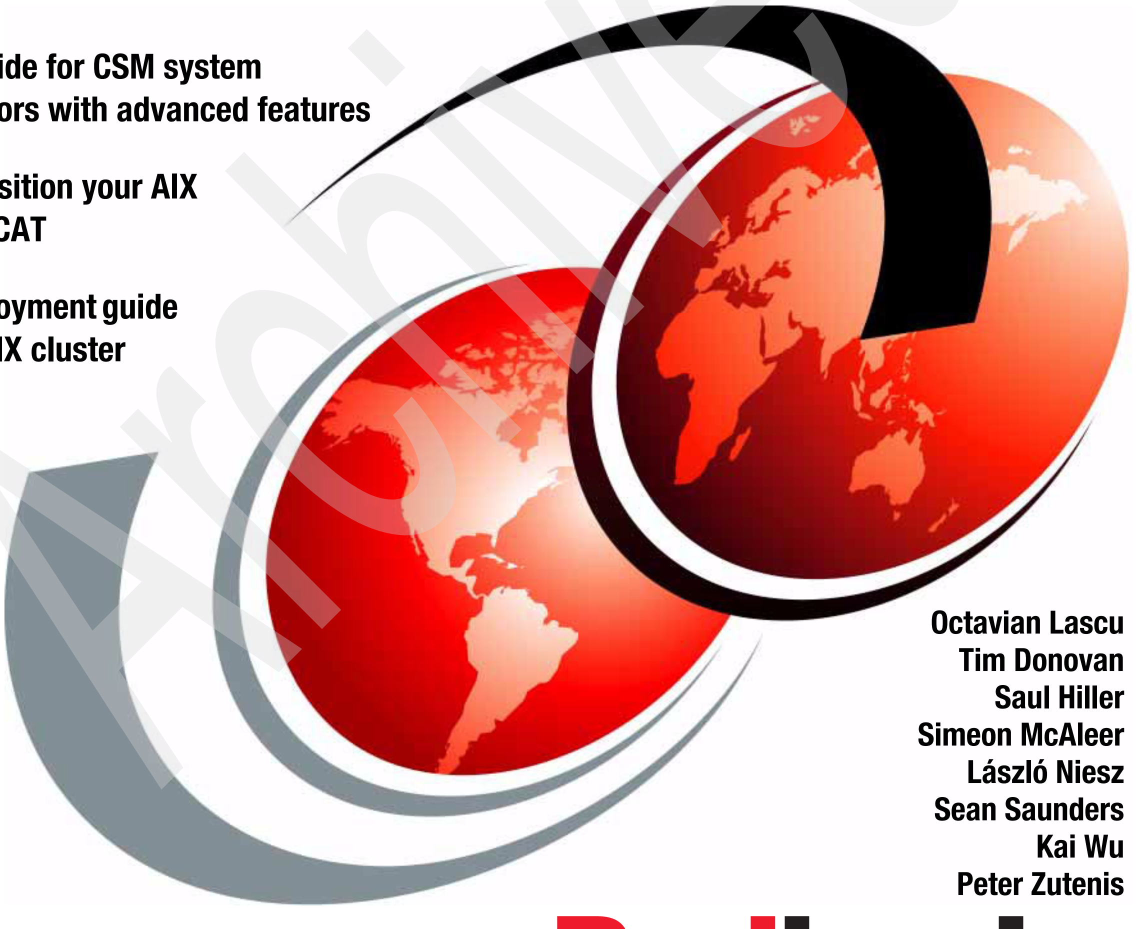
IBM

Configuring and Managing AIX Clusters Using xCAT 2

An xCAT guide for CSM system administrators with advanced features

How to transition your AIX cluster to xCAT

xCAT 2 deployment guide for a new AIX cluster



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Configuring and Managing AIX Clusters Using xCAT 2

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

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This edition applies to Version 2, Release 2, Modification 1 of Extreme Cluster Administration Tool (xCAT 2) for AIX.

Contents

Notices

Trademarks

Preface

This IBM® Redbooks® publication positions the new Extreme Cluster Administration Toolkit 2.x (xCAT 2) against the IBM Cluster Systems Management (CSM) for IBM Power Systems™ running AIX in a High Performance Computing (HPC) environment.

This book provides information to help you:

- ► Understand, from a broad perspective, a new clustering management architecture. We emphasize the benefits of this new solution for deploying HPC clusters of large numbers of nodes.
- ► Install and customize the new xCAT cluster management in various configurations.
- ► Design and create a solution to migrate from existing CSM configurations to xCAT-managed clusters for IBM System p platforms running AIX.

The team that wrote this book

This book was produced by a team of specialists from around the world working at the International Technical Support Organization, Poughkeepsie Center.

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Simeon McAleer has been with IBM for 6 years . His current role is as an Accredited IT Architect on the IBM World Wide Deep Computing Technical Sales team. In this role, he covers the full IBM server, storage, and middleware portfolio from x86 Linux clusters to Blue Gene systems including GPFS, xCAT, and LoadLeveler. He has expertise in designing solutions for Life Science, Higher Education, Digital Media, and Weather clients. Prior to this position, he worked as a solution architect on the Americas Advanced Technical Sales team configuring and installing Linux clusters as well as educating clients about the use of CSM and xCAT. As part of that team, he helped to install the clusters at the National Geographic Society that are used to power the Genographic project.

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Part 1

Introduction

In this part we introduce cluster management concepts and discuss xCAT 2 architecture and functionality. We also present a functional comparison between the IBM Cluster Systems Management and xCAT 2.

1

Introduction to clustering

This chapter provides a high-level overview of IT cluster computing, including the various components of a cluster. Additionally, it provides an overview of cluster management software including xCAT 2.0.

The topics covered are:

- Cluster concepts
  - Cluster types
  - HPC Cluster components
    - Cluster nodes
    - Cluster interconnects
    - Hardware control and consoles
- Cluster management software
  - Cluster systems management (CSM) software
  - xCAT 2.0
  - CSM to xCAT transition
  - Differentiating IBM Director and xCAT 2.0

1.1 Clustering concepts

In information technology (IT), a cluster is a group of nodes (computers) that are linked together to provide improved reliability, availability, and/or performance.

While the initial view of a cluster might focus solely on the compute node, a full IT cluster solution is comprised of various node types: the interconnect networks, hardware management, management software, storage, and application software. While each cluster might be slightly different, each of these elements must be included in order to ensure that the system can function as a useful solution.

1.1.1 Cluster types

Despite their varied uses, IT clusters are typically divided into three common types:

- Load Balancing
- High Availability
- High Performance Computing (HPC)

Each cluster type may also be found within one overall cluster solution. For example, a particular environment might utilize a load-balancing cluster of Web servers to provide access to the solution. The system might utilize two servers in a high availability cluster to provide user authentication. Lastly, the solution's high performance computing cluster may be used to perform the user's calculation.

High availability

As mentioned before, clusters can be used to provide improved reliability over a single server through the use of redundancy. Such cluster types are called high availability or failover clusters. There are two standard types of high availability clusters:

- Active-Passive

  In an active-passive high availability cluster, one server actively provides the service while the remaining servers in the cluster remain idle. If the active server fails, the high availability software brings one of the passive servers to an active state and transfers future service requests to the new active server.

- Active-Active

  In an active-active high availability cluster, all servers in the cluster actively provide the service. If an active server fails, future service requests are directed to one of the other active servers. In an active-active high availability cluster, care must be given to how service requests are distributed amongst the high availability cluster nodes.

Load balancing

Load balancing clusters are used to spread a workload across identical resources where the workload might overwhelm a single resource. The load can be spread among these resources either through a simple round-robin algorithm or more detailed and adaptive algorithms such as those found in IBM WebSphere Application Server. A common example of a load balancing cluster is a cluster of Web servers.

High Performance Computing (HPC)

Many computational problems cannot be solved through the use of a single computational resource in a timely manner. As a result, IT professionals have grouped computational nodes together in order to provide a unified system which can address much larger computational problems. HPC clusters, for example, are necessary to unfold the human genome, generate weather forecasts on a regional scale, model the size and shape of a petroleum reservoir, or render the pixels for an animated movie. Each node in an HPC system can either be tightly coupled to its neighbor nodes or act independently.

New uses for HPC clusters are constantly being identified and forcing the systems to grow in size and complexity. Four teraflop systems, which were considered the cutting edge technology in 1998, are now considered trivial as the computing industry moves to exascale computing. As a result, important consideration must be given to the energy constraints and management of these HPC systems.

1.1.2 Cluster components

While the compute servers usually garner all the attention in discussions about clusters, there are a number of elements that are necessary to make the cluster a truly useful tool.

Nodes

The nodes of an HPC cluster are at the heart of a cluster. They provide the access to the system, the platform from which to manage the system, and the horsepower to calculate difficult computational problems. These nodes can be single processors or SMP servers running any combination of Linux®, Windows®, AIX®, or other operating system. In fact, it is quite common to find HPC clusters with a heterogeneous mix of compute node architectures.

Interconnects

The networks in a cluster provide the glue to hold the system together. These networks can provide access to the system from the outside, a method for the compute servers to communicate amongst themselves, and a pathway for the IT administrator to reach the systems even if they have been powered off.

Storage

Although it is often overlooked, the storage system of a cluster provides the fuel which allows a cluster to operate. Without a centralized storage component the compute nodes might not have anything on which to operate, or a place to store their data once their operations have been completed. If not enough attention is given to the underlying design of the storage subsystem, even the most powerful HPC system can be rendered useless as compute resources sit idle waiting for their I/O requests to be completed.

The discussion of the cluster storage system must also extend past the actual storage hardware to the file system that sits on top of the disks. The cluster architect must look at the performance, reliability and expandability requirements to identify the proper middleware to meet the requirements of the HPC cluster. An excellent example of a cluster file system which addresses these considerations is the IBM General Parallel File System (GPFS™).

HW management

The hardware management capabilities of a cluster include the hardware control devices such as the IBM Hardware Management Console (HMC) or Advanced Systems Management Interface (ASMI) for IBM Power Servers, the BladeCenter® Advanced Management Module (AMM), and the Integrated Management Module for IBM System x® servers. These devices let you monitor the hardware for fault errors, turn the power on and off to the servers, and perform remote console access to the servers.

Management SW

As HPC systems grow in size and complexity, strong management software becomes increasingly important. The days have long passed where an IT administrator could manually install the operating system on each cluster node via a CD or update the firmware on all of the nodes through a floppy drive. IT administrators now have the management software to install thousands of nodes within a few minutes, run parallel commands across all of the cluster nodes simultaneously, and update the firmware on all of the cluster nodes in parallel.

Also included in the cluster management software topic is the batch job scheduling software such as IBM Tivoli® Workload Scheduler LoadLeveler®. This software allows users to submit a job to the cluster and have it distributed across the system resources to be executed immediately on available resources or executed once the other tasks on the system resource queue are completed.

Tools such as the open source Ganglia monitoring suite allow administrators to monitor how the resources of the HPC cluster are being utilized.

Application SW

The application software of a cluster is the technical or scientific code run on the compute nodes. Examples of HPC application software are weather prediction models, gene sequence assembly, financial model prediction, or animation pixel digital rendering.

1.1.3 Cluster nodes

This section presents the types of nodes in HPC clusters. They are:

- Login or front-end nodes
- Development, compilation, and interactive nodes
- Compute nodes
- Storage nodes
- Control nodes
- Management nodes
- Service nodes

A cluster can utilize separate physical nodes to address each of these node types or a cluster can utilize one physical node to handle multiple functions. For example, a management node used to monitor and install the cluster could also provide the DNS capabilities typically found in a control node. Conversely, a cluster can have multiple copies of a node type in order to add resiliency and reliability to the solution.

Login or front-end nodes

Any computational resource that is placed on a network becomes an instant target for hackers who wish to use that system for their own purposes. When multiple unprotected HPC systems are placed on the network at the same time, the risk factors start to multiply. In a fully open HPC cluster, the system administrator must carefully monitor the OS patches and firewall settings of each resource. In our experience, with large open HPC systems, independent of the IT administrator's skill level, something usually gets overlooked and the system is compromised. We have seen newly installed open HPC clusters at universities begin to see hacking attacks within two hours of deployment and suffer from complete penetration within 24 hours. The administrator must then spend months trying to secure the system and purge the system of traces of the hack.

Therefore, we recommend that public access is not granted for every resource in an HPC cluster. Instead, only the login or front-end nodes should be connected to the public user network. In this environment, the IT administrator can focus his attention on securing this limited number of resources from outside attacks.

Users should only be allowed to access the HPC cluster through the login nodes. User credentials will be authenticated on the login node. On the login node users can submit batch jobs to the HPC cluster compute nodes and view the results from those jobs. From the login node, users can also access the HPC interactive nodes in order to perform code development.

GUIs require additional system resources and memory overhead. While these tools might help to improve the accessibility of the system, they limit the resources which can be applied to calculate a computational problem. By adding login nodes to an HPC system, GUIs can be limited to the login nodes. These tools can be stripped from the compute node images and thus maximize the computational power of the compute nodes.

Development, compilation, and interactive nodes

The desk side computational resources of users of the HPC system might not match the computational resources provided in the HPC cluster. Therefore, it is important that the design of the HPC cluster provides the users with resources on which to develop and test their code.

These nodes can be used to develop and compile code prior to using it on the cluster. Users can interactively access these nodes to step through applications to locate problems with their code.

By limiting the development of applications to these nodes, software licenses for compilers and other software development tools can be constrained to this subset of nodes, thus helping to reduce the overall cost of the system.

Compute nodes

The vast majority of work done by an HPC cluster is performed by the compute nodes. Jobs are typically dispatched to the compute nodes through the job scheduler resident on one of the other cluster nodes. Depending on the application requirements and system resources, one or more tasks can be executed simultaneously on a single physical compute node. The tasks performed on the compute node can be independent of the other compute nodes or the task can rely on the results calculated by its neighbors in the HPC cluster.

Storage nodes

As mentioned earlier, the design of the storage subsystem is a very important consideration to the overall design of an HPC cluster. Each node of a cluster can have its own storage on local disk or be directly connected to a storage controller.

A more cost-effective method to design HPC cluster storage is to limit the number of nodes which are directly attached to the storage enclosure. These storage nodes then serve the storage file system to the rest of the nodes in the HPC cluster. The file system can then be remotely mounted on the other HPC cluster nodes either through NFS, CIFS, or the GPFS native client protocol. Depending on the design of this system, this method could provide better performance, scalability, and expandability than direct attach methods.

Control node

The control nodes of an HPC cluster provide the unifying services to the cluster that allow it to act as a cohesive system. These services include the Domain Name System (DNS) service, the Domain Host Configuration Protocol Service (DHCP), and the Network Time Protocol (NTP) service. Additionally, the control nodes can also manage the batch queuing resource manager and scheduler which allocate jobs to the compute nodes based on available resources and user priority settings.

Management node

The management node of an HPC cluster can control the entire operation of a cluster. The management node is responsible for providing access to the hardware control points of all of the systems in the cluster. The management node is used as a centralized resource for installation, sending out parallel commands, sending power cycle commands to the cluster resources, and monitoring the resources in the cluster. In small HPC systems, many of the other types of cluster nodes are combined into the management node.

Service node

As the size of HPC clusters increases, the workload for installing and managing the cluster must be distributed to a second tier of nodes. If a single management node was used to provide the OS image for a thousand compute nodes, its NFS capabilities for serving the image would be easily overwhelmed. Instead, by distributing the installation and management capabilities to a second hierarchical layer of service nodes, the process can be smoothed and higher service levels achieved.

1.1.4 Cluster networks

The main virtual local area network (VLAN) types and roles in an HPC cluster are:

- Management VLAN

- Storage VLAN
- Message Passing Interface (MPI) VLAN
- Cluster VLAN
- Public or Login VLAN

Typically, these VLANs are separated within a cluster environment. However, some of these networks can be combined or eliminated. For example, some clusters will not require an MPI network.

Management VLAN

The management VLAN is used to connect the management server of a cluster with the hardware control points of the cluster. This network is usually kept separate from the other networks in order to avoid errant usage.

Serial Over Console (SOL) connections will also be conducted over the management VLAN.

Due to the limited bandwidth requirements of this network, a 10/100/1000 Ethernet connection is typically sufficient for the management VLAN.

Storage VLAN

The storage VLAN is used to provide the file systems from the I/O nodes to the rest of the nodes in the cluster. Depending on the I/O requirements of the HPC cluster, this network could be separate or combined with the cluster network.

Typically, the uplink from the I/O storage nodes to the main network switch will be either 4x DDR Infiniband or 10 Gb Ethernet. The storage network from the main switch to the individual compute nodes could be either Infiniband or even Gigabit Ethernet.

MPI VLAN

For some HPC applications it is important for the compute nodes to communicate with one another during the execution of a particular task or job. These interprocess communications could require high bandwidth and low latency. This type of communication would require an independent Infiniband, Myrinet, or 10 Gb Ethernet network to exist between the nodes.

If the user's applications do not depend heavily on the latency characteristics of the MPI communication, this network can be combined with the cluster or storage VLANs.

If a separate VLAN is designed for MPI communication, special care should be given to ensure that the management node also resides on the MPI VLAN so that the management server can monitor and control the resources of the MPI VLAN.

Cluster VLAN

The cluster VLAN is the internal network for the compute nodes in the cluster. Jobs are distributed from the login node to the cluster nodes over the cluster VLAN.

Nodes in the cluster also utilize the cluster VLAN for network booting of their OS image. The cluster VLAN adapters should therefore be capable of PXE booting across the network.

Public or login VLAN

The Public VLAN should be the only access into the cluster from the outside network. As discussed in “Login or front-end nodes” on page 7, allowing uncontrolled access to all of the computational resources in the HPC cluster could prove disastrous. As a result, only the login node should be connected to the public VLAN. Using the public VLAN, users submit jobs through the front-end node.

1.1.5 Hardware, power control, and console access

This section describes the HPC cluster components that are involved in remote console and hardware control access.

Hardware control points

The management node communicates with the hardware control points of the cluster nodes in order to monitor and power cycle the nodes. The typical functions carried out on the hardware control points are:

- Node MAC address collection
- Displaying the running status of the cluster nodes
- Booting the nodes in the HPC cluster
- Remote power cycling of the nodes in the HPC cluster
- Monitoring the hardware status of the nodes in the HPC cluster

These communications are usually carried out over the Cluster VLAN.

The most common hardware control points in IBM servers are:

- Hardware Management Console (HMC) - for HMC-attached System p® nodes

- Integrated Virtualization Manager (IVM) - for IVM-managed System p nodes
- Advanced System Manager/flexible service processor (ASM/FSP) - for System p direct attach nodes
- Advanced Management Module (AMM) - for Blade Center nodes
- Baseboard management controller (BMC) - for IBM xSeries® 336, 346, System x3455, x3550, and x3650 servers
- Remote Supervisor Adapter II (RSA II) - for System x nodes
- Integrated Management Module (iMM) - for System x nodes with Intel® Nehalem processors.

Note: For more details about each of the hardware control points, see *xCAT 2 Guide for the CSM System Administrator*, REDP-4437.

Console access device (terminal server)

A management node can also communicate with the control point hardware to open a remote console window to a cluster node.This communication can be between the cluster node hardware control point or a standalone terminal server. A remote console window allows the IT Administrator to use a local window on the management node that mirrors what would be seen if the administrator were to open a window at the console of the remote cluster node.

The console traffic should be conducted over the management VLAN. This allows the IT administrator remote access to the cluster node even if the cluster VLAN is inaccessible.

The following devices provide remote console access for IBM servers:

- For HMC-attached System p, the HMC is the remote console server.
- For System p servers without an HMC, console traffic can be managed by the FSP.
- For IBM BladeCenter, remote console capabilities are provided through the ethernet switch module (ESM) using Serial-over-LAN (SOL).
- For System x servers, the BMC II, RSA II, or iMM can provide SOL capabilities.
- For standalone System x servers, an independent console server such as those from MRV, Avocent, or Cyclades can provide remote console access.

1.2 Suggested cluster diagram

As mentioned earlier, HPC clusters can include all of the above cluster components in various combinations. In some clusters, all of the elements may be present as distinct physical entities. At the other extreme, some of the components may be eliminated while others may be combined into one physical entity.

Figure 1-1 shows the absolute minimum architecture that can be used to define an HPC architecture. In this architecture, the only independent physical networks are the public, management, and cluster VLANs. The storage VLAN shares the same physical network as the cluster VLAN.

Similarly, the management node in this architecture also functions as the login node, control node, storage node, and development node. This is an architecture that we have seen but it has made significant trade-offs in terms of performance, reliability, and redundancy.

