified in the ERS install documentation, which can be found at:

[http://help.sap.com/saphelp\\_nw04s/helpdata/en/de/cf853f11ed0617e10000000a114084/content.htm](http://help.sap.com/saphelp_nw04s/helpdata/en/de/cf853f11ed0617e10000000a114084/content.htm)

We performed the following steps to install an enqueue replication server. We used the statements shown in the examples to generate the ERS for the ASCS.

1. Activate replication in the start profiles of the ASCS and SCS instances with the **enque/server/replication = true** parameter.
2. Add the **enque/deque\_wait\_answer = TRUE** to the DEFAULT.PFL.
3. Create the instance directories for the ERS, shown in Example 4-11.

Example 4-11 Create ERS instance directories

---

```
mkdir /usr/sap/SU1/ERS10
mkdir /usr/sap/SU1/ERS10/exe
mkdir /usr/sap/SU1/ERS10/log
mkdir /usr/sap/SU1/ERS10/data
mkdir /usr/sap/SU1/ERS10/work
mkdir /usr/sap/SU1/ERS10/profile
mkdir /usr/sap/SU1/ERS10/exe/servicehttp
mkdir /usr/sap/SU1/ERS10/exe/servicehttp/sapmc
```

---

4. Copy the files as shown in Example 4-12.

Example 4-12 Copy the files for ERS

---

```
cp -p /sapmnt/SU1/exe/enqt /usr/sap/SU1/ERS10/exe
cp -p /sapmnt/SU1/exe/enrepserver /usr/sap/SU1/ERS10/exe
cp -p /sapmnt/SU1/exe/ensmon /usr/sap/SU1/ERS10/exe
cp -p /sapmnt/SU1/exe/libicudata.so.30 /usr/sap/SU1/ERS10/exe
cp -p /sapmnt/SU1/exe/libicui18n.so.30 /usr/sap/SU1/ERS10/exe
```

---

```

cp -p /sapmnt/SU1/exe/libicuuc.so.30 /usr/sap/SU1/ERS10/exe
cp -p /sapmnt/SU1/exe/libsapu16_mt.so /usr/sap/SU1/ERS10/exe
cp -p /sapmnt/SU1/exe/librfcum.so /usr/sap/SU1/ERS10/exe
cp -p /sapmnt/SU1/exe/sapcpe /usr/sap/SU1/ERS10/exe
cp -p /sapmnt/SU1/exe/sapstart /usr/sap/SU1/ERS10/exe
cp -p /sapmnt/SU1/exe/sapstartsrv /usr/sap/SU1/ERS10/exe
cp -p /sapmnt/SU1/exe/sapcontrol /usr/sap/SU1/ERS10/exe
cp -p /sapmnt/SU1/exe/servicehttp/sapmc/sapmc.jar
   /usr/sap/SU1/ERS10/exe/servicehttp/sapmc/
cp -p /sapmnt/SU1/exe/servicehttp/sapmc/sapmc.html
   /usr/sap/SU1/ERS10/exe/servicehttp/sapmc/
cp -p /sapmnt/SU1/exe/servicehttp/sapmc/frog.jar
   /usr/sap/SU1/ERS10/exe/servicehttp/sapmc/
cp -p /sapmnt/SU1/exe/servicehttp/sapmc/soapclient.jar
   /usr/sap/SU1/ERS10/exe/servicehttp/sapmc/

```

---

##### 5. Create an ers.lst file

The ers.lst file is used by **sappce** during the start of the installation to copy the files to the instance execution directory.

It is created in the `/../exe` directory of the ERS, for example in `/usr/sap/SU1/ERS10/exe`. The content of the ers.lst is identified in Example 4-13.

*Example 4-13 Content of ers.lst*

---

```

enrepserver
ensmon
enqt
libsapu16_mt.so
libsapu16.so
libicuuc.so.30
libcudata.so.30
libcui18n.so.30
librfcum.so
sapcpe
sapstartsrv
sapstart
sapcontrol
servicehttp
ers.lst

```

---

##### 6. Create the start profiles for ERS.

You have to create a start profile for both the ERS10 and the ERS11 instances.

The naming convention for the start profile is  
START\_<INSTANCENAME>\_<HOSTNAME>

In our installation we used these profiles:

- START\_ERS10\_lnxsu2h
- START\_ERS11\_lnxsu2h

Example 4-14 shows how to set up a start profile. (For Example 4-14 and Example 4-15, additional adapted files for SCS (Java) ERS are necessary).

*Example 4-14 Create start profile for ASCS (ABAP) ERS*

---

```
SAPSYSTEM = 10 1
SAPSYSTEMNAME = SU1 1
INSTANCE_NAME = ERS10 1
#-----
# Special settings for this manually set up instance
#-----
ASCSID = 00 1
DIR_EXECUTABLE = $(DIR_INSTANCE)/exe
DIR_CT_RUN = /usr/sap/SU1/SYS/exe/run 1
SETENV_00 = PATH=$(DIR_INSTANCE)/exe:$(PATH)
SETENV_01 = LD_LIBRARY_PATH=$(DIR_EXECUTABLE)_PF = $(DIR_PROFILE)/SU1_ERS10_lnxsu2h 1
#-----
# Copy SAP Executables
#-----
_CPARGO = list:$(DIR_EXECUTABLE)/ers.lst
Execute_00 = immediate $(DIR_EXECUTABLE)/sapcpe$(FT_EXE) $(_CPARGO) pf=$(_PF)
#-----
# start enqueue replication server
#-----
_ER = er.sap$(SAPSYSTEMNAME)_$(INSTANCE_NAME)
Execute_01 = immediate rm -f $(_ER)
Execute_02 = local ln -s -f $(DIR_EXECUTABLE)/enrepserver $(_ER)
Restart_Program_00 = local $(_ER) pf=$(_PF) NR=$(ASCSID)
```

---

## 7. Create the instance profiles for ERS.

You have to create an instance profile for each instance, ERS10 and ERS11.

The naming convention for the instance profile is  
<SAPSID>\_<INSTANCENAME>\_<HOSTNAME>.

In our installation we used these profiles:

- SU1\_ERS10\_lnxsu2h
- SU1\_ERS11\_lnxsu2h

---

<sup>1</sup> This line must be changed to the parameters of your SAP system.

Example 4-15 shows how to set up an instance profile.

*Example 4-15 Instance profile for ASCS (ABAP) ERS*

---

```
SAPSYSTEM = 10 2
SAPSYSTEMNAME = SU1 2
INSTANCE_NAME = ERS10 2
#-----
# Special settings for this manually set up instance
#-----
DIR_EXECUTABLE = $(DIR_INSTANCE)/exe
DIR_CT_RUN = /usr/sap/SU1/SYS/exe/runU 2
#-----
# Settings for enqueue monitoring tools (enqt, ensmon)
#-----
enqueue/process_location = REMOTESA
rdisp/enqname = $(rdisp/myname)
#-----
# standalone enqueue details from (A)SCS instance
#-----
ASCSID = 00 2
ASCSHOST = suascsh 2
enqueue/serverinst = $(ASCSID)
enqueue/serverhost = $(ASCSHOST)
```

---

#### 4.4.1 Testing the Enqueue Replication Server

After we installed the Enqueue Replication Server we tested the replication mechanism by doing the following:

1. Start the ASCS and SCS by specifying the virtual host names on Inxsu1h:

```
startsap suascsh
startsap suscsh
```

As shown in Example 4-16, the ASCS and SCS are running on our Inxsu1h. No ERS is running on this Linux on System z guest.

*Example 4-16 Output of ps -ef | grep -e SCS -e ERS on first guest*

---

```
Inxsu1:suladm 54> ps -ef | grep -e SCS -e ERS
suladm      1903      1  0 16:54 ?        00:00:00 /usr/sap/SU1/ASCS00/exe/sapstartsrv
pf=/usr/sap/SU1/SYS/profile/START_ASCS00_suascsh -D -u suladm
suladm      2140      1  0 16:54 ?        00:00:00 /usr/sap/SU1/SCS01/exe/sapstartsrv
pf=/usr/sap/SU1/SYS/profile/START_SCS01_suscsh -D -u suladm
```

---

<sup>2</sup> This line must be changed to the parameters of your SAP system.

```

suladm 5921 1 0 20:39 ? 00:00:00 /usr/sap/SU1/ASCS00/exe/sapstart
pf=/usr/sap/SU1/SYS/profile/START_ASCS00_suascsh
suladm 5933 5921 0 20:39 ? 00:00:00 ms.sapSU1_ASCS00
pf=/usr/sap/SU1/SYS/profile/SU1_ASCS00_suascsh
suladm 5934 5921 0 20:39 ? 00:00:00 en.sapSU1_ASCS00
pf=/usr/sap/SU1/SYS/profile/SU1_ASCS00_suascsh
suladm 6241 1 0 20:40 ? 00:00:00 /usr/sap/SU1/SCS01/exe/sapstart
pf=/usr/sap/SU1/SYS/profile/START_SCS01_suscsh
suladm 6253 6241 0 20:40 ? 00:00:00 ms.sapSU1_SCS01
pf=/usr/sap/SU1/SYS/profile/SU1_SCS01_suscsh
suladm 6254 6241 1 20:40 ? 00:00:00 en.sapSU1_SCS01
pf=/usr/sap/SU1/SYS/profile/SU1_SCS01_suscsh
suladm 6278 5428 0 20:41 pts/0 00:00:00 grep -e SCS -e ERS
lnxsul:suladm 55>

```

---

2. Start the CI on lnxsu1h:

```
startsap lnxsu1h
```

3. Start the ERS and the DI on lnxsu2h (the second Linux on System z guest):

```
startsap lnxsu2h
```

As shown in Example 4-17, the ERS is running on our second Linux on System z guest.

*Example 4-17 Output of ps -ef | grep -e SCS -e ERS on second guest*

---

```

lnxsu2:suladm 54> ps -ef | grep -e SCS -e ERS
suladm 24283 1 0 16:35 ? 00:00:00 /usr/sap/SU1/ERS10/exe/sapstartsrv
pf=/usr/sap/SU1/SYS/profile/START_ERS10_lnxu2h -D
suladm 24287 1 0 16:35 ? 00:00:00 /usr/sap/SU1/ERS10/exe/sapstart
pf=/usr/sap/SU1/SYS/profile/START_ERS10_lnxu2h
suladm 24483 1 0 16:36 ? 00:00:00 /usr/sap/SU1/ERS11/exe/sapstartsrv
pf=/usr/sap/SU1/SYS/profile/START_ERS11_lnxu2h -D
suladm 24487 1 0 16:36 ? 00:00:00 /usr/sap/SU1/ERS11/exe/sapstart
pf=/usr/sap/SU1/SYS/profile/START_ERS11_lnxu2h
suladm 25459 1 0 16:41 ? 00:00:00 /usr/sap/SU1/ASCS00/exe/sapstartsrv
pf=/usr/sap/SU1/SYS/profile/START_ASCS00_suascsh -D
suladm 25482 24287 0 16:41 ? 00:00:03 er.sapSU1_ERS10
pf=/usr/sap/SU1/SYS/profile/SU1_ERS10_lnxu2h NR=00
suladm 25759 1 0 16:41 ? 00:00:00 /usr/sap/SU1/SCS01/exe/sapstartsrv
pf=/usr/sap/SU1/SYS/profile/START_SCS01_suscsh -D
suladm 25782 24487 0 16:41 ? 00:00:03 er.sapSU1_ERS11
pf=/usr/sap/SU1/SYS/profile/SU1_ERS11_lnxu2h NR=01
suladm 29638 28806 0 20:26 pts/2 00:00:00 grep -e SCS -e ERS
lnxsu2:suladm 55>

```

---

4. Log on to the SAP system using the dialog instance.
5. Go to transaction SCC4 and click **Change**.

In Figure 4-18 you can see what we changed.

The screenshot displays the SAP SCC4 transaction in 'Change View' mode for Client 066. The title bar reads 'Change View "Clients": Details'. The main form contains the following fields and options:

- Client:** 066 Test EarlyWatch Profiles
- City:** Walldorf1 - Test by ITS0
- Logical system:** (empty)
- Std currency:** EUR
- Client role:** SAP reference
- Last Changed By:** ITS0
- Date:** 27.10.2008

Below the fields are three sections with radio button options:

- Changes and Transports for Client-Specific Objects:**
  - ☒ Changes without automatic recording
  - ☐ Automatic recording of changes
  - ☐ No changes allowed
  - ☐ Changes w/o automatic recording, no transports allowed
- Cross-Client Object Changes:**
  - ☒ Changes to Repository and cross-client Customizing allowed
- Protection: Client Copier and Comparison Tool:** (empty)

The status bar at the bottom shows 'SU1 (1) 001' and 'Inxsu2h OVR'.

