IBM

Best Practices for Windows and Linux Integration in the iSeries

Discover what iSeries offers for integration opportunity

Review the methodologies for sizing integrated servers

Once integrated overview the ongoing management considerations

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Redpaper

IBM

International Technical Support Organization

Best Practices for Windows and Linux Integration in the iSeries

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Note: Before using this information and the product it supports, read the information in "Notices" on page v.

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Contents

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Preface

This IBM® Redpaper will provide you with a broad understanding of the integration of existing, separate Microsoft® Windows® and Linux® PC servers in an IBM @server® iSeries™ system with an integrated IBM @server xSeries® server.

We discuss the overall considerations for selecting and sizing servers. We also describe best practices and provide information about other resources that are available to you.

This guide is developed for IBM employees, IBM Business Partners, and customers.

The team that wrote this Redpaper

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Why integrate into a single server?

This chapter describes reasons to integrate into a single server on integrated IBM @server xSeries hardware from iSeries, Linux, and Microsoft Windows perspectives. This solution helps server consolidation, because Linux and Windows on an IBM @server Integrated xSeries Server combines three operating systems (Linux, Windows, and IBM OS/400 or IBM @server i5/OS).

The iSeries integrated xSeries solutions enable businesses to operate heterogeneous environments that include Intel®-based servers running Microsoft Windows or Linux applications in addition to core business applications on iSeries.

The integrated application servers provide support for Linux, OS/400 and i5/OS (the next generation of OS/400), Java™ technology, Lotus® Domino, IBM WebSphere, UNIX®, Microsoft Windows 2000 Server, and Microsoft Windows Server 2003 applications. In a single server, you can run your core business and on demand applications, all managed centrally and running independently.

1.1 Overview

The goal is to improve efficiency, ease integration, and enable dynamic provisioning of resources. iSeries systems can help speed the move toward becoming an On Demand Business, helping to create a competitive advantage in difficult business environments. Advantages include:

► Innovative integration

► A better way to do Windows

► Linux with integrated operations

► Exceptional storage management

► Flexible server deployment

► Additional key benefits

The iSeries system provides the following benefits to the Linux and Windows server™ customer:

► A hardware platform of proven reliability and stability

► Virtual disk, enabling RAID-5 and disk striping to be deployed without extra effort

► Virtual LAN, which enables a Windows server and Linux partition to communicate with OS/400 or another iSeries efficiently, but without expensive gigabit hardware

► The ability to "right size" disk storage to what is needed using virtual disk, rather than to the size of the device

► The ability to share OS/400 hardware that provides access to large amounts of direct access storage device (DASD) and centralized management of resources

► Server consolidation

► Potentially initiating interaction with a large portfolio of existing e-business and business applications

A Linux environment with the iSeries platform offers the following benefits:

► Most of the benefits of Windows, plus the following benefits unique to Linux:
  – Involvement in the open source community
  – New possibilities for Web applications and components

► Leverage the IBM investment in Linux

► Expand its Internet flexibility and scope, as the ability to integrate with Linux expands

► Potentially gain access to new hardware through Linux drivers

For more information, see:

  http://www.ibm.com/servers/eserver/iseries/integratedxseries/

The most common benefits of integration into a single server are:

► Administration perspective

► Total application

► Physical

► Management

► Cost

In the following sections, we discuss these benefits in more detail.

1.2 Administration perspective

From an administrative perspective, you have many opportunities to use the following iSeries integrated xSeries solution capabilities:

► Centralized, graphical server management

► Synchronized security

► Consolidated backup

► Reliable, highly secure, high-speed communication

► Exceptional storage management

► Flexible and reliable server deployment

► Support for complementary applications

1.2.1 Centralized, graphical server management

iSeries Navigator provides a graphical user interface for managing both i5/OS (the next generation of OS/400) and Integrated xSeries Servers. Administrators can easily start and stop servers, enroll i5/OS users to a Windows domain, and perform storage management tasks, such as adding new virtual disks to an xSeries. iSeries Navigator for Wireless enables administrators to view server status, star and stop servers, and run Windows commands for Integrated xSeries Servers from a Web-enabled cell phone.

Enhancements to iSeries Navigator

iSeries Navigator is a Windows-based, fully graphical interface for OS/400 operations. It is as easy way to perform many of the operational tasks in a well-designed graphical user interface (GUI). iSeries Navigator has been designed from the ground up to be logical, consistent, and easy to use. Wizards are used extensively to make configuration easier. Using iSeries Navigator, you do not need to remember commands, and you see much more information in the windows than on a text-based display. There are some exceptions when using iSeries Navigator, for example, the iSeries system shutdown command is not available in iSeries Navigator. iSeries Navigator is the strategic choice for performing OS/400 operational tasks and is the best choice if you are the new to iSeries.

iSeries Navigator is enhanced with functions for managing Windows and Linux in a logical partition, including the ability to:

► Start a server

► Shut down or stop a server

► Create a disk drive

► Link a disk drive to the server

► Unlink a disk drive from the server

► Delete a disk drive

To find other information about what is new or changed in iSeries Navigator, visit the IBM @server iSeries Information Center at:

```
http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info
/rzaj2/rzaj2whatnew.htm
```

It is simple to access the Linux and Windows administration functions of iSeries Navigator. You simply:

1. Launch iSeries Navigator from your Windows desktop.

2. Expand your iSeries connection.

3. Expand **Network**.

4. Expand **Windows Administration**.

5. Expand **Integrated xSeries Servers**, as shown in Figure 1-1 on page 5.
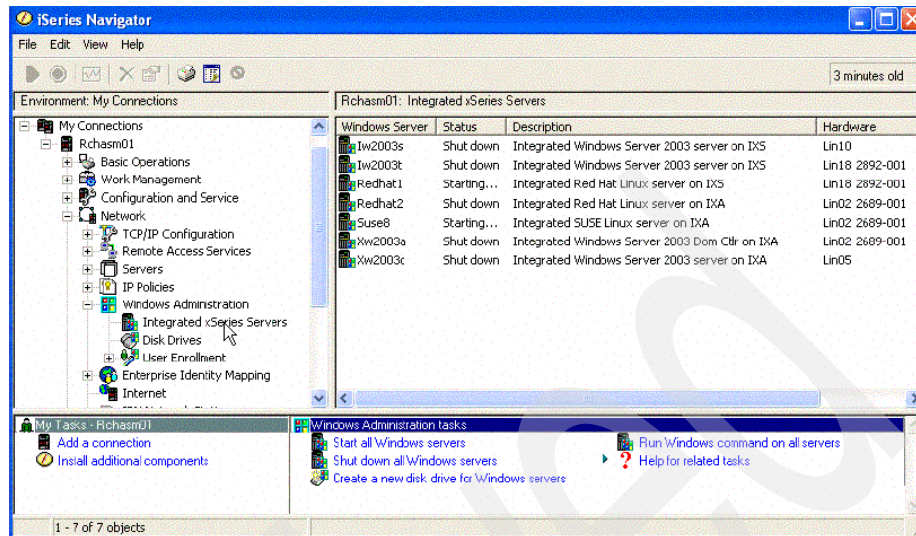
Figure 1-1   Accessing iSeries Navigator for administration functions

The administration of integrated Linux servers is included under the Windows Administration option of iSeries Navigator, because the implementation of the integrated Linux server uses the same basic architecture and code as the integrated Windows server, and because both implementations use network server descriptions and storage spaces.

You can see integrated Linux servers displayed next to integrated Windows servers in the example shown in Figure 1-1. However, there are some Windows administration functions, such as Windows User Enrollment, that are not available in the initial implementation of Linux integration support. The following sections describe two functions of iSeries Navigator.

Integrated xSeries Servers

This function is used to manage integrated Linux and Windows server instances installed on iSeries. You can also use the WRKCFGSTS *NWS CL command from the OS/400 command line. In Figure 1-2 on page 6, we see an example of a number of integrated Linux and Windows servers.

Figure 1-2   Windows and Linux server instances

Disk Drives

This option is used to manage integrated Linux and Windows server disk drives, and is similar to the OS/400 command WRKNWSSTG that you can enter on the OS/400 command line.

Figure 1-3 on page 7 shows an example of the Disk Drives option. To view and customize the information shown in the window, refer to *Implementing Linux on Integrated xSeries Solutions for iSeries*, SG24-6379, available at:

    http://www.redbooks.ibm.com/abstracts/sg246379.html
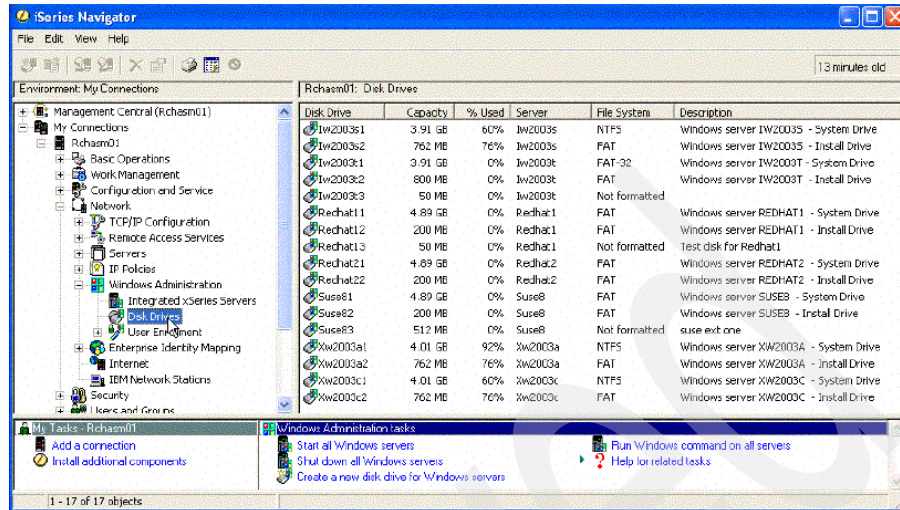
Figure 1-3   Windows and Linux server disk drives

1.2.2 Synchronized security

With integrated xSeries solutions, i5/OS and Windows server user IDs and passwords can be integrated and centralized. When a user is added to i5/OS, the user can be automatically added to the Windows environment with proper authorities. When the user changes their OS/400 password, the user's Windows password can be automatically synchronized. Or, through Enterprise Identity Mapping (EIM) integration in i5/OS, if the user indicates that the profile is to be used in a single sign-on (SSO) environment, the user's password can be managed from within Windows. This integration helps reduce user administration costs because it cuts down on the maintenance of multiple user IDs, passwords, and authorizations across multiple IT environments. It also provides greater security by reducing the number of passwords when supporting a single sign-on environment.

Enterprise Identity Mapping (EIM), described in the following section, is a mechanism for mapping (associating) a person or entity to the appropriate user identities in various registries throughout the enterprise.

Enterprise Identity Mapping

Enterprise Identity Mapping (EIM) provides an infrastructure that lowers the expense for application developers to provide single sign-on solutions. The OS/400 exploitation of EIM and Kerberos, along with exploitation by other IBM platforms and IBM software, provides single sign-on capabilities. This, in turn, provides users, administrators, and application developers with the benefits of

easier password and user identity management across multiple platforms, without changing the underlying security schema.

EIM enables OS programmers and independent software vendors (ISVs) to independently implement support for a single sign-on environment without having to wait for support from a specific product vendor.

EIM is a part of the IBM autonomic computing initiative, whose goal is to give businesses the ability to manage systems and technology infrastructures that are hundreds of times more complex than those in existence today.

The initiative represents the next stage of development under new tools. Self-managing servers are the ultimate in new tools for our customers. They are self-optimizing, self-configuring, self-healing, and self-protecting.

Advantages of using EIM

EIM makes it easy for customers to associate a user's multiple identities in the enterprise and to manage those associations. You can develop this in such a way that it can be extended to other facets of cross-platform management and simplify administration. Additional benefits include:

► Relies on existing security semantics already in place for existing data.

► Reduces the load on administrators for "lost" passwords.

► Reduces client-side risks (cached passwords, hand-written notes, and so on).

► Provides better application design.

► No need to implement new user registries.

► No need to define or enforce additional security semantics.

► Provides maximum flexibility for distributed, multi-tier application developers.

► Simplifies the process for the user; access is controlled under the covers.

► Provides seamless audit trails in a multi-tier environment.

Single sign-on (SSO)

Sign on once to the network using, for example, a user ID and password. Subsequent connection requests to application services and resources are authenticated without prompting for the user ID and password again. Network authentication protocols, such as Kerberos, are used to perform authentication.

Taking multiple user identities for various applications for a single user into consideration is a very desirable function. Figure 1-4 on page 9 shows SSO connectivity between systems.

Figure 1-4   SSO connectivity between systems

For more information, refer to *Windows-based Single Signon and the EIM Framework on the IBM @server iSeries Server*, SG24-6975, available at:

    http://www.redbooks.ibm.com/abstracts/sg246975.html

Also, refer to the following information:

    http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info
    /rzalv/rzalvplan.htm

Kerberos

Kerberos has grown out of the need for a secure protocol that enables users to identify themselves to applications and services. Normally in a network, information is transmitted across the network in an insecure form, usually plain text. This presents a security problem for many organizations, because passwords and confidential data are transmitted without any security on the network. Malicious hackers, whether internal or external, have the opportunity to write malicious programs that can take advantage of these plain text transmissions on the network. By monitoring the contents of packets as they are transmitted across the network, hackers are able to intercept passwords and read and change data that might be sensitive to the operation of the business. Kerberos removes many of the risks by encrypting passwords, reducing or eliminating the use of passwords, and providing a method to check the data integrity.

The current version of Kerberos is Version 5, which is standardized in RFC 1510, the Kerberos Network Authentication Service (V5). For details, see:

http://www.ietf.org/rfc/rfc1510.txt

Kerberos is one of the possible solutions to your network security problems. It provides the tools for authentication and strong cryptography over the network to help you secure your information systems across your entire enterprise. Kerberos authentication itself does not automatically imply that an entire session is encrypted. However, Kerberos enables a secure exchange of encryption keys that can be used by a client program for session encryption. iSeries Access, for example, does not implement the encryption part of Kerberos, but iSeries Access traffic can be encrypted by Secure Sockets Layer (SSL) instead.

It is also important to understand what Kerberos cannot do or is not defined to do in order to know what else is needed to work with Kerberos in an organization's infrastructure.

For more information, see *Windows-based Single Signon and the EIM Framework on the IBM @server iSeries Server*, SG24-6975, available at:

http://www.redbooks.ibm.com/abstracts/sg246975.html

Figure 1-5 shows how all the different Kerberos components fit together to perform a Kerberos network solution.
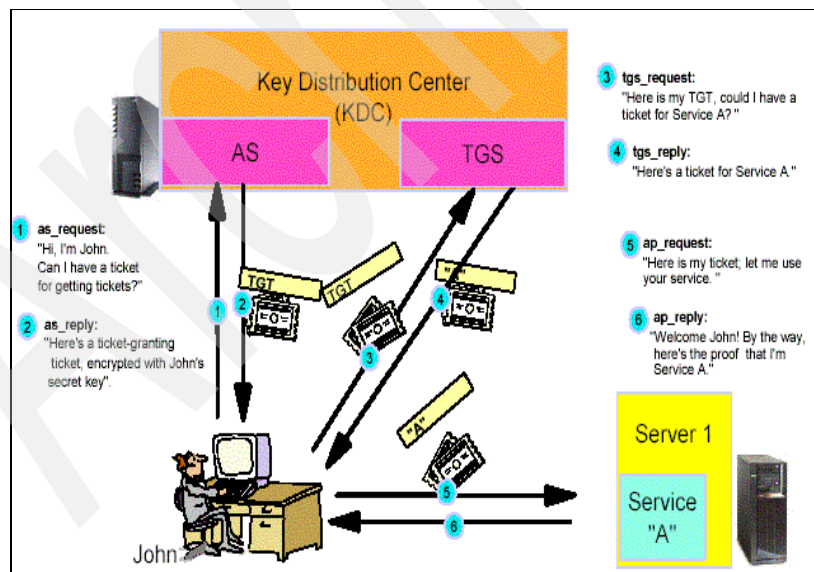

Figure 1-5   Kerberos overview

The different components that fit into the implementation of the Kerberos protocol are:

► Tickets

► Principals and realms

► Key Distribution Center (KDC)

► Services

For more information, refer to:

```
http://www.ietf.org/rfc/rfc1510.txt
http://www.redbooks.ibm.com/abstracts/sg246975.html
```

1.2.3 Consolidated backups

Integrated xSeries solutions provide consolidated i5/OS, Windows, and Linux backups, enabling businesses to more fully leverage hardware and IT support resources. In a typical Windows server farm, data might be scattered across multiple servers, with backup processes running on each one and multiple tape drives to manage. With iSeries and xSeries server integration, i5/OS, Windows, and Linux storage and backup resources are shared and consolidated. One tape device can perform automated backup for the entire infrastructure. It is that simple.

Automating backup and recovery

Backups are one of the key areas that many people want to automate from i5/OS or OS/400 because of the sophisticated backup application support, high-speed tape drives, and powerful scripting capabilities. Therefore, when we talk about automation, we are really looking at automating backup- and recovery-related functions from the OS/400 side. Typically, most people want to automate backups by running unattended backups overnight when their systems are not being used. You can automate the backup (and recovery) of an Integrated xSeries Server from the i5/OS or OS/400 side at a storage-space level. To do so, write command line (CL) programs to automate backup and recovery tasks.

If you want to perform an unattended storage space backup of an Integrated xSeries Server, you can incorporate the backup into a program by including the appropriate CL commands. This means that you can save your OS/400, Linux, and Windows server environments unattended as part of a single backup procedure.

If you decide to go with the OS/400 backup option, we recommend that you review your Linux and Windows server backup requirements with the person in your organization who is responsible for backing up the iSeries to make sure that the OS/400 backup procedures include the Linux and Windows server integration

components (network server description, communications objects, and so on). Many organizations modify the default OS/400 backup options to suit their own requirements. Verify that your organization has not removed the commands that save the Linux and Windows integration objects.