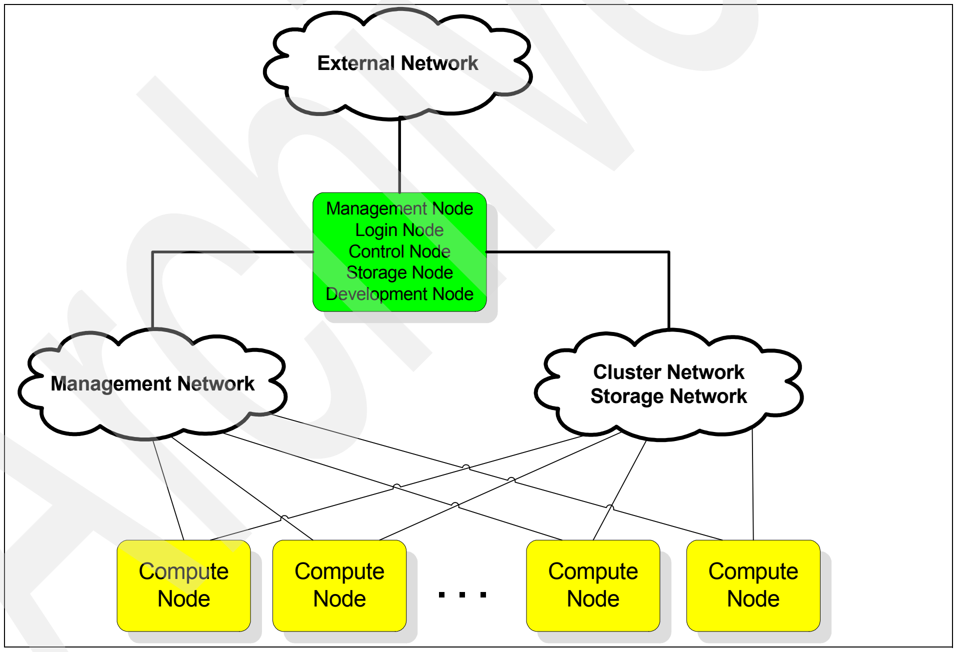

Figure 1-1 Minimum HPC cluster architecture design

Figure 1-2 on page 14 shows the opposite extreme from the first architecture. In this architecture, all five network VLANs are present as well as all seven HPC cluster node types. Each rectangle in the diagram represents multiple copies of the same node type for redundancy. These nodes can be configured in a combination of high availability or load balancing clusters. Even though only a single link is depicted from each node type to the networking VLANs, there can be multiple physical connections present. As can be seen in Figure 1-2, it is quite easy for an HPC cluster to quickly gain a high level of complexity. Therefore, a strong management software toolkit is extremely important for installing and maintaining an HPC cluster.

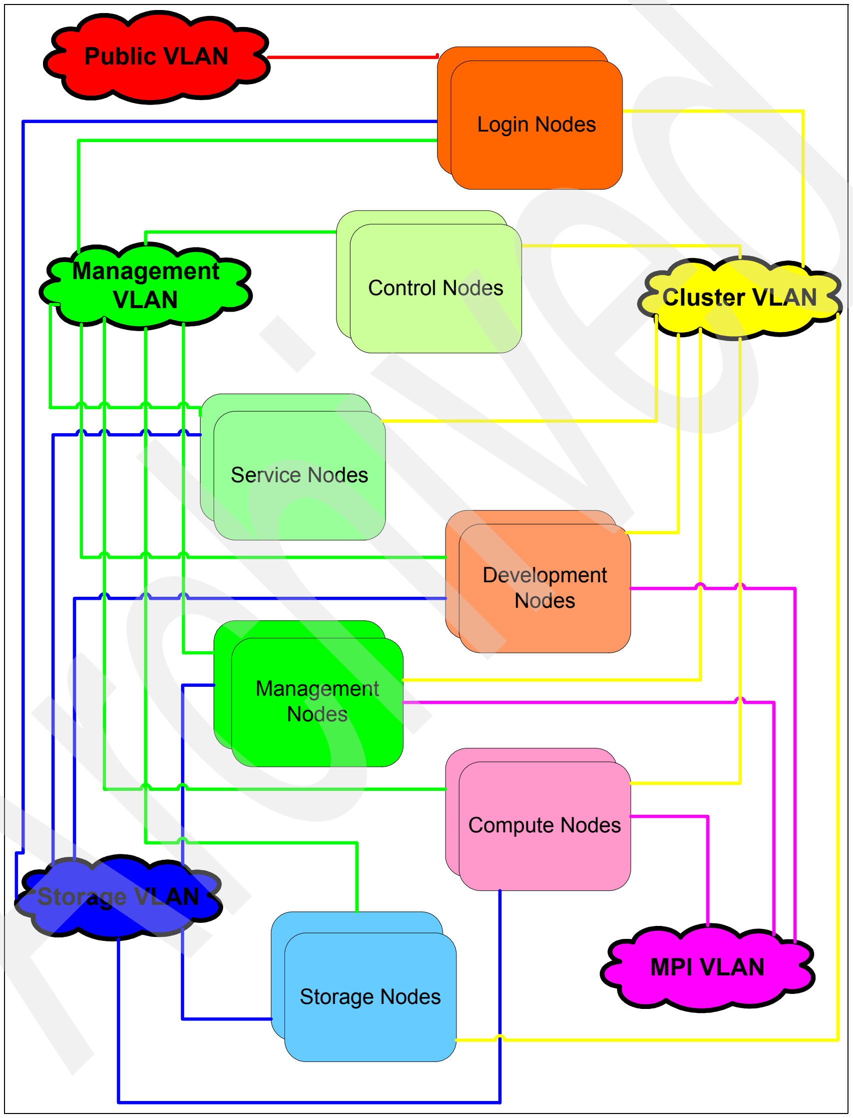

Figure 1-2 Complex HPC architecture design

1.3 Managing high performance computing (HPC) clusters

As mentioned in 1.1.2, "Cluster components" on page 5, when HPC clusters grow in size and complexity, the management software used to administer the clusters becomes increasingly more important. An individual IT administrator can not install operating systems by hand on each of the cluster nodes with a CD or update the firmware on each cluster node with a floppy drive.

Additionally, as the HPC clusters expand in size, the energy consumed will expand and the failure rate of the individual components will multiply to create a much higher system failure rate. One of the cluster node components that is a large source of this heat and failure rate are the local hard drives on the individual cluster nodes. If this component is eliminated from the equation, we can drastically reduce the power consumption of a cluster and improve the system's uptime.

To accomplish this goal, IT administrators have developed the practice of removing the hard drives with diskless clusters. In a diskless scenario, the local hard drives usually used for maintaining the operating system are removed from the cluster nodes. Typically, IT administrators instead boot the cluster node via storage area network (SAN) or iSCSI booting. In between power cycles, the state of the operating system for each cluster node is maintained on the remote storage controller.

The next natural evolution of this concept is stateless computing. In stateless computing, a local hard drive is not needed to maintain an image of the operating system. Instead, when a cluster node is rebooted it uses PXE booting to obtain its OS image and store it in the system RAM. When the node is powered off, the state of the current operating system is lost. This practice not only eliminates the need for a local hard drive for the OS image but it also eases the number of OS images that the IT administrator needs to manage. Instead of having to maintain the consistency of firewalls and patches for the operating systems on thousands of cluster nodes, the IT administrator only has to maintain one OS image that can be distributed to all of the nodes equally.

1.3.1 What is CSM

Cluster Systems Management (CSM) software is an IBM licensed product used to manage AIX and Linux clusters. CSM is a powerful, highly integrated system management and monitoring product that provides a centralized control interface for large compute clusters for commercial environments. CSM borrowed from a long line of IBM clustering technology and experience developed for the

RS/6000® SP, such as the Reliable Scalable Cluster Technology (RSCT), and combined it with industry tested and accepted open source software. CSM is designed to be used on cluster nodes as part of the IBM System Cluster 1600 and the IBM System Cluster 1350™.

CSM will continue to be supported for existing and new IBM Power Systems™ and System p hardware running AIX or Linux throughout the life of the entire Power6 program.

CSM customers should continue to utilize CSM to manage their current CSM deployments. IBM can help CSM administrators analyze whether CSM or another management tool such as xCAT 2.0 would be appropriate for future cluster deployments.

For HPC clusters, the best features of CSM and the eXtreme Cluster Administration Toolkit (xCAT) are being combined into a new powerful tool called xCAT 2.0. This tool is not an evolution of xCAT but instead an entirely new product.

1.3.2 xCAT 2: An 0pen source method for cluster management

The eXtreme Cluster Administration Toolkit (xCAT) 2 is an open source initiative developed by IBM to support the deployment of large HPC clusters based on various hardware platforms. xCAT 2 is not an evolution of the earlier xCAT 1 but instead a complete code write that combines the best practices of both CSM and xCAT 1.

The source code for xCAT 2 can be obtained from:

`http://xcat.sourceforge.net/`

xCAT 2 is a scale-out management system that provides:

- Remote hardware control
- Remote console management
- Automagic discovery and destiny control
- Automated unattended provisioning of cluster resources

xCAT 2 is designed to utilize only scripts. This makes the code portable and modular in nature which allows for the easy inclusion of additional functions and plug-ins.

Besides the performance requirements, the modern HPC environments must also be flexible, easy to administer, and highly reliable. By building upon the work of others, xCAT 2 is able to leverage the set of best practices. Instead of simply including the best code of others, as was the case in xCAT 1, the best ideas of others are also included in xCAT 2.

xCAT 2 is used in the first petaflop computer that is deployed at Los Alamos National Labs. The stateless provisioning capabilities of xCAT 2 are also used to manage the cloud environment of the Virtual Computing Lab at North Carolina State University.

A more complete and in-depth discussion of xCAT 2, its features and architecture can be found in Chapter 2, "xCAT 2 architecture" on page 21.

1.3.3 xCAT 1.1.4 and CSM to xCAT 2 - History and evolution

The original xCAT was created in 1999 as a solution for the installation of Web 1.0 customers. It was a scripted solution that was nearly open source. Between 2000 and 2008, xCAT developed a community of at least 273 active developers and was used to deploy Linux and Windows clusters world-wide including the initial four teragrid sites and the first petaflop computer at Los Alamos National Labs.

Egan Ford, xCAT's initial developer, provides a concise history of the evolution of xCAT in the following Web page:

http://www.linux-mag.com/id/7230

The above article describes how some of the initial design goals of xCAT 1 led to problems as the project started to grow. For example, the use of scripts in xCAT 1 led to a wide variety of hard-to-manage Korn, Bash, Perl, and Python scripts. Secondly, saying yes to all function requests and developer inputs led to a bloated and impossible-to-manage solution that was missing a clearly defined roadmap. Lastly, due to large numbers of developers and rapid growth, xCAT 1 suffered from a lack of adequate up-to-date documentation for all of its features and functions.

For high performance computing, CSM suffered from its own share of problems. First, CSM was not designed to scale to the number of nodes required for the next generation of HPC computing. Secondly, as a fully licensed IBM product, it was difficult to rapidly incorporate user suggestions and code modifications into the releases. Lastly, CSM could only support a limited number of platforms and operating systems in order to maintain a reasonable test bed for a software product.

Because high performance computing is moving towards the generation of exascale computing, IBM looked to develop an open source cluster management toolkit that would be more flexible and scalable than both xCAT and CSM. Where xCAT 1 was able to scale to 10,000 cluster nodes, xCAT 2 scales to systems with 100,000 cluster nodes. Additionally, as an open source project scale-out, users can easily contribute to it and improve it. IBM has pooled the code and expertise from both CSM and xCAT to form the basis of the open source software. Instead of saying yes to all requests, such as in xCAT 1, xCAT 2 will have a clearly defined roadmap and a strong community direction.

In xCAT 2, support is not limited to IBM hardware. Since the software is open sourced, customers and third parties can contribute to it. Hopefully, this results in more and better functions. Customers can debug problems (if desired) because they have all of the source code. The open source nature of the code should also lead to improved integration with other open source management tools. Customers can also expand the support to non-IBM hardware.

Additionally, xCAT 2 has virtually all of the capabilities of CSM, plus much more. For example, more hardware and operating systems are supported in xCAT 2 than in CSM. xCAT will also have expanded administrator and operator roles, pluggable database support with SQL reporting capabilities, power level management for green computing, and a Web interface.

1.3.4 IBM (Systems) Director vs. xCAT 2

Although IBM is moving CSM expertise to strategic products such as IBM Director and xCAT 2, we must maintain a clear distinction between xCAT 2 and IBM Director:

- xCAT 2 is designed for high performance computing clusters. It runs parallel jobs on large clusters. Although support from IBM is available, xCAT 2 is an open source product.
- IBM Director is typically involved in commercial, small and medium business (SMB), and server consolidation. IBM Director is a fully licensed IBM product.

We have the opportunity to make xCAT 2 the exploratory branch of IBM Director, by moving new features pioneered in xCAT into Director. But for now both products will remain distinct entities.

Figure 1-3 on page 19, which was taken from a presentation by Egan Ford and Bruce Potter given at the IBM Systems and Technology Meeting in April, 2008, delineates the evolution and positioning of xCAT 1, CSM, IBM Director, and xCAT 2.

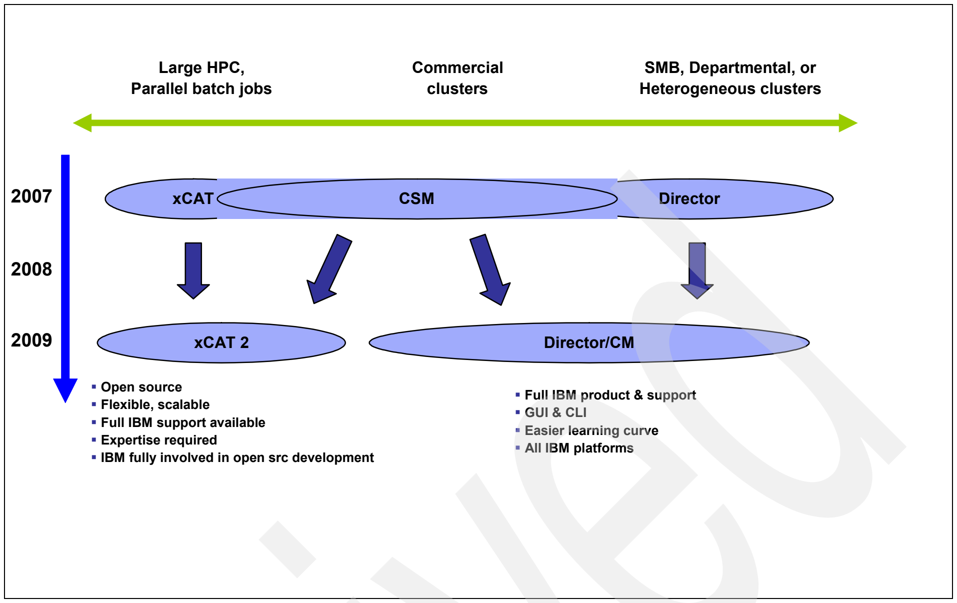

Figure 1-3 The history and future of xCAT 2.0, IBM Director, and IBM CSM

2

xCAT 2 architecture

The objective of this chapter is to describe in more detail the components of xCAT 2.0, outlining how they operate and interact in the process of managing large HPC clusters.

Topics covered in this chapter are:

- The software distributions that can be managed
- The hardware platforms supported by xCAT 2
- Hardware Management and Control
- xCAT features:
  - xCAT 2 directory structure
  - xCAT 2 database
  - xCAT 2 networks types
  - Parallel commands
- xCAT 2 support structure

2.1 Overview of xCAT 2 features

xCAT Version 2 is an open source project developed to provide a scalable distributed computing management and provisioning tool that provides a unified interface for hardware control, discovery, and OS diskful/diskless deployment.

It was a new project created originally by the best cluster management developers at IBM, from teams who worked on CSM, and xCAT 1.x, and developers are still working on System x, System p, Cluster 1350, and iDataPlex™ technologies in IBM. xCAT 2 is also open to the general High Performance Cluster community under the Eclipse Licence to help support and enhance the product in the future.

The following is a list of the main features of the xCAT architecture:

- Client/server architecture

  Clients can run on any Perl-compliant system (including Windows). All communications are SSL encrypted.

- Role-based administration

  Different users can be assigned various administrative roles for different resources.

- New stateless and iSCSI nodes support

  Stateless nodes can be RAM-root, compressed RAM-root, or stacked NFS-root. Linux software initiator iSCSI support for Red Hat® Enterprise Linux (RHEL) and SUSE® Linux Enterprise Server (SLES) is included. Systems without hardware-based initiators can also be installed and booted using iSCSI.

- Scalability

  xCAT 2 has been designed to scale to 100,000 and more nodes with xCAT's Hierarchical Management Cloud. A single management node may have any number of stateless service nodes to increase the provisioning throughput and management of the largest clusters. All cluster services such as LDAP, DNS, DHCP, NTP, Syslog, and so on, are configured to use the Hierarchical Management Cloud. Outbound cluster management commands (for example, **rpower**, **xdsh**, **xdcp**, and so on) utilize this hierarchy for scalable systems management. See Figure 2-1 on page 25.

- Automatic discovery

  Single power button press physical location-based discovery and configuration capability. Although this feature is mostly hardware-dependent, xCAT 2 has been developed to ease integration for new hardware. The plug-in software architecture provides an easy development mechanism for the new hardware.

- Plug-in architecture for compartmental development

  Add your own xCAT functionally to do whatever you want. New plug-ins extend the xCAT vocabulary available to xCAT clients.

- Notification infrastructure

  This allows you to be able to watch for xCAT DB table changes, via the notification infrastructure.

- SNMP monitoring

  Default monitoring uses SNMP trap handlers to handle all SNMP traps.

- Flexible monitoring infrastructure

  You can easily integrate third-party vendor monitoring software into the xCAT cluster. Currently, the following plug-ins are provided with xCAT: SNMP, RMC (RSCT), Ganglia, and Performance Copilot.

- Centralized console and system logs

  xCAT provides console access to managed nodes and centralized logging. Documentation available includes cookbooks, how-to information, complete man pages, and database table documentation.

2.1.1 Operating systems and distributions supported

xCAT 2 has evolved to support a number of operating systems including AIX, and the many derivatives of Linux, including SLES, openSUSE, RHEL, CentOS, and Fedora Core. It is also possible for xCAT to provision Windows 2008 through imaging, and Virtual Machine (VMware, Xen, KVM) images to hosted systems.

With both AIX and Linux, xCAT supports both traditional local disk, SAN disk, and stateful diskless, provisioning via native deployment methods.

Also, support is provided for stateless diskless nodes including ramfs root, compressed ramfs root and NFS root with ramfs overlay support (Linux and AIX) and stateful diskless using iSCSI (Linux).

Because xCAT is an open source project, there are no reasons why other operating systems cannot be added to the supported list in the future.

For a more up-to-date list of supported distributions, visit the xCAT Web sites:

http://xcat.sourceforge.net/

and

http://xcat.wiki.sourceforge.net/XCAT+Features

2.1.2 Supported hardware

The following is a list of hardware supported and tested by xCAT:

- IBM BladeCenter (including HS21, HS21 XM, LS21, LS41, QS21, QS22, JS21, JS22) - needs to be fitted with an Advanced Management Module.
- IBM System x (x3455, x3550, x3650, x3655, x3755, and more)
- IBM Power Systems (including the HMC)
- IBM iDataplex
- Machines based on the Intelligent Platform Management Interface (IPMI)

Because only IBM hardware is available for testing, this is currently the only hardware supported. However, other vendors' hardware could be managed with xCAT as well. For the latest list of supported hardware refer to the xCAT Web site, previously shown.

2.1.3 Hardware control

The xCAT manager working with the relevant hardware control units within the nodes, BladeCenter, and HMC has the capability to instruct these units to perform a number of hardware functions, or gather information about the hosts. These hardware control features include:

- Power control (power on, off, cycle, and current state)
- Event logs
- Boot device control (full boot sequence on IBM System BladeCenter, next boot device on other systems)
- Sensor readings (temperature, fan speed, voltage, current, and fault indicators as supported by systems)
- Node MAC address gathering
- LED status and modification (ability to identify LEDs on all systems, and diagnostic LEDs on select IBM rack-mount servers)
- Serial-over-LAN (SOL) - utilize or redirect input and output
- Service processor configuration
- Hardware control point discovery using Service Location Protocol (SLP): BladeCenter Advanced Management Module (AMM), IBM Power Systems Hardware Management Console (HMC), and Flexible Service Processor (FSP)

- Virtual partition creation

This functionality has been provided in xCAT via a set of Perl scripts, in conjunction with a particular set of the xCAT tables. One example is the *nodehm* table, which details the type of hardware control group a particular node falls into, that is, *blade* for BladeCenter, or *hmc* for a System p node. Thus, from this table and the group information, xCAT knows which additional tables contain detailed information about how to access the hardware control unit of the required node.

2.1.4 Hierarchical clusters

xCAT 2 was designed to be able to manage the complete spectrum of High Performance Clusters, from a simple BladeCenter, with only a few blades, to the world's current #1 HPC cluster[1], IBM Roadrunner. This scalability is achievable by xCAT implementing a Hierarchical Management Cloud structure.