Figure 4-18 SCC4 before we saved

6. Update the text for client 001 without saving. This will create a lock.  
The lock in transaction SM13 is shown in Figure 4-19.

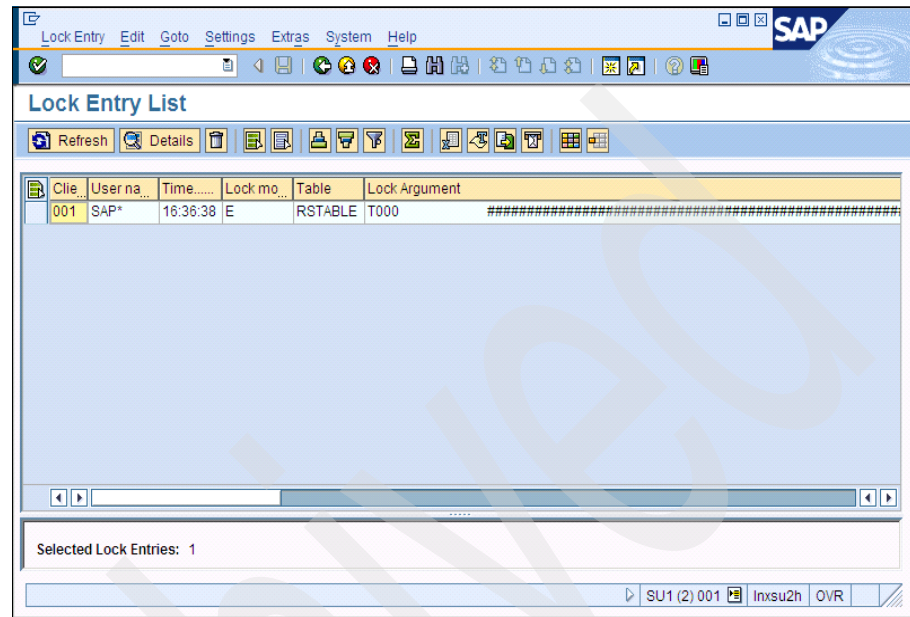


Figure 4-19 SM13 holding the lock

7. Stop your Linux on System z guest (Inxsu1h in our example) by doing a z/VM logoff of the guest user.
8. Start the virtual hosts on your failover Linux on System z guest (Inxsu2h in our example).
9. Start ASCS and SCS on Inxsu2h.

```
startsap suascsh
startsap suscsh
```

Both the ASCS and the SCS are now running on the second Linux on System z guest using their virtual host names.

After the ASCS and the SCS are started, each standalone enqueue server reads the lock table from the shared memory of its associated ERS. We saw both ERSs stopping, which is the expected behavior. Replication of ASCS and SCS data worked properly.

We observed what happened when we started the instances in the following order:

- a. ASCS
- b. ERS10 (for ASCS) on second guest

- c. SCS
- d. ERS11 (for SCS) on second guest
- e. CI
- f. DI

The ERS stopped (or ends/exits) automatically when the ASCS and SCS came up on our failover Linux on System z guest.

In the log file of the enqueue replication server shown in Example 4-18 you can see that the failover ASCS took over.

*Example 4-18 log file of ERS*

---

```
[Thr 2199026828592] Thu Oct 30 16:35:20 2008
[Thr 2199026828592] Replication server start with instance number 00
[Thr 2199026828592] ShadowTable:create: ShmCreate(,SHM_CREATE,len=2752840)
-> 0x200036b3000
[Thr 2199026828592] Connected to Enqueue Server and created repl. table
with 3603 lines

ASCS failed over to secondary node and attached to replication table on
secondary node.

[Thr 2199026828592] Thu Oct 30 16:41:08 2008
[Thr 2199026828592] EnEnqToRep::checkEnserverAttached: the enqueue server
has attached to the replicationtable
[Thr 2199026828592] checkActive: Enqueue server has attached my repl. table
[Thr 2199026828592] checkActive: shutdown ...
```

---

10. Save the changes made in SCC4 earlier.

As you can see in Figure 4-20 on page 105, you will be able to save your changes although the ASCS and SCS were moved to the failover machine.



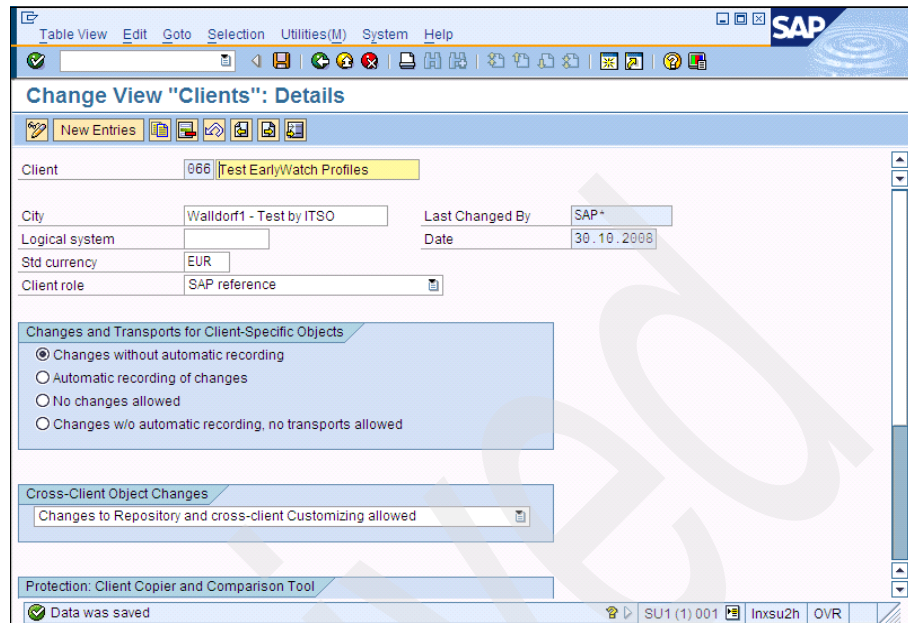


Figure 4-20 SCC4 after saving

## 4.5 Problems while running SAPinst

We encountered the following problems during the installation:

- ▶ The J2EE engine did not start. This happened several times. We clicked the **Retry** button and the J2EE engine started successfully and the installation continued.
- ▶ Database instance installation. During the Update Statistics phase we got the error SQL Error -471 Error Code 00E79002 (Time out). The installation stopped. After pressing the **Retry** button, the installation finished successfully.
- ▶ ERS Installation. Error in documentation at:

[http://help.sap.com/saphelp\\_nw04s/helpdata/en/36/67973c3f5aff39e1000000a114084/content.html](http://help.sap.com/saphelp_nw04s/helpdata/en/36/67973c3f5aff39e1000000a114084/content.html)

This document said to create an **sapcpe** list file with the name ers.lst in directory /usr/sap/<SID>/ERS<inst.no.>/exe. This was found to be in error. Instead, we created the ers.lst in /usr/sap/SU1/SYS/exe/run.

- We received the following error when we started the Red Hat Enterprise Linux SAP system installation:

```
root@lnxrh1 IM_LINUX_S390X_64# ./sapinst SAPINST_USE_HOSTNAME=rhascsh
./sapinst: error while loading shared libraries: libstdc++.so.5: cannot
open shared object file: No such file or directory
```

To solve the problem we installed the RPM package `compat-libstdc++-33-3.2.3-61.s390x.rpm`, which is included in the RHEL 5.1 installation media (also see 3.4.2, “Preparing for SAP installation on Red Hat Enterprise Linux” on page 62).

- During the installation of a second dialog instance we discovered the following error:

```
An exception occurred while connecting to the message server instance
SU1/ASCS00 on host lnxsu2h, port 3900.
DIAGNOSIS: The original exception was: wapsmod.ms.MsAttachFailed:
Connect to message server (lnxsu2h/3900) failed: NIECONN_REFUSED.
SOLUTION: Make sure the message server is started.
```

As described in SAP Note 1052298: Inst.NW 7.0 SR3/Business Suite 2005 SR3-UNIX, you have to exchange your `control.xml` before starting your installation when you use the `SAPINST_USE_HOSTNAME` parameter and other instances are already installed on your Linux on System z.

We did not test this. For our tests we always used the original `control.xml` located on the Installation Master DVD. The error did not occur when the enqueue and message server were running on a different Linux on System z.

## 4.6 Performing the post installation steps

We followed the steps for post installation as described in *SAP NetWeaver 7.0 SR3 ABAP+Java on Linux: IBM DB2 for z/OS*.

Additionally, we executed the steps discussed in this section.

### 4.6.1 Ownership of jdbc directory

We set the correct ownership for the JDBC Driver as described in *SAP Note 1100775: SAP NetWeaver 7.0 (2004s) SR3 Installation IBM DB2 on z/OS*. Without changing the ownership of the JDBC driver it will not be possible to start your SAP system correctly.

## 4.6.2 Apply latest kernel

We exchanged the kernel to address a known error as described in *SAP Note 1146808: Connection to standalone enqueue server is cancelled*.

**Note:** Applying the latest kernel after your installation is finished is always recommended.

## 4.6.3 Apply SAP BASIS support packages

Because it is required for CCMS metrics in transactions OS06N, ST06N, and OS07N, we applied SAP BASIS SP 15, 16, and 17 (see 6.2, “OS monitoring for virtualized Linux environments” on page 132). For documentation about how to configure the SAP Transport Management System, navigate to SAP help at:

<http://help.sap.com>

Make the following selections: **SAP NetWeaver** → **SAP NetWeaver 7.0 Library English** → **SAP NetWeaver Library** → **SAP NetWeaver by key capability** → **Software Lifecycle Management** → **Software Logistics**.

Open Transport Management System by clicking the + button.

Documentation about how to apply support packages can be found by making these selections from the SAP help page:

**SAP NetWeaver** → **Installation, Configuration, Upgrade** → **Support Package Stacks** → **SAP NetWeaver 7.0** → **SP Stack Guide 17**.

## 4.6.4 Setting the parameters for the Java virtual machine

We set the parameters for the Java virtual machine (JVM) as described in *SAP Note 746299: Recommended Settings for the Linux for zSeries JVM*.

Changing the parameters that the SAP Java instance uses when starting the JVM is done with the SAP Java configuration tool. The configuration tool only needs to be started once in order to change the parameters for all Java instances of one SAP system.

The SAP Java configuration tool is a graphical tool running under X11. To display it you can use either of the following:

- ▶ A running X11 server on the machine from which you connect to the Linux on System z machine where the configuration tool runs

- A VNC session running on the Linux on System z machine where the configuration tool runs

We started the configuration tool on our SU1 system as follows:

```
> cd /usr/sap/SU1/DVEBMGS02/j2ee/configtool
> ./configtool.sh
```

**Note:** You must change to the directory in which the configuration tool is installed and start it the way we did (./configtool.sh). Any attempt to start the configuration tool from another directory and specifying a path leads to an error (for example, specifying the absolute path to the configuration tool: /usr/sap/SU1/DVEBMGS02/j2ee/configtool/configtool.sh).

We carried out the following steps both on our central instances (running on lnxsu1 and lnxrh1) and on our dialogue instances (running on lnxsu2 and lnxrh2):

- In the tree navigator we navigated to **cluster-data** → **instance\_IDxxxxxxx** → **server\_IDxxxxxxxxx**, then clicked the **General** tab and adjusted the values as follows:
  - Max heap size (in MB) field:  
We did not change the value in this field because it was already set to 2048 MB.
  - Java parameters field:
    - We changed -Xms1024M to -Xms2048M.
    - We left all other parameters as specified.
    - We added the following parameters:
      - Xconcurrentbackground1
      - Xlratio0.3
      - Xparrot
      - Xconcurrentlevel6
      - XSoftRefThreshold0
      - Xconmeter2
      - Xk32000
      - verbose:Xgccon
      - Xdisableexplicitgc

The resulting parameters are shown in Figure 4-21 on page 109.