For more information, see the following resources:

► IBM @server iSeries Information Center

  http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm

► *Linux on the IBM @server iSeries Server: An Implementation Guide*, SG24-6232

  http://www.redbooks.ibm.com/abstracts/sg246232.html

Share devices

One advantage Integrated xSeries Servers have is the ability to use iSeries devices. You can use iSeries optical drives and tape drives and your Linux and Windows server.

Accessing iSeries devices

OS/400 and Integrated xSeries Server refer to devices by different names, so you first need to learn the appropriate device descriptions and hardware resource names you plan to use. For more information, see the "Determine the device description and hardware resource names for iSeries devices" topic in the iSeries Information Center, available at:

  http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm

To use an optical drive on an integrated xSeries, vary it on from OS/400. For more information, see the "Use iSeries optical drives with integrated xSeries Windows servers" topic in the iSeries Information Center.

See the "Use iSeries tape drives with integrated Windows servers" topic for information about allocating drives to integrated Windows servers, formatting tapes, transferring drives between servers, and transferring drives back to OS/400.

i5/OS or OS/400

A storage space can be saved to disk either by saving it to a save file, or by copying it to a another storage space.

Using the GO SAVE command is a simple way to make sure that you have a good backup of your entire server. The GO SAVE command presents you with Save menus that make it easy to back up your server, no matter what backup strategy you decide to use. It is a good idea to use menu option 21 of the GO SAVE command right after you install your server.

Menu option 21 of the GO SAVE command is the basis for all save strategies. This option enables you to perform a complete save of all the data on your server. After using menu option 21, you can use other menu options to save parts of the server, or use a manual save process. For more information, see *IBM @server iSeries Backup and Recovery Version 5*, SC41-5304, available at:

```
http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/info/rzaiu/sc4
15304.pdf
```

Another save method uses Backup, Recovery, and Media Services (BRMS) to automate your save processes. BRMS provides a comprehensive and easy solution for your backup and recovery needs. For more information about BRMS, see:

```
http://publib.boulder.ibm.com/iseries/v5r3/ic2924/index.htm?info/rzaiu/rzai
uintro.htm
```

Figure 1-6 on page 14 illustrates the commands and menu options you can use to save parts of the server and the entire server.
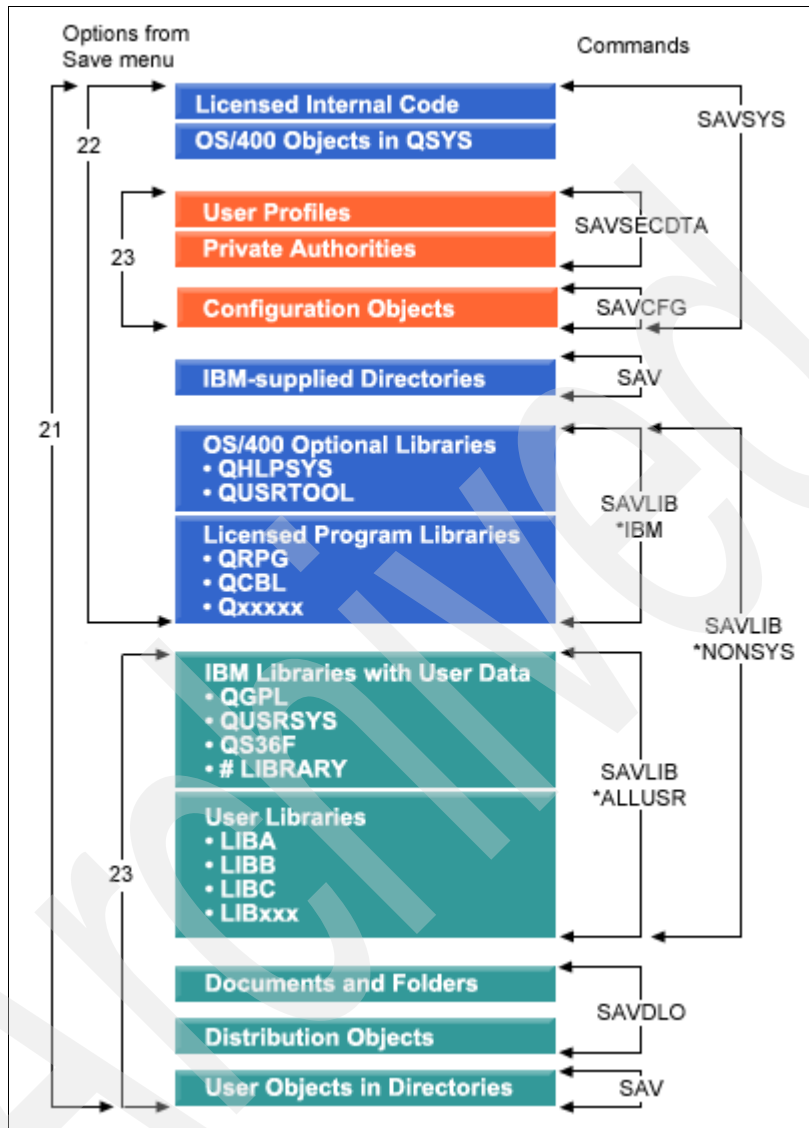
Figure 1-6   Go Save menu

Linux

Linux files can be saved to disk through the Linux console using Linux utilities
and backup applications. Linux backup utilities such as `tar`, `cpio`, and `dump`
provide a capability similar to that provided by OS/400 save files in that you can
save multiple files to a single archive on disk or tape. Archives can also be

created directly on a shared integrated file system (IFS) directory using iSeries NetServer™ and Samba.

If you use tape drives for back up, refer to:

http://www.ibm.com/servers/eserver/iseries/integratedxseries/linux/tape_support.html

Microsoft Windows

The Windows environment on iSeries combines two operating systems (Windows 2000 Server or Windows Server 2003 with OS/400). You can use OS/400, Windows server utilities, or a combination of both to manage backups. When you plan your backup strategy, refer to the "Backup and recovery topic" in the iSeries Information Center and Microsoft documentation.

To back up an integrated server on iSeries, you have these basic options:

- ► Do a full system backup on your OS/400. See the topic "Back up your server."
- ► Back up the network server description (NWSD) and the disk drives that are associated with the integrated server on iSeries. See the topic "Back up the NWSD and disk drives associated with an integrated Windows server."
- ► Back up individual integrated server files by using the OS/400 SAV and RST commands and iSeries NetServer or a backup utility. See the topic "Back up individual integrated Windows server files and directories."

For more information about these options, see the iSeries Information Center at:

http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm

Recommendation: To be fully protected against data loss, we recommend that you perform backups at both a storage space and file level. Storage space backups protect you against a complete loss of the iSeries system or Linux server, while file level backups enable you to recover individual files.

Figure 1-7 on page 16 shows an IFS tape selection.
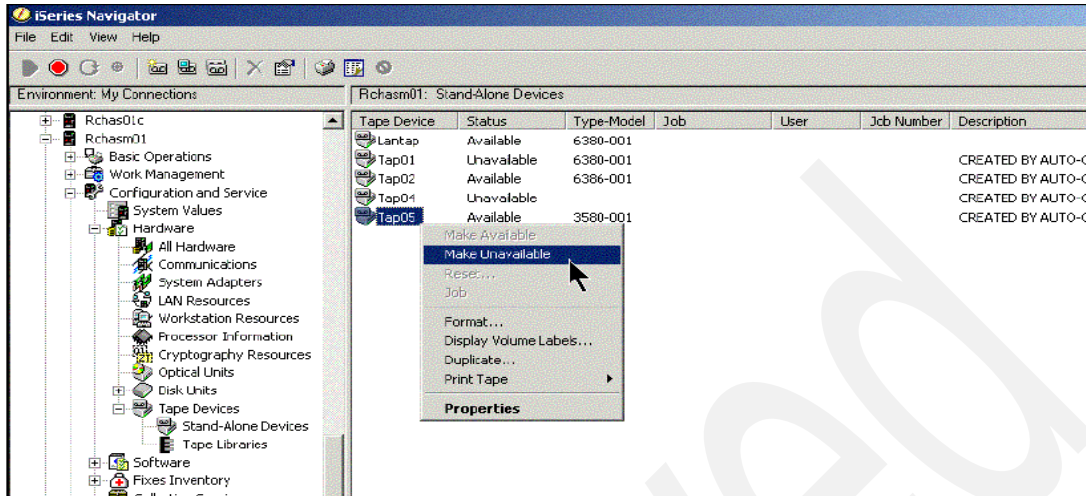
Figure 1-7   IFS tape selection

1.2.4 Reliable, highly secure, high-speed communication

i5/OS and OS/400 operating systems and Integrated xSeries Servers running Windows and Linux are able to communicate over high-speed virtual Ethernet network connections. These networks can be used for Windows-to-Windows, Windows-to-i5/OS or even Windows-to-Linux on POWER™ technology-based communications. Because there are no cables, connectors, hubs, or routers, there are fewer points of potential failure. Network traffic travels inside the iSeries, not across external networks. Virtual Ethernet networks can isolate server-to-server traffic and help provide more reliable and secure communications, faster network communications (1 Gbps) between servers, and reduced external network traffic.

iSeries offers the virtual Ethernet LAN facilities to support partition-to-partition communication. With virtual Ethernet, up to 16 networks can be defined for application communication. These connections can provide 1 GB performance and do not require LAN adapters, switches, or physical networks.

Virtual LAN consideration

You can use virtual Ethernet as an alternative to using a network card for inter-partition communication. It enables you to establish high-speed communication between logical partitions without purchasing additional hardware. For each of the 16 ports enabled, the system creates a virtual Ethernet communications port, such as CMNxx with a resource type of 268C. Logical partitions assigned to the same local area network (LAN) then become

available to communicate through that link. A physical system enables you to configure up to 16 different virtual local area networks. Virtual Ethernet provides the same function as using a 1 GB Ethernet adapter. Token-ring or Ethernet 10 Mbps and 100 Mbps local area networks are not supported with virtual Ethernet.

Figure 1-8 shows a virtual Ethernet that enables communication among four logical partitions and uses proxy Address Resolution Protocol (ARP) to allow the data to flow between the virtual area network.
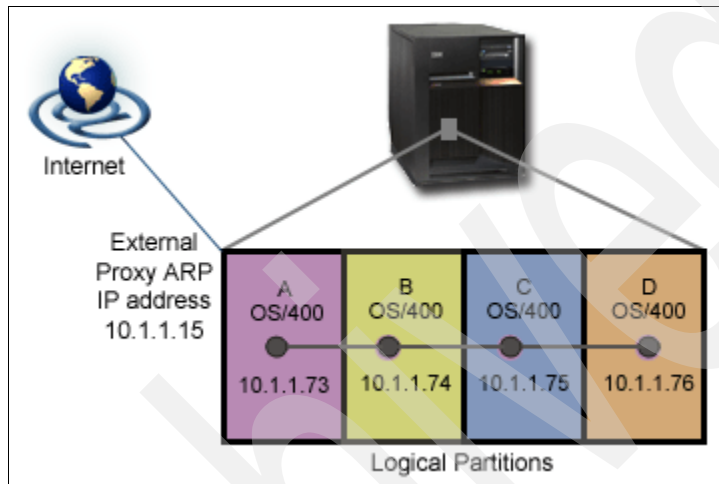
Figure 1-8   Virtual LAN connectivity

Virtual Ethernet is an economical networking solution that provides substantial benefits:

► Economical

Potentially no extra networking hardware is required. You can add partitions to the server and communicate with an external LAN without installing extra physical LAN cards. If the current server has limited available card slots in which to install additional LAN cards, using virtual Ethernet offers the capability to operate LAN-attached partitions without the requirement to upgrade the server.

Figure 1-9 on page 18 shows a virtual LAN connectivity example.
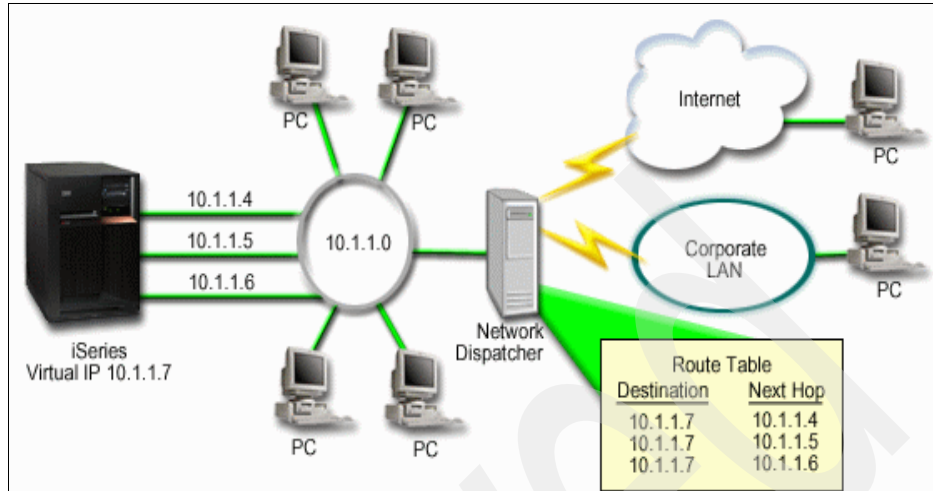
Figure 1-9   Virtual LAN connectivity example

► Flexible

You can configure a maximum of 16 distinctive connections, enabling the configuration of selective communication paths between partitions. For added flexibility, the configuration model allows logical partitions to implement both a virtual Ethernet and physical LAN connection. This is a desirable feature when using the Linux partition to host a firewall application.

► Fast

The virtual Ethernet emulates a 1 GB Ethernet connection and provides a fast and convenient communication method between partitions. This enhances the opportunity to integrate separate applications that run on different logical partitions.

► Versatile

Regardless of whether your partitions are running on OS/400 or Linux and Windows on an Integrated xSeries Server, they can all be connected to the same virtual Ethernet.

► Reduced congestion

By using the virtual Ethernet for inter-partition communication, communication traffic is reduced on the external LAN. In the case of Ethernet, which is a collision-based standard, this will help prevent a degradation of service for other network or LAN users.

For more information, refer to the virtual Ethernet topics in the iSeries Information Center, available at:

http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm

1.2.5 Exceptional storage management

One of the most significant advantages of the iSeries family of servers is its unique storage architecture that can provide more flexibility than conventional Linux and Windows server implementations, where there are typically dedicated disk drives attached to every server and each server's capacity is managed separately. With @server iSeries and @server i5, there can be one pool of disk drives that i5/OS or OS/400 and Linux and integrated xSeries all use and i5/OS or OS/400 can automatically spread the data across all the physical disk drives on the system. This architecture can provide tremendous performance advantages and more efficient use of storage resources.

With the Integrated xSeries Server and Integrated xSeries Adapter, the superior storage area network-like management capabilities of the iSeries systems are made available for Windows and Linux transparently. Disk storage is allocated to xSeries by creating a storage space object (that is, virtual disk space) from the i5/OS or OS/400 pool of available capacity. Up to 32 storage spaces can be created and linked to each Integrated xSeries Server or xSeries attached through an Integrated xSeries Adapter. Each storage space can be up to 1 TB in size, for a maximum of up to 31 TB per Windows server.

In addition, multiple storage spaces can be linked together using the Windows disk administrator utility for large volume sets. Storage spaces can be added dynamically to an xSeries server using i5/OS or OS/400 storage management facilities.

Figure 1-10 on page 20 shows an example of user-defined storage.
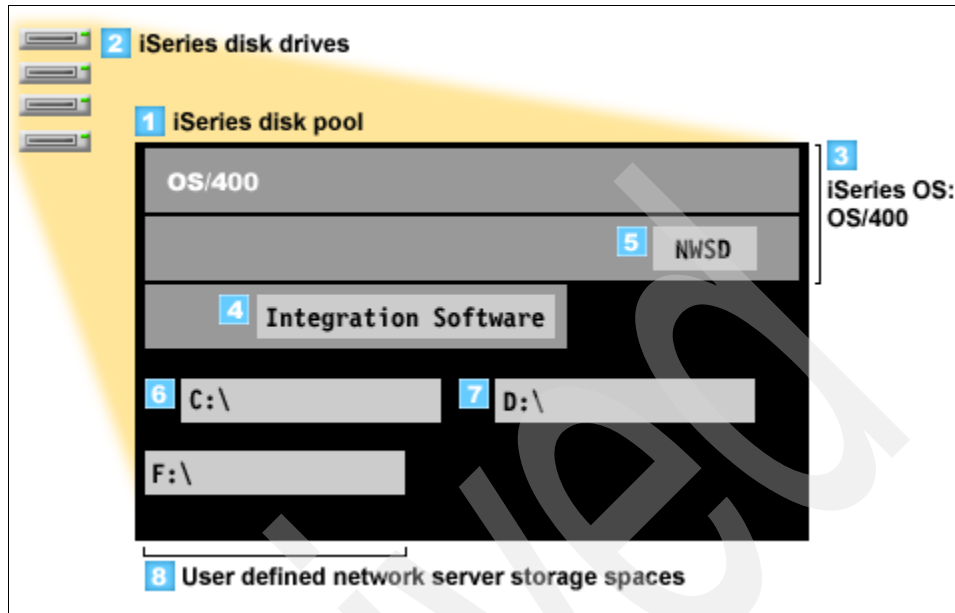
Figure 1-10   Example of user-defined storage

iSeries storage

The iSeries system has a unique way of addressing storage. It views the disk space on your server and your server's main memory as one large storage area. This way of addressing storage is known as single-level storage.