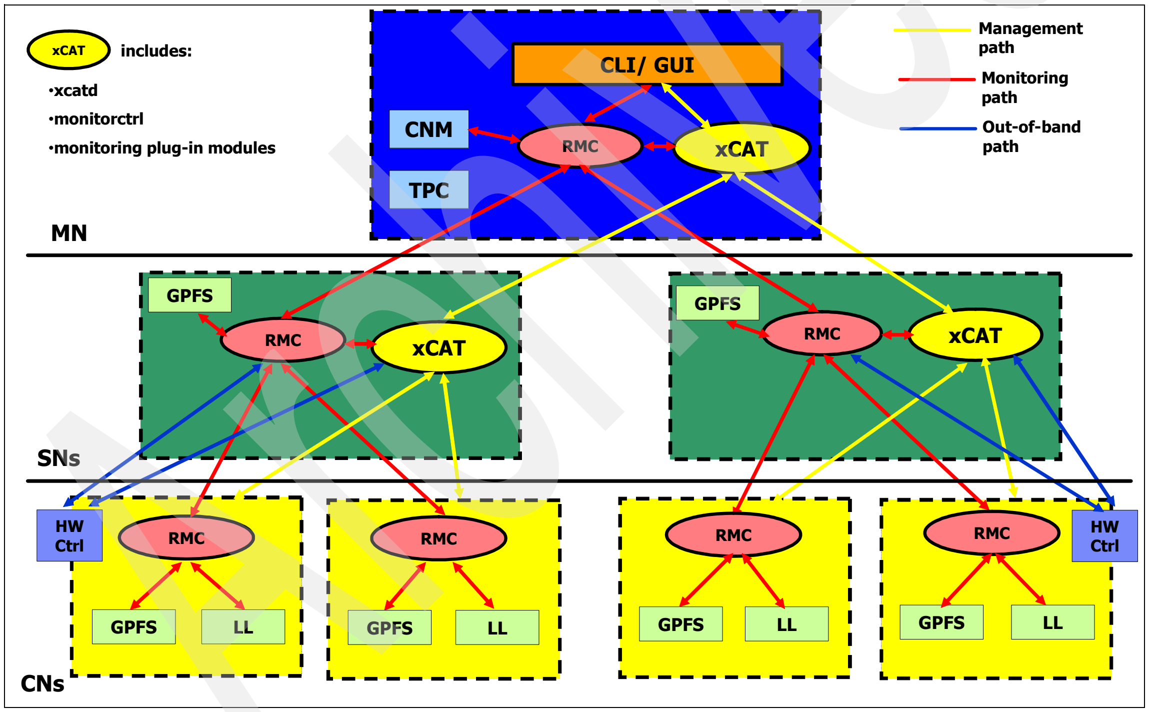

Figure 2-1 Overview of a hierarchical xCAT cluster

Figure 2-1 details the high-level overview of an xCAT2 cluster, with the xCAT2 management node at its head. In a large cluster implementation, it may be

[1] As of June 2009, see http://www.top500.org/lists/2009/06

necessary to implement xCAT service nodes, which would perform some of the duties of the management node. Each service node is responsible for a subset of the compute nodes. Smaller clusters would function without the need for service nodes, with all the compute nodes being the responsibility of the xCAT management node.

The main reason for deploying service nodes to propagate xCAT management tasks such as OS installs, and outbound commands such as **`rpower`**, **`xdsh`**, and **`xdcp`**, is to keep the performance of these functions at an optimum level in a large cluster, and reduce the risk of overloading the xCAT management node.

As will be demonstrated in the implementation section of this book, the management node first installs and then configures the service nodes, then utilizes these nodes to perform the install of its subset of compute nodes. Part of the configuration of these service nodes is to install a subsection of the xCAT package, a number of Perl scripts that perform on the service node, and the xCAT daemon that communicates with the xCAT daemon on the xCAT master.

Figure 2-2 illustrates this process.

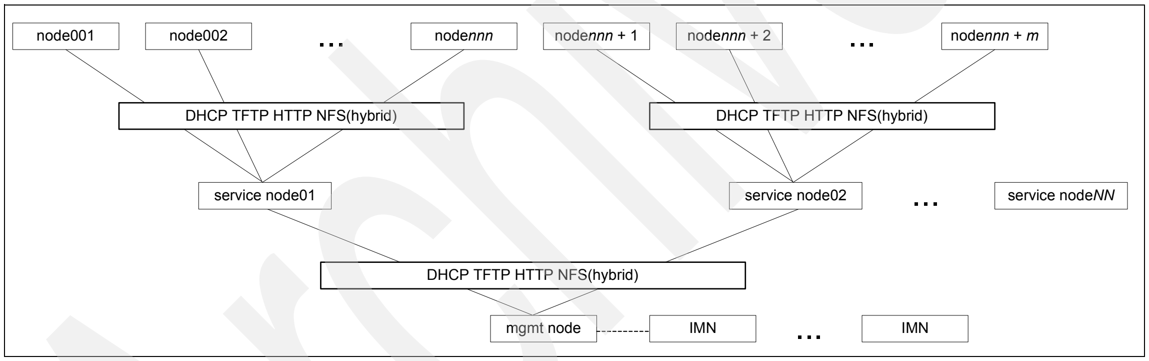

Figure 2-2 Scalable hierarchical management cloud

2.2 Overview of the xCAT 2 architecture

The xCAT 2 package has been developed almost entirely in Perl scripts, while employing the underlying native operating system Perl libraries. It thus provides a very extensible framework upon which additional commands, functionality and new supported platforms can be developed.

As can be seen in the xCAT structure diagram in Figure 2-3 on page 27, the xCAT daemon (xcatd) plays a major role in the way xCAT operates. Although the xCAT daemons are also running on the service nodes, they only function as agents to the master daemon running on the management node. The xCAT daemon receives requests from the clients, validates the requests, and then invokes the operation. The xcatd daemon also receives status and inventory information from the nodes as they are being discovered, installed, or booted.

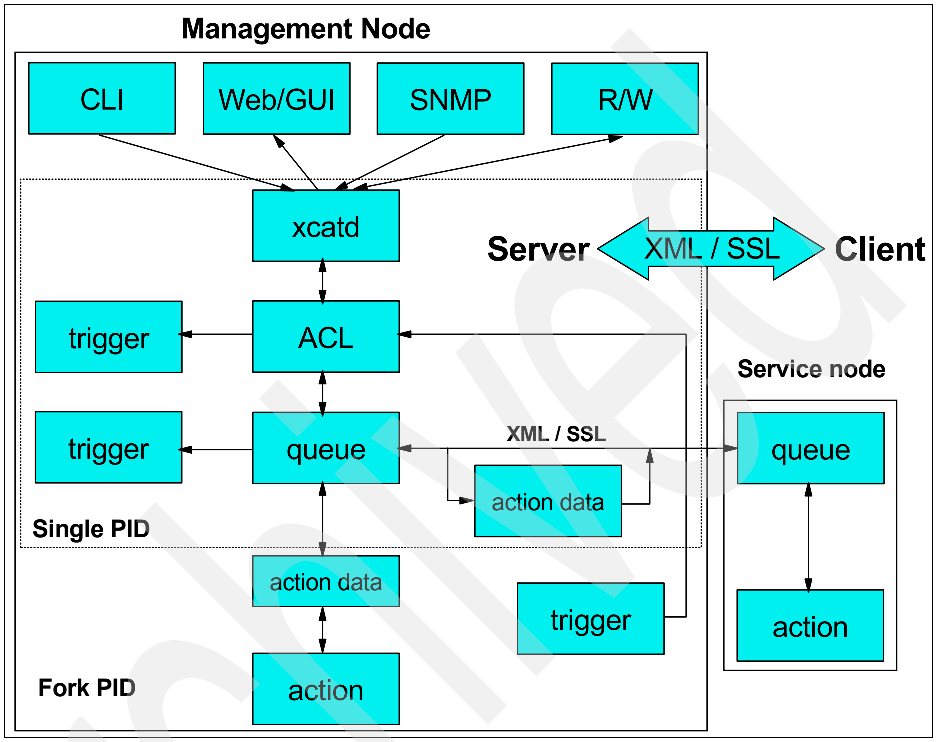

Figure 2-3 xCAT 2 architecture

The data flow between client and server is controlled by the xCAT daemon. Although the flow has not yet been entirely implemented, the basic order of data flow is as follows:

1. When a user invokes an **xcat** command on the client, the command can either be a symbolic link to xcatclient/xcatclientnnr or a thin wrapper that calls:

   ```
   xCAT::Client::submit_request()
   ```

2. The **xcatclient** command packages the data into XML and passes it to xcatd.
3. When xcatd receives the request, it forks to process the request.
4. The ACL (role policy engine) determines whether this person is allowed to execute this request by evaluating the following information:
   – The command name and arguments

  - Who executed the command on the client machine
  - The host name and IP address of the client machine
  - The node range passed to the command

5. If the ACL check is approved, the command is passed to the queue.

   The queue can run the action in either of the following two modes. The client command wrapper decides which mode to use (although it can give the user a flag to specify):

   - For the life of the action, keep the socket connection with the client open and continue to send back the output of the action as it is produced.
   - Initiate the action, pass the action ID back to the client, and close the connection. At any subsequent time, the client can use the action ID to request the status and output of the action. This action is intended for commands that are long-running.
     - The queue logs every action performed, including date and time, command name, arguments, who, and so on.
     - In phase two, the queue will support locking (semaphores) to serialize actions that should not be run simultaneously.

6. To invoke the action, the data (XML) is passed to the appropriate plug-in Perl module, which performs the action and returns results to the client.

For more details about xCAT architecture, see the xCAT wiki:

http://xcat.wiki.sourceforge.net/

2.2.1 xCAT 2 database

For xCAT to function, it needs to store information about the HPC environment, which it does with a number of different tables within an SQL database. Each table stores information relevant to an element or an element's status, within the cluster, or information needed to perform an install and configuration of these elements. As xCAT uses standard SQL and the Perl database interface (DBI) to manipulate these tables, any standard SQL database can be utilized to host these tables.

During a normal install of xCAT, a default database and tables are created using SQLite, a simple database included in the xCAT install media. However, if the cluster is to include service nodes, then SQLite will not be up to the task, because it does not contain functionality to allow remote access from the service nodes. For this reason xCAT has been tested with both MySQL™ and Postgresql, both of which can be configured to allow remote access from the service nodes.

As previously mentioned, during a standard install a number of default tables are created by xCAT, the majority of which are empty awaiting population either via a manual or automated process. With SQLite, each table is stored as a file, usually in /etc/xcat, as shown in Example 2-1.

Example 2-1 SQLite tables for xCAT 2

```
[p630n05][/etc/xcat]> ls
bootparams.sqlite    mp.sqlite           policy.sqlite
boottarget.sqlite    mpa.sqlite          postscripts.rules
ca                   networks.sqlite     postscripts.sqlite
cert                 nimimage.sqlite     ppc.sqlite
chain.sqlite         nodegroup.sqlite    ppcdirect.sqlite
deps.sqlite          nodehm.sqlite       ppchcp.sqlite
eventlog.sqlite      nodelist.sqlite     prodkey.sqlite
hostkeys             nodepos.sqlite      servicenode.sqlite
hosts.sqlite         noderes.sqlite      site.sqlite
ipmi.sqlite          nodetype.sqlite     switch.sqlite
iscsi.sqlite         notification.sqlite switches.sqlite
mac.sqlite           osimage.sqlite      vm.sqlite
monitoring.sqlite    passwd.sqlite       vpd.sqlite
monsetting.sqlite    performance.sqlite  websrv.sqlite
[p630n05][/etc/xcat]>
```

The xCAT man pages detail the function of each of these tables, and the information they hold.

A set of commands is provided to manipulate these tables, as will be demonstrated in the examples in this book, the most common being **mkdef** and **chdef**. The **tabdump** and **tabedit** commands have been provided for compatibility with the original flat file xCAT V1.x table format, but are also very useful in performing large edits on a table (**tabedit** command), or in showing the entire table contents (**tabdump** command).

To access the tables, all xCAT code employs the Perl script Table.pm, which implements the following features

- Notifications for table changes (triggers)

  A separate table lists the table name (or lists *) and a command that is run when that table is changed. When the command is run, the changed rows are piped into its standard input (stdin).

- A begin and end mechanism

  The xCAT code can use the mechanism when it updates many rows. This allows Table.pm to optimize the update to the database and call the notifications only once for all the updates.

- Ability to support other, non-Perl, programs

  These programs read the database using packages such as ODBC (for C program access).

Figure 2-4 details the database interaction performed by the Table.pm script.

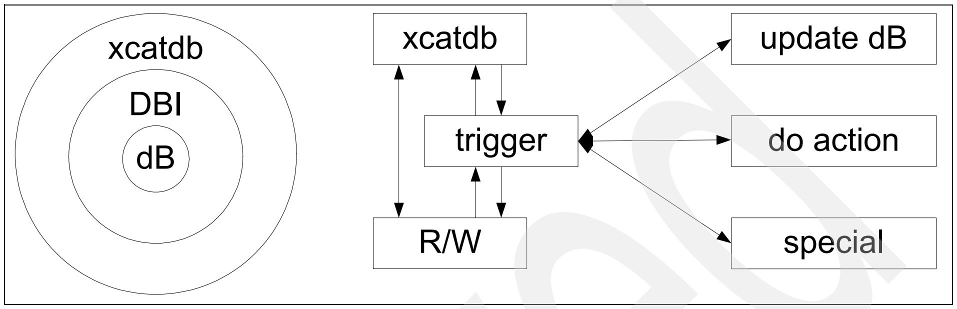

Figure 2-4 xCAT database interaction

2.2.2 xCAT 2 directory structure

Figure 2-5 on page 31 depicts the directory structure and location of files on the master node, after a default install of the xCAT software. However, during the install process the user does get the opportunity to change the default location (/install), where xCAT holds the resources needed during the install of service and compute nodes. Note, these are the directory locations of xCAT on an AIX platform; for Linux the file structure would be slightly different.

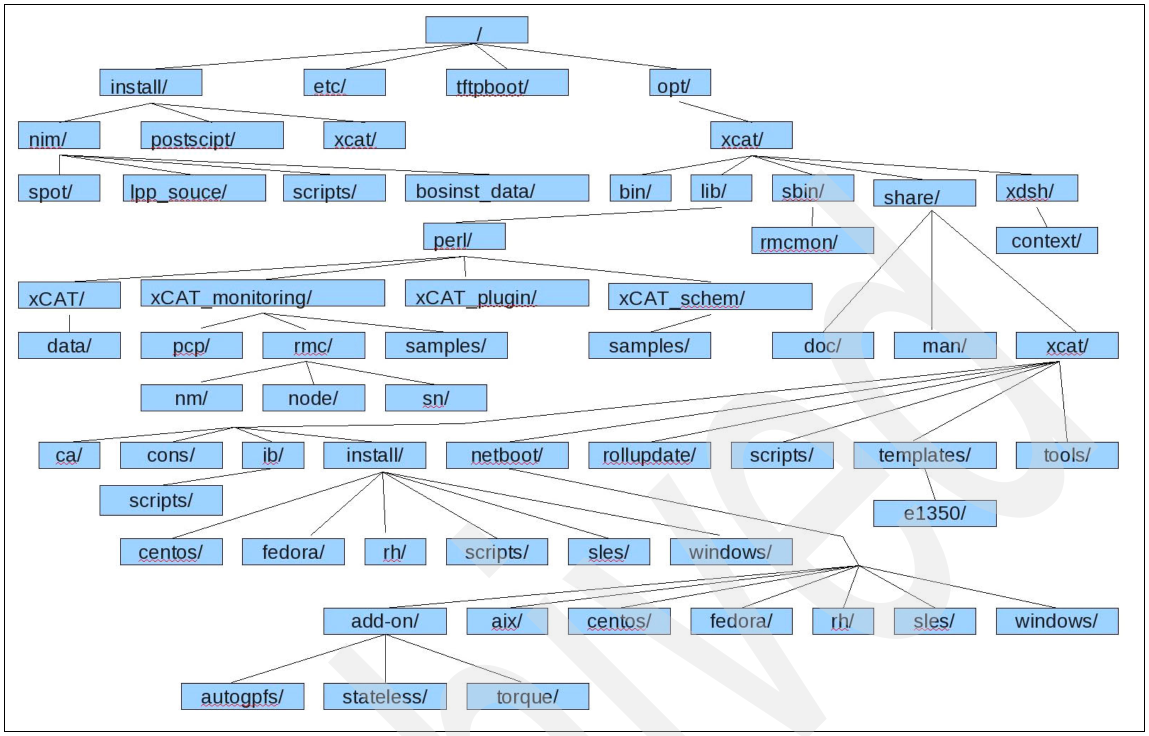

Figure 2-5 xCAT 2 directory structure

2.2.3 xCAT network fundamentals

In any xCAT installation there is a normal requirement for two networks, otherwise known as virtual local area networks (VLANs). One is used for xCAT management functions, such as node installations. The other is utilized for hardware control. In a normal operation it is not recommended that applications hosted on the compute nodes share either of xCAT's management VLANs. Thus it is suggested that a third VLAN be provided solely for application traffic. This VLAN may just connect the compute nodes or extend out to external servers, depending on the applications hosted in the cluster. Often in HPC clusters a fourth VLAN linking just the compute nodes is created using high performance network technology, one example being InfiniBand®.

On IBM System x servers (Intel and AMD™ platforms), the hardware control VLAN is connected to the Baseboard Management Controller (BMC) port of a server, often being the first ethernet port, which is physically shared with xCAT's management VLAN.

With an IBM BladeCenter, the hardware VLAN is internal to the blade chassis, and so only the management VLAN is required.

With IBM System p nodes (excluding IBM Power Blades) the Hardware Management Console (HMC) has the ability to control the hardware functions of the nodes, and so again no xCAT hardware VLAN is required.

Note: The HMC communicates with the service processor within a System p server via a dedicated ethernet network, either point-to-point for a single machine or via a switch for multiple System p servers. It could thus be said that this LAN provides the same functionality as the xCAT hardware VLAN. However, xCAT does not utilize this LAN to perform any communication with the service processor.

Figure 2-6 illustrates a typical network layout for an xCAT cluster.

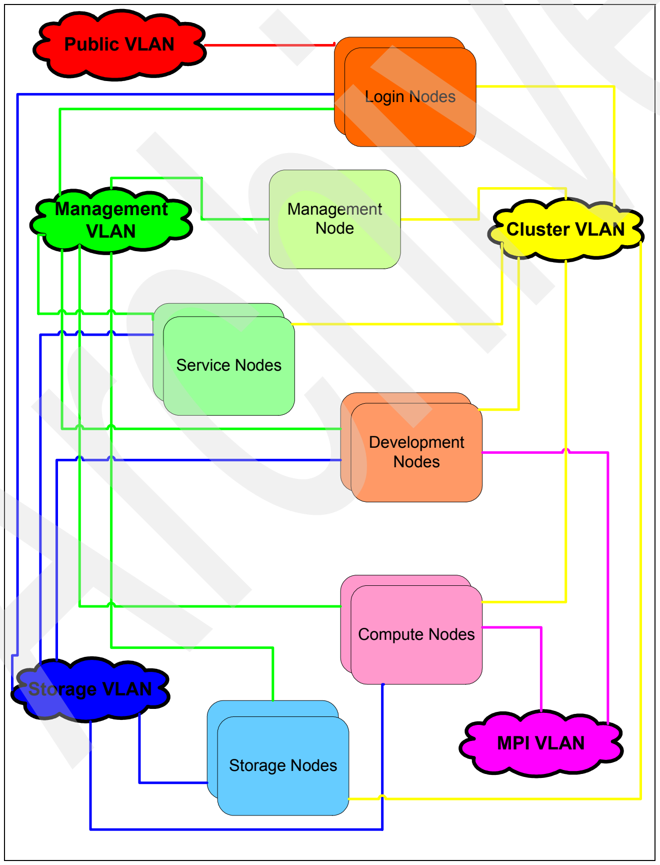

Figure 2-6 Typical xCAT network layout

The management VLAN is required by xCAT to enable it to perform many of its functions, from a nodes initial power-up boot process and OS install right through to its use via parallel commands in shutting down the node, with the required OS power-down command, that is, on AIX 'shutdown -H'.

Common Hardware Reference Platform boot

The IBM Power Systems architecture adheres to the Common Hardware Reference Platform (CHRP) standard. CHRP was published jointly by IBM and Apple in 1995. The CHRP boot process is different from that in a standard PXE boot procedure, but in principle their functionality is similar. A Power System, if set or manually instructed to boot from the network in its firmware, would issue a bootp request packet onto the management network. The xCAT manager would compare the MAC address of the issuing node with those under its control, using either its bootp or DHCP config files. Again a micro kernel and IP address is returned, with the boot or install process moving onto the next element, usually to mount an NFS directory exported from the xCAT manager (or service node) hosting a full AIX kernel.

You can find more details about the CHRP boot process and bootinfo config variables at:

http://playground.sun.com/1275/bindings/chrp/chrp1_7a.ps

2.2.4 Monitoring infrastructure

Two monitoring infrastructures are available in xCAT 2:

- xCAT monitoring plug-in infrastructure

  This allows you to plug in one or more vendor monitoring software such as Ganglia, RMC, SNMP and others to monitor the xCAT cluster. This section describes the xCAT monitoring plug-in infrastructure.
- xCAT notification infrastructure

  This allows you to watch for the changes in xCAT database tables.

For details, select the xCAT2-Monitoring.pdf file from:

http://xcat.svn.sourceforge.net/svnroot/xcat/xcat-core/trunk/xCAT-client/share/doc/

xCAT monitoring plug-in infrastructure

With xCAT 2.0, you can integrate vendor monitoring software into your xCAT cluster. The idea is to use monitoring plug-in modules that act as bridges to connect xCAT and the vendor software. Although you may write your own monitoring plug-in modules, over time xCAT will supply a list of built-in plug-in modules for the most common monitoring software, such as:

- xCAT (xcatmon.pm) - Provides monitoring node status using fping.
- SNMP (snmpmon.pm) - The SNMP monitoring.
- RMC (rmcmon.pm) - Provides resource monitoring and control through IBM Reliable Scalable Cluster Technology (RSCT).
- Ganglia (gangliamon.pm) - An open source monitoring suite for HPC environments.
- Nagios (nagiosmon.pm) - Another open source host, service and network monitoring program.
- Performance Co-pilot (pcpmon.pm) - A family of products from SGI for system-level performance monitoring and management services.