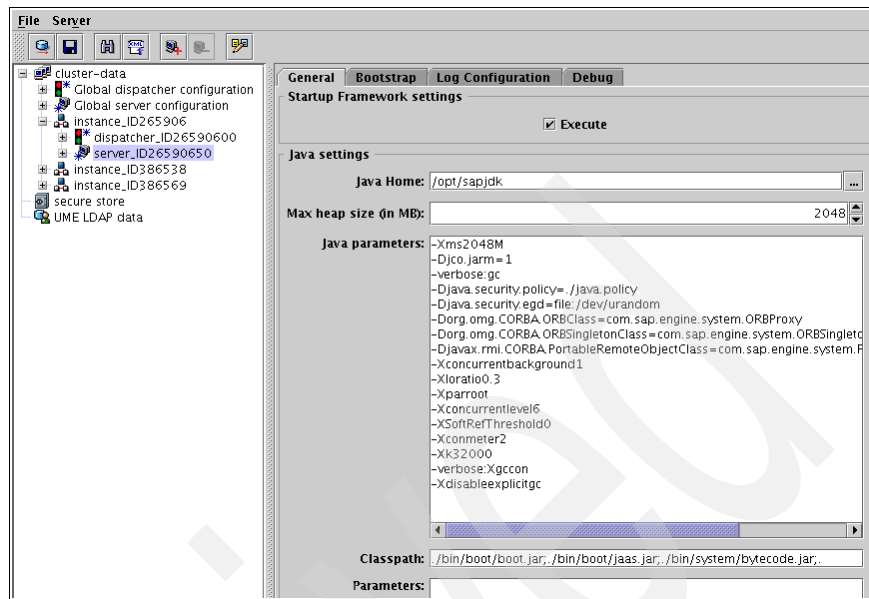


Figure 4-21 JVM parameters for *cluster-data / instance\_IDxxxxxxx / server\_IDxxxxxxx*

- In the tree navigator we navigated to **cluster-data** → **instance\_IDxxxxxxx**. We clicked the **Message Server & Bootstrap** tab and adjusted the values as follows:
    - Max heap size (in MB) field:  
We changed the value from 256 to 1024.
    - Java parameters field:  
We did not make any changes (-Xmx1024M was already set)
- The resulting parameters are shown in Figure 4-22 on page 110.

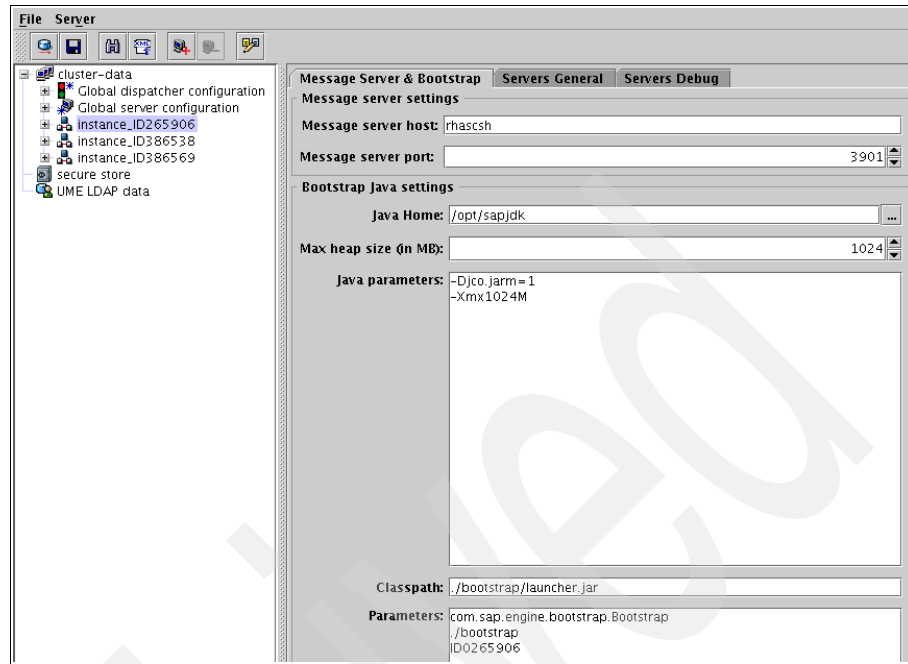


Figure 4-22 JVM parameters for cluster-data / instance\_IDxxxxxxx

- In the tree navigator we navigated to **cluster-data** → **instance\_IDxxxxxxx** → **dispatcher\_IDxxxxxxx**. We clicked the **General** tab and adjusted the values as follows:
  - Max heap size (in MB) field:  
We did not change the value 200.
  - Java parameters field:
    - We changed -Xms170M to -Xms200M
    - We added the following parameters:
      - Xmx200M
      - verbose:Xgccon
    - We left all other parameters unchanged.

The resulting parameters are shown in Figure 4-23 on page 111.

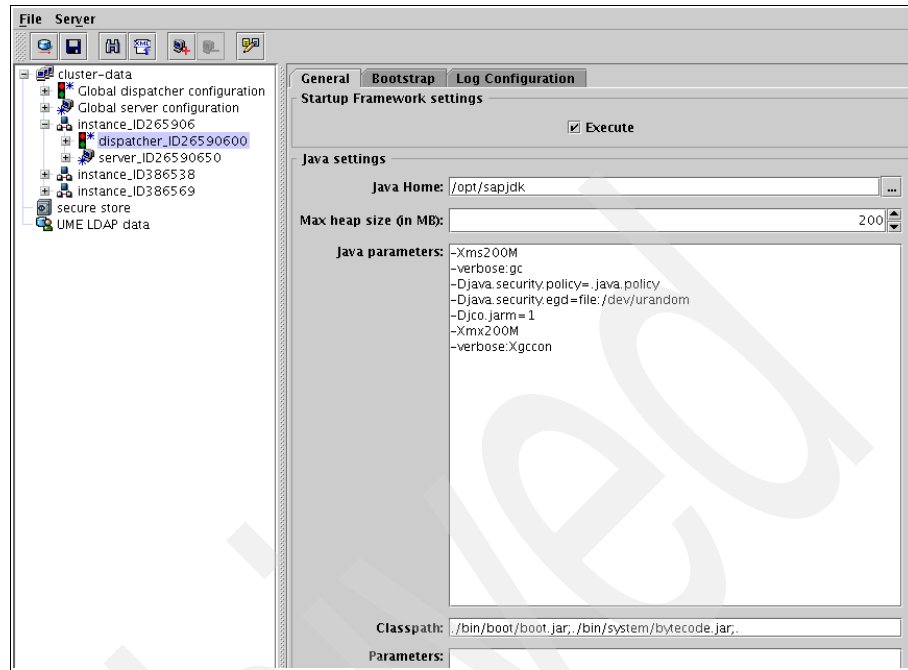


Figure 4-23 JVM parameters for cluster-data / instance\_IDxxxxxxx / dispatcher\_IDxxxxxxxxx

For all three parameter sets we confirmed that the `-Djava.compiler=NONE` parameter was not set. According to SAP Note 746299 you should remove this parameter if it is set.

SAP Note 746299 also gives some instructions in case you run into Java-related problems; refer to the note for further information.

Archived



## Performance and setup considerations

This chapter provides performance recommendations as well as some considerations for setting up your system. The focus is on z/VM and Linux on System z settings that influence performance. The following performance considerations are discussed:

- ▶ z/VM version/release
- ▶ z/VM memory and paging space configuration
- ▶ z/VM dispatcher and System Resource Management configuration
- ▶ z/VM minidisk cache
- ▶ z/VM system dump space
- ▶ Linux on System z swap space
- ▶ Guest privilege classes
- ▶ Number of virtual CPUs in a guest
- ▶ Linux on System z kernel versions and features
- ▶ Linux on System z runlevels and unnecessary services
- ▶ Linux on System z disks and filesystems
- ▶ Linux on System z I/O schedulers
- ▶ Collaborative memory management (CMM and CMMA)
- ▶ Performance benefits with QIOASSIST
- ▶ Additional documentation regarding performance

## 5.1 z/VM version or release

A new version or release of z/VM is made available approximately every 12 to 18 months. In addition to incorporating fixes to previously reported/identified problems, new releases place an emphasis on new function and features that improve virtualization and the use of z/VM as a hipervisor for other System z operating systems (meaning z/OS, z/VSE, z/TPF, Linux, and z/VM itself). Customers are advised to run their production z/VM systems at the most current supported version and release available.

IBM provides recommended service for all components, products, and features delivered with the z/VM base system in a single package called a Recommended Service Upgrade (RSU). An RSU contains cumulative service including all pre- and co-requisites in a pre-built format that is available on tape or electronically. An RSU contains service required by most customer installations and includes all closed HIPER fixes available at the date of release. Customers are advised to maintain RSU currency on their production z/VM systems.

## 5.2 z/VM memory and paging space configuration

The need for a paging hierarchy exists within z/VM. In z/VM 5.1.0 and earlier, all CP code, all CP control blocks, and most guest pages being referenced for CP processing (I/O, IUCV, and so forth) were required to reside below 2GB. This can create contention for storage below 2GB. Such contention is often indicated by significant paging to DASD when a large number of pages are available above 2GB. Systems with a 2GB constraint might benefit from having more of their storage configured as expanded storage. z/VM 5.2.0 has removed most of these restrictions and z/VM 5.3.0 made further improvements by allowing Page Management Blocks above 2GB. Therefore, contention for storage below 2GB is much less likely on these current releases; however, the recommendation remains to configure some expanded storage to be used as a high speed paging device and provide a paging hierarchy. The rule of thumb is to configure 25% of real memory as expanded storage, up to a maximum of 2 to 4 GB.

The z/VM system as shipped contains enough page space to get the system installed and running trivial work. However, DASD page space should be added to do real work. *CP Planning and Administration Manual*, SC24-6803 has details on determining how much space is required. Here are a few things to consider:

- ▶ If the system is not paging, it doesn't matter how much page space is defined or where it is located. However, sooner or later the system will grow to a point where it will begin to page.
- ▶ VM paging is most optimal when it has large contiguous available space on volumes of the same physical geometry that are dedicated to paging. It is also recommended that page volumes be spread across multiple

channels/control units, and over multiple ranks within an Enterprise Storage Subsystem (ESS), in order to avoid channel bottlenecks and maximize throughput.

- ▶ As a general rule, page space on DASD should not be allowed to eclipse 50% utilization, because the available page space can become very fragmented.
- ▶ A rough starting point for page space, keeping the 50% rule in mind, is to add up the virtual machine sizes of all running virtual servers. Subtract the amount of central and expanded storage, then multiply the result by 2. Keep an eye on the page allocation percentage and the block read set size.

We checked our z/VM setup against these recommendations. Example 5-1 lists the commands for user maintenance and their output.

*Example 5-1 Checking the memory and paging space setup*

**q storage**

13:37:21 STORAGE = **8G** CONFIGURED = 8G INC = 256M STANDBY = 4G RESERVED = 0  
Ready; T=0.01/0.01 13:37:21

**q xstorage**

13:37:24 XSTORE= 2048M online= **2048M**  
13:37:24 XSTORE= 2048M userid= SYSTEM usage= 99% retained= 0M pending= 0M  
13:37:24 XSTORE MDC min=0M, max=0M, usage=0%  
13:37:24 XSTORE= 2048M userid= (none) max. attach= 2048M  
Ready; T=0.01/0.01 13:37:24

**q alloc page**

VOLID	RDEV	EXTENT START	EXTENT END	TOTAL PAGES	PAGES IN USE	HIGH PAGE	% USED
LX6PG1	CD33	1	3338	600840	204233	593997	33%
LX6PG2	CD39	1	3338	600840	207064	592051	34%
LX6PG3	AA23	1	3338	600840	188380	554397	31%
LX6PG4	AA24	1	3338	600840	192817	553780	32%
LX6PG5	AB22	1	3338	600840	191888	537271	31%
LX6PG6	AB23	1	3338	600840	200104	562315	33%
LX6PG7	AC22	1	3338	600840	191895	577897	31%
LX6PG8	AC23	1	3338	600840	193586	545482	32%
LX6PG9	AF22	1	3338	600840	194234	554400	32%
LX6PGA	AF23	1	3338	600840	193123	583670	32%
				-----	-----	-----	----
SUMMARY				5868K	1911K		32%
USABLE				5868K	1911K		32%

Ready; T=0.01/0.01 13:37:32

With our 6 Linux on System z guests, each guest having a machine size of 4 GB, the recommended size for paging space would be 28 GB (see Example 5-2). We did not add the machine size of any other guests (such as TCPIP) into the equation.

*Example 5-2 Calculation of suggested size of paging space*

---

$$(6 \bullet 4\text{GByte} - (8\text{Gbyte} + 2\text{GByte})) \bullet 2 = 28\text{GByte}$$

---

The sum of all usable paging space is approximately 23 GB with a page size of 4KB. We monitored the paging space usage while running our SAP systems by issuing the **query alloc page** command (see Example 5-1).