Figure 1-11 shows how single-level storage works.
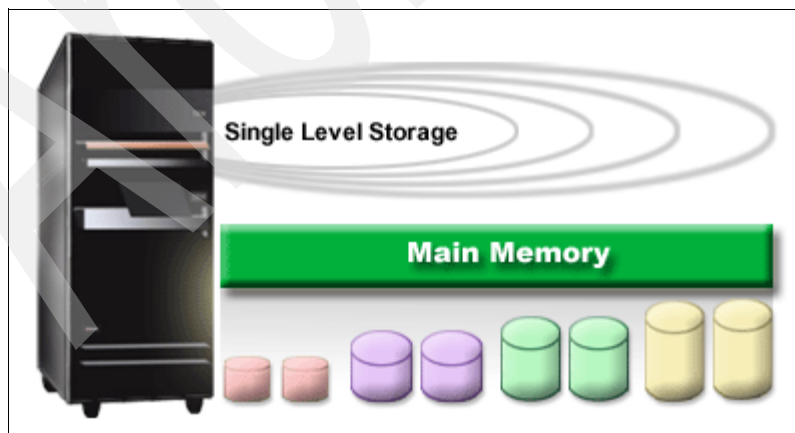
Figure 1-11   Example of single-level storage

Direct access storage device (DASD)

Disk storage is the storage that is usually internal to your iSeries system; however, it can also be attached externally to it. You can group your disk drives into logical subsets called disk pools (also known as auxiliary storage pools or ASPs). One reason to do this is to provide a level of protection for your data. If one disk unit fails, you only have to recover the data stored in the disk pool of which the failed disk unit was a part.

Disk pools also enable you to set disk space aside for a particular purpose, application, or data type. For example, you can create a disk pool for backups done to save files. You can then move these save files to tape or other media when it is convenient for you. Figure 1-12 shows a disk pool that is composed of disk units 1, 4, 5, 7, and 11.

For more detailed information about using disk pools for different purposes, refer to:

    http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info
    /rzaly/rzalyaspsovrvw.htm

For information about how to configure disk units and disk pools, refer to:

    http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info
    /rzaly/rzalyoptimize.htm
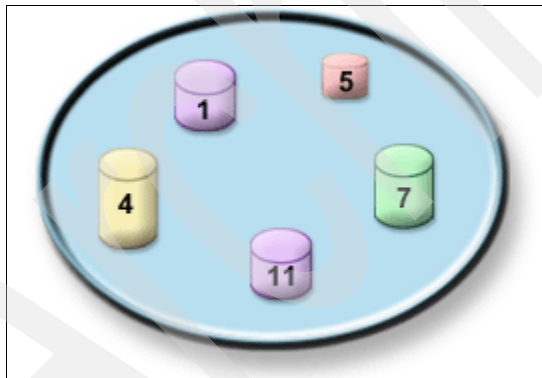
Figure 1-12   Disk pool example

Independent disk pools can be brought online or taken offline without any dependencies on the rest of the storage on a system. This is possible because all of the necessary system information associated with the independent disk pool is contained within the independent disk pool. Independent disk pools offer a number of availability and performance advantages in both single and multiple system environments.

For detailed information, refer to:

```
http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info
/rzaly/rzalyoverview.htm
```

Besides disk pools, there are a few other ways to protect your disk units and the data on them. *Mirrored protection* protects your data by keeping a copy of the data on two separate disk units. When a disk-related component fails, the system can continue to operate without interruption by using the mirrored copy of the data until the failed component is repaired. *Device parity protection* is a hardware function that enables your server to reconstruct data in the event of a disk failure. It is important to remember that these disk protection methods are not a guarantee against failure or data loss. You still need to have a good backup and recovery strategy in place in order to truly protect your data. For detailed information, refer to:

```
http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info
/rzaly/rzalyprtctvsdtalss.htm
```

Compared to tape or optical, disk is a more expensive storage option. However, the data on disk is more quickly accessible than on tape or optical. It is important to balance the cost of storing data on disk with the speed and convenience with which you can access that data.If you have older data that you access infrequently, you might want to consider storing it on tape or optical, rather than on disk. Likewise, current information that you access frequently might be worth the cost of disk storage because you can access it quickly.

This type of storage strategy is called *hierarchical storage management*. Figure 1-13 on page 23 shows the different layers of hierarchical storage management.
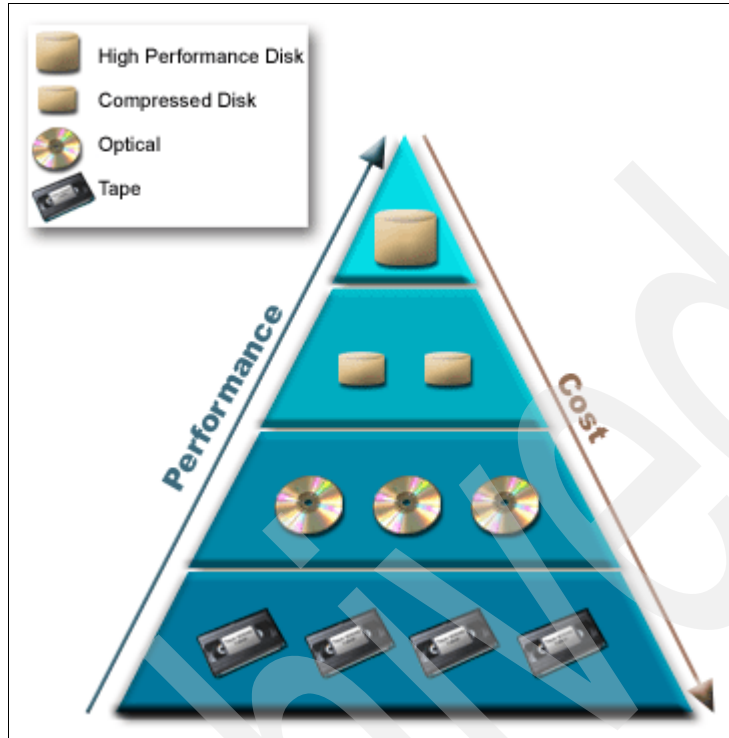
Figure 1-13   Hierarchical storage a management

For more information, see *IBM AS/400e Hierarchical Storage Management*, SC41-5351, available at:

> http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/info/rzam4/sc415351.pdf

Disk protection

OS/400 disks can be protected in two ways:

► RAID-5

The RAID-5 technique groups several disks together to form an array. Each disk holds checksum information of the other disks in the same array. If a disk fails, the RAID-5 disk controller can re-create the data of the failing disk with the help of the checksum information on the other disks. When you replace a failing disk with a new one, OS/400 can rebuild the information from the failed disk on the new (and therefore empty) disk.

► Mirroring

Mirroring keeps two copies of data on two different disks. OS/400 performs write operations on both disks at the same time and can simultaneously perform two different read operations on the two disks of a mirrored pair. If one disk fails, OS/400 uses information from the second disk. When you replace the failing disk, OS/400 copies the data from the intact disk to the new disk.

Information about Integrated xSeries Server disk drives

If you want to know what percentage of an integrated server disk drive (network server storage space) is in use or what its format is, you can obtain the information from OS/400. Follow these steps:

1. In iSeries Navigator, select **Network** → **Windows Administration** → **Disk Drives**.

2. Select a disk drive from the list.

3. Right-click the disk drive and select **Properties**.

If you want to use the CL command, see the "Work with Network Server Storage Spaces (WRKNWSSTG)" topic in the iSeries Information Center.

Add disk drives to Integrated xSeries Servers

Creating and formatting what the integrated xSeries perceives as disk drives for your applications and data involves creating network server storage spaces on OS/400. For conceptual information about user-defined network server storage spaces, refer "Disk drives for integrated Windows servers" topic at:

    http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info
    /rzahq/rzahqstcco.htm

To add an integrated server disk drive (network server storage space), perform these tasks:

1. Create an integrated server disk drive. Refer to:

    http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info
    /rzahq/rzahqcstpi.htm

2. Link a disk drive to an integrated server. Refer to:

    http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info
    /rzahq/rzahqlstpi.htm

3. Format integrated server disk drives. Refer to:

    http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info
    /rzahq/rzahqfstpi.htm

Dynamic disk drive unlinking

The i5/OS V5R3 iSeries Integrated xSeries Server and Integrated xSeries Adapter offerings are enhanced to allow disk drives (network server storage spaces) to be unlinked (removed) from an active Windows or Linux server. Among other things, this enables additional Windows and Linux server backup scenarios.

You can use either the Windows administration function of iSeries Navigator or the i5/OS Remove Server Storage Link (RMVNWSSTGL) command to dynamically unlink a disk drive from an active server.

Only the disks that are linked with the *dynamic* link type can be dynamically unlinked. When using iSeries Navigator, the "Dynamic" link type must be used. When using the i5/OS ADDNWSSTGL command, the "Dynamic storage link" parameter must be *YES and the "Access" parameter must be *UPDATE.

The following conditions must be satisfied before the disk drive can be dynamically unlinked:

► Users and applications cannot be using the disk drive.

► There cannot be any drive mappings to the disk drive.

► For Linux servers, the volumes on the disk drive must be unmounted.

► For Windows servers, the disk drive cannot contain spanned volume sets. Windows Explorer cannot be opened to volumes on the disk drive.

For more information, refer to:

http://www.ibm.com/servers/eserver/iseries/integratedxseries/dunlink.html

It might not be possible to dynamically unlink some of the disk drives on the server. For example, the system drive and install drive (the first two disk drives that are linked to the server) cannot be dynamically unlinked because they cannot be linked with the dynamic link type. In addition, the server operating system and the iSeries integration support are always accessing the system drive and install drives, so even if they were linked with the dynamic link type, they still could not be dynamically unlinked. Likewise, if your server has other disk drives that are always in use by users or applications, the dynamic unlink function will not work for those disk drives.

Note: If the main reason that you want to dynamically unlink a disk drive is to back up the data on that drive, see "Additional backup scenario" on page 26.

Effects on the Windows or Linux server

When a disk drive is dynamically unlinked without shutting down the Windows or Linux server, users and applications on the server will see the following effects:

► Volumes on the disk drive will no longer be accessible.

► In Windows Disk Drive Management, a reference to the drive might still be there if using dynamic volumes.

► Windows event log messages or device removed pop-ups might be seen, because the SCSI bus disk drive device has been removed.

> **Note:** Disk drives can be dynamically re-linked for instant access to the volumes on the disk drive.

Additional backup scenario

The ability to unlink a disk drive from an active server enables additional methods for backing up the server. The following scenario illustrates one way to do a file-level backup of a Windows or Linux server:

1. Create a temporary disk drive to hold the backup data using the CRTNWSSTG command.

2. Dynamically link the temporary disk drive to the active server using the ADDNWSSTGL command.

3. Format the temporary disk drive with a volume using the appropriate Windows or Linux method.

4. Use a native Windows or Linux backup application to do a file-level backup of the server files on other disk drives, specifying to store the backed up files on the temporary disk drive.

5. Dynamically remove the temporary disk drive from the server using the RMVNWSSTGL command.

6. Perform an OS/400 or i5/OS backup of the temporary disk drive using the SAV command.

This entire process can be performed while the Windows or Linux server is active, so there is no need to bring the server down when backing it up.

The key to making this backup scenario work is that only the native Windows or Linux backup application needs to access the volume on the temporary disk drive. When the backup application ends after backing up the server files to the temporary disk drive, there are no users of the temporary disk drive anymore, and it can be safely removed without affecting users or applications on the server.

To restore one or more files from the previously described backup, perform the following steps:

1. Perform an OS/400 or i5/OS restore of the temporary disk drive using the RST command.

2. Dynamically link the temporary disk drive to the active server using the ADDNWSSTGL command.

3. Use the native Windows or Linux backup application to restore one or more files from the temporary disk drive.

4. Dynamically remove the temporary disk drive from the server using the RMVNWSSTGL command.

Requirements

Consider the following requirements:

► i5/OS V5R3 with some PTFs. See the following site for the latest list of PTFs that are required for V5R3:

> http://www.ibm.com/servers/eserver/iseries/integratedxseries/ptfs.html

► One of the following operating system versions running on an Integrated xSeries Server or Integrated xSeries Adapter-attached xSeries server:

– Windows Server 2003 Standard Edition
– Windows Server 2003 Enterprise Edition
– Windows Server 2003 Web Edition
– Windows 2000 Server
– Windows 2000 Advanced Server
– Red Hat Enterprise Linux 3.0 ES Edition
– Red Hat Enterprise Linux 3.0 AS Edition

For more information about Integrated xSeries Server and Integrated xSeries Adapter, refer to:

> http://www.ibm.com/servers/eserver/iseries/integratedxseries/ixs_overview.h
> tml
> http://www.ibm.com/servers/eserver/iseries/integratedxseries/xseriesmodels/

Refer to the Integrated xSeries Adapter install read me first page, available at:

> http://www.ibm.com/servers/eserver/iseries/integratedxseries/ixareadme/

1.2.6 Flexible and reliable server deployment

Integrated xSeries solutions and i5/OS storage virtualization provide innovative options that can enable customers to enhance the reliability and recoverability of their Windows server environment. If a Windows server fails, you can quickly and easily switch the server's storage spaces to another "hot spare" xSeries server

without restarting your @server iSeries or @server i5. This might easily reduce the overall number of Intel processor-based servers needed to provide increased availability. It also adds flexibility by enabling one "spare" server to be used to protect multiple production servers.

If automatic failover is required to support Windows application availability, integrated xSeries solutions support Microsoft Cluster Services in Windows Server 2003 Enterprise Edition and Windows 2000 Advanced Server.

A single xSeries integrated with an iSeries system can easily be used to support multiple test and deployment environments. One xSeries server can be made to "look like" any of the other servers, because the server hardware can be completely divorced from the storage spaces on which a specific Intel server configuration and data is installed. There is no physical boot drive within the xSeries server; all Windows drives are, in reality, just storage space objects in the i5/OS storage pool.

Storage virtualization provides tremendous flexibility for deploying new Intel processor-based servers, because everything needed to operate each Windows server is just data within a storage space. By copying storage spaces, new servers can be easily deployed and changes easily tested. Restoring storage spaces can allow rapid recovery of complete Intel servers in the event of a software failure or data corruption. It can also help reduce the time and complexity often associated with restoring a complete application infrastructure that relies on a combination of i5/OS, Windows, and Linux applications.

As shown in Figure 1-14 on page 29, you can reserve one of your Integrated xSeries Servers or Integrated xSeries Adapter-attached xSeries as a hot spare. If an integrated hardware resource fails for some reason (for example, a failed processor or power supply), all you need to do to get the server instance up and running again is to:

1. Shut down the server instance running on the failed hardware through iSeries Navigator or the OS/400 green screen.

2. Change the resource name in the server instance's NWSD to the hot spare machine.

3. Restart the server instance.
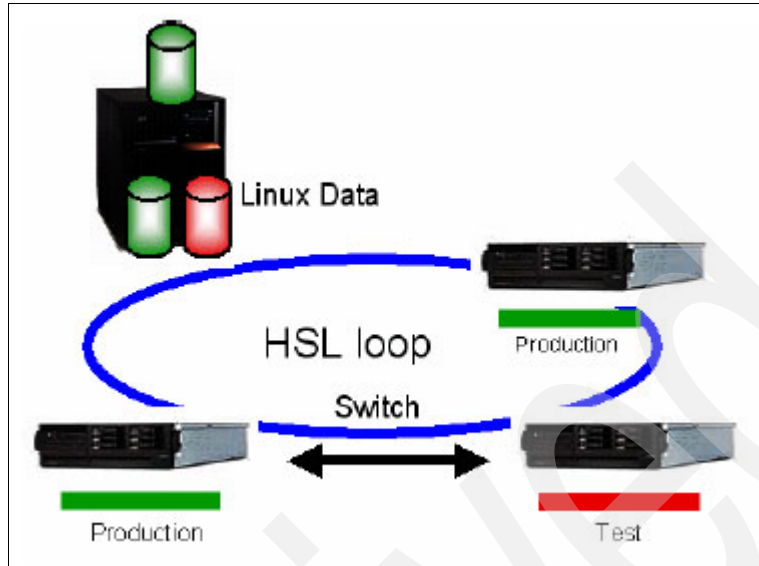
Figure 1-14   Hot spare example

This hot spare capability can be thought of as hardware hot spare. It is a very simple and effective way to protect your integrated Linux and Windows servers from hardware failures.

> **Note:** The hot spare capability we have been describing does not protect you against a software failure that renders your server inoperable. Such a failure can be caused, for example, by a faulty driver or bad application. Again, with a stand-alone server, you would probably need to rebuild the server. However, with an integrated server, you can save and restore the server's drives as complete objects. Therefore, even if you experience a catastrophic failure of the integrated server's system drive, you should be able to recover by simply restoring a copy of the drive from a recent backup. This capability can be thought of as software hot spare.

Both hardware hot spare and software hot spare are simple but effective techniques that provide your integrated Linux and Windows servers with a high level of availability.

Hot spare hardware compatibility

Switching a Windows or Linux server from one set of xSeries hardware to another is like migrating the Windows or Linux system drive from one PC to a second PC. Differences in the required hardware abstraction layer (HAL), the basic input/output system (BIOS) level, or the devices that are installed on the

two PCs can cause problems with the migration. During the initial boot of Windows or Linux on the second PC, hardware differences are detected and are handled in one of several ways.

Some can be automatically handled through plug and play. Others might require manual intervention, for example, a new device driver might need to be installed.

If the hardware differences are great enough, they could prevent the second PC from booting. For example, the two PCs might require incompatible versions of the HAL.

These same hardware compatibility considerations apply when hot sparing between Integrated xSeries Servers and between Integrated xSeries Adapter-attached xSeries servers. In order for the hot spare migration to work successfully, the hardware configurations of the two Integrated xSeries Servers or Integrated xSeries Adapter-attached xSeries servers must be closely matched.

Integrated xSeries Server hot spare

In order to use hot spare between Integrated xSeries Servers, they need to be compatible types, have a comparable configuration of LAN adapters, and so on. The Integrated xSeries Server configurations table gives the specific Integrated xSeries Server hot spare configurations that are supported, available at:

```
http://www.ibm.com/servers/eserver/iseries/integratedxseries/ixs_system_con
fig.html#configs
```

Integrated xSeries Adapter-attached xSeries server hot spare

In order to use hot spare between Integrated xSeries Adapter-attached xSeries servers, we strongly recommend that the two xSeries servers be the same type. For example, an xSeries 236 can be a hot spare for another xSeries 236. In addition, the xSeries servers should have a similar configuration of PCI adapters.