You may choose one or more monitoring plug-ins to monitor the xCAT cluster.

xCAT monitoring commands overview

Seven commands are available for monitoring purposes. They are listed in Table 2-1.

Table 2-1 xCAT monitoring commands

Command	**Description**
monis	Lists the current or all the monitoring plug-in names, their status, and description.
monadd	Adds a monitoring plug-in to the monitoring table. This also adds the configuration scripts for the monitoring plug-in, if any, to the postscripts table.
monrm	Removes a monitoring plug-in from the monitoring table. It also removes the configuration scripts for the monitoring plug-in from the postscripts table.
moncfg	Configures the vendor monitoring software on the management server and the service node for the given nodes to include the nodes into the monitoring domain. It does all the necessary configuration changes to prepare the software for monitoring the nodes. The -r option configures the nodes, too.
mondecfg	Deconfigures the vendor monitoring software on the management server and the service node for the given nodes to remove the nodes from the monitoring domain. The -r option deconfigures the nodes, too.
monstart	Starts vendor software on the management server and the service node for the given nodes to monitor the xCAT cluster. It includes starting the daemons. The -r option starts the daemons on the nodes, too.
monstop	Stops vendor software on the management server and the service node for the given nodes from monitoring the xCAT cluster. The -r stops the daemons on the nodes, too.

The two ways to deploy third-party software to monitor the xCAT cluster are:

- Configure the software on the nodes during the node deployment phase.
- Configure the software after the node is up and running.

xCAT monitoring options

The three xCAT monitoring options are:

- Start and stop monitoring
- Automated node update
- Node status monitoring

Start and stop monitoring

In Figure 2-7, the *monitorctrl* module is the control center. The xcatd invokes **`monitorctrl`**, which gets node hierarchy from the xCAT database, then invokes a plug-in module with the node hierarchy information. The plug-in module invokes and initializes third-party monitoring software, compares the node hierarchy information with the current nodes in the third-party monitoring domain, and makes sure they are in sync.

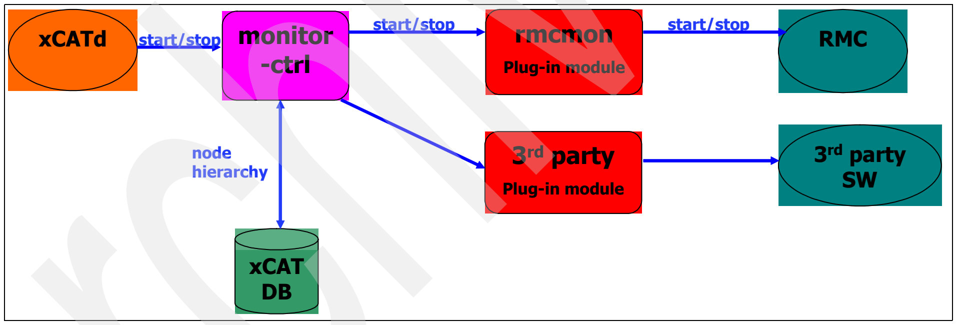

Figure 2-7 xCAT start and stop monitoring

Automated node update

As shown in Figure 2-8 on page 36, xCAT notification infrastructure notifies monitorctrl of nodes being added or removed from the xCAT cluster, and monitorctrl informs all the plug-in modules. The plug-in module calls relevant functions in third-party software to add or remove the nodes in the monitoring domain.

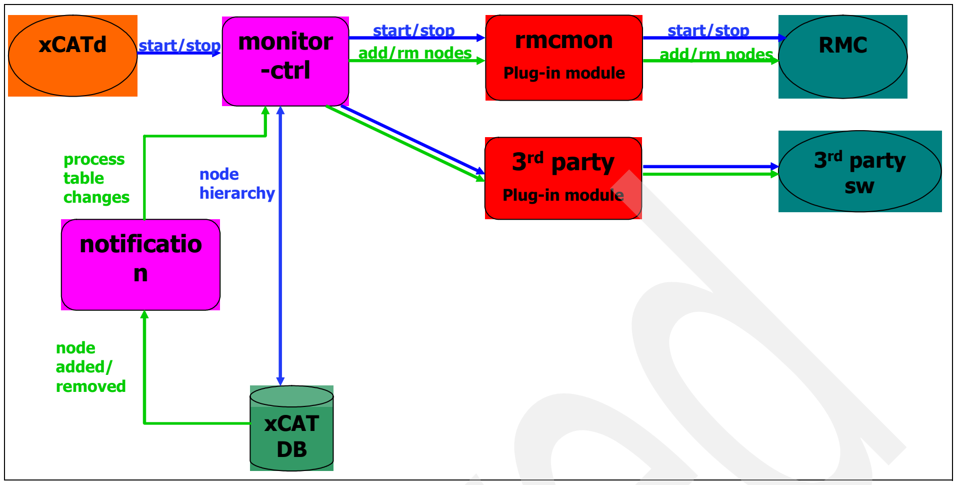

Figure 2-8 xCAT automated node update

Node status monitoring

As depicted in Figure 2-9 on page 37, xCAT maintains current node status for each node. Possible node status values are defined, installing, booting, active, off, and others. Nodes status is stored in the status column in the nodelist table. Optionally, a third-party product can be chosen to help by providing the node liveliness status if it has the capability. The monitorctrl invokes the third-party node status monitoring through its plug-in module. Also, third-party software can update the xCAT database with the node status changes through its plug-in module or directly access the database with the **`chtab`** command.

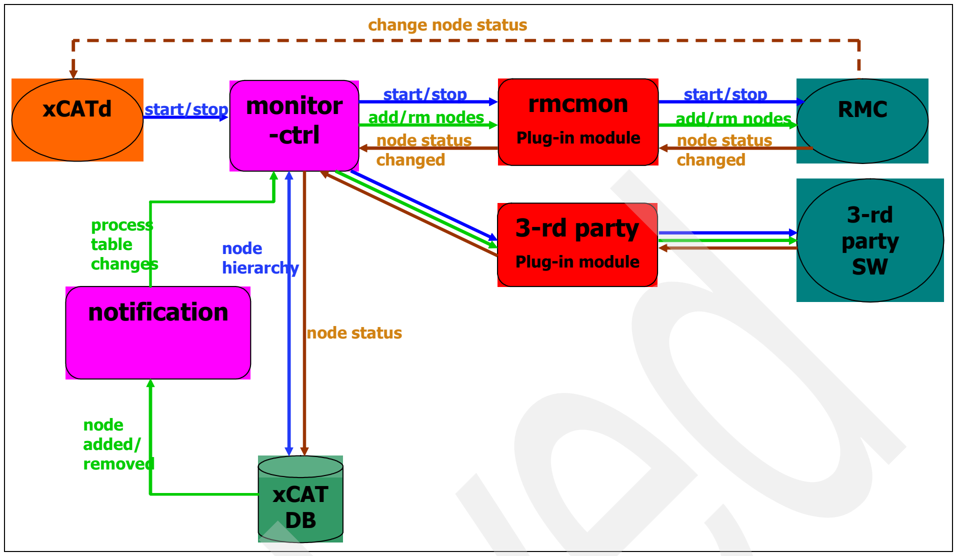

Figure 2-9 xCAT node status monitoring

2.2.5 Parallel remote command execution and file copy, File Sync

One of the most important aspects of cluster management is the parallel remote command execution and file copy from Management Node to managed nodes. This is required for node configuration changes and other administrative operations. The operation of the parallel commands is secured using standard available OS tools and libraries (for example, OpenSSL and OpenSSH). On the xCAT management node in the /bin directory are the following parallel commands.

The following commands, **`xdsh`**, **`xdcp`**, **`ppsh`**, and **`pcp`**, implemented as Perl scripts, utilize the underlying available OS tools and xCAT tables to perform their functions. These scripts use these tables to perform such functions as resolving a group name to individual nodes, on which the associated command would be performed. Examples of the use of these commands is described in 6.3, “xCAT 2's distributed commands” on page 271.

Figure 2-10 on page 38 illustrates the parallel remote command and file copy infrastructure in an xCAT cluster.

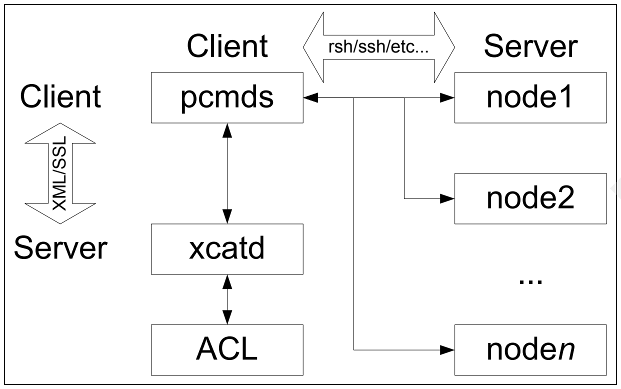

Figure 2-10 Parallel remote command execution

2.2.6 Additional features

xCAT also provides the following additional features:

- Command Line Interface mode, scripts, simple text-based configuration files.
- Uses Perl primarily for scripts and commands, allowing easy debugging and development.
- xCAT installed Linux nodes are identical to kickstart (Redhat) or autoyast (SUSE) installed nodes, w.r.t. RPMs, and so on. Nothing is altered from the standard distribution (for example, Rocks switched from /etc/passwd to 411 for authentication), we use standard kernels, maintaining support for commercial distributions and their support structures.
- Multiple operating systems are supported on a single cluster.
- Works well with any Intel or AMD x86/x86_64 server and Linux on Power.
- Custom extensions need only minimal effort, for example, adding a new operating system, or Linux distribution.
- Portable Batch Systems (PBS), IBM General Parallel File System (GPFS), Myrinet installations are supported with install scripts.
- Postscripts - Post installation scripts supported for both diskful and diskfree environments.

Many of the items above not related to Linux will be covered in more detail later in this book. For Linux and non-Power platforms, details can be found on the xCAT Web site.

2.3 Support offering terms

xCAT 2 is an open source project, developed under the Eclipse Public licence terms and conditions. As such, new versions and bug fixes for xCAT are hosted on the xCAT Web site:

http://xcat.sourceforge.net/

It is also possible on the same Web site to report both defects via the Bug tracker Web link, and submit feature requests for later versions of xCAT.

For commercial customers, IBM also offers the opportunity to obtain an official IBM support contract for xCAT Version 2 and beyond. No support contract is available for xCAT 1.3, the details of which can be found on the xCAT Web site listed above, or on the Web site:

http://www-03.ibm.com/systems/clusters/support/xcat/index.html

See also the IBM United States Software Announcement 208-23, September 09, 2008.

For more details on the support contract, contact your IBM representative.

3

CSM and xCAT functional comparison

In this chapter we compare CSM and xCAT functions. We point out the differences in the architectural features and provide a functional comparison between commands in CSM and xCAT. In addition, we provide some useful examples of some general CSM administration tasks and how to achieve the same results in xCAT.

3.1 Architectural comparison

In general, both xCAT and CSM perform very similar functions. In this section we identify the main architectural differences between xCAT and CSM.

3.1.1 Hierarchical versus flat

- CSM - The flat architecture of CSM means all management of the cluster is provided by the CSM management server. It is not hierarchical because of CSM relies on RSCT, which cannot provide this functionality.
- xCAT - Hierarchical support in xCAT allows large, scalable, systems to distribute the management of the cluster to service nodes. A single management node may have any number of service nodes to increase the provisioning throughput and management of the largest clusters. Cluster services such as LDAP, DNS, DHCP, NTP, Syslog, and so on, are configured to use the Hierarchical Management Cloud. Outbound cluster management commands (for example, **`rpower`**, **`xdsh`**, **`xdcp`**, and so on) utilize this hierarchy for scalable systems management. See Figure 3-1.

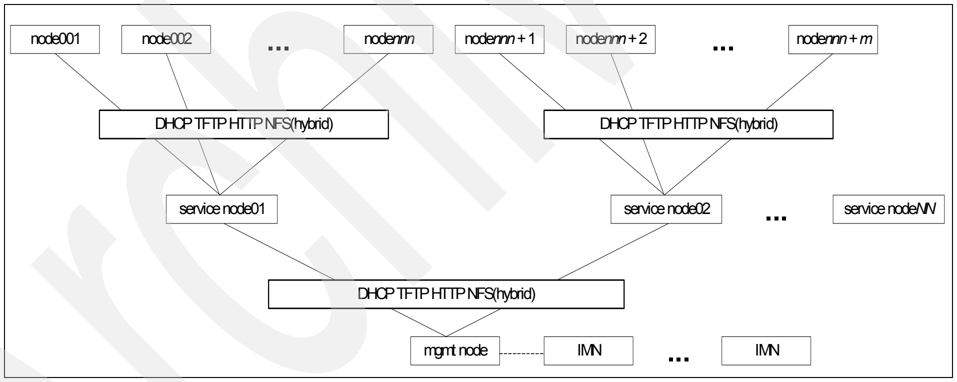

Figure 3-1 Scalable hierarchical management cloud

3.1.2 Modular structure

- CSM: The cluster relies on the RSCT framework to maintain the environment and provide resources to satisfy the requests from commands. It does not provide a plug-in infrastructure.
- xCAT: The cluster architecture relies on the xCAT daemon (xcatd) on the management node. This receives requests from the client, validates the

requests, and then invokes the operation. The word client in this context does not mean the nodes in the cluster but represents the command that is requesting an action from the xcatd. These requests are submitted to the xcatd via SSL in XML format. xCAT provides a plug-in infrastructure for monitoring, database, and bespoke functionality development (see Figure 3-2).

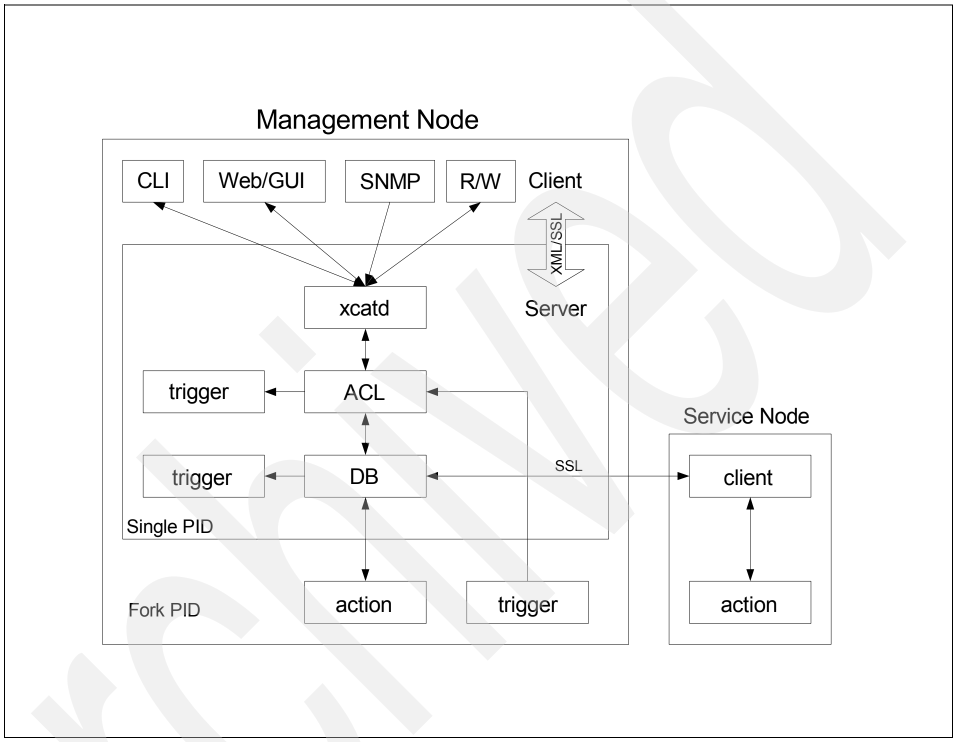

Figure 3-2 Client-server conversation in xCAT

3.1.3 Database

- CSM: A proprietary database is used (RSCT registry).
- xCAT: Stores data in a plug-in relational database. Currently SQLite and MySQL are supported with AIX. MySQL enables xCAT hierarchical clusters.

3.1.4 Notification infrastructure

- CSM: Not available.
- xCAT: Lets users monitor xCAT database table changes. This is not enabled by default but it is possible to enable this function so that you are aware of changes in the database tables.

3.1.5 Deploying both diskless and diskful nodes

- CSM: Not available out of the box; requires additional products and configuration.
- xCAT: Supports diskless and diskful nodes and currently uses the xCAT database and NIM functions to deploy both diskful and diskless nodes.

3.1.6 Automatic setup of services

- CSM: Limited - some services require manual configuration and the use of CFM (for example, syslog).
- xCAT: For syslog, remote shell, DNS, DHCP, and NTP for both the xCAT management node and the cluster nodes.

3.1.7 Role-based system administration

- CSM: Uses the LPCommands[1] and the RSCT ACLs (for resource management).
- xCAT: Uses the database (that is, policies table) to allow different users to perform various administrative functions. Due to the pluggable nature, you may also use RSCT ACLs and LPCommands.

3.1.8 Dynamic nodegroups

- CSM: The infrastructure provided by RSCT means that dynamic node groups can be defined and used.
- xCAT: There are no dynamic node groups at this time.

[1] LPCommands - Least Privilege Commands, managed in RSCT by LPRM - Least Privilege Resource Manager - see *RSCT Administration Guide*, SA22-7889-12

3.1.9 Secondary adapters

- CSM: Provides a facility to manage additional adapters; alternately, NIM secondary adapter definitions can be used.
- xCAT: NIM can be used to manage the additional adapters.

3.1.10 RMC monitoring

This section lists the RMC resource managers used for monitoring your cluster.

CSM-related RMC resource managers

Hardware control resource manager

The IBM.HWCTRLRM hardware control resource manager controls the following resource classes:

- IBM.NodeHwCtrl: node hardware control
- IBM.HwCtrlPoint: hardware control point
- IBM.DeviceHwCtrl: hardware device
- IBM.DeviceGroup: hardware device group
- IBM.HwSecKey: maybe SSL related, but it is empty in our cluster

The hardware control resource manager runs on the host designated as the management server and is automatically started by the RMC subsystem.

The hardware control resource manager is a component of CSM. For information about the resource managers that are available with RSCT, see the *IBM RSCT: Administration Guide*.

Domain management server resource manager

As a CSM component, the IBM.DMSRM domain management server resource manager controls the following resource classes:

- IBM.ManagedNode: managed node information
- IBM.NodeGroup: static and dynamic node groups
- IBM.NodeAuthenticate: node authentication (empty in our cluster)
- IBM.DmsCtrl: CSM cluster configuration, which is set by csmconfig
- IBM.MNNetworkInterface: managed node network interface information

The domain management server resource manager runs on the host designated as the management server and is automatically started by the RMC subsystem.

For information about the resource managers that are available with RSCT, see *IBM RSCT: Administration Guide*.

Management domain configuration

When an operating system image is booted on a POWER4™ pSeries® system or a System p5 system, the RMC subsystem is started and then the IBM.CSMAgentRM resource manager is started. This resource manager implements the necessary function to automatically add the operating system image, as a managed node, to the management domains created automatically on each HMC.

This resource manager initiates a series of sessions to the RMC daemon on each HMC as follows:

- A session to each configured IP address of each HMC to validate the IP address. No commands are sent.
- A session to each HMC. A command is sent to determine the code level on the HMC of the IBM.DMSRM resource manager.
- A session to each HMC. A command is sent containing necessary information, including the node's public key. The response contains necessary information, including the HMC's public key.

As a result of these sessions, barring any errors, the operating system image becomes a managed node and an entry is created in the IBM.ManagementServer resource class, which is managed by the IBM.CSMAgentRM resource manager. Once it is a managed node, the RMC daemon begins communication with the RMC daemon on each HMC, as described above.

Periodically, the IBM.CMSAgentRM resource manager examines the state of the operating system image and, if appropriate, initiates another series of sessions and commands to the RMC daemon on each HMC to adjust the managed node configuration in the management domains.

When the **updatenode** command is executed on a CSM Management Server, the **dsh** command is used to execute the **mgmtsvr** command on each node that is specified to the **updatenode** command. The **mgmtsvr** command then triggers the IBM.CSMAgentRM on the node to initiate a series of sessions to the RMC daemon on the Management Server:

- A session to the MS®. A command is sent to determine the code level on the MS of the IBM.DMSRM resource manager.
- A session to the MS. A command is sent containing necessary information, including the node's public key. The response contains necessary information, including the HMC's public key.

Management domain resource managers for CSM and xCAT

Configuration resource manager

Provides the ability, through its command-line interface, to create and administer a peer domain (a cluster of nodes configured for high availability), but it is useful to monitor network interface status as well as it manages the *IBM.NetworkInterface* resource class.

Management domain resource manager

Provides resource classes to support configuration of an RSCT management domain. A management domain is defined as a set of nodes whose resources can be managed and monitored from one of the nodes that is designated as the Management Control Point (MCP). All other nodes are considered to be Managed Nodes.