## 5.3 z/VM dispatcher and System Resource Management configuration

This section discusses settings for the z/VM dispatcher and System Resource Management.

### 5.3.1 System Resource Management settings

The default SRM values for STORBUF (120 105 95) are an artifact from the days of intensive CMS user VM systems. These settings favored short, infrequent interactive transactions for small footprint CMS virtual machines. For Linux systems, where transactions are long running and virtual machine storage sizes are large, these settings are ineffective and can result in the formation of eligible lists. Modification of the STORBUF setting to allow over-commitment of real storage by a factor of 2 or 3 is not unreasonable.

The default SRM values for LDUBUF (100 75 60) are also an artifact from the past. Most active Linux virtual machines will remain in transaction class Q3 and be limited to only 60% of paging slots on DASD, which can also result in the formation of eligible lists. Modification of the LDUBUF setting to allow Q2 and Q3 guests to consume more than 75% and 60%, respectively, of the available DASD paging slots is desirable.

The recommended settings for STORBUF are (300 250 200), LDUBUF (100 100 100). We checked the settings and applied the recommendations; see Example 5-3 which was executed on userid maint. The **SET SRM** commands (1) and (2) should be placed in the AUTOLOG1 userid's PROFILE EXEC so they are executed after every IPL.

```
q srm
IABIAS : INTENSITY=90%; DURATION=2
LDUBUF : Q1=100% Q2=75% Q3=60%
STORBUF: Q1=125% Q2=105% Q3=95%
DSPBUF : Q1=32767 Q2=32767 Q3=32767
DISPATCHING MINOR TIMESLICE = 5 MS
MAXWSS : LIMIT=9999%
..... : PAGES=999999
XSTORE : 0%
Ready; T=0.01/0.01 15:03:56
1set srm storbuf 300 250 200
STORBUF: Q1=300% Q2=250% Q3=200%
Ready; T=0.01/0.01 15:04:05
2set srm ldubuf 100 100 100
15:04:16 LDUBUF : Q1=100% Q2=100% Q3=100%
Ready; T=0.01/0.01 15:04:16
q srm
IABIAS : INTENSITY=90%; DURATION=2
LDUBUF : Q1=100% Q2=100% Q3=100%
STORBUF: Q1=300% Q2=250% Q3=200%
DSPBUF : Q1=32767 Q2=32767 Q3=32767
DISPATCHING MINOR TIMESLICE = 5 MS
MAXWSS : LIMIT=9999%
..... : PAGES=999999
XSTORE : 0%
Ready; T=0.01/0.01 15:04:20
```

---

### 5.3.2 z/VM Quick Dispatch setting

When the sum of the virtual machine sizes of the logged-on Linux guests approaches the size of central storage, eligible lists may start to form. This is because Linux guests tend to touch all of their pages and tend not to drop from the dispatch list. You can solve this with either of two approaches: use of QUICKDSP or changing the SRM STORBUF settings.

In general, setting QUICKDSP is only recommended for select production guests and server virtual machines that perform critical system functions on behalf of many users (that is, VMRACF, TCPIP, and so forth). Setting QUICKDSP makes a virtual machine exempt from being held back in an eligible list during scheduling. Instead, the virtual machine goes directly to the dispatch list. General users, including most Linux guests, should not be run with QUICKDSP. Over

commitment of real memory should be managed by the scheduler/dispatcher and tuned using the SRM values described previously.

Because this is seen as a last resort, we checked whether our guests were configured with QUICKDSP. The results are shown in Example 5-4.

*Example 5-4 Querying QUICKDSP settings*

---

```
q quickdsp lnxsu1
14:22:23 USER LNXSU1 : QUICKDSP = OFF
Ready; T=0.01/0.01 14:22:23
q quickdsp lnxsu2
14:22:25 USER LNXSU2 : QUICKDSP = OFF
Ready; T=0.01/0.01 14:22:25
q quickdsp lnxsu3
14:22:27 USER LNXSU3 : QUICKDSP = OFF
Ready; T=0.01/0.01 14:22:27
q quickdsp lnxrh1
14:22:31 USER LNXRH1 : QUICKDSP = OFF
Ready; T=0.01/0.01 14:22:31
q quickdsp lnxrh2
14:22:33 USER LNXRH2 : QUICKDSP = OFF
Ready; T=0.01/0.01 14:22:33
q quickdsp lnxrh3
14:22:34 USER LNXRH3 : QUICKDSP = OFF
Ready; T=0.01/0.01 14:22:34
```

---

If you want to configure guests with the `OPTION QUICKDSP`, add the following option to the user configuration in the `USER DIRECT` file:

```
OPTION QUICKDSP
```

## 5.4 z/VM minidisk cache

Minidisk cache (MDC) can provide I/O performance benefits. However, the I/O performance benefits come at a cost of real memory, so it is definitely not recommended on a memory constrained system. MDC is a write-through cache, so a typical candidate for minidisk cache is a minidisk being shared read-only by multiple virtual machines. Minidisks being used for Linux file systems should be configured with MDC OFF unless they are almost exclusively read-only. This is especially true for minidisks holding Linux swap extents. Also, most z/VM performance experts agree that expanded storage is more effective as a high speed paging device and should not be used for minidisk cache (particularly on pre-z/VM 5.2 systems). The default system values allow all central and

expanded memory to be consumed entirely by MDC. As a general rule, MDC should be limited to about 10% of VM central storage and excluded from expanded storage altogether.

As a recommendation, eliminate minidisk cache from expanded storage and limit the amount available for use in central storage. The SET commands **1** and **2** in Example 5-5 should be placed in the AUTOLOG1 userid's PROFILE EXEC so they are executed after every IPL.

---

*Example 5-5 Minidisk cache settings*

---

```
q mdc
Minidisk cache ON for system
Storage MDC min=0M max=8192M, usage=0%, bias=1.00
Xstore MDC min=0M max=2048M, usage=0%, bias=1.00
Ready; T=0.01/0.01 15:00:08
1set mdc stor 0m 819m
14:38:59 Minidisk cache ON for system
14:38:59 Storage MDC min=0M max=819M, usage=0%, bias=1.00
14:38:59 Xstore MDC min=0M max=2048M, usage=0%, bias=1.00
Ready; T=0.01/0.01 14:38:59
2set mdc xstor 0m 0m
14:40:14 Minidisk cache ON for system
14:40:14 Storage MDC min=0M max=819M, usage=0%, bias=1.00
14:40:14 Xstore MDC min=0M max=0M, usage=0%, bias=1.00
Ready; T=0.01/0.01 14:40:14
q mdc
14:41:00 Minidisk cache ON for system
14:41:00 Storage MDC min=0M max=819M, usage=0%, bias=1.00
14:41:00 Xstore MDC min=0M max=0M, usage=0%, bias=1.00
Ready; T=0.01/0.01 14:41:00
```

---

Because minidisk cache is not recommended for Linux swap space, we checked the minidisk cache for DASDs that were allocated for Linux swapping.

Example 5-6 shows our commands in userid maint to check the minidisk cache settings for minidisk 201 and to set the minidisk cache off for this device. We confirmed the settings with the **query** command again. Make sure the minidisk cache settings for your system are as recommended or put the commands **1**, **2**, **3**, **4**, **5**, and **6** in the AUTOLOG1 userid's PROFILE EXEC so they are executed after every IPL.

---

*Example 5-6 Minidisk cache settings for Linux swap devices*

---

```
q mdc mdi userid lnxsu1 201
14:49:28 DASD 0201 MDCACHE ON (DEFAULT for LNXSU1 0201; DFLTON for DASD C409)
Ready; T=0.01/0.01 14:49:28
```

```

q mdc mdi userid lnxsu2 201
14:49:47 DASD 0201 MDCACHE ON (DEFAULT for LNXSU2 0201; DFLTON for DASD C40A)
Ready; T=0.01/0.01 14:49:47
q mdc mdi userid lnxsu3 201
14:49:58 DASD 0201 MDCACHE ON (DEFAULT for LNXSU3 0201; DFLTON for DASD C40B)
Ready; T=0.01/0.01 14:49:58
q mdc mdi userid lnxrh1 201
14:50:04 DASD 0201 MDCACHE ON (DEFAULT for LNXRH1 0201; DFLTON for DASD C40C)
Ready; T=0.01/0.01 14:50:04
q mdc mdi userid lnxrh2 201
14:50:08 DASD 0201 MDCACHE ON (DEFAULT for LNXRH2 0201; DFLTON for DASD C40D)
Ready; T=0.01/0.01 14:50:08
q mdc mdi userid lnxrh3 201
14:50:11 DASD 0201 MDCACHE ON (DEFAULT for LNXRH3 0201; DFLTON for DASD C40E)
Ready; T=0.01/0.01 14:50:11
1set mdc mdi off userid lnxsu1 201
14:53:18 Minidisk cache OFF for LNXSU1 0201
Ready; T=0.01/0.01 14:53:18
2set mdc mdi off userid lnxsu2 201
14:53:21 Minidisk cache OFF for LNXSU2 0201
Ready; T=0.01/0.01 14:53:21
3set mdc mdi off userid lnxsu3 201
14:53:25 Minidisk cache OFF for LNXSU3 0201
Ready; T=0.01/0.01 14:53:25
4set mdc mdi off userid lnxrh1 201
14:53:30 Minidisk cache OFF for LNXRH1 0201
Ready; T=0.01/0.01 14:53:30
5set mdc mdi off userid lnxrh2 201
14:53:35 Minidisk cache OFF for LNXRH2 0201
Ready; T=0.01/0.01 14:53:35
6set mdc mdi off userid lnxrh3 201
14:53:41 Minidisk cache OFF for LNXRH3 0201
Ready; T=0.01/0.01 14:53:41
q mdc mdi userid lnxsu1 201
14:56:21 DASD 0201 MDCACHE OFF (OFF for LNXSU1 0201; DFLTON for DASD C409)
Ready; T=0.01/0.01 14:56:21
q mdc mdi userid lnxsu2 201
14:56:24 DASD 0201 MDCACHE OFF (OFF for LNXSU2 0201; DFLTON for DASD C40A)
Ready; T=0.01/0.01 14:56:24
q mdc mdi userid lnxsu3 201
14:56:27 DASD 0201 MDCACHE OFF (OFF for LNXSU3 0201; DFLTON for DASD C40B)
Ready; T=0.01/0.01 14:56:27
q mdc mdi userid lnxrh1 201
14:56:32 DASD 0201 MDCACHE OFF (OFF for LNXRH1 0201; DFLTON for DASD C40C)
Ready; T=0.01/0.01 14:56:32
q mdc mdi userid lnxrh2 201
14:56:34 DASD 0201 MDCACHE OFF (OFF for LNXRH2 0201; DFLTON for DASD C40D)
Ready; T=0.01/0.01 14:56:34
q mdc mdi userid lnxrh3 201

```



## 5.5 z/VM system dump space

CP hard abend dumps and CP snap dumps, by default, share spooling space with other spool files. Dumps can be sent to spool as long as enough spool space is available to contain the dump, or dedicated DASD space for dumps can be allocated. The amount of space required for a dump is directly related to the amount of real storage used by the following:

- ▶ CP Nucleus
- ▶ CP Frame Table
- ▶ System Execution Space Data Structure
- ▶ CP Control Blocks and Structures

You should provide space for more than one dump. Space for three dumps is recommended: space for the next dump and space for two dumps that you may not have yet been processed with DUMpload. The *CP Planning and Administration Manual*, SC24-6803 provides a table for various sized systems and a method to estimate how much space to provide for each dump.

## 5.6 Linux on System z swap space

The general swap recommendation for Linux on System z is to keep swapping as minimal as possible. To keep swapping as fast as possible, it is even recommended to use virtual disks for the first small swapping device. This is only possible if you have enough main memory available.

SAP recommends in the *SAP NetWeaver 7.0 SR3 ABAP+Java on Linux: IBM DB2 for z/OS* installation guide twice the size of ram for swap space. We have 4 GB of main memory available for the SAP installations and 7 GB of swap. As documented in the SAP installation guide, we planned to add additional swap space if we ran into swap shortage.