Note: It might be possible to hot spare between two xSeries server models that are not the same type. However, there are often significant hardware differences between xSeries models. Therefore, test the specific combination of xSeries server models that you plan to use for hot spare in this case. Test to verify that the xSeries server models have compatible hardware configurations and can be migrated seamlessly between each other before you use them for hot spare server backup in a production environment.

Windows Server 2003 activation

Each time a Windows Server 2003 server's storage spaces are switched to another hot spare xSeries server, Windows activation might be triggered. There

are a limited number of free activations per license key. If activation is triggered enough times, this might require a phone call to Microsoft in order to reactivate. This can limit the speed that a server can be reactivated. Volume licenses of Windows Server 2003 can help in this case, because there is no activation.

1.2.7 Support for complementary applications

Some software providers are delivering applications that leverage multiple server platforms. With these complementary applications, both OS/400 and Windows or Linux server environments are required to support the total solution. The Integrated xSeries Server and xSeries servers attached via Integrated xSeries Adapter are ideal ways to meet this requirement, by offering an integrated IBM solution.

For an example of how complementary applications can benefit from the integrated iSeries/xSeries environment, see white paper *IBM eServer iSeries Advantage: Benefits of Integrated xSeries Adapter for J.D. Edwards OneWorld / ERP 8.0*, available at:

> http://www.ibm.com/servers/eserver/iseries/integratedxseries/pdf/jdeixa.pdf

1.3 Integrated xSeries solution applications

This section provides information about applications and the integrated xSeries solution.

Proven application solutions

The Integrated xSeries Server is an xSeries ServerProven® platform on which software vendors can validate their applications, accelerating the time it takes to get them into production. The Integrated xSeries Adapter is a ServerProven hardware adapter. Many of the complementary applications available for the xSeries are also ServerProven.

Managed delivery of Windows applications

The integrated xSeries solution provides support for Citrix MetaFrame and Microsoft Windows 2000 Server or Windows Server 2003 (with built-in terminal server support) to deliver Windows personal productivity applications to the desktop. By serving Windows desktop applications on the server instead of installing them on every desktop, management can be dramatically simplified. Application software changes need be done only once, at the server level, and they're automatically and transparently rolled out to every desktop in the organization.

Microsoft Windows server and Linux server products supported

IBM supports selected Microsoft Windows server and Linux server products with the various integrated xSeries solutions. See the iSeries Windows integration and Linux on integrated xSeries solutions pages for details at:

http://www.ibm.com/servers/eserver/iseries/integratedxseries/windows/

> **Note:** IBM does not support Microsoft BackOffice® Small Business Server with the integrated xSeries solutions.

Applications for Linux are available from variety of sources:

► Linux distributions include 100s of open source applications and tools, including the Samba file and print server, Apache Web server, Netfilter firewall, and MySQL database.

► Other open source applications can be downloaded and complied for Linux-based, POWER-optimized solutions.

► Intel Linux applications recompiled for Linux-based, POWER-optimized solutions.

► Applications complied for Linux on POWER distributions will run on iSeries. For more information about the many applications offered by independent software vendors (ISVs), refer to:

http://www.ibm.com/servers/eserver/linux/power/isv_quotes.html

► IBM Software Group offers many products, including IBM WebSphere Application Server and IBM DB2® Universal Database™ (UDB).

For more information about Linux and IBM POWER-based processors, see:

http://www.ibm.com/developerworks/linux/power/

Microsoft Windows service packs supported

IBM has verified that various Microsoft Windows service packs work with the integrated xSeries solutions. Refer to the Microsoft service packs page for details.

> **Note:** IBM and non-IBM application software that is not "generally available" or has not "officially shipped" is not supported with the integrated xSeries solutions.

> **Note:** There are some special considerations for using any of the integrated xSeries solutions as a firewall. See "Firewall considerations for Windows servers" at:
>
> http://www.ibm.com/servers/eserver/iseries/integratedxseries/windows/fire wall.htm

iSeries Access for Linux support for an ODBC driver and 5250 session

iSeries Access for Linux includes an Open Database Connectivity (ODBC) driver to access iSeries database data from Linux applications written to the ODBC API and a 5250 emulator to access the iSeries system. The ODBC driver is based on the iSeries Access for Windows ODBC driver.

For further information, see the "iSeries Access for Linux" topic in the iSeries Information Center, available at:

http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info /rzatv/rzatvaccesslinux.htm

iSeries Access for Linux

iSeries Access for Linux is the latest offering in the iSeries Access product line. iSeries Access for Linux enables you to access the DB2 Universal Database (UDB) for iSeries using its ODBC driver and to establish a 5250 session to an iSeries system from a Linux client. Version 1.1 was supported on Linux operating systems with Intel processors and Version 1.2 and later versions support Power PC. Version 1.2 and later are supported on Linux operating systems with Intel processors and on Power PCs or an iSeries system logical partition (LPAR). Version 1.4 of iSeries Access for Linux is available. Version 1.4 works with servers that have OS/400 and i5/OS™ V5R1 and later.

iSeries Access for Linux includes:

► New IBM5250 -STAND_ALONE command line option. This allows multiple Virtual Network Computing (VNC) and Linux Terminal Server Project (LSTP) users to easily use the 5250 emulator.

► Support for some of the complementary applications.

Software providers are delivering applications for multiple server platforms. With these complementary applications, OS/400, Windows, or Linux environments are required to support the total solution.

The Integrated xSeries Server and xSeries servers attached through the Integrated xSeries Adapter are ideal ways to meet this requirement by offering an integrated IBM solution.

- Linux and POWER technology-based applications run on @server iSeries and @server i5, pSeries® and p5, @server BladeCenter™ JS20, and @server OpenPower™ systems. For more information, see:

  http://www.ibm.com/servers/eserver/linux/power/apps/all.html

WebSphere for Linux on iSeries

Get to market faster, meet the needs of a dynamic e-business, and boost developer productivity with the combined power of WebSphere, Linux, and iSeries.

IBM WebSphere Application Server V5.0.2 is now available for Linux on iSeries and pSeries. WebSphere provides an industry leading Web application solution on Linux to support new applications from solution providers and in-house development efforts.

WebSphere Application Server V5 is the premier Java 2 Platform, Enterprise Edition (J2EE™) and Web services technology-based application platform, offering one of the first production-ready application servers for the deployment of enterprise Web services solutions for dynamic e-business.

WebSphere Application Server running in a Linux partition on iSeries can leverage the data and applications running in OS/400 to extend applications to new users, customers, and partners.

With WebSphere Application Server for Linux on iSeries, you can leverage the on demand benefits offered by iSeries, including dynamic logical partitioning, shared processor, virtual storage management, virtual Ethernet LAN, and IBM @server On/Off Capacity on Demand. You can also leverage the skills and solutions available in the Linux marketplace. To learn more, read the *Linux on iSeries* white paper, available at:

  http://www.ibm.com/servers/eserver/iseries/linux/pdfs/iseries.pdf

Linux on iSeries supports the following WebSphere Application Server products:

- WebSphere Application Server V5.0.2
- WebSphere Application Server Network Deployment V5.0.2
- WebSphere Application Server Enterprise V5.0.2

For more information about WebSphere Application Server, see:

  http://www.ibm.com/software/webservers/appserv/was/

Linux distribution requirements include:

- SUSE LINUX Enterprise Server 8 for iSeries

► Turbolinux Enterprise Server 8 for iSeries

iSeries requirements include:

► iSeries system that supports Linux

For a listing of the servers that support Linux, see the Linux on iSeries system requirements page:

http://www.ibm.com/servers/eserver/iseries/linux/hardware.html

► OS/400 V5R2 or V5R1 with the appropriate updates

For a listing of the PTFs required, refer the Linux-related PTFs for OS/400 page:

http://www.ibm.com/servers/eserver/iseries/linux/ptfs.html

Integrated Platform for e-business

If you are evaluating using WebSphere to connect your OS/400 applications and data to new users, suppliers, or partners, the IBM @server Integrated Platform for e-business can cut the time, skill, and risk associated with setting up an e-business infrastructure. The Integrated Platform is a blueprint that sets up three Linux partitions on iSeries (WebSphere Application Server, firewall, and Web server) and provides a connection back to OS/400 and DB2.

DB2 for Linux on iSeries

The freedom of Linux. The power of DB2. The flexibility of iSeries. Bring them together, and you have got a flexible, scalable database solution that lets you get more done, faster than ever before.

DB2 UDB V8.1 is now available for Linux on iSeries. DB2 provides an industry leading database management solution on Linux to support new applications from solution providers and in-house development efforts.

DB2 UDB V8.1 includes DB2 Connect™, which provides another option for you to access information in DB2 on OS/400 from a Linux application. IBM also provides migration toolkits for moving data from Oracle, Microsoft SQL Server, or Sybase SQL Server.

With DB2 for Linux on iSeries, you can benefit the on demand options offered by iSeries, including dynamic logical partitioning, shared processor, virtual storage management, virtual Ethernet LAN, and On/Off Capacity on Demand. You can also leverage the skills and solutions available in the Linux marketplace. To learn more, read the *Linux on iSeries* white paper, available at:

http://www.ibm.com/servers/eserver/iseries/linux/pdfs/iseries.pdf

IBM Tivoli Storage Manager, Version 5.2 Client: Linux for iSeries

Combine the reliability of iSeries, the freedom of Linux, and the protection of IBM Tivoli® Storage Manager for robust, easy-to-manage enterprise data backup and restore function. Tivoli Storage Manager Client for Linux used with Tivoli Storage Manager Server for OS/400 enables customers to back up data from an iSeries Linux partition to most iSeries attachable tape devices.

Tivoli Storage Manager enhances the function of OS/400 backup and restore by providing automated, managed data archive and retrieval and a way to integrate iSeries backups, including Linux partitions on iSeries, with the backups of other servers in your enterprise. Specifically, Tivoli Storage Manager Client for Linux on iSeries enables customers to perform file- and directory-level backups of their iSeries Linux partitions from OS/400 or any other server running Tivoli Storage Manager Server.

iSeries Models 825, 870, and 890 Enterprise Edition

For deploying Tivoli Storage Manager on an iSeries, one server license for Tivoli Storage Manager Server V5 and five Tivoli Storage Manager Clients are included with iSeries Enterprise Edition Models 825, 870, and 890.

Requirements

The requirements include:

► Linux distribution:

– SUSE LINUX Enterprise Server 8 for iSeries

– Turbolinux Enterprise Server 8 for iSeries

► iSeries for Linux:

– iSeries system that supports Linux

– OS/400 V5R2 or V5R1 with the appropriate updates

For more information about the server requirements and PTFs, respectively, see the following sites:

```
http://www.ibm.com/servers/eserver/iseries/linux/hardware.html
http://www.ibm.com/servers/eserver/iseries/linux/ptfs.html
```

1.4 Physical considerations: Hardware overview

In this section, we discuss the basic information to plan and consider for the implementation of Linux and Windows on the Integrated xSeries Server or the Integrated xSeries Adapter.

First, we define the Integrated xSeries Server and Integrated xSeries Adapter:

► Integrated xSeries Server definition

  The Integrated xSeries Server is an Intel-based server on a PCI card. It can be plugged directly into an iSeries system without requiring the attachment on an external xSeries server. It has own processor (uniprocessor), memory, and LAN adapter, but it uses iSeries storage, such as DASD, tape, DVD, and system management resources, while operating as a stand-alone Windows server. Up to 32 Integrated xSeries Servers can be installed inside the iSeries system and I/O towers.

► Integrated xSeries Adapter definition

  Integrated xSeries Adapters are PCI-based cards installed inside selected xSeries servers. An Integrated xSeries Adapter provides a 1 Gbps high-speed link to iSeries system. This consecration provides centralized storage and systems management, allowing the attachments to 32 stand-alone, n-way xSeries servers to a single iSeries system, leveraging xSeries processing power while tapping into iSeries systems management and storage architecture.

The Integrated xSeries Server is a unique product that puts the power of an xSeries server on a single card that can be plugged into your iSeries.

You can view the latest hardware available at:

http://www.ibm.com/servers/eserver/iseries/integratedxseries

The following link provides a table that summarizes the integrated server configurations, which Integrated xSeries Servers work with which @server i5 or iSeries system models and which i5/OS, OS/400, Windows, and Linux versions, as well as hot spare support servers (Integrated xSeries Servers) work with which iSeries system models:

http://www.ibm.com/servers/eserver/iseries/integratedxseries/ixs_system_con fig.html

You can also view iSeries support to determine the maximum number of Integrated xSeries Servers that are supported by each iSeries system model:

http://www.ibm.com/servers/eserver/iseries/integratedxseries/ixs_model_supp ort.html

With Integrated xSeries Adapter, iSeries, Windows, and Linux benefits include:

► Provides flexible storage area network (SAN) management for Windows or Linux servers

► Delivers heterogeneous application solutions with one offering

► Consolidates up to 60 direct-attached xSeries servers

► Supports a less expensive high availability solution with hot spare technology

► Lowers the cost of user administration by synchronizing i5/OS and Windows profiles and passwords

► Reduces operations and skills costs through iSeries Navigator management

► Improves Windows and Linux server uptime and stability

For more information, refer to:

    http://www.ibm.com/servers/eserver/iseries/integratedxseries/2_0ghz.html

Figure 1-15 shows an example of an Integrated xSeries Server, and Figure 1-16 on page 39 shows an example of an Integrated xSeries Adapter.
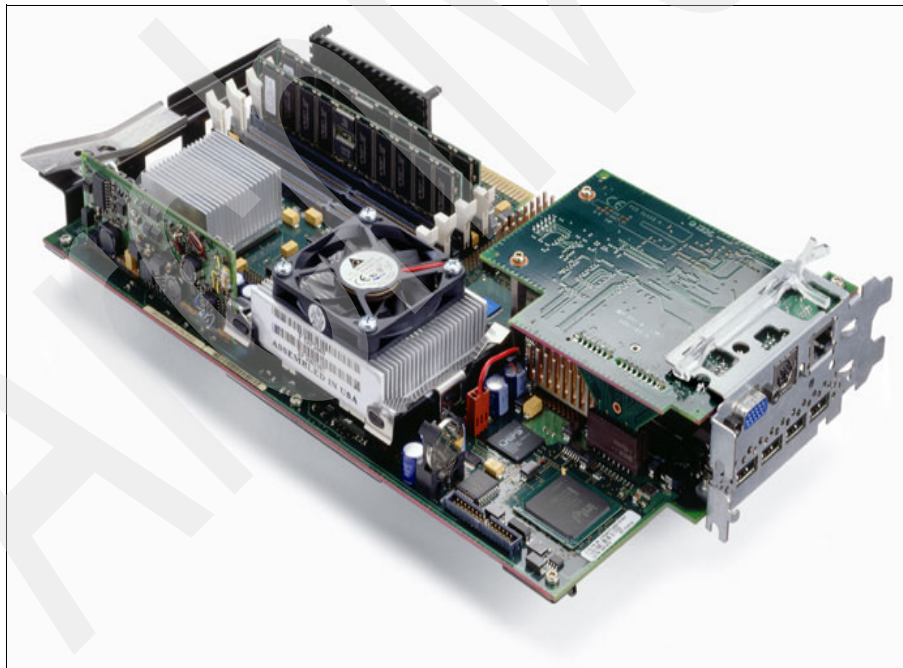
Figure 1-15   Example of an Integrated xSeries Server
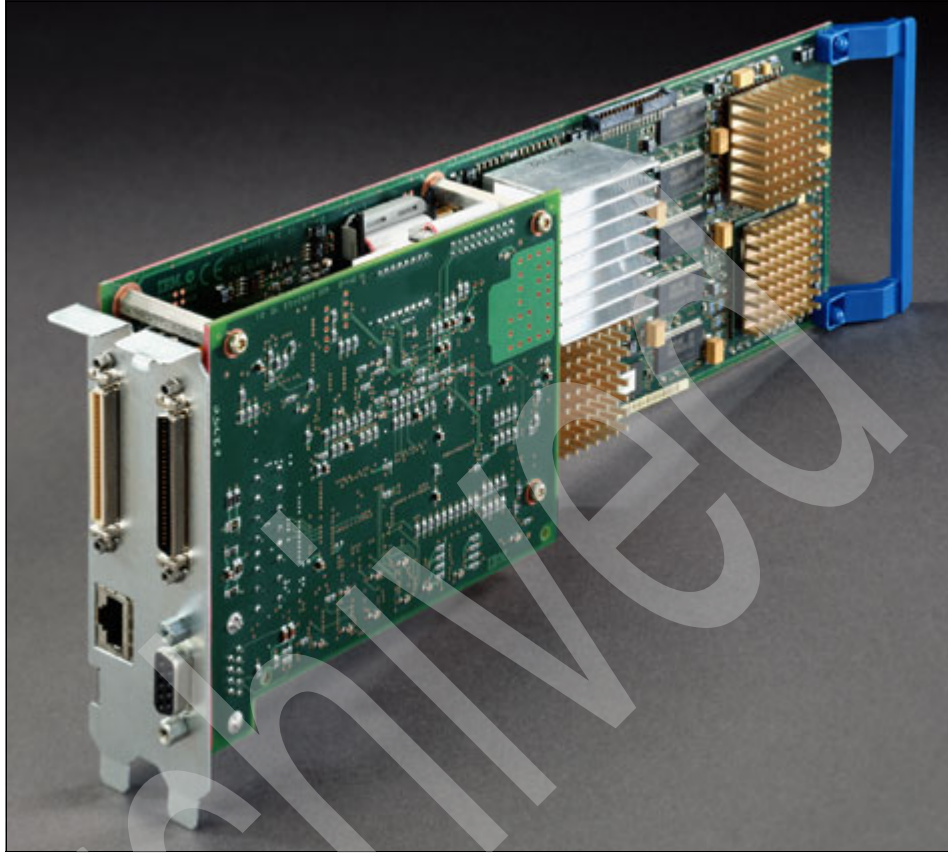
Figure 1-16   Example of an Integrated xSeries Adapter controller

1.5 Management considerations

IBM @server i5 servers offer tremendous flexibility and ease with which they can be implemented to meet a wide range of business challenges.

The new @server i5 servers are built for today's constantly changing business requirements. They are designed to deliver the power and capacity to run core business applications and the ability to add new e-business applications on the same server.