This resource manager is intended to be exploited by the Extreme Cluster Administration Toolkit (xCAT); however, it is available in CSM clusters also. The resources supported by this resource manager are defined, modified and removed using the standard RMC commands **`mkrsrc`**, **`chrsrc`** and **`rmrsrc`**.

The following resource classes are available:

- IBM.MCP - Used on nodes and contains management server and node and HMC information.
- IBM.MngNode - Defines a managed node to the Management Domain.
- IBM.MngNodeNetIF - Resources of this class are created and defined automatically as associated IBM.MngNode resources are defined, modified, and removed, one per IP address configured to a managed node.
- IBM.PublicKeyExchange - Used by the resource manager to exchange the public keys of an MCP and a managed node.

These resource classes are populated and managed automatically in CSM, but they are used in the xCAT cluster only when the RMC monitoring is configured and started for the nodes.

Table 3-1 RMC conditions in CSM and xCAT compared

CSM conditions	xCAT conditions	Description
AIXNodeCoreDump	AIXNodeCoreDump	An event will be generated when a core dump is logged in the AIX error log of a node in the cluster.

CSM conditions	xCAT conditions	Description
	AIXNodeCoreDump_H	This condition collects all the AIXNodeCoreDump events from the service nodes. An event will be generated when a core dump is logged in the AIX error log of a node in the cluster.
AIXNodeSyslog	N/A	
AllServiceableEvents	AllServiceableEvents	An event will be generated whenever there is output from running sensor related to any serviceable events.
	AllServiceableEvents_H	This condition collects all the AllServiceableEvents events from the service nodes. An event will be generated whenever there is output from running sensor related to any serviceable events.
AllServiceableHardwareE vents	N/A	
AllServiceableSwitchEven ts	N/A	
AnyNodeAnyLoggedError	AnyNodeAnyLoggedError	An event will be generated when an error is logged to either the AIX error log or the Linux syslog of a node in the cluster.
	AnyNodeAnyLoggedError_H	This condition collects all the AnyNodeAnyLoggedError events from the service nodes. An event will be generated when an error is logged to either the AIX error log or the Linux syslog of a node in the cluster.
AnyNodeFileSystemInode sUsed	AnyNodeFileSystemInodesUse d	Event: An event will be generated when more than 90 percent of the total inodes in the file system is in use. Rearm: A rearm event will be generated when the percentage of the inodes used in the file system falls below 75 percent.

CSM conditions	xCAT conditions	Description
	AnyNodeFileSystemInodesUsed_H	Event: This condition collects all the AnyNodeFileSystemInodesUsed events from the service nodes. An event will be generated when more than 90 percent of the total inodes in the file system is in use. Rearm: A rearm event will be generated when the percentage of the inodes used in the file system falls below 75 percent.
AnyNodeFileSystemSpaceUsed	AnyNodeFileSystemSpaceUsed	Even: An event will be generated when more than 90 percent of the total space of the file system is in use. Rearm: A rearm event will be generated when the percentage of the space used in the file system falls below 75 percent.
	AnyNodeFileSystemSpaceUsed_H	Event: This condition collects all the AnyNodeFileSystemSpaceUsed events from the service nodes. An event will be generated when more than 90 percent of the total space in the file system is in use. Rearm: A rearm event will be generated when the percentage of the space used in the file system falls below 75 percent.
AnyNodeNetworkInterfaceStatus	AnyNodeNetworkInterfaceStatus	Event: An event will be generated whenever any network interface on the node is not online. Rearm: A rearm event will be generated when the network interface on the node becomes online again.
	AnyNodeNetworkInterfaceStatus_H	Event: This condition collects all the AnyNodeNetworkInterfaceStatus events from the service nodes. An event will be generated whenever any network interface on the node is not online. Rearm: A rearm event will be generated when the network interface on the node becomes online again.

CSM conditions	xCAT conditions	Description
AnyNodePagingPercentSpaceFree	AnyNodePagingPercentSpaceFree	Event: An event will be generated when the total amount of free paging space falls below 10 percent. Rearm: A rearm event will be generated when the free paging space increases to 15 percent.
	AnyNodePagingPercentSpaceFree_H	Event: This condition collects all the AnyNodePagingPercentSpaceFree events from the service nodes. An event will be generated when the total amount of free paging space falls below 10 percent. Rearm: A rearm event will be generated when the free paging space increases to 15 percent.
AnyNodeProcessorsIdleTime	AnyNodeProcessorsIdleTime	Event: An event will be generated when the average time all processors are idle at least 70 percent of the time. Rearm: A rearm event will be generated when the idle time decreases below 10 percent.
	AnyNodeProcessorsIdleTime_H	Event: This condition collects all the AnyNodeProcessorsIdleTime events from the service nodes. An event will be generated when the average time all processors are idle is at least 70 percent of the time. Rearm: A rearm event will be generated when the idle time decreases below 10 percent.
AnyNodeSwitchResponds	N/A	
AnyNodeTmpSpaceUsed	AnyNodeTmpSpaceUsed	Event: An event will be generated when more than 90 percent of the total space in the /tmp file system is in use. Rearm: A rearm event will be generated when the percentage of the space used in the /tmp file system falls below 75 percent.

CSM conditions	xCAT conditions	Description
	AnyNodeTmpSpaceUsed_H	Event: This condition collects all the AnyNodeTmpSpaceUsed events from the service nodes. An event will be generated when more than 90 percent of the total space in the /tmp file system is in use. Rearm: A rearm event will be generated when the percentage of the space used in the /tmp file system falls below 75 percent.
AnyNodeVarSpaceUsed	AnyNodeVarSpaceUsed	Event: An event will be generated when more than 90 percent of the total space in the /var file system is in use. Rearm: A rearm event will be generated when the percentage of the space used in the /var file system falls below 75 percent.
	AnyNodeVarSpaceUsed_H	Event: This condition collects all the AnyNodeVarSpaceUsed events from the service nodes. An event will be generated when more than 90 percent of the total space in the /var file system is in use. Rearm: A rearm event will be generated when the percentage of the space used in the /var file system falls below 75 percent.
CFMRootModTimeChanged	CFMRootModTimeChanged	An event will be generated whenever a file under /cfmroot is added or modified.
NodeChanged	N/A	
NodeFullInstallComplete	N/A	
NodeGroupMembershipChanged	N/A	
NodeManaged	N/A	
NodePowerStatus	N/A	
NodeReachability	NodeReachability	An event will be generated when a status changes.

CSM conditions	xCAT conditions	Description
	NodeReachability_H	This condition collects all the NodeReachability events from the service nodes. An event will be generated when a node becomes network unreachable from the management server.
ProbeSensorIsActive		
UpdatenodeFailedStatusChange		
pSeriesNodeFullInstallComplete		
	Drawer_not_configured	Event: Drawer (FSP) has not been populated with its server-specific configuration data. Rearm: Drawer (FSP) is configured.
	HFI_down	Even: HFI is unavailable for use due to severe HFI or ISR hardware error. Rearm: HFI is back to normal.
	HFI_not_configured	Event: HFI did not get configured during server power-on. Rearm: HFI is configured.
	IBSwitchLog	An event will be generated when an error is logged to the syslog in the local node for IB.
	ISR_down	ISR is unavailable for use due to severe hardware error.

Note: As shown in Table 3-1 on page 47 some of the xCAT conditions are appended with _H. This represents a condition to be used in a hierarchical cluster using service nodes.

Table 3-2 lists the CSM and xCAT responses created by default.

Table 3-2 RMC responses in CSM and xCAT compared

CSM response	xCAT response
AuditLogServiceableEvents	

CSM response	xCAT response
BroadcastEventsAnyTime	BroadcastEventsAnyTime
CFMModResp	
CFMNodeGroupResp	
GatherKRB5keytabs	
GatherSSHHostKeys	
LogCSMEventsAnyTime	
LogNodeErrorLogEntry	
LogOnlyToAuditLogAnyTime	LogOnlyToAuditLogAnyTime
RunCFMToNode	
SetupSSHAndRunCFM	
UpdatenodeFailedStatusResponse	
WriteProbeSensorMessage	
rconsoleUpdateResponse	
	DisplayEventsAnyTime
	EmailRootAnyTime
	EmailRootHierarchicalEvents
	EmailRootOffShift
	LogEventToxCATDatabase
	MsgEventsToRootAnyTime
	MsgRootHierarchicalEvents
	UpdatexCATNodeStatus

Table 3-3 lists the CSM condition and response associations created by default.

Table 3-3 CSM condition and response associations

Condition	Response	Status by default
"AllServiceableSwitchEvents"	"AuditLogServiceableEvents"	"Not active"

Condition	Response	Status by default
“AllServiceableEvents”	“AuditLogServiceableEvents”	“Not active”
“ProbeSensorIsActive”	“WriteProbeSensorMessage”	“Active”
“NodeFullInstallComplete”	“SetupSSHAndRunCFM”	“Active”
“NodeChanged”	“rconsoleUpdateResponse”	“Active”
“NodeFullInstallComplete”	“GatherKRB5keytabs”	“Not active”
“AllServiceableHardwareEvents”	“AuditLogServiceableEvents”	“Not active”
“UpdatenodeFailedStatusChange”	“UpdatenodeFailedStatusResponse”	“Active”

Table 3-4 lists the xCAT condition and response associations create by default.

Table 3-4 xCAT condition and response association

Condition	**Response**	**Status by default**
“NodeReachability_H”	“UpdatexCATNodeStatus”	“Active”
“NodeReachability”	“UpdatexCATNodeStatus”	“Active”

3.2 Features

The features in xCAT 2 are different if the cluster is running AIX or Linux. Here are the current xCAT 2 on AIX features:

- Deploying diskless and diskfull nodes.
- Node discovery.
- Operating system image management (using NIM).
- Support for user-provided customization scripts.
  xCAT supports the automatic running of user-provided customization scripts on the nodes when they are deployed (installed or booted).
- xCAT data store in plug-in relational database (SQLite, MySQL).
- Hardware control commands for discovering hardware, gathering MAC addresses, VPD, and environments, power control, initiating a network boot, and LPAR creation and deletion.
- Hierarchical support to allow a large system to distribute the management of the cluster to service nodes.
- Remote console support.

- Parallel remote shell and remote copy commands.
- Monitoring plug-in infrastructure (RMC, Ganglia).
- Notification infrastructure which lets users monitor xCAT database table changes.
- Predefined conditions, responses and sensors.
- Software and firmware inventory.
- Allowing continuous operation during cluster software updates using plug-in job scheduler (LoadLeveler, Moab).

Automatic setup for syslog, remote shell, DNS, DHCP, and NTP for both the xCAT management node and the cluster nodes.

3.3 Hardware and software considerations

xCAT has not been tested or been designed to run on certain hardware types and software versions. Before installing xCAT you need to ensure the hardware and software you are intending to run in the xCAT environment are supported.

3.4 Hardware considerations

- Any system that can run AIX 5.3 or 6.1 can be managed, by xCAT, at a software level. Refer to Table 3-5.
- For HMC control - Power 5 and above HMCs are supported (this provides hardware control for commands such as **`rpower`** and **`rcons`**).
- All fast interconnects are supported apart from the High Performance Switch (HPS) because this requires csm.server.

3.5 SW considerations

xCAT 2 has been tested on AIX 5.3 and 6.1. Table 3-5 shows the current support software prerequisites for xCAT 2 on AIX.

Table 3-5 Table of software prerequisites for xCAT 2 on AIX

AIX version	**5.3**	**6.1**
Technology level	TL 8 to TL 10	TL 1 to TL 3
xCAT 2	xCAT-2.2.x	

AIX version	5.3	6.1
Technology level	TL 8 to TL 10	TL 1 to TL 3
Dependant RPMS	tcl-8.4.7-3, tk-8.4.7-3, expect-5.42.1-3, conserver-8.1.16-2, perl-DBI-1.55-1,perl-DBD-SQLite-1.13-1, perl-IO-Socket-SSL-1.06-1, perl-IO-Tty-1.07-1, perl-IO-Stty-.02-1, perl-Net_SSLeay.pm-1.30-1,	perl-Digest-MD5-2.36-1, perl-Expect-1.21-1, fping-2.2b1-1, openslp-1.2.1, perl-Crypt-SSLeay-0.57-1, perl-Net-Telnet-3.03-1.2, net-snmp-5.4.2.1-1, net-snmp-devel-5.4.2.1-1, net-snmp-perl-5.4.2.1-1, bash-3.2-1.aix5.2.ppc.rpm
Optional RPMS	perl-DBD-mysql-4.007-1,	xcat-mysql-5.0-1 (mysql-5.0.67)
RSCT for (RMC)	2.4.9.0 (2.4.10.0 for full RMC functionality)	2.5.1.0 (2.5.2.0 for full RMC functionality)

If you have an HPC software stack multicluster environment you need to ensure that the SSL version you are using is compatible.

3.6 Database

At the time of writing this book, xCAT 2 for AIX only supports the use of SQLite and MySQL. The database that is installed by default is SQLite but if your cluster is configured to take advantage of the hierarchical facilities available in xCAT 2, MySQL will need to be installed. When xCAT is installed with either of these database types, the same number of database tables are created on the xCAT MN. Table 3-6 provides a list and description of the default tables created on the xCAT 2 MN when xCAT is installed. The tables are listed in the order they are displayed by the **tabdump** command.

Table 3-6 Standard xCAT 2 tables created on the MN

Table name	Description
bootparams	Current boot settings to be sent to systems attempting network boot for deployment, stateless, or other reasons. Mostly automatically manipulated by xCAT.
boottarget	Target profiles with their accompanying kernel parameters
chain	Controls what operations are done (and it what order) when a node is discovered and deployed.

Table name	Description
deps	Describes dependencies some nodes have on others. This can be used, for example, by rpower -d to power nodes on or off in the correct order.
eventlog	Stores the events that occurred.
hosts	IP address and host names of nodes. This info can be used to populate /etc/hosts or DNS.
ipmi	Settings for nodes that are controlled by an on-board BMC via IPMI.
iscsi	Contains settings that control how to boot a node from an iSCSI target.
mac	The MAC address of the node's install adapter. Normally this table is populated by getmacs or node discovery, but you can also add entries to it manually.
monitoring	Controls what external monitoring tools xCAT sets up and uses. Entries should be added and removed from this table using the provided xCAT commands **monstart** and **monstop**.
monsetting	Specifies the monitoring plug-in specific settings. These settings will be used by the monitoring plug-in to customize the behavior such as event filter, sample interval, responses, and so on. Entries should be added, removed or modified with the **chtab** command. Entries can also be added or modified with the **monstart** command when a monitoring plug-in is brought up.
mp	Contains the hardware control info specific to blades. This table also refers to the mpa table, which contains info about each Management Module.
mpa	Contains info about each Management Module and how to access it.
networks	Describes the networks in the cluster and info necessary to set up nodes on that network.
nimimage	All the info that specifies a particular AIX operating system image that can be used to deploy AIX nodes.
nodegroup	Not supported yet! Contains group definitions, whose membership is dynamic depending on characteristics of the node.
nodehm	Settings that control how each node's hardware is managed. Typically, an additional table that is specific to the hardware type of the node contains additional info. For example the ipmi, mp, and ppc tables.
nodelist	The list of all the nodes in the cluster, including each node's current status and what groups it is in.

Table name	Description
nodepos	Contains info about the physical location of each node. Currently, this info is not used by xCAT, and therefore can be in whatever format you want. It will likely be used in xCAT in the future.
noderes	Resources and settings to use when installing nodes.
nodetype	A few hardware and software characteristics of the nodes.
notification	Contains registrations to be notified when a table in the xCAT database changes. Users can add entries to have additional software notified of changes. Add and remove entries using the provided xCAT commands **`regnotif`** and **`unregnotif`**.
osimage	Basic information about an operating system image that can be used to deploy cluster nodes.
passwd	Contains default userids and passwords for xCAT to access cluster components. In most cases, xCAT will also actually set the userid/password in the relevant component when it is being configured or installed. Userids/passwords for specific cluster components can be overidden in other tables, for example mpa, ipmi, ppchcp, and so on.
performance	Describes the system performance every interval unit of time.
policy	Not fully implemented! Controls who has authority to run specific xCAT operations.
postscripts	The scripts that should be run on each node after installation or diskless boot.
ppc	List of system p hardware: HMCs, IVMs, FSPs, BPCs.
ppcdirect	Info necessary to use FSPs to control system p CECs.
ppchcp	Info necessary to use HMCs and IVMs as hardware control points for LPARs.
prodkey	Specifies product keys for products that require them.
servicenode	List of all Service Nodes and services that will be set up on the Service Node.
site	Global settings for the whole cluster. This table is different from the other tables in that each attribute is just named in the key column, rather than having a separate column for each attribute. The following is a list of the attributes currently used by xCAT.
switch	Contains what switch port numbers each node is connected to.
switches	Parameters to use when interrogating switches.

Table name	Description
vm	Virtualization parameters.
vpd	The machine type, model, and serial numbers of each node.
websrv	Web service parameters.

Note: To get more details about the xCAT database tables, you can run the following:

- **`man xcatdb`** will provide a description of the tables.
- **`man <tablename>`** will provide more detailed information on the individual tables.
- **`tabdump -d <tablename>`** will dump the table column description.

This information can also be found at:

`http://xcat.sourceforge.net`

3.7 Administrative task comparison

CSM and xCAT do perform a similar role and there are many similarities in the commands and their functions. You should be aware that some of the functionality in CSM is not longer available in xCAT 2 but some functionality missing from CSM is now available in xCAT 2.

3.7.1 Table comparing functionality

Table 3-7 provides a comparison between the CSM commands and functions and the equivalent in xCAT2.

Table 3-7 Comparison of CSM and xCAT 2 functions for AIX

Category	CSM	xCAT 2 on AIX
Database type	Proprietary database	Pluggable database: SQLite or MySQL
Database commands	csmconfig	ldef, chdef, tabdump, tabedit, chtab
	definenode	mkdef, tabedit, chtab, nodeadd
	lsnode	nodels, lsdef -t node -l, tabdump nodelist or gettab

Category	CSM	xCAT 2 on AIX
	chnode	chdef -t node -o <option>, tabedit, chtab
	csmstat	None - need to use the nodestat and status from IBM.NetworkInteface
Hardware control commands	rpower	rpower
	lshwinfo	rscan
	getadapters	getmacs
Remote console	rconsole	rcons and wcons
	consolerefresh	makeconservercf
	chrconsolecfg	makeconservercf
Firmware flashing commands	rfwscan	rinv
	rfwflash	rflash
	mkflashfiles	not required
Parallel commands	dsh	xdsh
	dcp	xdcp
	dping	pping and ppping
	dshbak	xdshback and xcoll
Node deployment (NIM on AIX)	lsnim	lsnim
	csm2nimnodes?	xcat2nim
	csm2nimgrps	xcat2nim
	csmsetupnim	nimnodeset
		nimnodecust
		mknimimage and rmnimimage
		rinstall and winstall
		mkdsklsnode and rmdsklsnode

Category	CSM	xCAT 2 on AIX
	rte/mksysb install	rte/mksysb install
	/csminstall and NIM FS usage CSM and NIM install (pre/post) scripts	The *installdir* /install can contain all the install images or separate NIM install file systems can be used as well as /install. *installdir* can be changed in the site table.
Network boot	netboot	rnetboot, nodeset
diskless	(not done/Not CSM)	
Update Nodes	updatenode	updatenode
HW config	Not CSM	
File management	cfmupdatenode	dRSYNC or other tools of your choice. Refer to our version of CFM in Table 4.3.29 on page 113.
CHRS	CHRS	lsslp (CEC assignment to HMC coming in 10/09)
RMC Monitoring and related commands	lscondition, lsresponse and lscondresp on CSM MS	lscondition, lsresponse and lscondresp on xCAT 2 MN & SN
	mkcondresp, rmcondresp, startcondresp, stopcondresp	mkcondresp, rmcondresp, startcondresp, stopcondresp
	mksrc, chsrc, rmsrc	mksrc, chsrc, rmsrc
	N/A	monadd and monrm
	N/A	moncfg and mondecfg
	N/A	monstart and monstop
	N/A	monls
Other monitoring	N/A	Ganglia, SNMP, Performance Copilot. fping
LPCommands	Part of rsct.core.lprm	Par of rsct.core.lprm
Hierarchical Management	N/A	Complete support
Software inventory	only on Linux	sinv

Category	CSM	xCAT 2 on AIX
Discovery	hwdsa	lsslp
Services	dns, ntp, ftp, bootp, ssh, rsh, syslog, LDAP, etc	dns, ntp, ftp, bootp, ssh, rsh, syslog, LDAP, etc
backup/restore	csmbackup	dumpxCATdb
	csmrestore	restorexCATdb
HAMS[a]	hams	Available as a service offering
	hamsrecover	Available as a service offering
Data gathering for support	csmsnap	None
HPS (High Performance Switch)	CSM MS manages the switch (csm.server is required)	There is no support for HPS in an xCAT cluster.

a. High availability management server - CSM MS HA feature

Note: CSM has smitty menu pages to perform some administration tasks. xCAT does not have this at this time.

3.7.2 Comparison of common admin commands

CSM has specific commands that produce output or perform a required function, but in xCAT 2 there can be more than one way to perform the same operation. It is possible to run queries against specific xCAT database tables but also objects that provide information from multiple tables. The name of the table and the object are sometimes the same, for example site, but there is no guarantee. Below are some comparisons of administration commands in CSM and xCAT 2.