A parameter to influence the likeliness of the Linux kernel to swap pages is swappiness. The parameter is a numeric value between 0 and 100 and can be read and changed via `/proc/sys/vm/swappiness`. A discussion of Linux and tuning swappiness is available at:

<http://kerneltrap.org/node/3000>

## 5.7 Guest privilege classes

Linux guests generally do not require anything more than privilege class “G.” Although providing Linux guests with additional privilege classes will not impact system performance, it can create security exposures. Anyone with either the ability to logon as the user or has root access to the Linux system could issue commands that affect the operation on the entire z/VM system. (That means a Linux guest with privilege class “A” could shut down the z/VM system.)

## 5.8 Number of virtual CPUs in a guest

The general rule is to never define more virtual CPUs to a guest than there are real CPUs on the processor and do not define more virtual CPUs than a guest actually needs or uses. When defining virtual CPUs to guests that are not used, no increase in performance is achieved. Moreover, additional control blocks and management overhead for the z/VM dispatcher (scheduler) are created.

Example 5-7 demonstrates the command that shows how many processors (CPs, IFLs, CPUs) you have on your z/VM system. Example 5-8 shows the command and parts of the output to get LPAR and CPU information on Linux on System z.

*Example 5-7 Query processor on z/VM*

---

```
q proc
15:57:01 PROCESSOR 00 MASTER CP
15:57:01 PROCESSOR 01 ALTERNATE CP
15:57:01 PROCESSOR 02 ALTERNATE CP
15:57:01 PROCESSOR 03 ALTERNATE CP
15:57:01 PROCESSOR 04 ALTERNATE CP
15:57:01 PROCESSOR 05 STANDBY CP
15:57:01 PROCESSOR 06 STANDBY CP
15:57:01 PROCESSOR 07 STANDBY CP
15:57:01 PROCESSOR 08 STANDBY CP
15:57:01 PROCESSOR 09 STANDBY CP
Ready; T=0.01/0.01 15:57:01
```

---

*Example 5-8 Get LPAR and CPU information on Linux on System z*

---

```
# cat /proc/sysinfo
Manufacturer:      IBM
Type:              2097
Model:             714                E26
```

```

Sequence Code:      000000000001DE50
Plant:             02
Model Capacity:     714                00001139
Model Perm. Capacity: 714            00001139
Model Temp. Capacity: 714            00001139

CPUs Total:         28
CPUs Configured:    14
CPUs Standby:       0
CPUs Reserved:      14
Capability:         904 1350
Adjustment 02-way:   61500 61500
...
Adjustment 28-way:   40400 40360
Secondary Capability: 904

LPAR Number:        4
LPAR Characteristics: Shared
LPAR Name:          A04
LPAR Adjustment:     357
LPAR CPUs Total:     10
LPAR CPUs Configured: 5
LPAR CPUs Standby:   5
LPAR CPUs Reserved:  0
LPAR CPUs Dedicated: 0
LPAR CPUs Shared:    5

VM00 Name:          LNXSU1
VM00 Control Program: z/VM      5.4.0
VM00 Adjustment:     400
VM00 CPUs Total:     2
VM00 CPUs Configured: 2
VM00 CPUs Standby:   0
VM00 CPUs Reserved:  0

```

---

## 5.9 Linux on System z kernel versions and features

Distributors continue to add performance enhancements, new functions, and fixes to their Linux distribution. Keeping up to date with service packages ensures your system remains free from known bugs and possibly avoids any compatibility issues.

## 5.10 Tickless kernel

In the past, Linux on System z “woke up” 100 times per second. These timer pops are used by the Linux scheduler to determine if it has work to do. It also maintains its “jiffies” through this mechanism. These timer pops have three system impacts when Linux runs in a z/VM guest:

- ▶ Processor time is consumed in this process. The majority of the cycles are used by z/VM’s control program in virtualizing the interrupt.
- ▶ Parts of the interrupt reflection must run on VM’s master processor (this changed in z/VM 5.1.0).
- ▶ Because the Linux guest wakes up so often, VM considers it to always be active.

Therefore, the Linux guest is not dropped from the dispatch list and the storage management routines tend not to steal pages from these guests. This problem is addressed with the so called “on-demand timer” patch that is included in the recent Red Hat Enterprise Linux and SLES kernels.

This patch disables the 10 ms timer tick and sets the timer to pop only when the kernel needs to wake up. Even though this does not make a real “zero load idle Linux guest,” the periods between two timer ticks are normally long enough for z/VM to recognize the guest as idle (and start taking measures to trim memory pages).

You can check the settings with the command shown in Example 5-9. A printed 0 means the tickless kernel is active. If you want to reenale kernel ticks you just need to echo 1 to the file `/proc/sys/kernel/hz_timer`. It is recommended to keep the default tickless timer settings.

**Note:** The kernel version that was installed with our SLES 10 SP2 system (kernel-default-2.6.16.60-0.3) did not expose tickless timer settings via `/proc/sys/kernel/hz_timer`. An updated version (kernel-default-2.6.16.60-0.21) solved that issue.

*Example 5-9 The tickless timer Linux kernel*

---

```
# cat /proc/sys/kernel/hz_timer
0
```

---

## 5.11 Linux on System z runlevels and unnecessary services

The default runlevel for a Linux guest should be a runlevel that does not include X11 service startup. On SLES and on Red Hat Enterprise Linux the multiuser runlevel without X11 startup is 3. The following examples show the commands and output to check the default runlevel:

► SLES

```
# grep id::initdefault /etc/inittab
id:5:initdefault:
```

► Red Hat Enterprise Linux

```
# grep id::initdefault /etc/inittab
id:3:initdefault:
```

We changed the default runlevel on all our SLES guests to 3 with **yast**. The path in yast is **System** → **System Services (Runlevel)** → **Expert Mode** → **Set default runlevel after booting to**.

### *Unnecessary services*

Starting unused services consumes resources. We removed the following services from the init profile using **chkconfig**:

- SLES: cups, xinetd, postfix, novell-zmd, earlygdm
- Red Hat Enterprise Linux: cups, sendmail, auditd, xfs, atd, avahi-daemon, yum-updatesd

Check whether you need a service before removing it from the system startup configuration.

## 5.12 Linux on System z disks and filesystems

Each of the file systems available in Linux for System z has its own set of features and characteristics:

- ext2 - Also known as the second extended filesystem, ext2 is a file system for the Linux kernel and is the most widespread Linux file system used to date.
- ext3 - Also known as the third extended filesystem, ext3 evolved from ext2 and adds journaling features.
- ReiserFS - Developed by Hans Reiser and sponsored by Novell/SuSE, the reiserfs journaling behavior is comparable to ext3 in order mode.

- ▶ XFS - The IRIX file system. This file system was developed by SGI and released to open source in 2000, making it one of the oldest journaling file systems.

In a comparison of file systems contained in Novell/SuSE Linux Enterprise Server using the well known benchmark dbench, the ext2 file system provided the highest throughput. Reiserfs had the highest throughput of all journaling file systems with XFS and ext3 slightly behind reiserfs. However, further examination reveals an increased CPU consumption for reiserfs over the other journaling file systems. The IBM System z Linux development team has recommended the ext3 file system for Linux on System z for some time because of its reduced CPU load compared to the other journaling file systems.

**Tip:** The latest technical benchmarks from the IBM Linux development lab state: "Overall we could recommend XFS as the best file system for large multiprocessor systems because it is fast at low CPU utilization. Ext3 is the best second choice."

We used ext3 for our scenario. It is the default file system for RHEL 5.1 and SLES 10 SP2 and our Linux guests with 2 virtual CPUs are not considered large multiprocessor systems.

## 5.13 Linux on System z I/O schedulers

The Linux 2.6 kernel offers a choice of four different I/O schedulers. The I/O scheduler optimizes disk access; the strategy for optimization aims to minimize the number of I/O operations and disk head movements.

- ▶ Noop scheduler
- ▶ Deadline scheduler
- ▶ Anticipatory scheduler (AS)
- ▶ Complete Fair Queuing scheduler (CFQ)

The default in the kernel 2.6 is the anticipatory scheduler. Both SLES and Red Hat Enterprise Linux distributions replace this with the deadline scheduler. The AS scheduler is designed to optimize the access to physical disks. Its strategy is not suitable for storage servers like the IBM ESS and therefore is not a good choice for the System z environment. All other I/O schedulers perform similarly. However, Linux systems running large numbers of concurrent processes may benefit from using the deadline scheduler.

We checked the configured scheduler with the following command:

```
# cat /sys/block/dasd*/queue/scheduler
noop anticipatory [deadline] cfq
noop anticipatory [deadline] cfq
noop anticipatory [deadline] cfq
noop anticipatory [deadline] cfq
noop anticipatory [deadline] cfq
noop anticipatory [deadline] cfq
```

The brackets around the deadline scheduler indicate that it is the active scheduler for all DASDs.

Other options selectable as kernel parameters are “fixedbuffer” and “spin\_retry.” The “fixedbuffer” option is recommended when I/O intensive Linux workloads are being hosted under z/VM5.1 and earlier. This option can actually degrade performance on z/VM5.2 and later. The “spin\_retry” option can help to reduce the number of DIAG44 calls and the associated overhead when z/VM is hosting large numbers of concurrently active guests.

## 5.14 Cooperative memory management and collaborative memory management assist

Cooperative memory management (CMM) and collaborative memory management assist (CMMA) allow z/VM and the Linux guest to exchange information regarding memory usage. Using CMM (or CMM1), the Linux guest gets information from an external entity, such as the z/VM resource monitor (VMRM) to shrink its memory usage.

Collaborative memory management assist (CMMA) has a different approach. Here the z/VM control program (CP) and Linux on System z can exchange information about memory usage. CP can identify Linux clean disk cache pages that Linux is able to reconstruct and can reclaim the backing page frames from Linux bypassing paging-out of the data. For CMMA you need a CMMA-aware kernel and z/VM 5.3. Only SLES 10 SP2 included the CMMA patch to their distribution kernel, the RHEL 5.1 kernel did not include this patch.

For our Linux systems we enabled CMMA with the boot parameter `cmma` in `/etc/zipl.conf`. The example line of `zipl.conf` reads

```
parameters = "root=/dev/dasdb1 TERM=dumb selinux=0 audit_enable=0 \
    audit=0 audit_debug=0 cmma=on"
```

In z/VM, we logged in as `userid maint` and checked that CMMA is enabled for all guests by using the command `query memassist`. Example 5-10 shows the command and output for guest `lnxsu1`.

---

```
q memassist user lnxsu1
14:12:24 ALL USERS SET - ON
14:12:24
14:12:24 USER      SETTING  STATUS
14:12:24 LNXSU1    ON       ACTIVE
Ready; T=0.01/0.01 14:12:24
```

---

After reboot, we checked the kernel parameters for the SLES guests:

```
# for host in lnxsu1 lnxsu2 lnxsu3 ; do ssh $host cat /proc/cmdline ; done
root=/dev/dasdb1 TERM=dumb selinux=0 audit_enable=0 audit=0
audit_debug=0 cmma=on BOOT_IMAGE=0
root=/dev/dasdb1 TERM=dumb selinux=0 audit_enable=0 audit=0
audit_debug=0 cmma=on BOOT_IMAGE=0
root=/dev/dasdb1 TERM=dumb selinux=0 audit_enable=0 audit=0
audit_debug=0 cmma=on BOOT_IMAGE=0
```

**Note:** To our knowledge, to make sure that CMMA is switched on, it is always necessary to set the kernel parameter `cmma=on`. Even if z/VM shows CMMA STATUS ACTIVE for a specific guest, you cannot be sure that CMMA is active on this guest.

For more information about CMM and CMMA, see

- ▶ *Linux on IBM eServer zSeries and S/390: Performance Toolkit for VM*, SG24-6059
- ▶ *Linux on System z Device Drivers, Features, and Commands*, SC33-8289-03
- ▶ *Memory Management: VMRM-CMM and CMMA*  
<http://www.vm.ibm.com/perf/reports/zvm/html/530cmm.htm>

## 5.15 QIOASSIST

On processors that support the queue-I/O assist there is a performance benefit for I/O performed with the queued I/O protocols. With the aid of the assist, I/O interruptions can be passed directly from the hardware to the virtual machine. In addition, certain QDIO-related instructions can be interpretively executed by the processor, without z/VM involvement. This interpretive execution assist applies to devices that use the Queued Direct I/O (QDIO) architecture, HiperSockets devices, and FCP devices.



We checked the status for QIOASSIST on our system for all linux guests with query **QIOASSIST** command, as shown in Example 5-11.