@server i5 servers can help you reduce complexity, simplify your infrastructure, and reduce your total cost of ownership (TCO). And with multiple growth options and upgrades available, you can start small and expand as your needs grow.

With the enhanced iSeries family, you will have the flexibility to run virtually any technology you need, whenever you need it. Each server in the line is enabled for multiple operating systems and application environments, so you do not need to limit yourself in choosing the hardware and software that best suit the realities of your business.

iSeries customers can capitalize on the integration of iSeries and xSeries technologies to deliver storage and operations benefits to their Windows server environment.

1.5.1 Improve server management

Improve sever management by integrating iSeries and Windows operations, including security and storage management. iSeries operators can manage users, view Windows messages, start, stop, and restart Windows or Linux servers, and even dynamically allocate disk storage to Windows or Linux servers without requiring them to be shut down.

1.5.2 Flexible server replacement

You can use a hot spare xSeries server to test and deploy changes to Windows or Linux servers easily and efficiently. If a server fails, quickly switch to a hot spare Intel server without reinstalling Windows, or use hot-plug to replace a failed server without restarting your iSeries.

1.5.3 Enhanced reliability

iSeries disk drives with RAID-5 and mirroring options can cost-effectively improve uptime and consolidate storage. You can increase business recovery protection with backup of the combined iSeries and Windows or Linux servers through iSeries switched disk capabilities and support for Microsoft Clustering Services.

For more information about support for Linux on iSeries integrated xSeries solutions with OS/400 V5R2 and i5/OS V5R3, refer to the following site:

> http://www.ibm.com/servers/eserver/iseries/integratedxseries/linux/

For information about available iSeries Integrated xSeries utilities, see:

> http://www.ibm.com/servers/eserver/iseries/integratedxseries/ixu/

1.5.4 Simplify your infrastructure

Delivered first on @server i5 servers, new IBM Virtualization Engine™ platform technologies and services can help you grow your business without adding extra servers, thanks to:

► Capacity on Demand

   On/Off Capacity on Demand and Capacity Upgrade on Demand allow you to pay for processing capacity only when you need it and only as long as you need it.

► Dynamic logical partitioning

   Run i5/OS, AIX® 5L™, Microsoft Windows, WebSphere, Linux, Lotus Domino, and other business applications on a single platform, cutting costs through server consolidation.

► Blades

   Reduce the cost and complexity of managing Windows environments with Integrated xSeries Servers.

1.6 Cost

Consider the following points:

► iSeries warranty and maintenance cover Integrated xSeries Servers. Linux (Intel) running on Integrated xSeries Servers optimize investments.

► Use i5/OS virtual SCS and shared devices such as DASD, backup devices, and some of the I/O resources.

► Integrate i5/OS, Linux, and Windows server backups.

► Leverage resources, skills, and best practices.

► Deliver support for Linux (Intel) applications.

► iSeries provides the support for OS/400, Linux, Java, Domino, WebSphere, selected UNIX, and Windows 2000 Server applications. In a single server, you can run your core business and e-business applications, all managed centrally and running completely independently of one another.

► iSeries offers innovative Linux systems integration and consolidation through industry-leading logical partitioning and resource virtualization. iSeries can enable you to reduce your cost of ownership through consolidation or to improve the return on investment with new applications.

► iSeries can consolidate several infrastructure servers with Linux partitions. At the high end of the product line, iSeries supports up to 31 Linux partitions, at the low end, up to 9 Linux partitions are supported on a 1-way server.

- iSeries can share resources among OS/400 and Linux partitions, thus reducing the cost of managing and supporting a heterogeneous environment. Logical partitioning supports sharing and dynamically moving processor resources at a granularity of one hundredth of a processor between OS/400 and Linux partitions.

- iSeries provides you with the flexibility with On/Off Capacity on Demand. iSeries processors can be activated temporarily or permanently and dynamically allocated to Linux partitions.

- iSeries offers the virtual Ethernet LAN facilities to support partition-to-partition communication. With virtual Ethernet, up to 16 networks can be defined for application communication. These connections can provide 1 GB performance and do not require LAN adapters, switches, or physical networks.

- iSeries provides storage area network-like facilities for the Linux partitions. Linux partitions are able to access disk, tape, CD-ROM, and DVD resources in OS/400 partitions. With virtual I/O, Linux is able to leverage the performance availability and manageability of the advanced iSeries storage architecture.

- iSeries provides integration between Linux applications and OS/400 facilities. Linux applications can access data stored in DB2 UDB in OS/400 and can access files stored in the OS/400 integrated file system.

- With shared processor and virtual I/O support, there is a minimal hardware requirement for a Linux environment. This can translate into a minimal dollar investment to run Linux applications on iSeries.

- iSeries is a very reliable server, offering leading single server availability. With the unique virtual disk support, iSeries provides an excellent Linux test/development environment.

The real advantage of any server consolidation project aimed at achieving IT optimization is that the resulting structure should enable the enterprise to manage technology more efficiently. In the case of iSeries server consolidation, in many consolidations, you can expect to see reduced operational costs and improved productivity for users and staff.

Essentially cost savings from consolidation can loosely be identified as falling into the following categories:

- Administrative savings: Two machines are more difficult to manage than one, and several are many times more difficult. All of the standard systems management processes, such as security, backup/restore, change, and network management, are more difficult and time-consuming in a multisite/multisystem environment.

- ► Space savings: The latest systems take up far less space than previous hardware with more processor power per square inch of footprint. Consolidations enable fewer and smaller computer rooms. For systems that support dynamic, flexible partitioning, resources can be reassigned "off shift" from one system image to another, making more effective use of many hardware resources.

- ► Power: The latest systems require far less electricity, air conditioning, or UPS backup systems than before.

- ► Performance: A single large system does deliver better performance, at a lower cost per user, than multiple small systems even where both options use the same technology.

- ► DASD savings: An enterprise is forced to store many system objects, multiple times, in a distributed environment. As an example, multiple small systems consume more disk space by storing the operating system and its associated objects on every system.

Opportunities to use Linux on iSeries falls in three major areas:

- ► Consolidation: Run multiple Linux servers on iSeries. Little to no integration with OS/400 applications. Examples include a file server, e-mail server, and a simple Web server.

- ► Replace Windows services: Use Linux to replace Windows services such as file, print, DNS, DHCP, and Web server.

- ► Support for the integration of iSeries, OS/400, and Linux on iSeries

Asking basic questions regarding OS/400 logical partitioning and reporting suspected defects in the OS/400 implementation of logical partitions are included within your IBM Support Line OS/400 offering contract. Your OS/400 Support Line representative will attempt to answer basic Linux on iSeries installation questions. The Support Line OS/400 offering does not provide support for the Linux kernel, Linux distribution, or any applications running on Linux.

Learn more at:

    http://www.ibm.com/servers/eserver/support/iseries/index.html

2

Methodology for sizing and migrating Windows servers

This chapter contains information about the best methodology to use for sizing definitions, migration plans, and migrations tools for IBM @server iSeries systems.

2.1 Sizing

Properly sizing iSeries systems or any other server can be difficult because every environment is unique. Usually, there is not enough information to make the best decision. Therefore, you must take a realistic approach, using your experience and your knowledge about the environment. And if you make proper assumptions, you can reach an adequate solution migration. Figure 2-1 illustrates sizing tasks.
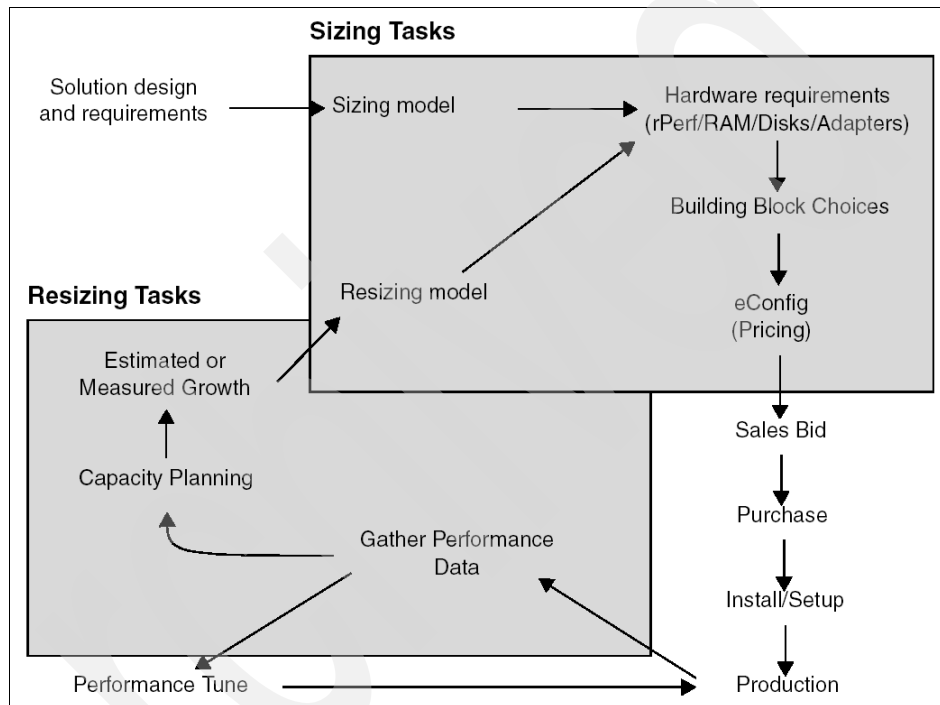
Figure 2-1   Sizing tasks

Sizing Microsoft Windows

The version of Microsoft Windows Server 2003 that you need to acquire depends on whether you need clustering support and the number of CPUs and the amount of RAM you want to install in the xSeries server. For a Windows server without clustering:

► Windows Server 2003, Web Edition, supports up to two CPUs and 2 GB of RAM.

► Windows Server 2003, Standard Edition, supports up to four CPUs and 4 GB of RAM.

► Windows Server 2003, Enterprise Edition, supports up to eight CPUs and 32 GB of RAM.

For clustering support, Windows Server 2003, Enterprise Edition, supports up to eight nodes.

Deciding which type of server role (server or domain controller) to install on the Integrated xSeries Adapter or Integrated xSeries Server requires careful planning, especially if you already have an existing domain. You should consult your Microsoft documentation for guidance on this matter. A lot of useful material about this subject is available on the Technical Resources for Windows Server 2003 Web site at:

http://www.microsoft.com/windowsserver2003/techinfo/

Notice that you must install Windows Server 2003 as a server and, if required, upgrade it to a domain controller later.

2.2 Benchmark

There are several reasons to study benchmark tests. The most well-known reason is to compare performance of different computers because clients need to know which system is better for their applications when they are deciding to buy a system. However, it is difficult to find an absolute measurement, because, nowadays, computers are complex systems in which many components influence the overall performance of the system. System performance especially depends on the kind of application software that is running on the system.

Benchmarks are necessarily abstract and simplified models of application environments. For this reason, benchmarks represent a good measuring tool to compare different systems rather than a precise tool for capacity planning for a given client application environment. No benchmark can fully characterize the performance of a system in a true production environment because:

► The behavior of benchmark applications is essentially constant on a given system. Real applications, when executed several times, almost invariably have different inputs, and consequently exhibit different behavior each time.

► Benchmarks are executed under ideal circumstances. The benchmark is typically the only application that is executed on a system dedicated to a single purpose. For this reason, system overheads, such as paging and context switches, are lower than in actual production use of a processor. Benchmark processors are often equipped with the latest and greatest memory and disk subsystems. They might include features that might not match exactly a system that is of interest to a client. In this sense, benchmarks represent the upper limit of system performance.

Nonetheless, there is useful information we can gather from benchmark results. Benchmarks provide some insight into the performance of a computer:

► A computer that performs well on all benchmarks in a given class, such as floating-point-intensive codes with data structures that are too large to fit into cache memory, is likely to perform well in all applications that share these characteristics.

► A processor that performs well in throughput benchmarks (where many instances of many applications are run) tends to perform better in a true production environment than one that does not perform well in this context. If you fully understand the benchmarks scenario, transaction characteristics, and metrics, and you know your application and transaction characteristics, you can use the benchmark results as a source of guideline information for your system sizing.

Benchmark centers

The iSeries benchmarking centers provide world-class benchmarking-related skills and facilities to the worldwide iSeries community. iSeries benchmarking facilities are located in Montpellier, France and Rochester, MN. The facilities are staffed with iSeries experts with more than 75 years of collective experience in iSeries performance and testing methodology. The centers can provide any iSeries system configured to your exact specification so that you can stress, tune, and test your application, measure performance, and determine workload capacity. The result of your benchmarking experience will provide you with the information needed to make sound business and computing decisions.

Figure 2-2 on page 49 shows a picture of an iSeries benchmark center.

For more information about the iSeries benchmark centers, visit:

http://www.ibm.com/servers/eserver/iseries/benchmark/cbc/index.html

Figure 2-2   Benchmark center

2.3 Migration

In this section, we discuss migrating servers.

2.3.1 Migrating servers from eServer iSeries 8xx models to eServer i5 5xx models

Because there are differences in the physical packaging and underlying technologies of the newer iSeries models, upgrades within or into these iSeries models can involve a change to the system unit and input/output (I/O). Newer hardware and applications can require newer levels of software. Careful planning can minimize time, effort, change impact, and business cost. Upgrades from the @server iSeries Models 810 and 820 to the @server i5 Models 520 and 550 and from Models 810, 820, 825, 830 to the Model 570, use a *9406* machine designator to allow IBM to better support the server. There is no physical difference between the machine types for these models. Planning and configuration tools can be used for configuration analysis by bypassing the difference in the 9402, 9404, or 9406 machine type designation.

Table 2-1 provides information about the supported migration between @server i5 and iSeries models.

Table 2-1   Supported migration between eServer™ i5 and iSeries models

From models	To models		
	520	550	570
800	No	No	No
810	Yes*	Yes	Yes
820	Yes*	Yes	Yes*
825		Yes	Yes*
830	Yes	Yes	Yes*
840			Yes*
870			Yes*
890			Yes*
* With restrictions			

Considerations

When migrating to iSeries models from earlier models, keep the following considerations in mind:

► Model 520, 550, and 570 processor features require i5/OS V5R3.

► Some upgrades require a two-step approach to reach the requested model.

► An upgrade is performed through an intervening processor model or edition.

► Main storage features of one model typically cannot be used in a different model. However, some Model 810 and 825 main storage features can be used in the Models 520, 550, and 570 if quad rules for these systems are fulfilled.

► Memory in the #2469 2-way Model 810 processor is not compatible and does not migrate to the Model 550 or 570. Refer to Table 2-2 on page 51 to see what memory can be reused when upgrading to the @server i5 servers.

► Some features supported on earlier models cannot be ordered on new Models 520, 550, 570, 800, 810, 825, 870, or 890.

Table 2-2   Memory reuse

From models	To models		
	520	**550**	**570**
800			
810	Yes	Yes	Yes
820	No	No	No
825		No	Yes
830	No	No	No
840			
870			No
890			

2.3.2 Using tools

There are various tools available to assist with the different stages of migration.

Performance Management

Performance Management for IBM @server iSeries provides the capabilities for customers to understand and manage the performance of their computing environments, including:

► Real-time monitoring
► History, trends of performance, capacity
► Capacity planning
► Performance tuning controls
► Performance problem isolation
► Workload balancing
► Application
► "Design for performance" tools

For more information about Performance Management, see:

http://www.ibm.com/servers/eserver/iseries/perfmgmt/

Workload Estimator

The purpose of IBM @server Workload Estimator is to provide a comprehensive iSeries and AS/400 sizing tool for new and existing customers interested in deploying new emerging workloads stand-alone or in combination with their current workloads. Workload Estimator recommends the model, processor,

interactive feature, memory, and disk resources necessary for a mixed set of workloads. Recommendations will be for currently orderable system models.

Workload Estimator is designed to be easy to use, typically with less than a dozen questions per workload application and defaults for most workload questions and system assumptions based on common field experiences. Workload Estimator can also be easily used with Performance Management collected data.

Workload Estimator can be used repeatedly to try "what-if" sizings. It has growth estimation capabilities, inputs can be saved and restored later for reuse, and results along with the inputs can be printed in addition to being displayed.

Figure 2-3 on page 53 shows a Workload Estimator page.