1. Check the cluster configuration

   CSM: **`csmconfig`**

   xCAT 2:

   – **`lsdef -t site -l`** (Example 3-1)

   Example 3-1 Using lsdef to display the cluster configuration

```
# lsdef -t site -l
Setting the name of the site definition to 'clustersite'.
```

```
Object name: clustersite
    consoleondemand=yes
    domain=p630n06
    installdir=/install
    master=192.168.100.36
    ntpservers=192.168.100.36
    rcp=/usr/bin/scp
    rsh=/usr/bin/ssh
    tftpdir=/tftpboot
    useSSHonAIX=yes
    xcatdport=3001
    xcatiport=3002
```

Note: To remove the message *`Setting the name of the site definition to 'clustersite'`* run **`lsdef -t site -o clustersite -l`**.

– **`tabdump site`** (Example 3-2)

Example 3-2 Using tabdump to display the cluster configuration

```
# tabdump site
#key,value,comments,disable
"xcatdport","3001",,
"xcatiport","3002",,
"tftpdir","/tftpboot",,
"installdir","/install",,
"master","192.168.100.36",,
"domain","p630n06",,
"useSSHonAIX","yes",,
"consoleondemand","yes",,
"rsh","/usr/bin/ssh",,
"rcp","/usr/bin/scp",,
"ntpservers","192.168.100.36",,
```

2. List nodes in the cluster

   CSM: **`lsnode`**

   xCAT 2: **`nodels`** (Example 3-3)

Example 3-3 Using nodels to list the nodes defined in the cluster

```
# nodels
vios-p5502
hmc-v7
```

```
p550_itso2
virt-p5502-p1
virt-p5502-p2
virt-p5502-p3
virt-p5502-p4
virt-p5502-p5
virt-p5502-p6
```

– **`lsdef -t node`** (Example 3-4)

Example 3-4 Using lsdef to list the nodes defined in the cluster

```
# lsdef -t node
vios-p5502
virt-p5502-p4
virt-p5502-p3
p550_itso2
virt-p5502-p6
virt-p5502-p2
virt-p5502-p5
hmc-v7
virt-p5502-p1
```

3. List node details

   CSM: **`lsnode -l <nodename>`**

   xCAT 2:

   – **`lsdef -t node <nodename>`** (Example 3-5)

Example 3-5 Using lsdef to display a full list of details for node virt-p5501-p1

```
# lsdef -t node virt-p5502-p1

Object name: virt-p5502-p1
    arch=ppc64
    cons=hmc
    groups=p5502,GPFSQuorumNodes,LLNodes,AIXNodes,GPFSNodes,HMCNodes
,AllNodes,ManagedNodes,NIMNodes,compute,all,lpar,all
    hcp=hmc-v7
    id=2
    mac=46DA90002002
    mgt=hmc
    nodetype=lpar,osi
    os=AIX
    parent=p550_itso2
    postscripts=setupntp,TEST_Setup_RMC._AllNodes
    power=hmc
    pprofile=p1_profile
    profile=compute
    serial=106627E
    serialflow=hard
    serialport=ttyS0
    serialspeed=9600
    status=unreachable
    termserver=hmc-v7
    xcatmaster=192.168.100.36
```

Note: `lsdef -t -o node virt-p5502-p1 -l`, `lsdef -t node virt-p5502-p1 -l` and `lsdef -t node -o virt-p5502-p1` all produce the same output.

4. List specific node details

   CSM: **`lsnode -a <attribute> <nodename>`**

   xCAT 2:

   – **`nodels <nodename> <tablename>.<attribute>`** (Example 3-6 and Example 3-7)

Example 3-6 Using nodels to identify the power type for node virt-p5502-p1

```
# nodels virt-p5502-p1 nodehm.power
virt-p5502-p1: hmc
```

Example 3-7 Using nodels to list multiple node attributes

```
# nodels virt-p5502-p1 nodehm.power nodelist.node
virt-p5502-p1: nodelist.node: virt-p5502-p1
virt-p5502-p1: nodehm.power: bmc
```

   – **`lsdef -t node <nodename> -i <attribute>`** (Example 3-8 and Example 3-9); the -o <nodename> can be used here but produces the same result.

Example 3-8 Using lsdef to identify the power type for node virt-p5502-p1

```
# lsdef -t node virt-p5502-p1 -i power

Object name: virt-p5502-p1
    power=hmc
```

Example 3-9 Using lsdef to list multiple node attributes

```
# lsdef -t node -o virt-p5502-p1 -i power name

Object name: virt-p5502-p1
    power=bmc
```

Note: The attributes can be separated by a space or a comma.

– **`gettab node=<nodename> <tablename>.<attribute>`** (Example 3-10 and Example 3-11)

Example 3-10 Using gettab to identify the power type for node virt-p5502-p1

```
# gettab node=virt-p5502-p1 nodehm.power
hmc
```

Example 3-11 Using gettab to list multiple node attributes

```
# gettab node=virt-p5502-p1 nodehm.power nodehm.node
nodehm.power: bmc
nodehm.node: virt-p5502-p1
```

5. Change a cluster configuration attribute

   CSM: **`csmconfig -c <attribute>=<value>`**

   xCAT 2:

   – **`chdef -t site <attribute>=<value>`** (Example 3-12)

Example 3-12 Using chdef to change the tftpboot field in the site table

```
# chdef -t site tftpdir=/newfs
Setting the name of the site definition to 'clustersite'.
Object definitions have been created or modified.
```

Note: To remove the message "`Setting the name of the site definition to 'clustersite'.`" from the output run **`chdef -t site -o clustersite tftpdir=/newfs`**.

– **`chtab key=<key> site.value=<value>`** (Example 3-13)

Example 3-13 Using chtab to change the tftpboot field in the site table

```
# chtab key=tftpdir site.value=/newfs
```

– **`tabedit site`** will allow the user to alter the table inside an editor like **`vi:`**

```
# tabedit site
```

6. Change a node definition

   CSM: **`chnode -n <nodename> attribute>=<value>`**

   xCAT 2:

   – **`chdef -t node <nodename> <attribute>=<value>`** (Example 3-14)

   Example 3-14 Using chdef to change the power type for the node

   ```
   # chdef -t node virt-p5502-p1 power=hmc
   Object definitions have been created or modified.
   ```

   Note: It is possible to run **`chdef -t node -o virt-p5502-p1 power=hmc`** but it makes the same change and to the database and does not produce any more output.

   – **`chtab node=<nodename> <tablename>.<attribute>=<value>`** (Example 3-15)

   Example 3-15 Using chtab to change the power type for the node

   ```
   # chtab node=virt-p5502-p1 nodehm.power=hmc
   ```

   – **`tabedit <tablename>`** (Example 3-16)

   Example 3-16 Using tabedit to change the power type for the node

   ```
   # tabedit nodehm
   ```

7. Check the power status of the nodes in the cluster

   CSM: **`rpower -a query`**

   xCAT 2:

   – **`rpower all state`** or **`rpower all stat`** (Example 3-17)

   Example 3-17 Using rpower to check the state of the nodes

   ```
   # rpower all state
   virt-p5502-p6: Running
   p550_itso2: Operating
   virt-p5502-p4: Running
   virt-p5502-p2: Running
   virt-p5502-p3: Running
   virt-p5502-p5: Running
   virt-p5502-p1: Running
   ```

Services that xCAT configures

Table 3-8 Table of xCAT configurables from CSM on node

Service	
NTP	xCAT configures added to postscript table
Syslog	xCAT configures not added to postscript table by default. But this is a problem if the user has TEC. Need to know what is in the syslog.conf file. Consider whether you want to use the postscript for syslog or not.
RMC	On node customized sensors are still present. RMC is different config on xCAT though plus new **`lscondresp`**. This is added to postscript table when configured.
CFM[a]	Scrips for: ssh, hosts, profile, GPFSstate, passwd ntpd.conf and syslog.conf files sorted by **`updatenode`** scripts in xCAT. -- super Kia

a. Configuration File Manager

Note: You need to ensure that the SSL versions for multicluster LL and GPFS are compatible with the versions in xCAT. May need to know for diskless environment.

Part 2

Implementation

This provides instructions on how to migrate your IBM Cluster System Management(CSM) to xCAT version 2. There are several ways to implement CSM to xCAT transition, depending on your environment and requirements.

We show the scenarios tested in our laboratory environment to install a new cluster from scratch. We use this scenario to demonstrate the installation of xCAT, installation of an hierarchical cluster using service nodes, the installation and customizing of diskfull and diskless nodes and also demonstrate xCAT's ability to configure Logical Partitions (LPARs) on a IBM System p.

We also how to install and configure a General Parallel File System (GPFS) cluster using both diskfull and diskless nodes.

CSM to xCAT 2 transition

This chapter provides instructions about how to migrate your IBM Cluster System Management (CSM) to xCAT version 2. There are several ways to implement CSM to xCAT transition, depending on your environment and requirements. We have tested several scenarios in our environment, such as transition on different management servers and the same management server, entire at once cluster transition and partial cluster transition (node groups).

The following scenarios are tested in this chapter:

CSM transition to xCAT diskful nodes on HMC-controlled System p nodes.

- Partial CSM cluster transition to a new xCAT management server - 4.3, "Transitioning nodes to a different MN" on page 84.
- Reverting an xCAT node to CSM. Reverting a transitioned node back into CSM.
- Entire CSM cluster transition to xCAT on the same management server - 4.5, "Steps for a same MS/MN transition" on page 124.

In addition, in 4.7, "Post transition checks" on page 133 we explain post transition steps to verify that the xCAT cluster is working as expected.

4.1 Introduction to implementation scenarios

We tested different migration scenarios using various types of hardware. For xCAT management nodes we used two older systems (that run the required SW levels), since a management node does not require to have its power controlled by the xCAT software (running on the same HW).

4.1.1 Hardware

Our test environment consisted of the following:

- Computing nodes: IBM System P5 550 (M/T 9113-550)
- xCAT and CSM Management Node: IBM System POWER4 630 (M/T 7208-6C4)
- Storage: IBM TotalStorage DS4500 (1742-900)
- Hardware management console (HMC) 7.3.4

4.1.2 Software

The software versions used were:

- AIX 5300-09-01--847
- RSCT 2.4.10
- GPFS 3.2.1.10
- LoadLeveler 3.5.0.4
- PE 5.1.0.4
- XLC compiler8.0
- openSSH 4.5.0.5301
- openSSL 0.9.8.4

4.1.3 Test environment diagram

Figure 4-1 depicts our test environment.

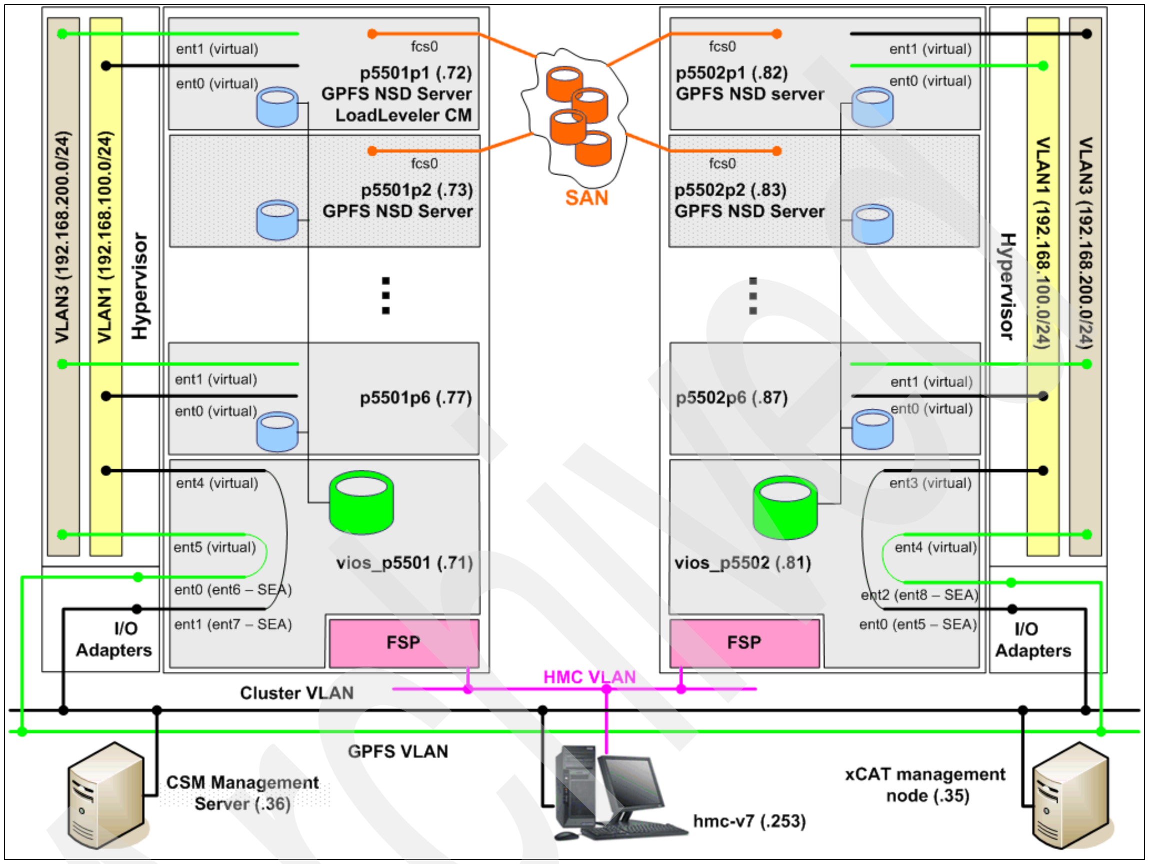

Figure 4-1 Our test environment

4.1.4 Scenarios description

We installed a typical HPC cluster using CSM, including a basic HPC software stack, such as IBM GPFS, PE, xlC, and LoadLeveler. For testing purposes (functional test only), we also installed the sample code for the modified application Hello World.

There are 12 computing nodes in the cluster, two physical p5 550, each with six partitions. These partitions are:

```
virt-p5501_p1 to virt-p5501_p6 for CEC#1 and
virt-p5502-p1 to virt-p5502-p6 for CEC#2
```

There are two subnets/VLANs in our cluster:

```
192.168.200.0/24 -- used for GPFS I/O traffic
192.168.100.0/24 -- management network and client traffic.
A private VLAN for HMC traffic.
```

Note: We chose two networks for simplicity; in your environment you could have a different network topology. For a description of the most common network types (based on cluster role and functionality), see 1.2, “Suggested cluster diagram” on page 13.

GPFS is used for the user home directory and holds all application data. The GPFS file system is available on all computing nodes, but not on the management nodes. There are four NSD servers (a.k.a. storage nodes) in the cluster:

```
virt-p5501_p1
virt-p5501_p2
virt-p5502-p1
virt-p5502-p2
```

All other nodes are NSD clients. See GPFS configuration Example 4-1.

Example 4-1 GPFS cluster configuration

```
# mmlscluster

GPFS cluster information
========================
  GPFS cluster name:         CSMtoxCAT.virt-p5501_p1
  GPFS cluster id:           13882456113010480887
  GPFS UID domain:           CSMtoxCAT.virt-p5501_p1
  Remote shell command:      /usr/bin/ssh
  Remote file copy command:  /usr/bin/scp

GPFS cluster configuration servers:
-----------------------------------
  Primary server:    virt-p5501_p1
  Secondary server:  virt-p5502-p1

 Node  Daemon node name            IP address       Admin node name            Designation
------------------------------------------------------------------------------------------------
   1   virt-p5501_p1               192.168.100.72   virt-p5501_p1              quorum-manager
   2   virt-p5501_p2               192.168.100.73   virt-p5501_p2              quorum-manager
   3   virt-p5501_p3               192.168.100.74   virt-p5501_p3
   4   virt-p5501_p4               192.168.100.75   virt-p5501_p4
   5   virt-p5501_p5               192.168.100.76   virt-p5501_p5
   6   virt-p5501_p6               192.168.100.77   virt-p5501_p6
  7   virt-p5502-p1              192.168.100.82   virt-p5502-p1              quorum-manager
  8   virt-p5502-p2              192.168.100.83   virt-p5502-p2              quorum-manager
  9   virt-p5502-p3              192.168.100.84   virt-p5502-p3
 10   virt-p5502-p4              192.168.100.85   virt-p5502-p4
 11   virt-p5502-p5              192.168.100.86   virt-p5502-p5
 12   virt-p5502-p6              192.168.100.87   virt-p5502-p6
```

The node virt-p5501_p1 is used as LoadLeveler Central Manager, as shown in Example 4-2.

Example 4-2 LoadLeveler configuration

```
$ llstatus
Name                      Schedd InQ  Act Startd Run LdAvg Idle Arch      OpSys
virt-p5501_p1             Avail     2   0 Idle     0 1.07  9999 R6000     AIX53
virt-p5501_p2             Avail     0   0 Idle     0 1.00  9999 R6000     AIX53
virt-p5501_p3             Avail     0   0 Idle     0 0.00  9999 R6000     AIX53
virt-p5501_p4             Avail     0   0 Idle     0 0.00  9999 R6000     AIX53
virt-p5501_p5             Avail     0   0 Idle     0 0.00  9999 R6000     AIX53
virt-p5501_p6             Avail     0   0 Idle     0 0.00  9999 R6000     AIX53
virt-p5502-p1             Avail     0   0 Idle     0 1.00  9999 R6000     AIX53
virt-p5502-p2             Avail     0   0 Idle     0 0.00  9999 R6000     AIX53
virt-p5502-p3             Avail     0   0 Idle     0 1.00  9999 R6000     AIX53
virt-p5502-p4             Avail     0   0 Idle     0 0.01  9999 R6000     AIX53
virt-p5502-p5             Avail     0   0 Idle     0 1.00  9999 R6000     AIX53
virt-p5502-p6             Avail     0   0 Idle     0 0.00  9999 R6000     AIX53

R6000/AIX53                12 machines      2  jobs      0  running tasks
Total Machines             12 machines      2  jobs      0  running tasks

The Central Manager is defined on virt-p5501_p1

The BACKFILL scheduler is in use

All machines on the machine_list are present.
```

We are trying to simulate a real HPC cluster environment when we are transitioning; we keep the sample HPC application running on the whole cluster. Example 4-3 shows the sample HPC application.

Example 4-3 Sample HPC application used in our test

```
$ cat helloworld.c
#include <stdio.h>
#include <unistd.h>
main()
{
        unsigned long i,j,count=0,haha=0;
        char hname[128];

        gethostname(hname, 127);
        hname[127]='\0';

        for (count=0; count<1000; count++)
        {
                haha=0;
                for(j=0;j<10;j++) for (i=0; i<100000000; i++) haha++;
               printf("[%s][%d] hello world, calculating step[%lu]\n", 
hname, (int)time(NULL), count);
        }
        exit(0);
}
```

We also create a customized RMC sensor to monitor GPFS status, which is a sample for RMC monitoring in HPC clusters.

We are trying to minimize the impact of transition, so we decide to use same SSH keys across the cluster so that the transition process will not affect GPFS, LoadLeveler, PE and the running jobs. This could be done in a production environment, and it is the easiest way to set up SSH.

4.2 Preparing your CSM cluster for transition

It is a good idea to ensure that your CSM environment is stable before transitioning to xCAT and that the software and hardware prerequisites have been satisfied.

4.2.1 Things to check before the transition

1. If your current CSM cluster is using the High Performance Switch then this will need to be replaced with another type of high-speed interconnect because there is no support for the HPS on xCAT 2.
2. xCAT has been tested on AIX 5.3 and 6.1. In order to transition a CSM cluster to xCAT, the nodes and the system that will become the xCAT MN need to be at a supported level. If RMC monitoring is going to be used, RSCT has to be at a specific level also. Refer to the prerequisites in 3.5, “SW considerations” on page 55.

3. xCAT has been tested on certain System p hardware. Check the xCAT Web site at:

   http://xcat.sourceforge.net

4. Decide whether the transition to xCAT will be done with the existing CSM MS being converted to xCAT or with a new system for the xCAT MN.
5. Decide how the nodes will be transitioned.
   - If the CSM MS is being converted to the xCAT MN, then all the nodes will have to be transitioned at the same time.
   - If a new system is being used for xCAT MN, then you can decide how many nodes you would like to transition at a time. It may be a good idea to transition one node initially to ensure the procedure works on your cluster.
6. Verify that the remote shell and remote copy facility being used in the cluster are working correctly.
7. Check how **cfmupdatenode** is being used in the cluster and what functionality may be lost when transitioning to xCAT.
8. Check to see what Monitoring has been configured in the CSM cluster. To check the current monitoring configuration, run **lscondresp** and **lssensor** on the CSM MS and the nodes.
   - This will display the current conditions and responses that are associated and whether they are Active or Not active.
   - It is possible to identify conditions, responses, and associations implemented by CSM by listing the following directories on the CSM MS under `/opt/csm/install/resources/base`:
     - IBM.Association
     - IBM.Condition
     - IBM.EventResponse
     - IBM.Sensor

   Note: When CSM is removed from the MS and the nodes the resources related to CSM will be removed as well.

9. Check whether syslog is enabled on any of the CSM nodes because, by default, xCAT will reconfigure `/etc/syslog.conf` to log node activity to the xCAT MN.
10. Check the NTP configuration because, by default, xCAT will reconfigure `/etc/ntpd.conf` on the nodes to point to the xCAT MN. The CSM cluster may be configured to use the `/opt/csm/bin/sprc`[1] script and **cfmupdatenode**.