*Example 5-11 Checking QIOASSIST status of Linux guests*

---

```
q qioassist user lnxsu1
12:54:11 ALL USERS SET - ON
12:54:11
12:54:11 USER      SETTING  STATUS
12:54:11 LNXSU1    ON      ACTIVE
Ready; T=0.01/0.01 12:54:11
q qioassist user lnxsu2
12:54:14 ALL USERS SET - ON
12:54:14
12:54:14 USER      SETTING  STATUS
12:54:14 LNXSU2    ON      ACTIVE
Ready; T=0.01/0.01 12:54:14
q qioassist user lnxsu3
12:54:16 ALL USERS SET - ON
12:54:16
12:54:16 USER      SETTING  STATUS
12:54:16 LNXSU3    ON      ACTIVE
Ready; T=0.01/0.01 12:54:16
q qioassist user lnxrh1
12:54:49 ALL USERS SET - ON
12:54:49
12:54:49 USER      SETTING  STATUS
12:54:49 LNXRH1    ON      ACTIVE
Ready; T=0.01/0.01 12:54:49
q qioassist user lnxrh2
12:54:50 ALL USERS SET - ON
12:54:50
12:54:50 USER      SETTING  STATUS
12:54:50 LNXRH2    ON      ACTIVE
Ready; T=0.01/0.01 12:54:50
q qioassist user lnxrh3
12:54:52 ALL USERS SET - ON
12:54:52
12:54:52 USER      SETTING  STATUS
12:54:52 LNXRH3    ON      ACTIVE
Ready; T=0.01/0.01 12:54:52
```

---

For more information about QIOASSIST, see the z/VM information center at:

<http://publib.boulder.ibm.com/infocenter/zvm/v5r4/index.jsp>

## 5.16 Additional documentation regarding performance

The performance recommendations made in this chapter are based on past customer experiences and testing in the development labs. They are considered general rules and best practices, *not a definitive statement about how your specific system should be configured*. Some of the content in this chapter is original material, and some came from the following sources:

- ▶ VM Performance Tips:  
<http://www.vm.ibm.com/perf/tips/#Tune>
- ▶ Linux Performance Tips when running under VM:  
<http://www.vm.ibm.com/perf/tips/linuxper.html>
- ▶ VM Performance Related APARS:  
<http://www.vm.ibm.com/perf/tips/prgapar.html>
- ▶ VM potential high impact service:  
<http://www.vm.ibm.com/service/redalert/>
- ▶ Linux390 Performance Hints and Tips:  
<http://www.ibm.com/developerworks/linux/linux390/perf/index.html>
- ▶ Linux kernel 2.6 - I/O scheduler:  
[http://www.ibm.com/developerworks/linux/linux390/perf/tuning\\_res\\_dasd\\_ioScheduler.html](http://www.ibm.com/developerworks/linux/linux390/perf/tuning_res_dasd_ioScheduler.html)
- ▶ *Linux on IBM System z: Performance Measurement and Tuning*, SG24-6926
- ▶ *Linux on IBM eServer zSeries and S/390: Performance Toolkit for VM*, SG24-6059
- ▶ SAP Application Server Measurements on IBM eServer™ zSeries Using Linux for zSeries and z/VM  
<http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP100722>
- ▶ SAP Application Server Consolidation on IBM System z: Opportunity, Metrics, and Case Studies  
<http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101169>
- ▶ Linux on System z provides a daemon (**cpuplugd**) that automatically starts and stops virtual processors based on virtual processor utilization and workload characteristics, exploiting z/VM V5.4 dynamic virtual processor management. Read more in the z/VM 5.4 announcement letter:  
<http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?subtype=ca&infotyp e=an&appname=iSource&supplier=897&letternum=ENUS208-249>.

## Miscellaneous considerations

This chapter discusses the following topics:

- ▶ Cloning of Linux on System z and SAP instances
- ▶ OS monitoring on Linux on System z with CCMS
- ▶ Solution completeness considerations
  - Adobe® Document Server
  - SAP liveCache
  - SAP JVM
  - Wily Introscope

## 6.1 Cloning of SAP dialog instances

This section discusses possible ways to multiply dialog instances. If you plan to run a large installation with many dialog instances, you want to keep the setup of the dialog instances as simple and fast as possible.

The following considerations are important when you plan your dialog instance setup:

- ▶ The installation of dialog instances with SAPinst is straightforward and will take less than an hour. It is the documented and supported way to add application servers to your SAP system.
- ▶ Since the J2EE engine of an SAP instance is represented in the database, cloning of SAP instances which need a J2EE engine is not supported.
- ▶ Cloning of Linux on System z is supported and well documented in the following books:
  - *z/VM and Linux on IBM System z The Virtualization Cookbook for SLES 10 SP2*, SG24-7493
  - *z/VM and Linux on IBM System z*, SG24-7492

With these considerations in mind, we recommend the following steps to multiply SAP dialog instances:

- ▶ Clone the Linux on System z according to the two IBM Redbooks publications mentioned here.
- ▶ Install additional dialog instances using SAPinst.

## 6.2 OS monitoring for virtualized Linux environments

SAP offers several transactions to monitor operations system activities using the SAP graphical user interface. A general description of the SAP operating system monitor can be found at:

<http://help.sap.com>

Select **SAP NetWeaver** → **SAP NetWeaver 7.0 Library English** → **SAP NetWeaver Library** → **Technical Operation Manual** → **Administration of SAP NetWeaver Systems** → **Application Server ABAP (AS ABAP)** → **Monitoring** → **Tools** → **Operating System Monitor**

In August 2007 SAP released a new set of transactions (OS06N, ST06N, OS07N) which are enhanced versions of the old transactions OS06, ST06, and OS07. A general description of the enhancements can be found in *SAP Note*

*1084019: OS07N: New operating system monitor.* OS06N, OS07N, and ST06N all map to the same ABAP code, which means you can use any of them to get the same new functionality. Therefore we will only talk about OS06N in the following.

As was the case for the old transactions, OS06N gets its data from the **saposcol** program. The saposcol program runs as a standalone process on an SAP application or database server and periodically gathers data related to the underlying operating system.

In 2008 modifications to saposcol were made to extend OS06N to display metrics related to Linux systems running in a virtualized environment. *SAP Note 1102124: SAPOSCOL on Linux: Enhanced function* generally describes the extensions. The modifications to saposcol related to Linux on System z systems running in a virtualized environment (LPAR or z/VM) were generally available in August 2008.

In order to be able to display the virtualization metrics in OS06N on a SAP NetWeaver 2004s SR3 system running on Linux on System z the following prerequisites must be met:

- ▶ SAP BASIS support package SP17 must be applied to the system. This support package is the first support package for SAP NetWeaver 2004s which implements the ABAP part of the Linux extensions for virtualization metrics.
- ▶ A saposcol version which implements the saposcol part of the Linux extensions for virtualization metrics must be installed. According to *SAP Note 1102124: SAPOSCOL on Linux: Enhanced function* the latest saposcol for SAP release 7.10 should be used even for SAP release 7.00. At the time of the writing of this book, saposcol for SAP release 7.00 does not implement the extensions for Linux virtualization metrics yet.

The latest version of saposcol for SAP release 7.10 can be downloaded from the SAP marketplace by navigating to:

<http://service.sap.com/swdc>

Select **SAP Software Distribution Center** → **Download** → **Support Packages and Patches** → **Entry by Application Group** → **SAP NetWeaver** → **SAP NETWEAVER** → **SAP NETWEAVER PI 7.1** → **Entry by Components** → **Application Server ABAP** → **SAP KERNEL 7.10 64-BIT UNICODE** → **Linux on zSeries 64bit** → **#Database independent**

We installed SAP BASIS support packages up to SP17 and the latest saposcol for the 7.10 SAP release on our systems. Figure 6-1 on page 134 shows the virtualization metrics for our Central Instance of SAP system RH1 on Linux host lnxrh1.

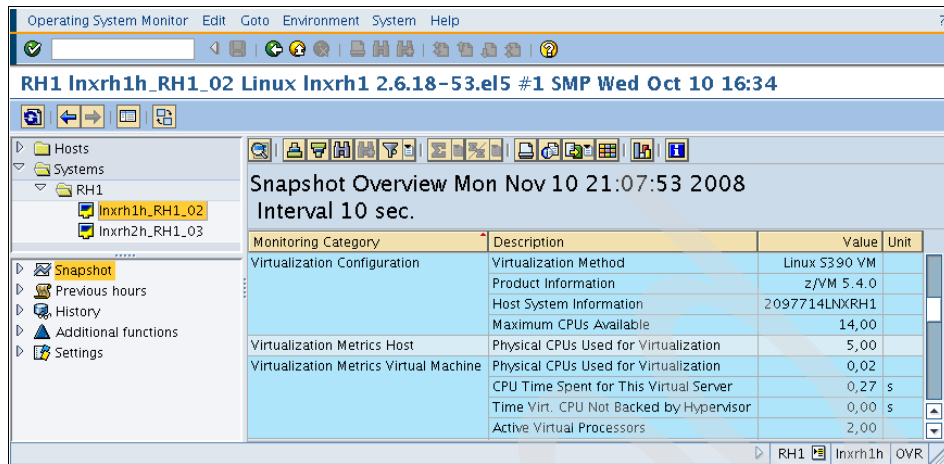


Figure 6-1 Virtualization metrics for the Central Instance of SAP system RH1, running on host Inxrh1

As you can see, the tree selection allows not only for choosing the local instance on Inxrh1 (the Central Instance of RH1) but also for choosing the remote instance on Inxrh2 (the additional Dialog Instance of RH1). Figure 6-2 shows the virtualization metrics for the Dialog Instance of SAP system RH1 on Linux host Inxrh2.

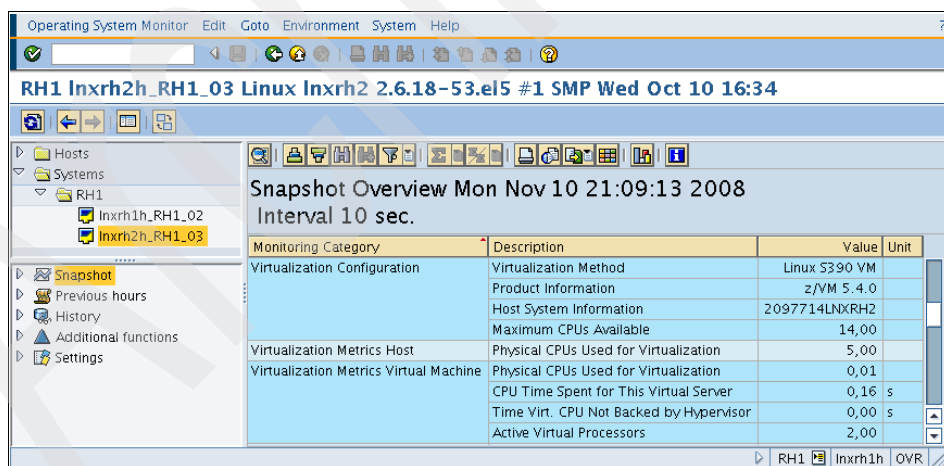


Figure 6-2 Virtualization metrics for the Dialog Instance of SAP system RH1, running on host Inxrh2

The meanings of the categories and the metrics is as follows:

- ▶ Virtualization Configuration:
  - Virtualization Method:

This metric has always the value “Linux S390 VM” (regardless of whether the Linux system runs in a z/VM guest or on an LPAR).
  - Product Information:

This metric displays a string identifying the virtualization layer on which the Linux system runs (“z/VM <z/VM version>” or “System z LPAR”)
  - Host System Information:

This metric displays a string of form <Type><Model><HS-Name>, where <Type> and <Model> correspond to the type and model of the System z machine respectively and <HS-Name> is either:

    - The name of the LPAR if the Linux system runs on an LPAR.
    - The name of the z/VM system if the Linux system runs on a z/VM guest.
  - Maximum CPUs Available:

This metric displays the number of configured CPs on the System z machine.
- ▶ Virtualization Metrics Host
  - Physical CPUs Used for Virtualization:
    - If the Linux system runs on an LPAR, this metric displays the number of CPs that are configured for the LPAR on which the Linux system runs.
    - If the Linux system runs in a z/VM guest, this metric displays the number of CPs that are configured for the LPAR on which the z/VM system runs.

In both cases the physical CPs might be shared with other LPARs.
- ▶ Virtualization Metrics Virtual Machine
  - Physical CPUs Used for Virtualization:
    - If the Linux system runs on an LPAR, this metric displays the average number of CPs configured for the LPAR that the Linux system used during the last saposcol period.
    - If the Linux system runs in a z/VM guest, this metric displays the average number of virtual CPs configured for the z/VM guest that the Linux system used during the last saposcol period.