Access Workload Estimator from the following site:

```
http://www-912.ibm.com/wle/EstimatorServlet
```
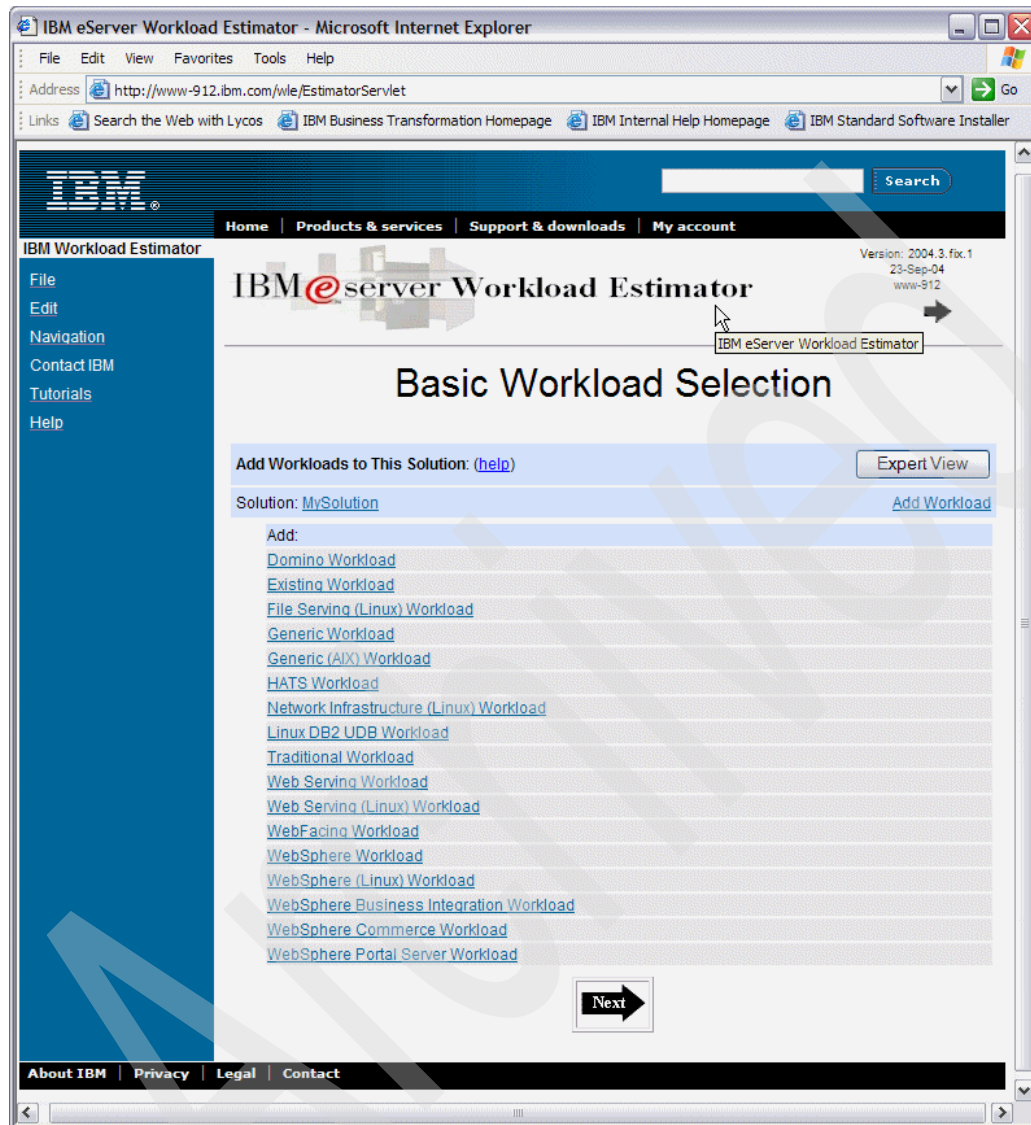
Figure 2-3   Workload Estimator page

Sizing Guides

IBM @server Sizing Guides provide sizing recommendations for @server systems (iSeries, pSeries, and xSeries) running one or more workloads associated with e-business, collaboration, or both. You can use the Sizing Guide tools to assist you with sizing definitions for new environments or for a

consolidation where you have two or more systems that need to be consolidated in one iSeries per example. Figure 2-4 shows the Sizing Guides page.

Access the Sizing Guides through the following Web site:
https://www.developer.ibm.com/sizing/sg
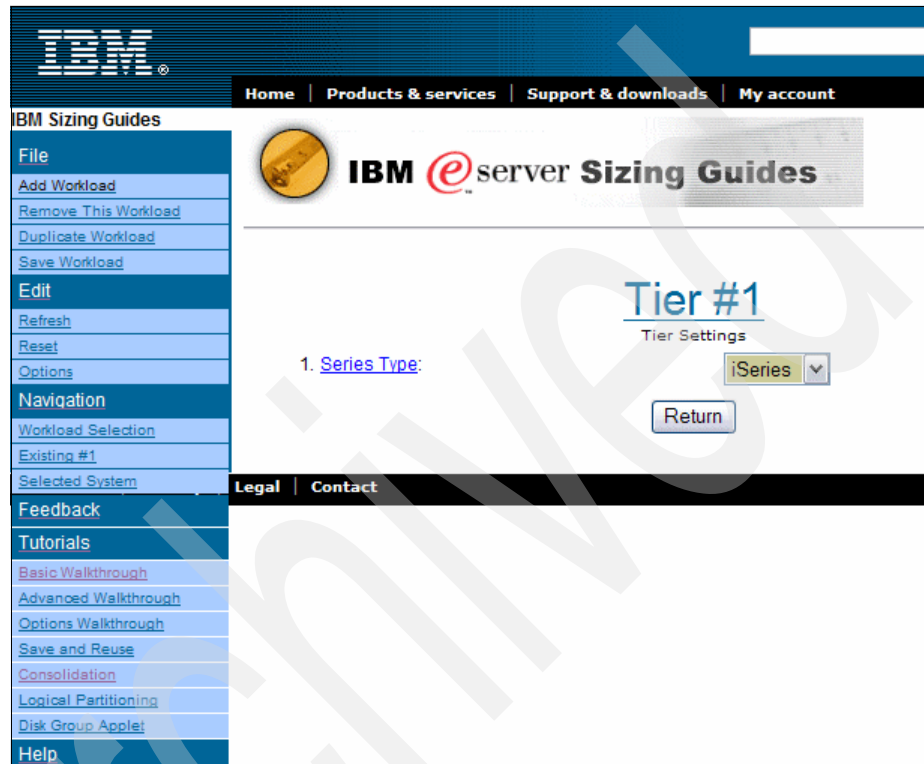
Figure 2-4   Sizing Guides page

How to use Sizing Guides

Use the Options page to set assumptions that apply to the entire @server environment that you are estimating. These options affect both the size of the projected workload and the manner in which the Sizing Guide combines multiple workloads. Remember that the Sizing Guide attempts to recommend the minimum system for adequate performance and is not a configurator.

The following list provides definitions of the parameters in the Sizing Guide:

► OS Version Selection: Because performance varies by i5/OS, OS/400, AIX 5L, or Linux release, be sure to select the correct release level for the existing system. Choose **Most Recent** to select the most recent version of OS that the tool supports.

- ► DBCS Support: Double-byte character set (DBCS) support for the iSeries does consume resources that must be accounted for. This option has two values, YES and NO. If this value is set to YES, the Sizing Guides calculate increased resource consumption for each iSeries workload. You have the option to override this value for each individual workload specification. There are not a lot of results quantifying the specific costs for running DBCS; however, the Sizing Guides are using performance sizing guidelines for DBCS provided by (and currently used by) Japanese Sales and Business Partners.

- ► RAID Support: Because iSeries provides the flexibility to configure disk storage into various storage pools and configuration, the RAID support setting tells the Sizing Guides how you plan to configure the disk storage for this server. The possible settings are NONE, MIRRORED, and RAID-5. You have the option to override this value for each individual workload specification. The RAID-5 setting is usually the optimal solution. This setting offers a high degree of data protection at a relatively economical price.

- ► Target Processor Utilization: This chart enables you to set the target processor utilization percentage for all n-way systems. Previously, only one parameter was allowed, functioning as the target percentage for all n-way systems. However, because larger n-way systems tend to require a smaller growth buffer (proportionally), this chart was introduced. The target percentage is used to prevent Sizing Guides from recommending a system that would experience performance problems when "spikes" occur in the processor utilization of the included workloads. The IBM defaults should provide a strong starting point for estimating the target percentage your system should size to on the various n-way systems.

  Note: We do not recommend setting the utilization values above the IBM defaults. This can lead to the selection of a system that might experience performance problems when "spikes" in the workloads occur.

- ► Target Interactive Feature Utilization: This chart enables you to set the target iSeries interactive feature utilization percentage for all n-way systems. Previously, only one parameter was allowed, functioning as the target percentage for all n-way systems. However, because larger n-way systems tend to require a smaller growth buffer (proportionally), this chart was introduced. The target percentage is used to prevent Sizing Guides from recommending a system that would experience performance problems when "spikes" occur in the interactive utilization of the included workloads. The IBM defaults should provide an adequate starting point for the target percentage your system should size to on the various n-way systems.

> **Note:** We do not recommend setting the utilization values above the IBM defaults. This can lead to the selection of a system that might experience performance problems when "spikes" in the workloads occur.

▶ Target LPAR Processor Utilization: This chart enables you to set the target iSeries processor utilization percentage for all n-way systems when using LPAR. The target percentage is used to prevent Sizing Guides from recommending a system that would experience performance problems when "spikes" occur in the processor utilization of the included workloads. The IBM defaults should provide a strong starting point for estimating the target percentage your system should size to on the various n-way systems.

> **Note:** We do not recommend setting the utilization values above the IBM defaults. This can lead to the selection of a system that might experience performance problems when "spikes" in the workloads occur.

▶ Disk Storage Percent Full: This parameter affects how the tool selects systems. For each workload, the Sizing Guides calculate the minimum amount of disk storage that will fulfill the definition as specified. To make a final system recommendation, the Sizing Guides add together the storage requirements for each workload plus the storage requirements for the operating system with no allowance for additional workspace, and so on. You can use this parameter to tell the Sizing Guides to calculate extra disk storage as a percentage of the total required. In simple terms, when you specify 100%, the Sizing Guides assume that the workloads can consume all the disk storage and do not calculate any extra disk. When you specify 75% full, the Sizing Guides calculate 25% extra disk capacity beyond what the calculated workloads require.

▶ Disk Attachment Type: This parameter selects the manner in which the disk drives will be attached to the system. The Sizing Guides use this parameter in the calculation of the number of drives that the workloads require. The iSeries IOA feature 2757/5709 are new attachment cards that can dramatically increase the number of disk operations that a given drive can perform.

▶ Disk Storage Type: This parameter selects which type of disk drives that the Sizing Guides will use as targets for the estimation. The 15,000 RPM disk drives have a faster latency. This means that they have a faster spinning rate for reading and writing information to disk. The benefit of using disk drives with a faster latency is that, in general, fewer drives are required to perform the same number of disk operations.

► Target Family: This parameter selects the family of systems that the Sizing Guides will use as targets for the estimation. As IBM announces new @server systems, "family designations" (typically the major model number) will be listed in the drop-down list. The values associated with "IBM Default" is to use the latest available technology systems.

2.3.3 Migrating data only

A data migration is the process of moving data from one iSeries system to a new iSeries system where the source server and the target server have different serial numbers.

Data migration process

The data migration process includes planning, ordering, preparing for, and performing the data migration. Planning is the most involved and might require up to six weeks, depending on the complexity of your environment. Installing the OS/400 release on the source server requires at least one hour. Migrating the data from the source server to the target server can normally be accomplished within three days.

Planning the migration

The time you spend planning for your data migration can help minimize your downtime and make performing the migration easier. You can use the information available in the Planning topic of the @server Information Center, where you have tools to assist you to create customized planning checklist. See the following site:

    http://publib.boulder.ibm.com/infocenter/iseries/v1r2s/en_US/info/iphac/cpi
    start.htm

Before you can migrate your data, you must complete the following steps:

1. Plan for the hardware, which includes:

   – Ordering the target server with feature code 0205. This feature code ensures that the target server is set up for the data migration and entitles you to run the new operating system on both the source and target servers for a maximum of 70 days so that you can complete the data migration. You must reinstall the previous operating system on the source server after the data migration is complete.

   – Identifying disk storage requirements. You must ensure that you have enough disk storage capacity for the new operating system and for the data from the source server and for any new data and software planned for the target server.

- – Identifying any tape incompatibilities. You must ensure that you have a tape drive that is compatible with the target server.

- – Ensuring that you have a physical plan for the target server. The target server is going to be set up and running beside the source server for a period of time. There are physical planning and setup implications that pertain to the target server.

2. Plan for the software, which includes:

- – Evaluating disk storage space requirements. You must ensure that you will have adequate disk storage before you start to install or replace software.

- – Identifying possible upgrade paths for licensed programs. When you install the new release of OS/400, some licensed programs might no longer work. You should identify licensed programs that are no longer available at this release and their replacements where applicable. Additionally, to avoid losing data that depends on these licensed programs, migrate the data from your server to an accessible location before installing the new release of OS/400.

3. Plan for your connection, which includes:

- – Choosing a console. If you are using a twinaxial console on the source server and using Operations Console on the target server, ensure that you have a twinaxial controller for any twinaxial devices you plan to run from the target server.

3

Methodology for sizing and migrating Linux servers

In this chapter, we describe Linux applications, migration, porting, tools, and education.

59

3.1 Linux support for iSeries

The open source community provides Web sites that have mailing lists, tips FAQs and other resources, especially from the Free Standards Group. See the following sites for more information:

```
http://www.freestandards.org
http://www.gnu.org
http://www.fsf.org
http://www.sourceforge.net
http://www.tldp.org
```

3.1.1 Desktop environments

There are several desktop environments available for Linux. The X Windows System is used indirectly through a window manager, such as ICEWM, or a desktop environment, such as the K Desktop Environment (KDE) or GNU Network Object Model Environment (GNOME). Each window manager has a unique look and often comes packaged with its own desktop themes.

X Windows System is more than just running a program with a graphical user interface. You can launch a complete desktop environment that gives you a complete environment to start programs, configure the system, and so on.

Depending on the distribution and the installation options you choose, one or more of them can be installed on your system. Each desktop environment has its own individual characteristics as well as its own collection of GUI-based Linux applications.

X Windows System

X Windows System (X or X11) is the de facto standard in Linux and UNIX. Linux uses Xfree86.

The following components use X Windows System as the underlying system:

► Widget sets

Widget sets or libraries give the ability to create menus, buttons, and windows. Motif widgets are a type of library.

► Toolkits

Toolkits are a set of APIs that can be used on multiple platforms and provide more capabilities than the widget libraries. Toolkits include applications such as GTK, Motif, and Qt.

– KDE

K Desktop Environment (KDE) is a customizable graphical desktop that provides administration and development tools and can be used with the Qt toolkit.

– GNOME

GNU Network Object Model Environment (GNOME) is a graphical customizable desktop that uses the GTK+ toolkit.

► Window managers

The window manager dictates the appearance and behavior of the windows environment, and as such, is an integral component of the desktop. KDE uses KWM. GNOME can use different window managers such as Sawfish or Metacity.

► Theme managers

KDE and GNOME have their own theme managers and control the appearance of the desktop. Theme managers control the behavior and appearance of menus, buttons and other items on the desktop.

K Desktop Environment (KDE)

KDE consists of various runtime libraries, base components (window-manager, desktop, Konqueror browser), KMail, graphics applications, and utilities.

GNU Network Object Model Environment (GNOME)

GNOME ranges in scope from utilities to low-level development libraries to end-user applications. The applications include e-mail, an Internet browser, graphics, and an office suite.

ICEWM

ICEWM has a desktop with a Windows-like task bar and start menu. You can add a text entry field to the task bar that acts like a command prompt and is a handy way to launch applications that do not appear in the start menus or to launch applications with custom command-line switches.

CDE

Common Desktop Environment (CDE) is a commercial desktop based on Motif and X11 and is what is used by AIX 5L.

3.1.2 Applications

There are many different compilers available for Linux, such as VisualAge® C, C++, and Fortran, and also Java Development Kits (JDKs). IBM JDKs are available at the following site (this site requires registration):

https://www6.software.ibm.com/dl/lxdk/lxdk-p

Integrated development environment

Several development tools and development environments are available to Linux developers. The most popular are the GNU tools, including the compilers mentioned previously, and the gdb (GNU Project Debugger) is the EMACS (Editor MACroS) integrated development environment.

EMACS is an open source integrated development environment (IDE) available from the GNU Project Web site and has been used by UNIX and Linux users for many years. Originally, simply an editor, it has now grown to a full-fledged IDE with built-in compiler and script support. For more information, see:

http://www.gnu.org/software/emacs/emacs.html

Another IDE is Eclipse. Eclipse is a fully integrated open source, extensible development platform rapidly achieving a high level of acceptance by the development community. By itself, Eclipse is a building block environment for easy plug in of development tools. However, it does provide a standard set of plug-ins such as Java Development Tools. Eclipse is not yet available for the POWER technology-based architecture but might become available later. For those interested in exploring Eclipse, visit the eclipse Web site for how-to and getting started articles:

http://www.eclipse.org

Using an IDE for development needs is a matter of personal choice. Some developers feel that access to a fully integrated development platform can take years off their development efforts.

Software deployment

Applications developed on a low-end Intel processor machine can be recompiled using the same development tools on the higher-end POWER technology-based servers in both 32-bit or 64-bit mode for deployment. It is also possible to use cross-compiler options that allow creation of POWER technology-based processor binaries on an Intel processor. However, we recommend that the VisualAge compilers be used for the best possible performance on the POWER technology-based processor family. We also recommend that any application that does not necessarily need 64-bit addressing, stay as a 32-bit binary to maintain its runtime efficiency.

Support and services

Support for Linux for iSeries and pSeries servers is available from several sources. Linux distributors such as SUSE and Red Hat include support and maintenance for the Linux distributions on iSeries platforms.

Additionally, Linux community support is available for all Linux distributions either through Web sites devoted to Linux development or through news groups and mailing lists. The main IBM pages for Linux and @server also offer resources and information at:

```
http://ibm.com/linux
http://ibm.com/eserver/iseries/linux
```

3.1.3 Migration

IBM developerWorks® migration station is a good place to start for knowledge and discussions about this fast evolving environment:

```
http://www.ibm.com/developerworks/ondemand/migrate/linux.html
```

The following site provides an overview of a nine-part developerWorks series about moving your operational skills from a Windows to a Linux environment, covering everything from logging to networking, and from the command-line to help systems, even compiling packages from available source code. For more information about this series, see:

```
http://www.ibm.com/developerworks/linux/library/l-roadmap.html
```

3.1.4 Porting

For an overview of porting applications to Linux, see:

```
http://www.ibm.com/servers/enable/site/porting/linux/index.html
http://www.ibm.com/developerworks/linux/library/l-mfc/
```

Porting to Linux on IBM @server servers is a well-understood process that can bring unique advantages to Linux solutions running on other platforms. @server series technologies added to Linux solutions can enhance them with flexible resource use through logical partitioning or enhanced management and backup capabilities.

It is generally easy to bring an application over to Linux on an @server platform, either from other platforms or from one @server platform to another. IBM and the Linux Standard Base (LSB) can assist in some cases in assessing the porting. Generally, the Linux source code only needs to be moved to the new platform and recompiled to have a Linux application on the new hardware architecture. The use of POWER technology-based architecture in both iSeries

and pSeries servers means that, for the majority of Linux application binaries, even the same compilation can be used for both series. Review the white papers and IBM Redbooks highlighted in the Migrate to Linux on pSeries and iSeries at the IBM Migration Station Web site:

http://www.ibm.com/developerworks/ondemand/migrate/linux.html

The Linux Standard Base (LSB) is a rapidly developing standard that can help Linux applications ensure portability. The LSB provides application programming interface (API) standards such as the UNIX standards. It also provides definitions and tools to check application binary interface (ABI) use for Linux on a specific architecture.