[1] SPRC - Simple Platform Resource Controller (CSM script)

11. Check what scripts are configured on the CSM cluster and whether they rely on CSM binaries. This includes LPCommands[2].
12. Ensure that the HPC stack is working as expected.
    - Check the GPFS cluster with the following:
        - Run **`mmgetstate -av`** from a node in the GPFS cluster.
        - Verify the file systems are mounted and accessible.
    - Check the Loadleveler cluster with the following:
        - Run **`llstatus`** from a node in the cluster.
        - Submit a job with **`llsubmit`** and check it using the **`llq`** command and by viewing the job output file.
13. In case of a consolidation environment using HACMP™, a new feature in HACMP 5.4.1 enables installing AIX and RSCT PTFs without disturbing HA applications, if the update does not need an operating system reboot. Find the detailed description about the Unmanage Resource Group option in HACMP for AIX 5L™ V5.4.1 Installation Guide.

4.2.2 Remote shell/copy back-end considerations

Decide if you are going to use SSH or RSH for the xCAT2 cluster. Both are supported and the site table will need to be updated to specify whether **`ssh`** and **`scp`** are to be used. In our tests we used SSH, and used the same keys on the CSM MS and the CSM nodes distributed by **`cfmupdatenode`**.

4.2.3 Backing up CSM data

Backups are taken for two reasons: return to old config or reuse parts of config.

- Backing up CSM database and RSCT components:
    - **`csmbackup`**

      It saves the following RMC resource classes defined on the CSM MS:
        - IBM.DeviceHwCtrl: hardware control devices
        - IBM.DeviceGroup: hardware control device groups
        - IBM.Sensor: RMC sensor information
        - IBM.EventResponse: event responses, which include the responses returned by the **`lsresponse`** command and scripts used by the ERRM responses.

[2] For LPCommands, see *IBM RSCT Administration Guide*, SA22-7889-12.

- IBM.Condition: information returned by the **lscondition** command
- IBM.Association: information regarding the mapped conditions and responses that are currently configured
- IBM.ManagedNode: data returned by the **lsnode** command
- IBM.NodeGroup: node group information (dynamic and static groups)
- IBM.DmsCtrl: information that is stored by the **csmconfig** command
- IBM.MNNetworkInterface is not saved

Restore of the RMC classes is possible with the **mkrsrc** command:

```
mkrsrc -f resource_data_input_file [-v] [-h] [-TV] resource_class
```

The command also saves a list of the files in the `/cfmroot` directory, but does not specify which item is a link and which is a normal file.

Full path to the errm directory

The conserver configuration is also saved.

A directory is created with the `/var/opt/csm/csmdata/errm` name for the files used by the RSCT Event Response Resource Manager, which are basically the scripts utilized by the RMC responses.

The passwords set by the **systemid** command to reach the HMCs saved in the `system_config` subdirectory.

It is possible to save additional files as well. Use the -f option specifying a file which contains additional files to save.

The command specifies additional tasks which should be performed by the administrators:

```
# cat tasks.csmbak
```

The following files/directories should be manually backed up by the user to ensure that CSM has been completely saved:

```
/csminstall/
/cfmroot/
```

A subdirectory named *resources* is created which contains all the Perl modules required for the recreation of the RMC definitions.

The file named `scripts.tgz` contains the CSM customization scripts in `/csminstall/csm/scripts` directory.

We did not find the scripts which are called by the CSM-related sensors in the backup.

► Copy of the `/cfmroot` directory

The **csmbackup** command does not back up the `/cfmroot` directory. If the files are to be used in the transition, they need to be backed up with:

```
# tar cvf cfmroot.tar /etc/opt/csm/cfmroot
```

- Backing up RSCT-related data located in the `/var/ct` directory (**`ctbackup`**)

  Run **`/usr/sbin/rsct/bin/ctbackup`** to save the content of the */var/ct* directory, which has the RSCT database and configuration data. The command will create a new directory named `/var/ct.backup`, but will overwrite it if it already exists.

  This can be restored with the **`ctrestore`** command on the original machine.

- We also suggest to take a CSM cluster configuration snapshot with the **`csmsnap`** command. Although this command is used to collect data to be sent to IBM support, it gives you a good set of data that can be used for future reference. The following directories and files are saved:

  ```
  /csminstall/csm/scripts/data/*
  /csminstall/csm/scripts/update/*
  /etc/*-release
  /etc/db_file.cr
  /etc/dhcpd.cfg
  /etc/dhcp.conf
  /etc/dhcpsd.cnf
  /etc/hosts
  /etc/nsswitch.conf
  /etc/opt/conserver/conserver.cf
  /opt/csm/install/*tmpl*
  /opt/csm/install/*.xml*
  /tftpboot/*
  /tmp/spot.out.*
  /var/adm/ras/nimlog
  /var/log/conserver
  /var/log/consoles/*
  /var/log/messages
  /var/log/csm/*
  ```

  The output of CSM-related commands is saved in the `csmsnap_out` subdirectory. This can be used to restore or load some of the configuration data. Configuration data is saved in these files:

  ```
  DSH_LIST.out
  arp_-a.out
  cfmroot.out
  csmconfig.out
  csmstat.out
  errpt_-a.out
  frame_-l.out
  ifconfig_-a.out
  instfix_-i.out
  lshwdev_-a_Mode.out
  ```

```
lslpp_-hac.out
lsmod.out
lsnim_-l.out
lsnode_-F.out
lsnode_-i.out
lsnode_-p.out
lspci.out
lsrhws_-e.out
lsrhws_-f.out
lsrhws_-m.out
lsrhws_-s_.Frame_BPA_MTMS==..TM*MS_of_BPA..._-L.out
lsrsrc_IBM.MNNetworkInterface_Name_IPAddress_Status.out
lsrsrc_IBM.ManagedNode.out
lsrsrc_IBM.ManagementServer.out
lssrc_-a.out
lssrc_-l_-s_dhcpsd.out
monitorinstall.out
netstat_-A.out
netstat_-in.out
netstat_-rn.out
nodegrp.out
rmcdomainstatus_-s_ctrmc.out
rpm_-qa.out
rpower_-av_cec_query.out
rpower_-av_query.out
systemid.out
```

- RSCT snapshot (**ctsnap** on MS and nodes)

  The **ctsnap** command gathers configuration, log, and trace information about the Reliable Scalable Cluster Technology (RSCT) components.

  The command creates a compressed file in the `/tmp/ctsupt` directory, which contains the RSCT configuration data with RMC databases. The RMC database contains the whole CSM cluster configuration. The RMC Resource Manager daemon setup is saved also, together with the contents of the `/var/ct` directory.

  The console and RMC logs are saved also.

- Back up the OS using either system backup (**mksysb**) or alternate disk install (**alt_disk_install**) on the management server.

  It may be necessary to back up the non-root volume groups, depending on your cluster config. For example, if the NIM file system is in a separate volume group, this should be backed up.

Note: If nodes in a cluster have specific a specific configuration (RMC), then you may need to issue **`ctbackup`** on the nodes, and you may need a way to restore config. We did not have this in our test. All RMC customization is in `cfmroot`.

- System logging (syslog) configuration

  Check and save the `syslog.conf` file on the node(s) being transitioned because it is replaced, by default, by xCAT postscipt (*syslog*). Back it up if the configuration is required after transition. It is possible to not run this script, either by specifying the scripts to run with the **`updatenode`** command or altering the scripts in the postscripts table.

4.2.4 Saving secondary adapter information

In a CSM cluster we can differentiate two kinds of network adapters: install adapters and secondary adapters. The install adapters are used for installing the nodes over the network. The secondary adapters are used for applications and other administration purposes. The administration of the secondary adapters can be configured and managed using either NIM or CSM functions.

- Adapters handled by CSM

  For each secondary, adapter information is stored in one stanza file assigned to the nodes via the AdapterStanzaFile node attribute.

  Save the stanza files for the nodes to be transitioned and move them to the new xCAT MN. This can be passed to the NIM configuration and used to restore secondary adapter configuration.

  Note: At the time of writing, xCAT does not have a utility that can handle secondary adapters out-of-the-box. You can handle secondary adapters (configure) either via NIM or via xCA postscripts.

- Adapters handled by NIM

  There is one or more NIM resource defined with the type `adapter_def`. Check the name of the resource on the NIM master with **`lsnim|grep adapter_def`**.

  Run **`lsnim –l “adapter resource”`**, for example if the resource name is *Adapters*:

```
# lsnim -l Adapters
Adapters:
   class       = resources
   type        = adapter_def
```

```
Rstate      = ready for use
prev_state  = unavailable for use
location    = /nimrepo/adapters
alloc_count = 0
server      = master
```

For each node to be transitioned, save the files found in the directory specified by the location attribute.

Note: It is possible to merge the files into one for easier transfer and handling.

4.2.5 Save RMC monitoring data

The RMC data backup is explained in sections related to the different RMC classes, where the data can be found (see the **ctbackup**, **csmbackup** commands).

- IBM.Sensor

  The RMC sensors are implemented via user-defined scripts and the IBM.SensorRM resource manager daemon, which starts the scripts in the predefined time.

  For the backup of the sensors we have to back up the sensor scripts and the sensor definition scripts.

  In our example the sensor script is already on the installed nodes, but for future installations we put it in the file collection also.

  The sensor definition is implemented via a CSM update script, so we have to back up this script for future use.

- IBM.Condition

  The conditions are managed by the IBM.ERRM resource manager. To back up the condition in a reusable format, run the **lsrsrc** command with the following parameters to save the GPFS-related data:

  ```
  #lsrsrc -i -s 'Name like "GPFS%"' IBM.Condition
  ```

  It is possible to change the search parameter according to the actual monitoring configuration, but in our scenario no other condition was created.

4.3 Transitioning nodes to a different MN

In this scenario we prepare a separate OS image (server) to be used as xCAT management node (MN). This scenario can be applied if, for example, before switching your cluster completely, you want to test how xCAT behaves on a subset of nodes, while, at the same time, preparing the transition process.

The diagram of this scenario is presented in Figure 4-2. We recommend that before you start this scenario, you identify the xCAT documentation pertaining to your specific platform, and also, take the necessary actions to prepare a fallback plan for the transitioned nodes, in case you will need to revert to the original configuration.

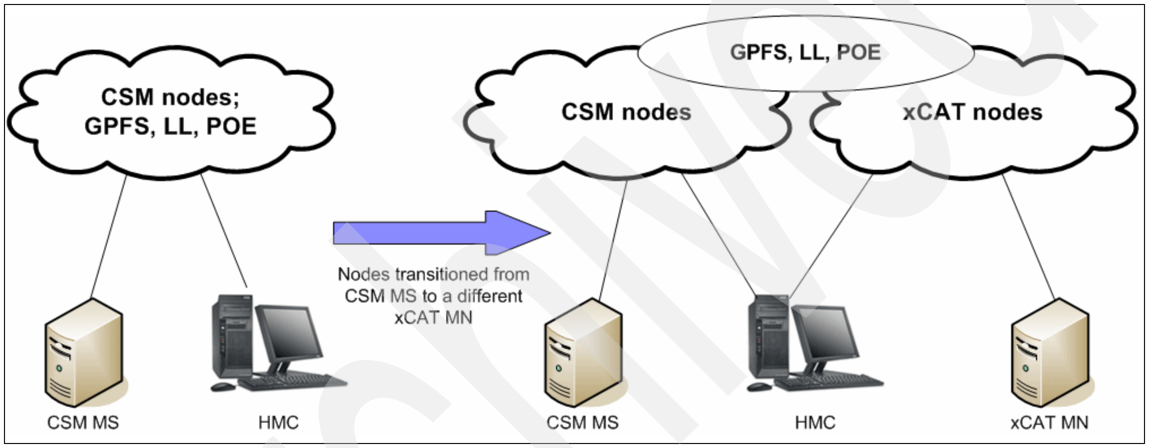

Figure 4-2 Transition diagram - different management servers

For this scenario we assume that the future xCAT management node has already been installed with the required AIX version and has the network connectivity and storage resources required for acting as xCAT management node.

4.3.1 Preparing the xCAT 2 management node (MN) for transition

Note: The starting point for this scenario is the xCAT2AIX document at:

https://xcat.svn.sourceforge.net/svnroot/xcat/xcat-core/trunk/xCAT-client/share/doc/xCAT2onAIX.pdf

These steps are run on the xCAT MN

1. Log in to your designated xCAT MN and create a volume group for `/install`.

2. Download the RPMs dep-aix-*.tar.gz and core-aix-2.2.tar.gz from:

   http://xcat.sourceforge.net/yum/download.html

3. Install the prerequisites, as shown in Example 4-4.

Note: Make sure directories are specified each time (full path).

Example 4-4 Install xCAT prerequisites

```
# mkdir /install/dep-aix-2.2
# cd /install/dep-aix-2.2
# tar xf dep-aix-2.2-snap200903291204.tar
#cd /install/dep-aix-2.2
# ./instoss
perl-DBI
##################################################
bash
##################################################
perl-DBD-SQLite
##################################################
conserver
##################################################
perl-Expect
##################################################
perl-IO-Tty
##################################################
perl-IO-Stty
##################################################
perl-IO-Socket-SSL
##################################################
perl-Net_SSLeay.pm
##################################################
perl-Digest-MD5
##################################################
fping
##################################################
openslp
##################################################
perl-Crypt-SSLeay
##################################################
perl-Net-Telnet
##################################################
net-snmp
##################################################
```

```
net-snmp-devel
##################################################
net-snmp-perl
##################################################
```

4. Install the core packages, as shown in Example 4-5.

Example 4-5 Installing xCAT core packages

```
# mkdir /install/core-aix-2.2
# cd /install/core-aix-2.2
# tar xf core-aix-snap.tar
# ./instxcat
perl-xCAT
##################################################
xCAT-client
##################################################
xCAT-server
##################################################
xCAT
##################################################
Created /etc/xCATMN file.
Added updates to the /.ssh/config file.
Created /install/postscripts/_ssh directory.
Copied /.ssh/id_rsa.pub to
/install/postscripts/_ssh/authorized_keys.
ln -sf /opt/freeware/sbin/conserver /usr/sbin/conserver.
ln -sf /opt/freeware/bin/console /usr/bin/console.
Command failed: lssrc -a | grep conserver 2>&1. Error message: .
Add subsystem conserver.
Updated cluster site definition.
Created postscripts definition.
Created policy definition.
syslog has been set up.
Setting up basic certificates.  Respond with a 'y' when prompted.
Running echo 'y
y
y
y' |/opt/xcat/share/xcat/scripts/setup-xcat-ca.sh 'xCAT CA'
        # NOTE use "-newkey rsa:2048" if running OpenSSL 0.9.8a or
higher
Generating a 2048 bit RSA private key
.............................+++
..........................................+++
writing new private key to 'private/ca-key.pem'
```

```
-----
/
Created xCAT certificate.
Created /install/postscripts/ca/certs directory.
Copied /etc/xcat/ca/* to /install/postscripts/ca directory.
Running echo 'y
y
y
y' |/opt/xcat/share/xcat/scripts/setup-server-cert.sh p630n06
Generating RSA private key, 2048 bit long modulus
........+++
..+++
e is 65537 (0x10001)
/
Using configuration from openssl.cnf
Check that the request matches the signature
Signature ok
Certificate Details:
        Serial Number: 1 (0x1)
        Validity
            Not Before: May  8 18:44:05 2009 GMT
            Not After : May  3 18:44:05 2029 GMT
        Subject:
            commonName                = p630n06
        X509v3 extensions:
            X509v3 Basic Constraints:
                CA:FALSE
            Netscape Comment:
                OpenSSL Generated Certificate
            X509v3 Subject Key Identifier:

B4:AA:0D:23:4D:FC:19:3E:90:F6:35:23:C1:73:83:DA:02:42:D9:C5
            X509v3 Authority Key Identifier:

keyid:DC:5B:E0:10:B1:06:A0:9A:30:4E:D3:82:FE:24:14:86:83:5A:67:CC

Certificate is to be certified until May  3 18:44:05 2029 GMT (7300
days)
Sign the certificate? [y/n]:

1 out of 1 certificate requests certified, commit? [y/n]Write out
database with 1 new entries
Data Base Updated
/
Created xCAT certificate.
Created /install/postscripts/cert directory.
Copied /etc/xcat/cert/* to /install/postscripts/cert directory.
Running echo 'y
y
y
y' |/opt/xcat/share/xcat/scripts/setup-local-client.sh root
Generating RSA private key, 2048 bit long modulus
...................................................................+++
............................................+++
e is 65537 (0x10001)
/
Using configuration from openssl.cnf
Check that the request matches the signature
Signature ok
Certificate Details:
        Serial Number: 2 (0x2)
        Validity
            Not Before: May  8 18:44:11 2009 GMT
            Not After : May  3 18:44:11 2029 GMT
        Subject:
            commonName                = root
        X509v3 extensions:
            X509v3 Basic Constraints:
                CA:FALSE
            Netscape Comment:
                OpenSSL Generated Certificate
            X509v3 Subject Key Identifier:

65:10:FA:C8:3C:92:4C:02:C9:49:A6:BD:B1:5E:C0:57:DC:70:F5:E2
            X509v3 Authority Key Identifier:

keyid:DC:5B:E0:10:B1:06:A0:9A:30:4E:D3:82:FE:24:14:86:83:5A:67:CC

Certificate is to be certified until May  3 18:44:11 2029 GMT (7300
days)
Sign the certificate? [y/n]:
1 out of 1 certificate requests certified, commit? [y/n]Write out
database with 1 new entries
Data Base Updated
/
Created xCAT certificate.
Created /install/postscripts/_xcat directory.
Copied /.xcat/* to /install/postscripts/_xcat directory.
Copied /etc/xcat/ca/certs* to /install/postscripts/ca/certs
directory.
```

```
Starting xcatd.....
xCAT-rmc
##################################################
Stopping xcatd processes....
Starting xcatd.....
```

Note: If, for whatever reason, you are reinstalling xCAT RPMs, duplicate entries in `/etc/profile` may be re-added each time. Check and correct.

This step is run on the xCAT MN

5. To check the site table to ensure xCAT has been installed correctly and the **`xcatd`** is running, run the command in Example 4-6.

Example 4-6 Checking the site table after installation of xCAT

```
# lsdef -t site -l
Setting the name of the site definition to 'clustersite'.

Object name: clustersite
    consoleondemand=yes
    domain=p630n05
    installdir=/install
    master=192.168.100.35
    tftpdir=/tftpboot
    useSSHonAIX=no
    xcatdport=3001
    xcatiport=3002
```

Note: A description of the site table can be found in Table 3-6 on page 56.

4.3.2 Gather CSM data using the csm2xcat script on CSM MS

xCAT provides a utility to save some of the CSM configuration data in stanza files, which can be used to create the definitions in xCAT. At the time of writing this book three stanza files are created for the site, device and node definitions. The script creates a log file as well, as shown in Example 4-7.

Example 4-7 Log file for csm2xcat utility

```
# cat conversion.log
Conversion started at Thu Apr 30 10:45:34 2009
Reading Site information

Reading Node information
Reading Device information

Conversion finished at Thu Apr 30 10:45:56 2009
```

The following steps show how to use the utility.

Note: The csm2xcat tool has been developed to facilitate migration from CSM to xCAT. The command must be run on the CSM management server and will build three xCAT stanza files that can be used to update the xCAT database using the **chdef** command.

These steps are run on the CSM MS.

1. Copy the /opt/xcat/share/xcat/tools/csm2xcat and /opt/xcat/share/xcat/tools/csm2xactdefs files from the xCAT 2 MN to the CSM MS.
2. On the CSM MS, run **csm2xcat**.
3. Data files are created in /tmp/csm2xcat.
4. Copy the following files to the xCAT MN:
   - site.stanza
   - node.stanza
   - device.stanza

4.3.3 Update /etc/hosts

These steps are run on the CSM MS.

5. Add the new IP label/address of the xCAT Management Node (MN) to the /etc/hosts file on CSM MS and run **cfmupdatenode** against the nodes that are being transitioned.
6. Copy the updated /etc/hosts from the CSM MS to the xCAT2 MN.

4.3.4 Set up user and group on the new xCAT MN

This step is run on the CSM MS.

7. Copy the following files from the CSM MS to the xCAT 2 MN to replicate the configuration:
   - /etc/hosts
   - /etc/passwd
   - /etc/group
   - /etc/security/passwd
   - /etc/security/group
   - /etc/security/limits
   - /etc/security/user

4.3.5 Configure remote shell

Note: To ensure smooth transition, we recommend that you copy the public key of the root@CSMMS and root@xCATMN into the ~/.authorized_keys of the root user on all nodes.

As described in 4.2.2, "Remote shell/copy back-end considerations" on page 78, SSH is not defined as default in xCAT 2 so the site table needs to be updated.

These steps are run on the xCAT MN.

8. Run the **chdef** command on the site file to enable **ssh** on AIX:

   ```
   chdef -t site useSSHonAIX=yes
   ```

9. Change the site table to reflect the **rsh** and **rcp** usage:

   ```
   chdef -t site rsh=/usr/bin/ssh rcp=/usr/bin/scp
   ```

   The CSM cluster used the same SSH keys. Therefore, to make the transition simpler and to minimize the impact on our applications, we copied the contents of `~root/.ssh` from the CSM MS to the xCAT 2 MN.