- CPU Time Spent for This Virtual Server:  
This metric displays the CP time in seconds that the Linux system spent during the last saposcol period.
- Time Virt. CPU not Backed by Hypervisor:  
This metric displays the time in seconds that the virtual CPs on which the Linux system is running were not backed by physical CPs during the last saposcol period.
- Active Virtual Processors:
  - If the Linux system runs on an LPAR, this metric displays the number of CPs that are configured for the LPAR on which the Linux system runs (that is, the same value displayed for metric “Physical CPUs Used for Virtualization” in category “Virtualization Metrics Host”).
  - If the Linux system runs in a z/VM guest, this metric displays the number of virtual CPs that are configured for the z/VM guest on which the Linux system runs.

## 6.3 Third party software considerations

### 6.3.1 Adobe document server

Adobe’s PDF technology integration into SAP NetWeaver started with SAP NetWeaver 2004. ADS (Adobe Document Services) adds the support for interactive PDF forms to business processes of SAP NetWeaver.

Although ADS does not run on Linux on System z natively, you can utilize any ADS installation in your SAP landscape by connecting your Linux on System z based SAP system to such an ADS installation.

For more documentation regarding ADS, see *Using Adobe Document Services with SAP on IBM DB2 for z/OS*:

<https://www.sdn.sap.com/irj/sdn/go/portal/prtroot/docs/library/uuid/2083cedc-e608-2b10-aa8f-e6a46bcee17c>

### 6.3.2 SAP liveCache

SAP liveCache is an in-memory technology enhancement to optimize performance. It helps solutions such as SCM/APO, which need to manage large and linked objects. The architecture is based on a liveCache server, which uses the MaxDB database, and a liveCache client.



The SAP application server on Linux on System z supports the liveCache client. Therefore, a supported liveCache scenario for SAP on System z is the use of a remote liveCache by accessing it through the liveCache client on Linux on System z.

For more information on liveCache product availability, see:

<http://service.sap.com/pam> → **SAP Application Components** → **SAP SCM** → **SAP SCM <version>** → **Operating Systems**

### 6.3.3 SAP JVM

Starting with SAP NetWeaver 7.10 SAP uses its own Java Virtual Machine (SAP JVM) on all supported platforms, including Linux on System z. With SAP JVM being installed by SAPinst during SAP installation, there is no need for third party vendor JDKs anymore.

### 6.3.4 Wily Introscope

Starting with SAP NetWeaver 7.00 SAP Solution Manager is needed for maintaining your SAP system landscape. Solution Manager Diagnostics is the preferred connection type for SAP support. For root cause analysis on J2EE engines, Wily Introscope is required.

SAP customers install Wily Introscope Enterprise Manager as part of their solution manager installation. Wily Introscope Agent is deployed on every J2EE engine.

Wily Introscope Enterprise Manager and Wily Introscope Agent are Java applications supported on Linux on System z application servers.

For more information about Solution Manager Diagnostics and Wily Introscope, see:

<http://service.sap.com/diagnostics>

and

*SAP Note 797147: Wily Introscope Installation for SAP Customers*



# Network configuration

This appendix shows files that we edited or created as part of the system network preparation. This includes:

- ▶ Script to bring IP aliases up and down
- ▶ Kernel parameterization files `/etc/sysctl.conf`
- ▶ `/etc/hosts` file for the DNS

## Script to bring IP aliases up and down

The following script Example A-1 was created to bring IP aliases up and down. It is used on Inxsu1, Inxsu2, Inxrh1, and Inxrh2 to start the IP aliases for the SCS and the ASCS instances.

*Example: A-1 Shell script hsictl.sh*

---

```
#!/bin/bash

#
# This script starts and stops additional ip addresses (ip aliases).
#

DOMAIN="itso.ibm.com"

NETWORK="192.168.4"
NETMASK="255.255.255.0"
NETPREF="24"
BROADCAST="$NETWORK.255"

INTERFACE="hsi0"

usage() {
    echo "Usage: $0 MODE IP-ALIAS-LABEL"
    echo "    where MODE           := { up | down | usage }"
    echo "    IP-ALIAS-LABEL := numeral label for the ip alias"
}

if [ $# -lt 2 ] ; then
    usage
fi

hostname=~hostname~
hostname=~basename $hostname . $DOMAIN~

case $hostname in
    Inxsu1|Inxsu2)
        ipaddr[1]=$NETWORK.100
        ipaddr[2]=$NETWORK.101
        ;;
endcase
```

```

    1nrxrh1|1nrxrh2)
        ipaddr[1]=$NETWORK.103
        ipaddr[2]=$NETWORK.104
        ;;
esac

ctlmode=$1
shift

addrnum=$1
shift

case $ctlmode in
    up)
        ip addr add ${ipaddr[$addrnum]}/$NETPREFIX \
            brd $BROADCAST \
            label $INTERFACE:$addrnum \
            dev $INTERFACE
        ;;
    down)
        ip addr del ${ipaddr[$addrnum]}/$NETPREFIX dev $INTERFACE
        ;;
    show)
        ip addr show dev $INTERFACE
        ;;
    help|usage)
        usage
        ;;
esac

```

---

# Kernel parameterization

The following file listings for Red Hat Enterprise Linux and SLES are a result of SAP Note applications to prepare the Linux on System z guest for SAP.

## Red Hat Enterprise Linux

This is the file listing for `/etc/sysctl.conf` on Red Hat Enterprise Linux:

*Example: A-2 /etc/sysctl.conf on Red Hat Enterprise Linux*

---

```
# Kernel sysctl configuration file for Red Hat Linux
#
# For binary values, 0 is disabled, 1 is enabled. See sysctl(8) and
# sysctl.conf(5) for more details.

# Controls IP packet forwarding
net.ipv4.ip_forward = 0

# Controls source route verification
net.ipv4.conf.default.rp_filter = 1

# Do not accept source routing
net.ipv4.conf.default.accept_source_route = 0

# Controls whether core dumps will append the PID to the core filename
# Useful for debugging multi-threaded applications
kernel.core_uses_pid = 1

# Controls the use of TCP syncookies
net.ipv4.tcp_syncookies = 1

# Controls the maximum size of a message, in bytes
kernel.msgmnb = 65536

# Controls the default maximum size of a message queue
kernel.msgmax = 65536

# Controls the maximum shared segment size, in bytes
kernel.shmmax = 68719476736

# Controls the maximum number of shared memory segments, in pages
kernel.shmall = 4294967296
```

```
# Added for Hipersocket tuning by JR on 2008-10-17
net.ipv4.tcp_wmem = 4096 65536 131072

# ADDED BY JCM 20081017 SAP NOTE 1048303
kernel.msgmni=1024
kernel.sem=1250 256000 100 1024
vm.max_map_count=300000
```

---

## SLES

This is the file listing for /etc/sysctl.conf on SLES:

*Example: A-3 /etc/sysctl.conf on SLES*

---

```
# Disable response to broadcasts.
# You don't want yourself becoming a Smurf amplifier.
net.ipv4.icmp_echo_ignore_broadcasts = 1
# enable route verification on all interfaces
net.ipv4.conf.all.rp_filter = 1
# enable ipv6 forwarding
#net.ipv6.conf.all.forwarding = 1
# Added for SAP on 2008-09-11 13:44:59 UTC
kernel.shmmax = -1
kernel.sem = 1250 256000 100 8192
kernel.shmall = 1152921504606846720
vm.max_map_count = 300000

# Added for Hipersocket tuning by JR on 2008-10-17
net.ipv4.tcp_wmem = 4096 65536 131072
```

---

## /etc/hosts file

This is the file content of the synchronized /etc/hosts file.

*Example: A-4 /etc/hosts file*

---

```
127.0.0.1      localhost.localdomain localhost

#
# OSA connections
#
9.12.4.20      sc04.itso.ibm.com      sc04

9.12.4.89      vmlinux6.itso.ibm.com vmlinux6

9.12.4.244     lnrxrh1.itso.ibm.com  lnrxrh1
9.12.4.245     lnrxrh2.itso.ibm.com  lnrxrh2
9.12.4.246     lnrxrh3.itso.ibm.com  lnrxrh3

9.12.4.241     lnxsu1.itso.ibm.com   lnxsu1
9.12.4.242     lnxsu2.itso.ibm.com   lnxsu2
9.12.4.243     lnxsu3.itso.ibm.com   lnxsu3

9.12.6.16      landisk.itso.ibm.com  landisk
#
# All HiperSockets device hostnames are market with trailing 'h'
#
192.168.4.20    sc04h.itso.ibm.com     sc04h

192.168.4.244   lnrxrh1h.itso.ibm.com  lnrxrh1h
192.168.4.245   lnrxrh2h.itso.ibm.com  lnrxrh2h
192.168.4.246   lnrxrh3h.itso.ibm.com  lnrxrh3h

192.168.4.241   lnxsu1h.itso.ibm.com   lnxsu1h
192.168.4.242   lnxsu2h.itso.ibm.com   lnxsu2h
192.168.4.243   lnxsu3h.itso.ibm.com   lnxsu3h

192.168.4.100   suscsh.itso.ibm.com    suscsh
192.168.4.101   suascsh.itso.ibm.com   suascsh

192.168.4.103   rhscsh.itso.ibm.com    rhscsh
192.168.4.104   rhascsh.itso.ibm.com   rhascsh
```

---



## /etc/hosts without HiperSockets

This is the /etc/hosts file that was used to show how to disable HiperSockets on our SLES systems by changing DNS.

*Example: A-5 /etc/hosts file without HiperSockets*

---

```
127.0.0.1      localhost.localdomain localhost
#
# OSA connections
#

9.12.4.20      scs04.itso.ibm.com    scs04

9.12.4.89      vmlinux6.itso.ibm.com vmlinux6

9.12.4.244     lnxxrh1.itso.ibm.com  lnxxrh1
9.12.4.245     lnxxrh2.itso.ibm.com  lnxxrh2
9.12.4.246     lnxxrh3.itso.ibm.com  lnxxrh3

9.12.4.241     lnxxsu1.itso.ibm.com  lnxxsu1
9.12.4.242     lnxxsu2.itso.ibm.com  lnxxsu2
9.12.4.243     lnxxsu3.itso.ibm.com  lnxxsu3

9.12.6.16      landisk.itso.ibm.com  landisk

#
# All former HiperSockets device hostnames are market with trailing 'h'
# Note: HiperSockets on Red Hat Enterprise Linux was not disabled
#
9.12.4.20      sc04h.itso.ibm.com    sc04h

192.168.4.244  lnxxrh1h.itso.ibm.com lnxxrh1h
192.168.4.245  lnxxrh2h.itso.ibm.com lnxxrh2h
192.168.4.246  lnxxrh3h.itso.ibm.com lnxxrh3h

9.12.4.241     lnxxsu1h.itso.ibm.com lnxxsu1h
9.12.4.242     lnxxsu2h.itso.ibm.com lnxxsu2h
9.12.4.243     lnxxsu3h.itso.ibm.com lnxxsu3h

9.12.4.241     suscsh.itso.ibm.com  suscsh
9.12.4.241     suascsh.itso.ibm.com suascsh
192.168.4.103  rhscsh.itso.ibm.com  rhscsh
192.168.4.104  rhascsh.itso.ibm.com rhascsh
```

---

## Obeyfile to move an IP address

The following obeyfile was used to add the IP address to the OSA link.

*Example: A-6 Obeyfile for IP configuration*

---

```
HOME
    9.12.4.20      OSA3080LNK
    192.168.4.20  OSA30A0LNK
;
BEGINROUTES
ROUTE 9.12.4.0 255.255.252.0 = OSA3080LNK MTU 1500
ROUTE DEFAULT 9.12.4.1 OSA3080LNK MTU 1500
ROUTE 9.12.4.0 255.255.252.0 = OSA30A0LNK MTU 1500
ROUTE DEFAULT 9.12.4.1 OSA30A0LNK MTU 1500
ROUTE 192.168.4.0/24 = OSA30A0LNK MTU 1500
ENDROUTES
```

---

## Parameter input

In this appendix we provide worksheets to help you keep track of configuration parameters. Each worksheet lists the parameter names and the values we used in the lab; a blank column is provided for you to record your values.