If the Linux application is dependent on distribution-specific headers or file structures that are outside of the specification of the LSB, check the availability of that distribution on the @server platform that is the target being explored for the port.

If open source or third-party middleware is in the solution, it also needs to be available on the destination platform. IBM Software Group middleware is being delivered in stages across @server Linux platforms for Red Hat and for United Linux, including Novell SUSE.

There is additional porting material that is specific to iSeries also available. Review the white papers and IBM Redbooks highlighted in the Migrate to Linux on pSeries and iSeries at the IBM Migration Station Web site:

http://www.ibm.com/developerworks/ondemand/migrate/linux.html

Skills
Linux and its standardization help minimize infrastructure costs for training for staff. Developers and systems administrators are likely to be able to use and operate a new Linux platform much as they do others that might already be in use. If you are moving to a new distribution, the Linux distributors offer training for their software. IBM developerWorks and PartnerWorld® for Developers also provide training, some Web-based, some online.

Procedures and tools
The procedures used to create and maintain the solution and the tools used to do it are key parts of moving to a new platform. The current version (1.3) of the Linux Standard Base covers a significant number of APIs and utilities, so many applications can be moved from one Linux platform to another without substantial impact to their development and test processes. If distribution-specific functions are used, the distribution currently used on other platforms is also available on @server platforms.

Tailoring

Tailoring is usually an additional consideration or use of available features on @server systems that can add greater customer value to Linux applications. In many cases, the use of these features can be coded once, and then reused from release to release of the application. Possible examples include scripts or plug-ins to integrate operations with other applications, directions for using other server backup facilities effectively, and insights in tailoring application use of resources across logical partitions.

The first point to remember is that "Linux is Linux." It is usually not necessary to tailor the application to conclude a successful port. Linux runs natively (directly on the processor) on all @server systems.

Many IBM @server technologies provide "extras" that can be exploited without changing your core application to help you deliver a higher-value solution on @server.

3.2 Tools

The following sections discuss some of the tools available for sizing existing and new Microsoft Windows and Linux workloads.

> **Note:** By discussing these tools we do not endorse or recommend their use. The main aim of this section is to express the need for sizing and show some examples of how it can be achieved.

3.2.1 CDAT

Consolidation Discovery and Analysis Toolset (CDAT) is an excellent IBM internal tool for generating an overview of enterprise-wide server infrastructure and discovering potential servers under various consolidation scenarios. It uses remote discovery methods to collect read-only information related to targeted systems and does not require installing new code on such systems. No write access to any of the targeted system is required.

We describe CDAT for information only. To get more information about CDAT or request a CDAT study, contact your local IBM Representative.

Data collected by CDAT is used for analysis by SCON SWAT and the SCON Qualification Process:

► Qualification objective

To have an agreement with the customer that IBM will be the vendor that they will consider seriously if we meet their SCON requirements.

► Motivation to qualify the customer:

These studies are expensive to execute ($10K-$20K in investment on the part of IBM).

► Strategy:

In order to qualify the customer for a free SCON study, IBM needs to establish a joint agreement with the customer. It should be made clear an investment is being made by IBM as a joint partner to help save money through server consolidation. IBM is willing to invest the money to evaluating the environment and proposing server consolidation scenarios to show cost benefits.

► An easy 3-step approach is recommended:

First, the customer must be qualified as a serious candidate for server consolidation.

Second, the customer (company executive) must internalize the problem and approve server consolidation as a strategy to embrace.

Third, after a good assessment of the customer problems, team IBM must provide a "tough to beat" end-to-end solution.

This step requires an easy to follow process for the client teams. The process is necessary to service the volume of SCON solution requests efficiently and effectively. It also helps track the engagements, so everyone contributing to the deal is aware of their role at each stage.

IBM is committed to maximizing the value of server resources in the enterprise. To this end, IBM has developed expertise and tools to assist in server consolidation. Consolidating enterprise resources is a critical task for every organization, because by consolidating resources, many systems can be used more efficiently, maximizing resource utilization, reducing server count, and reducing administrative staff.

Not surprisingly, the process of server discovery and collecting individual server information can be very time-consuming and becomes an obstacle in the process of consolidation analysis, planning, and execution. IBM is in continual development and testing of the automated Consolidation Discovery and Analysis Toolset (CDAT), which is providing tremendous value in the process of server discovery and information gathering for Windows-based consolidation projects.

CDAT is a stand-alone discovery toolset that automatically gathers certain server information.

The following are examples of the types of information that can be retrieved with CDAT:

- ► Domain-wide sorted list of servers
- ► Operating system version of Windows
- ► System information (domain, IP address, and so on)
- ► Configuration information (count of processors, MHz rating, memory, disk, and so on)
- ► Version number of Microsoft SQL Server (if installed and release level is 7.0 or later)
- ► Version number of Microsoft Exchange (if release level is prior to Exchange 2000)

All the information gathered is stored in a Microsoft SQL Server-compatible database by using the Microsoft SQL Server 2000 Desktop Engine. This database resides on the machine from which the CDAT tool is run. The database can be queried using the Enterprise Manager component of the Microsoft SQL Server or other similar tools, and various reports can be generated.

Note the following limitations:

- ► The tool discovers only Windows-based servers.

- ► The tool is unable to see servers in the DMZ domain.

- ► The tool does not and cannot capture all the information required for the server consolidation analysis. A site technical contact must be assigned to complete data collection. (that is, primary role/software/function, server location, number of connected users, SLA information, and so on).

3.2.2 Performance Inspector

Performance Inspector consists of Tprof, AI, PTT, JLM, post, jprof, a2n, swtrace, and heap dump.

For more information, see:

    http://sourceforge.net/projects/perfinsp

This site includes the Performance Inspector packages for download on multiple platforms and detailed installation and usage instructions.

The Performance Inspector package contains a suite of performance tools for Linux. The tools can be used to analyze performance of your C/C++ and Java

applications and performance of your system as a whole. The five easy-to-use tools are:

- ► Timer Profiler (Tprof)
- ► CPU utilization (AI)
- ► Per thread time (PTT)
- ► Java lock monitor (JLM)
- ► Java heap dump (heap dump)

3.3 Services

Services are a key part of most IT projects. In the following sections, we offer an overview of IBM services related to Windows and Linux.

3.3.1 IBM Linux Centers of Competency

State-of-the-art IBM Linux Centers of Competency are located at major product development labs, offering access to extensive technical resources and world-class research and development teams of IBM. For more information, see:

http://www.ibm.com/linux/va_4057.shtml

Critical IBM contributions to Linux include:

- ► Cluster management
- ► Availability
- ► Internationalization
- ► Networking
- ► Reliability
- ► Scalability
- ► Security
- ► Serviceability
- ► Standards and documentation
- ► Stress testing
- ► System management
- ► System performance

IBM Linux Centers of Competency offer:

- ► Customer briefings

  – Explore opportunities

  – Articulate IBM value

- ► Product and solution demonstrations

  – Linux on IBM

– Industry solutions on Linux

– e-business infrastructure

► Workshops

– Linux live workshops

– Linux strategy workshops

IBM Linux Centers of Competency are designed to:

► Supply infrastructure for the emerging Linux community, Linux distributors, resellers, and partners, joining the Linux movement.

► Be a destination for Linux events and activities.

► Serve as a showcase for ISV applications on Linux, and facilitate customer proof of concepts.

IBM Linux Center of Competency locations:

► Austin, TX, U.S.
► Bangalore, India
► Beijing, China
► Boeblingen, Germany
► Moscow, Russia
► Tokyo, Japan

To arrange a visit to an IBM Linux Center of Competency, contact your IBM representative or IBM Business Partner, visit our Web site, or call 1-845-433-3519.

For international accounts, contact the International Sales Support Office at 1-845-732-6743.

3.3.2 Linux solutions

IBM and IBM Business Partners bring together a combination of hardware, software, business expertise, industry experience, and Linux and other open source components to solve critical business challenges. For more information, see:

```
http://www.ibm.com/linux/
```

3.3.3 IBM Global Services

IBM Global Services offers one of the industry's most comprehensive portfolios of Linux consultative and support offerings, from planning and design to

implementation and technical support. IBM Global Services also offers a full portfolio of Linux services. IBM consultants skilled in Linux are available worldwide to help customers design, build, and enhance their Linux solutions. For more information, see:

http://www.ibm.com/services/us/index.wss/of_services/igs/a1002810

3.3.4 Linux strategy workshop

IBM Global Services has developed a unique, compact workshop that's customized just for your company. At the end, you will have a high-level strategy for incorporating Linux that is based on your IT environment, your business issues, and your budget requirements.

Highlights of the workshop include:

► A customized environment that helps cut through the clutter and focuses on your company
► Information-gathering assessments of your IT and business objectives and environment
► Two half-day work sessions to validate and prioritize findings
► A final strategy document with recommendations for implementing Linux

For more information, see:

http://www.ibm.com/services/us/index.wss/so/its/a1000017

3.4 Education

This section lists discussion and education resources.

3.4.1 Forums

To obtain the latest information and ask questions about Linux, visit:

http://www.ibm.com/developerworks/forums/dw_lforums.jsp

This site includes information about the following topics:

► Linux on Power architecture technical forum
► Power architecture forum
► Scripting clinic technical forum
► Speed-start your Linux application technical forum

3.4.2 Tutorials

For free introductory, intermediate, and advanced tutorials on Linux, see the following site:

```
http://www.ibm.com/developerworks/views/linux/tutorials.jsp
```

3.4.3 Courses

Visit the following resources for information about available courses:

► Free and fee classes about Linux:

```
http://www.ibm.com/services/learning/ites.wss/us/en?pageType=courses_az&sub
ChapterInd=C&sortBy=6&subChapter=5068&x=81&y=15
```

► Training paths for Linux:

```
http://www.ibm.com/services/learning/ites.wss/us/en?pageType=page&contentID
=a0000323
```

► Course catalog:

```
http://www.ibm.com/services/learning/ites.wss/us/en?pageType=page&contentID
=a0000037
```

► New to Linux information site:

```
http://www.ibm.com/developerworks/linux/newto/
```

► Speed start your Linux application, Linux trial code:

```
http://www.ibm.com/developerworks/offers/linux-speed-start/
```

3.4.4 Conferences and events

Conferences provide a forum where IT professionals can explore current and emerging technical topics, meet respected industry leaders, and network with peers from around the globe.

For more information, visit:

```
http://www.ibm.com/services/learning/ites.wss?pageType=page&contentID=a0000
058&eventType=Conferences
```

4

Best practices for managing integrated servers

This chapter describes a "best practices" way to work with integrated servers. We provide information about the best tools and practices from an IBM @server iSeries perspective.

4.1 PTFs and fixes

A number of resources are available to correct or prevent problems on your iSeries systems. In this section, we provide information about these resources and some best practices for working with your server.

To maintain your server, use these basic steps:

1. Create a maintenance strategy.

   This is recommend for all iSeries systems. Performing the following steps might reduce the impact in your server's operation and optimize server performance and availability:

   a. Evaluate the server's operations.
   b. Identify an appropriate strategy.
   c. Apply scheduled maintenance.

2. Keep your server up-to-date.

   Develop some procedures to keep your server up-to-date. Keep all servers on a supported release and apply the following packages of program temporary fixes (PTFs):

   – Cumulative PTF package
   – Additional HIPER Group PTFs
   – Database group PTFs
   – Other group PTFs related to your environment

3. Determine what fixes you have.

   You can use the Operations Navigator to determine the status of PTFs, group PTFs, and cumulative PTFs. For more information, see the iSeries Information Center, available at:

   http://publib.boulder.ibm.com/iseries/infocenter.htm

4. Get the fixes that your server needs.

   An efficient method of receiving your fixes is through Fix Central. This tool from IBM enables you to select, order, and download fixes through the Internet. Large orders for OS/400 and i5/OS PTFs might result in a shipment on CD-ROM.

   Perform the following steps:

   a. Issue the WRKCNTINF (Work with Contact Information) command.
   b. Select option **2** (Work with local service information).
   c. Select option **2** (Change service contact information).

   Fix Central enables you to order a complete cumulative PTF package or only those PTFs in the cumulative PTF package that are missing from your server.

Visit Fix Central at:

http://www-912.ibm.com/eserver/support/fixes/fcgui.jsp

> **Note:** Before you order PTFs for OS/400 or i5/OS, you should update your contact information on your iSeries system. Updating the information now will save you time later.

5. Load and apply your fixes.

   You must load and apply the fixes after they have been downloaded to your server.

4.1.1 PTFs

Before you attempt to install Microsoft Windows on the Integrated xSeries Server, you should ensure that your iSeries system has been loaded with any required PTFs. The list of available PTFs is on the iSeries integrated xSeries solutions Web site at:

http://www.ibm.com/servers/eserver/iseries/integratedxseries/

Select **Service & support**, and then select **i5/OS and OS/400 PTFs**. Information about the latest PTF that provides the service pack for the integration software can also be found at this Web site. Select **Service & support** and then **Service packs**. We strongly recommend that you order the PTF for the latest service pack on CD-ROM well in advance of your installation date. Most problems that arise after installation are due to the fact that service packs have not been applied to the Windows side.

To find information about downloading and ordering program temporary fixes (PTFs), iSeries/Client Access, group PTFs, and a wealth of other PTF information to help you manage your iSeries family system, visit the following Web site:

http://www.ibm.com/servers/eserver/support/iseries/fixes/index.html

4.1.2 Fix Central

Fix Central provides the latest fixes and updates for your system's software, hardware, and operating system. Visit Fix Central at:

http://www-912.ibm.com/eserver/support/fixes/fcgui.jsp

> **Note:** Fix Central has replaced the Fix Delivery Center (FDC) for AIX 5L and Internet PTF downloads (iPTF) for OS/400.

Figure 4-1 shows the Fix Central page.

Figure 4-1   Fix Central page

For Linux updates, Fix Central forwards you for the Web sites shown in Table 4-1 on page 77, depending on your distribution.

Table 4-1   Linux distribution support Web sites

Distribution	Web Site
Red Hat	http://bugzilla.redhat.com/bugzilla
SUSE LINUX	http://www.suse.com/us/private/download/updates
Turbolinux	http://www.turbolinux.com/security

4.1.3 iSeries Navigator

iSeries Navigator provides a powerful suite of functions to handle your administration tasks. Figure 4-2 on page 78 shows the iSeries Navigator window.
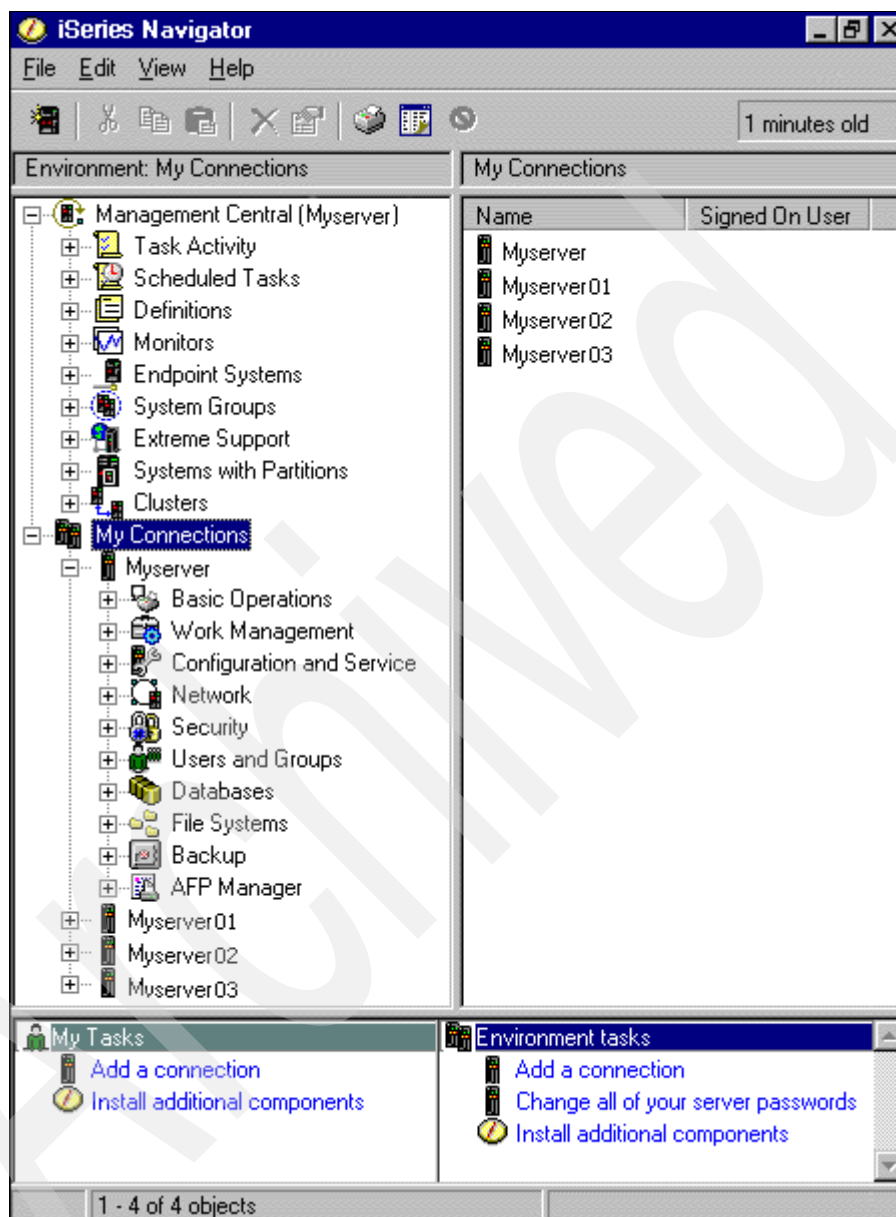
Figure 4-2   iSeries Navigator

What can you do with iSeries Navigator? Table 4-2 on page 79 shows you some of the most important tasks that you can do using iSeries Navigator.

Table 4-2   iSeries Navigator tasks

iSeries Navigator concepts	Description
Manage multiple systems	The Management Central technology, which is an integral part of iSeries Navigator, enables you to manage tasks across one or more servers simultaneously. Simplify your systems management with task scheduling, real-time performance monitoring, managing fixes (or PTFs), distributing objects, managing users and groups, running commands from a central system, and much more.
Manage logical partitions	Use iSeries Navigator to access your logical partition information, change the logical partition configuration, manage security, and change processing resources without requiring a system restart. On an iSeries system, you can use iSeries Navigator, Dedicated Service Tools, and System Service Tools to manage your logical partitions. If you are partitioning your server on an IBM @server Model 520, 550, 570, or 595, see the IBM @server Hardware Information Center at http://publib.boulder.ibm.com/infocenter/iseries/v1r2s/en_US/info/iphat/iphatlparkickoff.htm.
Manage your hardware	Use iSeries Navigator to configure, protect, and manage all of your disk units and disk pools and work with mirroring and parity protection. iSeries Navigator also allows you to view all stand-alone devices and all the tape resources and cartridges within your tape libraries. Using iSeries Navigator, you can duplicate tapes, display or print volume labels, eject a tape from a tape library, format a tape, make a tape cartridge or device (vary it on), make a tape device unavailable (vary it off), print save-or-restore-tape information, print volume contents, and reset tape resources.
Secure your network	Network security means that your customers, employees, and business partners can obtain the information that they need to do business with you in a secure environment. iSeries Navigator has several integrated features that will help build a strong defense against the security risks you might encounter along the way. Use iSeries Navigator to configure everything from your basic system security policy to secure end-to-end VPN connections, filter rules, address translation, SSL, enterprise identity mapping, and much more.
Work with database records	You can perform many of your database tasks using iSeries Navigator. These tasks include creating and maintaining database objects, inserting or changing data, monitoring and analyzing query performance, and creating a map of your database.

iSeries Navigator concepts	Description
Connect your network	Use the Network component of iSeries Navigator to configure and manage network communications on your server. Find wizards to easily configure the interfaces, routes, and servers that are necessary for network communications. Verify connectivity using the PING and trace route utilities. Then, choose from a variety of functions to customize the network; for example, you can select IP policies to control and secure your network traffic using QoS or VPN, or choose Remote Access Services to create point-to-point connections.
Manage your system workload	System jobs are created by the operating system to control system resources and perform system functions. System jobs run when the iSeries system starts, without user input. These jobs perform a variety of tasks, from starting the operating system, to starting and ending subsystems, to scheduling jobs.
Limit application availability	Application Administration enables administrators to limit or grant access to functions, including several iSeries Navigator functions, and other applications for the users and groups on a specific iSeries system. Administrators can also centrally manage many of the properties used by iSeries Access for Windows clients and use the advanced Application Administration settings to centrally control environment, password, connection, service, and language settings.

4.2 Backup and recovery

In this section, we describes backup and recovery best practices on the iSeries integrated environment from the iSeries, Linux, and Windows perspectives. Because iSeries integration for Windows and Linux servers combines three operating systems (Linux, Windows, and OS/400), you can choose to manage backups by using OS/400, Windows, and Linux utilities, or a combination of all of these.

We compare the various methods of saving and restoring Windows data and provide recommendations about the way we think that the backups should be done. We also provide tips for improving performance, sample CL programs for automating the backup and recovery process, and sample backup schedules.

From the Linux perspective, there are two approaches to backup and recovery. From the OS/400 side, you can save the network server storage spaces that correspond to the virtual disks in a Linux system. The other possibility is to use the Linux commands to do this. Which method is best is not a simple question. It depends of your environment. Therefore, this section looks at both approaches.

4.2.1 Linux side backup

Doing a backup from the Linux side is probably the best way to save the system. You can use the following standard Linux commands to save to files or to tape drives:

► Saving to tape drives can include virtual or direct-attached tape drives. To do this, you do not need to power down the Linux system before doing a backup as opposed to doing a backup from OS/400.

► If you save to file, you can transfer the file to an OS/400 partition and then back up the file along with the OS/400 backup process. For this transfer, you can use FTP or NFS, or you can mount the iSeries IFS using Samba.

By mounting the required export into the OS/400 mount points, you can use the OS/400 SAV command to do file-level backups of the Linux data. Then, you can use RST to restore even individual files as long as the UID and GID on OS/400 are set correctly.

Back up to virtual tape drive

As mentioned before, to Linux, almost everything is a file. Devices, such as tape drives (virtual and direct), are also seen as files in the /dev file system. However, they simply replace the file name by the name of the device to which you want to backup, and you are backing up to that device.

The Linux kernel

There are several ways the Linux kernel is loaded, depending on the location of the Linux kernel. This parameter can be set in the NWSD IPL source option. In most cases, it resides in a disk partition of the NWSSTG. It can boot up from a stream file in the iSeries IFS or from objects in the iSeries memory space. Be sure to back up this IPL source also if you want a complete backup of your Linux system. Back up the stream file or run the SAVSYS command to save the A and B load sources when you use them.

4.2.2 Microsoft Windows side backup

In this section, we discuss best practices regarding Windows file-level backup and recovery as it relates to the Windows integration environment, in particular, how to set up the iSeries to use OS/400 tape drives and disk storage to save files using Windows backup applications.

Consider the following best practices:

► If possible, do not store user data on the Windows system (C:) drive.

► Try to keep application software on a drive or drives separate from the system and data.

- Applications rarely change and do not require frequent backups, so you can eliminate these storage spaces from your daily routine.

- If possible, try to keep static data and frequently modified data on separate drives. Static data changes infrequently and only needs backing up when it changes, while frequently modified data needs to be saved regularly.

- Remember that all data on iSeries is scattered across every disk in a partition or auxiliary storage pool (ASP). Therefore, you can create very large virtual disk drives (up to 64,000 MB) to hold large amounts of data without adversely affecting performance. This might simplify your backup strategy.

- Always save the OS/400 system components of the integrated Windows server as soon as you are satisfied that the server is installed and configured correctly. Ensure that they are included in your periodic, complete OS/400 backup.

- Make frequent backups of the Windows system (C:) drive. This is where the Windows operating system is stored and where the registry, including the domain database, is kept if the integrated Windows server is a domain controller. As a precaution, you might also want to use a Windows utility to save the registry separately, in addition to backing up the C: drive.

- The fastest way to save the C: drive is to use a disaster recovery backup.

- If you have already implemented a backup strategy using a Windows backup application, you might want to continue using the backup infrastructure you already have in place.

- However, it is worthwhile to investigate whether using the backup functions available from the OS/400 side will complement or even improve your current procedures.

- If you need disk protection (RAID-5 or mirroring), implement this at the OS/400 level, and do not use any form of Windows protection. Using Windows RAID-5 or mirroring will adversely affect performance and add no additional protection.

4.3 Cluster services

Our purpose here is to overview the concepts, not discuss the detailed implementation. For more information about iSeries high availability options, see:

http://www.ibm.com/servers/eserver/iseries/ha/

On the Windows side, to enable Microsoft cluster services, you must have at least two Integrated xSeries Servers or Integrated xSeries Adapters installed in any kind of iSeries system.

Replication, switched disks, and cross-site mirroring

The primary advantages a clustered environment provides are those of replication, switchability, and cross-site mirroring (XSM).

Replicated resource

Replication is the process of copying objects from one node in a cluster to one or more other nodes in the cluster, which makes the objects on all the systems identical.

A replicated resource allows for objects, such as an application and its data, to be copied from one node in the cluster to one or more other nodes in the cluster. This process keeps the objects on all servers in the resource's recovery domain identical. If you make a change to an object on one node in a cluster, the change is replicated to other nodes in the cluster. Then, if a failover or switchover occurs, the backup node can seamlessly take on the role of the primary node. The server or servers that act as backups are defined in the recovery domain. When an outage occurs on the server defined as the primary node in the recovery domain and a switchover or failover is initiated, the node designated as the backup in the recovery domain becomes the primary access point for the resource.

Replication requires the use of either a custom-written application or a software application written by a cluster middleware business partner. For details, see the "Plan for replication" topic in the iSeries Information Center, available at:

    http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info
    /rzaig/rzaigplanreplication.htm

Switchable resource

Switchable resources enable the resources, such as data and applications, residing on an expansion unit or on an input-output processor (IOP) on a shared bus in a logical partition, to be switched between a cluster's primary node and backup node. This allows for a set of disk units to be accessed from a second server, a server defined as a backup node in the cluster resource group's recovery domain, when the server currently using those disk units experiences an outage and a failover or switchover occurs.

Taking advantage of switchable resources in your cluster requires the use of independent disk pools. For more information, see the "Plan for independent disk pools" topic at:

    http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm?info
    /rzaly/rzalyplan.htm

Cross-site mirroring

Cross-site mirroring, combined with the geographic mirroring function, enables you to mirror data on disks at sites that can be separated by a significant geographic distance. This technology can be used to extend the functionality of a device cluster resource group (CRG) beyond the limits of physical component connection. Geographic mirroring provides the ability to replicate changes made to the production copy of an independent disk pool to a mirror copy of that independent disk pool. As data is written to the production copy of an independent disk pool, the operating system mirrors that data to a second copy of the independent disk pool through another system. This process keeps multiple identical copies of the data.

Through the device CRG, if a failover or switchover occurs, the backup node can seamlessly take on the role of the primary node. The server or servers that act as backups are defined in the recovery domain. The backup nodes can be at the same or different physical location as the primary. When an outage occurs on the server defined as the primary node in the recovery domain and a switchover or failover is initiated, the node designated as the backup in the recovery domain becomes the primary access point for the resource and will then own the production copy of the independent disk pool. Therefore, you can gain protection from the single point of failure associated with switchable resources.

Use Table 4-3 to help you understand the benefits and advantages of replication, switched disk, and cross-site mirroring technology.

Table 4-3   Replication, switched disk, and cross-site mirroring considerations

Factor	Replication	Switched disk	Cross-site mirroring
Flexibility	10s of servers.	2 servers.	4 servers.
Single point of failure	None.	Disk subsystem.	None.
Cost	Additional disk capacity required.	Switchable I/O expansion unit (tower).	Additional disk for mirror copy of independent disk pool. Optionally switchable I/O expansion unit.
Performance	Replication overhead.	Little impact.	Geographic mirroring overhead.
Real time coverage	Journaled objects.	Objects contained in independent disk pool.	Objects contained in independent disk pool.

Factor	Replication	Switched disk	Cross-site mirroring
Geographic dispersion	Limited by performance considerations.	Limited attach distance because servers and expansion units must be attached to HSL OptiConnect loop (250 meters maximum).	Limited by performance considerations. (No limits are imposed by the system. However, response time and throughput over selected communications lines can dictate some practical limit.)
Disaster recovery protection	Yes.	No.	Yes.
Concurrent backup	Yes.	No.	No.
Setup	Replication environment. Determining what to replicate.	Independent disk pool environment. Populate independent disk pool.	Independent disk pool environment (include setting up geographic mirroring). Populate independent disk pool.

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this Redpaper.

IBM Redbooks

For information about ordering these publications, see "How to get IBM Redbooks" on page 90. Note that some of the documents referenced here may be available in softcopy only.

► *Microsoft Windows Server 2003 Integration with iSeries*, SG24-6959

► *Implementing Linux on Integrated xSeries Solutions for iSeries*, SG24-6379

► *IBM @server i5, iSeries, and AS/400e System Builder IBM i5/OS Version 5 Release 3*, SG24-2155

► *Windows-based Single Signon and the EIM Framework on the IBM @server iSeries Server*, SG24-6975

► *Linux on the IBM @server iSeries Server: An Implementation Guide*, SG24-6232

Other publications

These publications are also relevant as further information sources:

► *IBM @server i5 and iSeries System Handbook: IBM i5/OS Version 5 Release 3*, GA19-5486

► *IBM @server iSeries Backup and Recovery Version 5*, SC41-5304

► *IBM AS/400e Hierarchical Storage Management*, SC41-5351

► *IBM @server Integrated xSeries Adapter*

   http://publib.boulder.ibm.com/infocenter/eserver/v1r2s/en_US/info/iphbe/iphbe.pdf

► *IBM eServer iSeries Advantage: Benefits of Integrated xSeries Adapter for J.D. Edwards OneWorld / ERP 8.0* white paper

   http://www.ibm.com/servers/eserver/iseries/integratedxseries/pdf/jdeixa.pdf

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► *Linux on iSeries* white paper

`http://www.ibm.com/servers/eserver/iseries/linux/pdfs/iseries.pdf`

Online resources

These Web sites and URLs are also relevant as further information sources:

► IBM @server iSeries Information Center, Version 5 Release 3

`http://publib.boulder.ibm.com/infocenter/iseries/v5r3/ic2924/index.htm`

► iSeries Windows integration Web site

`http://www.ibm.com/servers/eserver/iseries/integratedxseries/`

► Integrated xSeries Server

`http://www.ibm.com/servers/eserver/iseries/integratedxseries/ixs_overview.html`

► 2.0 GHz Xeon Integrated xSeries Server

`http://www.ibm.com/servers/eserver/iseries/integratedxseries/2_0ghz.html`

► Integrated xSeries Adapter

`http://www.ibm.com/servers/eserver/iseries/integratedxseries/xseriesmodels/`

► iSeries Integrated xSeries utilities

`http://www.ibm.com/servers/eserver/iseries/integratedxseries/ixu/`

► Integrated xSeries solutions: Dynamic disk drive unlinking

`http://www.ibm.com/servers/eserver/iseries/integratedxseries/dunlink.html`

► Integrated xSeries solutions: "Planning guide for Windows servers"

`http://www.ibm.com/servers/eserver/iseries/integratedxseries/windows/planguide.htm`

► Integrated xSeries Adapter install read me first page

`http://www.ibm.com/servers/eserver/iseries/integratedxseries/ixareadme/`

► IBM @server i5/OS and OS/400 PTFs

`http://www.ibm.com/servers/eserver/iseries/integratedxseries/ptfs.html`

► Integrated xSeries Server configurations table

`http://www.ibm.com/servers/eserver/iseries/integratedxseries/ixs_system_config.html#configs`

► Installation and Usage Guide: iSeries Access for Linux

`http://www.ibm.com/servers/eserver/iseries/access/linux/guide/index.html`

► Linux on POWER applications

  http://www.ibm.com/servers/eserver/linux/power/apps/all.html

► Linux on Power Architecture Developer's Corner

  http://www.ibm.com/developerworks/linux/power/

► IBM @server Workload Estimator

  http://www-912.ibm.com/wle/EstimatorServlet

► Performance Management for IBM @server iSeries

  http://www.ibm.com/servers/eserver/iseries/perfmgmt/

► iSeries benchmark centers

  http://www.ibm.com/servers/eserver/iseries/benchmark/cbc/index.html

► IBM Developer Kit for Linux, Java 2 Technology Edition (requires registration)

  https://www6.software.ibm.com/dl/lxdk/lxdk-p

► Windows-to-Linux roadmap: A roadmap for developers making the transition to Linux

  http://www.ibm.com/developerworks/linux/library/l-roadmap.html

► IBM developerWorks: Migration station

  http://www.ibm.com/developerworks/ondemand/migrate/linux.html

► Porting MFC applications to Linux: A step-by-step guide to using wxWindows

  http://www.ibm.com/developerworks/linux/library/l-mfc/

► Porting Central: Follow a roadmap

  http://www.ibm.com/servers/enable/site/porting/linux/index.html

► IBM Technology Assessment and Consulting Services: Linux strategy workshop

  http://www.ibm.com/services/us/index.wss/so/its/a1000017

► IBM developerWorks: Linux forums

  http://www.ibm.com/developerworks/forums/dw_lforums.jsp

► Linux technical library

  http://www.ibm.com/developerworks/views/linux/tutorials.jsp

► Linux, UNIX, and Open Source training

  http://www.ibm.com/services/learning/ites.wss/us/en?pageType=courses_az&sub
  ChapterInd=C&sortBy=6&subChapter=5068&x=81&y=15

► Free and fee classes about Linux

  http://www.ibm.com/services/learning/ites.wss/us/en?pageType=courses_az&sub
  ChapterInd=C&sortBy=6&subChapter=5068&x=81&y=15

► Training paths for Linux

    http://www.ibm.com/services/learning/ites.wss/us/en?pageType=page&contentID=a0000323

► IBM Course catalog

    http://www.ibm.com/services/learning/ites.wss/us/en?pageType=page&contentID=a0000037

► New to Linux information site

    http://www.ibm.com/developerworks/linux/newto/

► Speed start your Linux application, Linux trial code

    http://www.ibm.com/developerworks/offers/linux-speed-start/

► Conferences and events

    http://www.ibm.com/services/learning/ites.wss?pageType=page&contentID=a0000058&eventType=Conferences

► IBM @server Fix Central

    http://www-912.ibm.com/eserver/support/fixes/fcgui.jsp

► IBM @server iSeries integrated xSeries solutions

    http://www.ibm.com/servers/eserver/iseries/integratedxseries/

► IBM @server fixes

    http://www.ibm.com/servers/eserver/support/iseries/fixes/index.html

► Red Hat Bugzilla main page

    http://bugzilla.redhat.com/bugzilla

► SUSE LINUX updates, patches, bugfixes

    http://www.suse.com/us/private/download/updates

► Turbolinux Security Center

    http://www.turbolinux.com/security

► OpenLinux

    http://www.caldera.com/support/security

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Best Practices for Windows and Linux Integration in the iSeries

Redpaper

Discover what iSeries offers for integration opportunity

Review the methodologies for sizing integrated servers

Once integrated overview the ongoing management considerations

This Redpaper will provide you with a broad understanding of the integration of existing, separate Microsoft Windows and Linux PC servers in an IBM @server iSeries system with an integrated IBM @server xSeries server.

We discuss the overall considerations for selecting and sizing servers. We also describe best practices and provide information about other resources that are available to you.

This guide is developed for IBM employees, IBM Business Partners, and customers.