The following four worksheets are included:

- ▶ Table B-1, “ASCS Installation” on page 148
- ▶ Table B-2, “SCS Installation” on page 148
- ▶ Table B-3, “Database Instance Parameters” on page 149
- ▶ Table B-4, “Central Instance Parameters” on page 150

Table B-1 ASCS Installation

Parameter	Our value	Your value
SID	SU1	
SAP system mount directory	/sapmnt	
Master Password	xxxxxxx <sup>a</sup>	
UID	200	
GID	2200	
ABAP SCS Instance Number	00	
ASCS Message Server Port	3600	
Internal ASCS Message Server Port	3900	
UC Kernel NW 7.0 SR3	/mnt/sapcds/kernel/NW_7.0_SR3_Kernel_LINUX	

a. The master password specified is used for setting all passwords on the SAP system such as the password for DDIC and SAP\*.

Table B-2 SCS Installation

Parameter	Our value	Your value
SID	SU1	
SAP system mount directory	/sapmnt	
master password	xxxxxxxxx <sup>a</sup>	
SCS Instance number	01	

a. The master password specified is used for setting all passwords on the SAP system such as the password for DDIC and SAP\*.

Table B-3 Database Instance Parameters

Parameter	Our value	Your value
Java Component NW 7.0 SR3	/mnt/sapcds/java/51033513	
JDK Directory	/opt/sapjdk	
JCE Unlimited Strength jurisdiction policy files archive	/mnt/landisk/SAPSOFTWARE/JCE/unrestricted.zip	
Profile Directory	/sapmnt/SU1/profile	
RDBMS Client IBM DB2 DVD	/mnt/sapcds/thin	
Database Subsystem ID (SSID)	DB2T	
Database Host	sc04h	
Location Name of DB2 Subsystem (DDF)	DB2T	
Port (DDF)	38300	
ABAP Schema	SAPR3	
DB Administrator User ID	KARENB	
Password	xxxxxxx <sup>a</sup>	
DB Connect userid	R3USER	
Java Schema	SAPJ1	
Java Connect userid	SAPJAVA	
Installation Export NW 7.0 SR3	/mnt/sapcds/51033493/51033493/EXP1	
SAP Code Page	4102	
Number of Parallel Jobs	10	
Secure Store Settings Key Phrase	xxxxxxx <sup>b</sup>	
Java Component NW 7.0 SR3 DVD	/mnt/sapcds/java/51033513	

a. The passwords for the DB Administrator userid, the DB Connect userid, and the Java connect userid are the passwords for these userids on the z/OS system.

b. We used the master password for this but you can decide based on your local requirements.

Table B-4 Central Instance Parameters

Parameter	Our value	Your value
Java Component NW 7.0 SR3 DVD	/mnt/sapcds/java/51033513	
JDK Directory	/opt/sapjdk	
Profile Directory	/sapmnt/SU1/profile	
Database Subsystem ID (SSID)	DB2T	
Database Host	sc04h	
Location Name of DB2 Subsystem (DDF)	DB2T	
Port (DDF)	38300	
ABAP Schema	SAPR3	
DB Administrator User ID	KARENB	
Password of DB Administrator	xxxxxxx <sup>a</sup>	
DB Connect User ID	R3USER	
Password of DB Connect User	xxxxxxxxx	
Java Schema	SAPJ1	
Java Connect User ID	SAPJAVA	
Password of Java Connect User	xxxxxxxxx	
Central Instance Number	02	
J2EE Engine Admin User Password	xxxxxxxxx	
J2EE Engine Communication User Password	xxxxxxxxx	
SDM Connection password	xxxxxxxxx	
UC Kernel NW 7.0 SR3	/mnt/sapcds/kernel/NW_7.0 _SR3_Kernel_LINUX	
password for ADSUSER	xxxxxxxxx	
password for ADS_AGENT	xxxxxxxxx	
Solution Manager Key	xxxxxxxxx	

a. The passwords for the DB Administrator userid, the DB Connect userid, and the Java connect userid are the passwords for these userids on the z/OS system.

## Profiles after installation

After we installed the SAP system and the ERS, the profiles shown in Table C-1 were located in our profile directory.

*Table C-1 SU1 SLES*

Profile name	Description
START_ASCS00_suascsh	Start profile for ASCS on suascsh
SU1_ASCS00_suascsh	Instance profile for ASCS on suascsh
START_SCS01_suscsh	Start profile for SCS on suscsh
SU1_SCS01_suscsh	Instance profile for SCS on suscsh
START_DVEBMGS02_Inxsu1h	Start profile for CI on Inxsu1h
SU1_DVEBMGS02_Inxsu1h	Instance profile for CI on Inxsu1h
DEFAULT.PFL	Default profile
START_D03_Inxsu2h	Start profile for dialog instance on Inxsu2h
SU1_D03_Inxsu2h	Instance profile for dialog instance on Inxsu2h
START_ERS10_Inxsu2h	Start profile for ERS10 on Inxsu2h
SU1_ERS10_Inxsu2h	Instance profile for ERS10 on Inxsu2h
START_ERS11_Inxsu2h	Start profile for ERS11 on Inxsu2h
SU1_ERS11_Inxsu2h	Instance profile for ERS11 on Inxsu2h





# Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this book.

## IBM publications

- ▶ *Backbone for Business Success - The added value of running SAP applications on IBM System z*  
Can be ordered at  
<http://ibm-sap.com/mentorsystemz>
- ▶ *CP Planning and Administration Manual*, SC24-6803
- ▶ *Business Continuity for SAP on IBM System z*, SC33-8206-02  
<http://www-03.ibm.com/servers/eserver/zseries/software/sap/documentation/docu.html>
- ▶ *Linux on System z Device Drivers, Features, and Commands*, SC33-8289-03

## IBM Redbooks publications

For information about ordering these publications, see “How to get Redbooks publications” on page 154. Note that some of the documents referenced here may be available in softcopy only.

- ▶ *HiperSockets Implementation Guide*, SG24-6816
- ▶ *Linux on IBM System z: Performance Measurement and Tuning*, SG24-6926
- ▶ *Linux on IBM eServer zSeries and S/390: Performance Toolkit for VM*, SG24-6059
- ▶ *Enhancing SAP by Using DB2 9 for z/OS*, SG24-7239
- ▶ *SAP Solutions on IBM DB2 UDB V8.2.2 Handbook*, SG24-6765
- ▶ *IBM Dynamic Infrastructure for mySAP Business Suite on IBM zSeries*, SG24-6473
- ▶ *SAP on DB2 for z/OS and OS/390: High Availability and Performance Monitoring with Data Sharing*, SG24-6950

- ▶ *OSA-Express Implementation Guide*, SG24-5948
- ▶ *DB2 UDB for z/OS V8: Through the Looking Glass and What SAP Found There*, SG24-7088
- ▶ *z/VM and Linux on IBM System z The Virtualization Cookbook for Red Hat Enterprise Linux 5.2*, SG24-7492
- ▶ *z/VM and Linux on IBM System z The Virtualization Cookbook for SLES 10 SP2*, SG24-7493

## How to get Redbooks publications

You can search for, view, or download Redbooks, Redpapers, Technotes, draft publications and Additional materials, as well as order hardcopy Redbooks, at this Web site:

[ibm.com/redbooks](http://ibm.com/redbooks)

## SAP publications

The starting URL for all SAP documentation is:

<http://service.sap.com/NW70d>

- ▶ Master Guide SAP NetWeaver 7.0
- ▶ Technical Infrastructure Guide - SAP NetWeaver
- ▶ SAP Planning Guide for SAP NetWeaver on IBM DB2 for z/OS SAP NetWeaver 7.0 SR3
- ▶ SAP Security Guide: IBM DB2 for z/OS
- ▶ SAP NetWeaver 7.0 SR3 ABAP+Java on Linux: IBM DB2 for z/OS
- ▶ SAP Database Administration Guide for SAP NetWeaver on IBM DB2 for z/OS SAP NetWeaver 7.0 SR3
- ▶ Media List for SAP NetWeaver 7.0 SR3

SAP on DB2 for z/OS project home page

<http://www.sdn.sap.com/irj/sdn/db2>

SAP Linux home page

<https://www.sdn.sap.com/irj/sdn/linux>

## SAP Notes

- ▶ SAP Note 81737: *DB2-z/OS APAR List*  
<http://service.sap.com/sap/support/notes/81737>
- ▶ SAP Note 1122387: *Linux: SAP Support in virtualized environments*  
<http://service.sap.com/sap/support/notes/1122387>
- ▶ SAP Note 1146808: *Connection to standalone enqueue server is cancelled*  
<http://service.sap.com/sap/support/notes/1146808>
- ▶ SAP Note 1263782: *DB2 z/OS: Recommended settings for HiperSockets (Linux on System z)*  
<http://service.sap.com/sap/support/notes/1263782>
- ▶ SAP Note 821904: *Separating SCS instance for ABAP and J2EE*  
<http://service.sap.com/sap/support/notes/821904>
- ▶ SAP Note 1100775: *SAP NetWeaver 7.0 (2004s) SR3 Installation IBM DB2 on z/OS*  
<http://service.sap.com/sap/support/notes/1100775>
- ▶ SAP Note 1039640: *Unpacking RAR archives*  
<http://service.sap.com/sap/support/notes/1039640>
- ▶ SAP Note 855498: *Installation Prerequisite Checker*  
<http://service.sap.com/sap/support/notes/855498>
- ▶ SAP Note 805390: *SAP Solution Manager is required for SAP Software*  
<http://service.sap.com/sap/support/notes/805390>
- ▶ SAP Note 1048303: *Red Hat Enterprise Linux 5.x: Installation and Upgrade*  
<http://service.sap.com/sap/support/notes/1048303>
- ▶ SAP Note 958253: *SUSE LINUX Enterprise Server 10: Installation notes*  
<http://service.sap.com/sap/support/notes/958253>
- ▶ SAP Note 171356: *SAP software on Linux: Essential information*  
<http://service.sap.com/sap/support/notes/171356>
- ▶ SAP Note 746299: *Recommended Settings for the Linux for zSeries JVM*  
<http://service.sap.com/sap/support/notes/746299>
- ▶ SAP Note 718901: *How to Change the JDK of the J2EE Engine*  
<http://service.sap.com/sap/support/notes/718901>
- ▶ SAP Note 183311: *DB2/390: Automated PTF Check*

- <http://service.sap.com/sap/support/notes/183311>
- ▶ SAP Note 797147: *Wily Introscope Installation for SAP Customers*  
<http://service.sap.com/sap/support/notes/797147>
- ▶ SAP Note 1084019: *OS07N: New operating system monitor*  
<http://service.sap.com/sap/support/notes/1084019>
- ▶ SAP Note 1102124: *SAPOSCOL on Linux: Enhanced function*  
<http://service.sap.com/sap/support/notes/1102124>
- ▶ SAP Note 1052298: *Inst.NW 7.0 SR3/Business Suite 2005 SR3-UNIX*  
<http://service.sap.com/sap/support/notes/1052298>

## Online resources

These Web sites are also relevant as further information sources:

- ▶ VM Performance Tips:  
<http://www.vm.ibm.com/perf/tips/#Tune>
- ▶ Linux Performance Tips when running under VM:  
<http://www.vm.ibm.com/perf/tips/linuxper.html>
- ▶ VM Performance Related APARS:  
<http://www.vm.ibm.com/perf/tips/prgapar.html>
- ▶ VM potential high impact service:  
<http://www.vm.ibm.com/service/redalert/>
- ▶ Linux390 Performance Hints and Tips:  
<http://www.ibm.com/developerworks/linux/linux390/perf/index.html>
- ▶ Linux: Tuning Swappiness  
<http://kerneltrap.org/node/3000>
- ▶ z/VM information center  
<http://publib.boulder.ibm.com/infocenter/zvm/v5r4/index.jsp>
- ▶ *Using Adobe Document Services with SAP on IBM DB2 for z/OS*  
<https://www.sdn.sap.com/irj/sdn/go/portal/prtroot/docs/library/uuid/2083cedc-e608-2b10-aa8f-e6a46bcee17c>
- ▶ SAP Product Availability Matrix:  
<http://service.sap.com/pam>

- ▶ SAP Application Server Measurements on IBM eServer zSeries Using Linux for zSeries and z/VM  
<http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP100722>
- ▶ SAP Application Server Consolidation on IBM System z: Opportunity, Metrics, and Case Studies  
<http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101169>
- ▶ z/VM 5.4 announcement letter, including information about cpuplugd:  
<http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?subtype=ca&infotype=an&apname=iSource&supplier=897&letternum=ENUS208-249>

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# SAP on DB2 9 for z/OS: Implementing Application Servers on Linux for System z

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