10. Copy `/.ssh/*` from MS to MN.

    Important: Be aware that commands that require root privilege will still be able to run on xCAT-managed nodes from the CSM MS.

11. Test whether it is now possible to **ssh** from the MN to the nodes. Use the command:

    ```
    ssh <nodename> date
    ```

4.3.6 Check the ulimit

12. Check the ulimit *fsize* for the MN.
13. Create an SSL policy for the MN.

Note: SSL is used for securing the communication between client and daemon, identifying client user ID and porting **ssh** key/credential exchanges during installation. There are three xcatd daemons:

One xCAT daemon is for node deployment purposes, listens on TCP port 3002, only accepts connections from nodes defined in xCAT, and handles the following XML format commands:

```
  next, installstatus, unlocktftpdir, locktftpdir, getpostscript,
rebootnodes, setiscsiparms
```

One xCAT daemon is only for blade discovering purposes by now; it listens on UDP port 3001 and handles the following XML format command:

```
  findme
```

One xCAT daemon is used for administration purposes. Most xCAT commands go through this daemon. It listens on TCP port 3001, uses SSL communication to only allow authorized users to run xCAT commands, and also checks the policy table to verify that the user is allowed to run a particular command. It handles the following XML format commands:

```
  authcheck, noderange, extnoderange, all plug-in commands
```

4.3.7 Enabling NTP

In the existing CSM cluster NTP was configured using CFM but we decided to enable the optional NTP feature in xCAT. When the *ntpservers* and *timezone* attributes are updated in the site table, all nodes that are installed or booted from the MN will use these settings. It is also possible to configure transitioned nodes to use these settings, as described in 4.3.25, “Run the xcataixscript utility on the nodes” on page 109.

14. Enable the NTP server in the site table with **chdef**:

```
chdef -t site ntpservers=<NTP server IP>
```

15. Set the time zone:

```
chdef -t site timezone=America/New_York
```

4.3.8 Enabling inetd entries

16. The NIM master uses the tftp and bootp subservers of the inetd daemon, so these have to be enabled via removing the comment sign in `/etc/inetd.conf` and refreshing the inetd daemon. Check the relevant part of the configuration file:

```
# grep -E "tftp|bootp" /etc/inetd.conf
bootps  dgram   udp     wait    root    /usr/sbin/bootpd
bootpd /etc/bootptab
tftp     dgram  udp6    SRC     nobody  /usr/sbin/tftpd
tftpd -n
```

4.3.9 Define HMC and VIO servers in xCAT

17. Define the HMC and VOIS to the xCAT MN node table:

   a. Check the file `device.stanza`, generated by the csm2xcat script, to ensure it contains the devices you want to transition, as shown in Example 4-8.

Example 4-8 Checking the device.stanza file

```
# cat p5502.device.stanza
# <xCAT data object stanza file
vios-p5502:
    objtype=node
    groups=AllDevices
    status=defined
    nodetype=ioserver
    mtm=550-9113
    serial=106627E
hmc-v7:
    objtype=node
    groups=HMCDevices,AllDevices
    status=defined
    nodetype=hmc
```

   b. Add the HMCs and VIOS[3]s to the xCAT database:

```
cat device.stanza | mkdef -z
```

   c. Add the field *`mgt=hmc`* to the HMC definition with the **`chdef`** command:

```
chdef -t node -o hmc-v7 mgt=hmc
```

   d. Add the hscroot user and passwd for the HMC with the **`chdef`** command:

```
chdef -t node -o hmc-v7 password=itsoadmin username=hscroot
```

[3] IBM Virtual Input Output Server

Note: To get **rcons** and **rpower** working we have to run **rscan** and then merge the csm2xcat file with the **rscan** output, then define the node. It is important to have the machine entries from **rscan**.

Ensure that the files are merged correctly because we do not want multiple field entries per stanza as the last entry, which may incorrect, to be used.

4.3.10 Discovering HW in xCAT (rscan)

It is necessary to run **rscan** to gather the required attributes for hardware control. It is possible to use the **-w** flag to write the relevant data straight into the xCAT database. We did not choose this option because we were populating the database in a specific way, as detailed in Example 4.3.11.

18. Collect the node information from the hardware control point:

```
rscan -z hmc-v7 > /tmp/csm2xcat/xcat_mystanzafile
```

4.3.11 Defining the nodes (populating the tables)

19. Define the xCAT compute nodes. We tested two ways to do this:

   – Defining a single node
   – Defining multiple nodes with a script called *convert.sh*

Defining a single node (manual process)

a. If you do not use the *convert.sh* script you will need to use the following steps:

Note: convert.sh is a script tool that helps you merge the attributes from the output of **csm2xcat** and **rscan** to define the nodes in xCAT easily.

i. Use the node.stanza file, created in 4.3.2, “Gather CSM data using the csm2xcat script on CSM MS” on page 89, to generate a new file containing a single node stanza, that is, for node *virt-p5501-p4*, and copy it to the new xCAT MN:

```
grep -p virt-p5501_p4 /tmp/csm2xcat/node.stanza >
virt-p5501_p4.stanza
```

ii. On the CSM management server run **lparstat** on the node and extract the LPAR partition name, as in Example 4-9.

Example 4-9 Identifying the partition name of virt-p5501_p4

```
# ssh virt-p5501_p4 "lparstat -i|grep 'Partition Name'|awk '{print
$4}'"
p5_1_p4
```

iii. Use the following commands to insert a line between each node stanza generated by **rscan**, **grep** the identified partition name, then replace the partition name for the node name and redirect to a file:

```
sed '/:/{x;p;x;}' /tmp/csm2xcat/xcat_mystanzafile | grep -p
p5_1_p4|sed s/p5_1_p4/virt-p5501_p4/ >
/tmp/csm2xcat/virt-p5501_p4.stanza_add
```

iv. Verify by data checking the two files, as shown in Example 4-10.

Example 4-10 node stanza generated by csm2xcat

```
# cat virt-p5501_p4.stanza
virt-p5501_p4:
    objtype=node
    groups=p5501,GPFSNodes,LLNodes,AIXNodes,HMCNodes,AllNodes,ManagedNo
des,NIMNodes,compute,all
    profile=compute
    status=defined
    mac=7241E0005003
    termserver=hmc-v7
    power=hmc
    mgt=hmc
    os=AIX
    arch=ppc64
    serial=106628E
    serialspeed=9600
    serialflow=hard
    serialport=ttyS0
    cons=hmc
    xcatmaster=192.168.100.35

# cat virt-p5501_p4.stanza_add
virt-p5501_p4:
        objtype=node
        nodetype=lpar,osi
        id=5
        mtm=
        serial=
        hcp=hmc-v7
        pprofile=p4_profile
        parent=p550_itso1
        groups=lpar,all
        mgt=hmc
        cons=hmc
```

v. Define the CEC (managed system) name as a separate node in the node table. This is known as the *parent* in the node definition, for example `parent=p550_itso1`. Use the `xcat_mystanzafile` file generated by the **rscan** command as shown in Example 4-11 to define the CEC, as shown in Example 4-12.

> **Note:** If you do not define the CEC as a node to xCAT, the **rpower** command will return VPD errors like this:
>
> ```
> # rpower virt-p5501_p4 state
> virt-p5501_p4: Node not defined in 'vpd: (p550_itso1)' database
> ```

Example 4-11 Node stanza from rscan

```
p550_itso1:
        objtype=node
        nodetype=fsp
        id=
        mtm=9113-550
        serial=106628E
        hcp=hmc-v7
        pprofile=
        parent=
        groups=fsp,all
        mgt=hmc
        cons=
```

vi. Define the node with the file created from Step i on page 94:

```
cat virt-p5501_p4_node.stanza | mkdef -z
```

Example 4-12 mkdef run successfully

```
# cat virt-p5501_p4.parent.stanza | mkdef -z
Object definitions have been created or modified.
```

vii. Define the node with the file created from Step iii on page 95:

```
cat virt-p5501_p4_node.stanza_add | chdef -p -z
```

viii. Alter the `xcatmaster` field in the node object with the IP address of the new xCAT MN, for example 192.168.100.35:

For a single node:

```
chdef -t node -o virt-p5501_p4 xcatmaster=192.168.100.35
```

Or for a group:

```
chdef -t node -o lpar xcatmaster=192.168.100.35
```

Defining multiple nodes at once (scripting it)

b. Using the `convert.sh` script:

> **Note:** Make sure you have the following files in the same directory with convert.sh
>
> – node.stanza, output of **`csm2xcat`**
> – xcat_mystanzafile, output of **`rscan`**
> – ssh is working, you can ssh to computing node without password. This is used to query the mapping between hostname and partition name.
>
> convert.sh needs three parameters:
>
> – hostname
>
> – CSM MN IP address
>
> – xCAT MN IP address, used to replace xcatmaster if you are using a different xCAT MN from CSM MN

i. On the xCAT Management Node generate a node list file to use with the `convert.sh` script; see Example 4-13.

Example 4-13 Commands to grab node list for multiple node transition

```
# cat node.stanza|grep :|sed s/://|grep p5501|grep -v p3|grep -v p4 >
multinode_p5501

# cat multinode_p5501
virt-p5501_p2
virt-p5501_p1
virt-p5501_p6
virt-p5501_p5
```

ii. Define nodes and the parent CEC in xCAT using the `convert.sh` script. The script details are shown in Example 4-14.

Example 4-14 Nodes defines to xCAT with convert.sh

```
# cat multinode_p5501|xargs -I {} ./convert.sh {} 192.168.100.36
192.168.100.35
Processing virt-p5501_p2
Generating virt-p5501_p2.stanza from csm2xcat
Partition id for virt-p5501_p2 is p5_1_p2
Generating virt-p5501_p2.stanza_add from xcat rscan
Generating parent stanzafile
Parent for virt-p5501_p2: p550_itso1
p550_itso1 not defined in xCAT
Object definitions have been created or modified.

Define node virt-p5501_p2 in xCAT
Object definitions have been created or modified.

Change node virt-p5501_p2 attributes
Object definitions have been created or modified.

..snippet..

Object definitions have been created or modified.

Change node virt-p5501_p5 attributes
Object definitions have been created or modified.
```

iii. Verify the xCAT definitions with **`lsdef -t node -l`**, as shown in Example 4-15.

Note: The **`csm2xcat`** script does not add devices to the *all* group.

Example 4-15 Verify the node definition

```
# lsdef -t node -o virt-p5501_p4 -l

Object name: virt-p5501_p4
    arch=ppc64
    cons=hmc
    groups=p5501,GPFSNodes,LLNodes,AIXNodes,HMCNodes,AllNodes,ManagedNo
des,NIMNodes,compute,all
    hcp=hmc-v7
    id=5
```

```
mac=7241E0005003
mgt=hmc
nodetype=lpar,osi
os=AIX
parent=p550_itso1
power=hmc
pprofile=p4_profile
profile=compute
serial=106628E
serialflow=hard
serialport=ttyS0
serialspeed=9600
status=defined
termserver=hmc-v7
xcatmaster=192.168.100.35
```

4.3.12 Configuring and testing conserver

This step is run on the xCAT MN.

20. Every time a node is added to the xCAT cluster, **makeconservercf** needs to be run:

```
# makeconservercf
```

Note: On a CSM cluster `conserver.cf` is located in `/etc/opt/conserver/conserver.cf` but on an xCAT cluster it is located in `/etc/conserver.cf`.

Verify that the node name has been added to `/etc/consever.cf`. If adding nodes to the xCAT cluster, you also need to run:

```
# stopsrc -s conserver
# startsrc -s conserver
```

Note: **rcons** and **rpower** will fail if *nodetype=lpar (*from **rscan***)* and machine entry (managed system) was not defined. Getting parent errors.

This step is run on the xCAT MN.

21. Test using **rcons** on the newly added node as shown in Example 4-16.

```
# rcons virt-p5501_p4
```

Note: To exit **rcons,** use the following keyboard sequence:

```
“cntrl-E” then “c” then “.”
```

Example 4-16 Testing remote console access

```
# rcons virt-p5501_p4
[Enter `^Ec?' for help]


AIX Version 5
Copyright IBM Corporation, 1982, 2008.
Console login:

# [disconnect]
#
```

4.3.13 Testing remote power control (rpower)

This step is run on the xCAT MN.

22. Test **rpower** against the added node as shown in Example 4-17.

    ```
    # rpower virt-p5501_p4 state
    ```

Example 4-17 Testing rpower

```
# rpower virt-p5501_p4 state
virt-p5501_p4: Running
```

4.3.14 Configuring NIM master and creating NIM resources

Attention: In this step we configure a different NIM master, controlled by the xCAT MN. This NIM master is different from the one controlled by the CSM MS. Once the nodes are migrated from CSM to xCAT, they will also be moved from the CSM NIM master to the xCAT NIM master.

This step is run on the xCAT MN.

23. If using a different xCAT MN from CSM MS, you need to set up a new NIM master and create NIM resources:
    a. Export `lpp_source` from CSM MS and mount on the xCAT MN.
    b. Run **mknimimage** on `lpp_source` on MN, as shown in Example 4-18.

Example 4-18 Using the mknimimage command

```
# mknimimage -s /mnt_point_to_lpp_source 539image
Configuring NIM.
Creating a NIM lpp_source resource called '539image_lpp_source'.
This could take a while.
Creating a NIM SPOT resource. This could take a while.
```

```
The following xCAT osimage definition was created. Use the xCAT
lsdef command
to view the xCAT definition and the AIX lsnim command to view the
individual
NIM resources that are included in this definition.
Object name: 539image
        bosinst_data=539image_bosinst_data
        imagetype=NIM
        lpp_source=539image_lpp_source
        nimmethod=rte
        nimtype=standalone
        osname=AIX
        spot=539image
```

c. Update `lpp_source` with the xCAT packages on the xCAT MN:

i. Copy the RPMs from the `dep-aix-*.tar.gz` and `core-aix-2.2.tar.gz` files to xCAT MN.

ii. Create a directory for bundles; we used `stall/nim/installp_bundle`.

iii. Copy the bundle files `xCATaixSN.bnd`, `xCATaixSSH.bnd`, and `xCATaixSSL.bnd` to the directory `/install/nim/installp_bundle`

iv. Define bundles for SSH and SSL (see Example 4-19):

```
# nim -o define installp_bundle -a server=master -a \
> location=<location> <bundlename>
```

Example 4-19 define xCAT bundles in NIM

```
nim -o define -t installp_bundle -a server=master -a
location=/install/nim/installp_bundle/xCATaixSSL.bnd xCATaixSSL.bnd
nim -o define -t installp_bundle -a server=master -a
location=/install/nim/installp_bundle/xCATaixSSH.bnd xCATaixSSH.bnd
```

v. Copy xCAT dependency RPMs to `lpp_source`.

vi. Update `lpp_source` with the xCAT packages.

```
nim -o update -a packages=all -a source=/xCAT2/dep-aix-2.2
539lpp_res
```

vii. If the cluster contains an SN, copy xCAT core packages to `lpp_source` and run:

```
nim -o update -a packages=all -a source=/xCAT2/core-aix-2.2
539lpp_res
```

4.3.15 Add installp bundles to xCAT osimage

This step is run on the xCAT MN.

24. To add bundles to the osimage, run:

```
chdef -t osimage -o 539image install_bundle="xCATaixSSL,xCATaixSSH"
```

4.3.16 Define xCAT networks

In our scenario we have two networks: `cluser_net` for administration and external login, and `gpfs_net` for GPFS private I/O. See Figure 4-1 on page 73 for the cluster diagram.

This step is run on the xCAT MN.

25. Create xCAT networks in the networks table:

   a. Cluster network

   ```
   mkdef -t network -o cluster_net net=192.168.100.0 \
   > mask=255.255.255.0 gate=192.168.100.60
   ```

   b. GPFS network

   ```
   mkdef -t network -o gpfs_net net=192.168.200.0 mask=255.255.255.0
   ```

Note: We changed the NIM network name to `cluster_net`, as advised by the xCAT documentation. This is the name created by the **`mknimimage`** command.

4.3.17 Create NIM secondary adapter definitions

This step is run on the xCAT MN.

26. Add secondary adapter information into NIM. We used the secondary adapters in each node on the network dedicated for GPFS I/O traffic.

   Note: This step is not required for an existing NIM config (that is, from existing MS.)

   This operation has to be done after the NIM master is defined on the new xCAT management node.

   The NIM resource will require a directory to place the adapter definition files for each node, which can be exported. Be sure that the NIM operation does not fail if the directory is already defined as a location for any NIM resources, as this could prevent NFS exporting it.

   a. Use the following command to create a new NIM adapter_def resource with the Adapters name in the /install/nim/adapters directory:

   ```
   nim -o define -t adapter_def -a server=master -a \
   > location=/install/nim/adapters Adapters
   ```

b. Populate the directory with the adapter definition files using the following command, where the source file can be either a CSM or NIM adapter stanza file saved based on the previous section. Use the file created in 4.2.4, “Saving secondary adapter information” on page 82.

```
nimadapters –d –f /tmp/adapterfile_from_csm Adapters
```

There is no adapter_def field in the nimimage table at the time of this writing. Thus, the resource will have to be allocated manually before a NIM operation.

4.3.18 Creating NIM client and group definitions

Note: We created the NIM client and NIM definitions using the CSM (NIM) naming convention.

This step is run on the xCAT MN.

27. Use the **xcat2nim** command to create NIM resources from the xCAT database.

a. Define standalone machines in NIM using **xcat2nim**:

```
xcat2nim [-t node] <nodename>
```

Example 4-20 shows how to define a single standalone node.

Example 4-20 xcat2csm against a single node - '-t' not required if against a node

```
# xcat2nim virt-p5501_p4
 Assuming an object type of 'node'.

p630n05: NIM operations have completed
successfully.
```

Example 4-21 shows how to define multiple standalone nodes.

Example 4-21 multiple nodes added to NIM with xcat2nim command

```
# cat multinode_p5501
virt-p5501_p2
virt-p5501_p1
virt-p5501_p6
virt-p5501_p5

# cat multinode_p5501|xargs -I {} xcat2nim {}
 Assuming an object type of 'node'.

p630n05: NIM operations have completed successfully.
```

```
 Assuming an object type of 'node'.

p630n05: NIM operations have completed successfully.

 Assuming an object type of 'node'.

p630n05: NIM operations have completed successfully.

 Assuming an object type of 'node'.

p630n05: NIM operations have completed
successfully
```

b. Define a NIM group using **`xcat2nim`**, as shown in Example 4-22.

```
xcat2nim -f -t group <groupname>
```

Example 4-22 Getting the Groups set up with xcat2nim

```
# xcat2nim -f -t group -o AIXNodes
p630n05: NIM operations have completed successfully.

# lsnim -l AIXNodes
AIXNodes:
   class   = groups
   type    = mac_group
   member1 = virt-p5501_p4
```

c. Check the machine definition in NIM with **`lsnim`**, as shown in Example 4-23.

Example 4-23 lsnim output after xcat2cms command

```
# lsnim -l virt-p5501_p4
virt-p5501_p4:
   class          = machines
   type           = standalone
   connect        = shell
   platform       = chrp
   netboot_kernel = mp
   if1            = cluster_net virt-p5501_p4 7241E0005003 ent
   cable_type1    = N/A
   Cstate         = ready for a NIM operation
   prev_state     = ready for a NIM operation
   Mstate         = currently running
```

4.3.19 Removing nodes from the NIM configuration on CSM MS

This step is run on the CSM MS.

28. Since the xCAT 2 cluster has a new NIM master, we need to remove the node from the old NIM master.

    Note: This removes the nodes from the CSM NIM master ODM and the `/etc/niminfo` on the nodes. If, for whatever reason, the remote command from the CSM NIM master fails, the `/etc/niminfo` on the nodes will not be deleted. However, in our scenario we register the NIM clients to the xCAT NIM master from the nodes, which automatically adjusts the `/etc/niminfo` file on the nodes.

    If resources are allocated to the machine, it may be necessary to run the commands shown in Example 4-24.

    Example 4-24 Removal of node virt-p5501_p4 from the NIM master

```
# nim -o deallocate -a subclass=all virt-p5501_p4
# nim -o remove -F virt-p5501_p4
```

    Example 4-25 shows how to remove multiple nodes:

    Example 4-25 Removal of multiple nodes from then NIM master

```
# cat multinode_p5501|xargs -I {} nim deallocate -a subclass=all {}
# cat multinode_p5501|xargs -I {} nim -o remove -F {}
```

4.3.20 Register the nodes with the new xCAT NIM master

This step is run on the client nodes.

29. Register the nodes to the new NIM master:

    – Run **`niminit`** on one node to register it with the new NIM master, as shown in Example 4-26.

    Example 4-26 Registering a single node to a new NIM master

```
# nimit -a master=p630n05 -a name=virt-p5501_p4
```

    – Alternately, to register multiple nodes to a new NIM master, run the command shown in Example 4-27 on the xCAT 2 MN.

    Example 4-27 Registering multiple nodes to a new NIM master

```
cat multinode_p5501|xargs -I {} xdsh {} niminit -a master=p630n05
-a name={}
```

4.3.21 Install xCAT dependency packages on the client nodes

There are three NIM bundles defined for xCAT, which list the required RPM and bff filesets for different machine types, as shown in Example 4-28.

Example 4-28 Listing installp_bundle resources

```
[p630n05][/]> lsnim -t installp_bundle
xCATaixSSL     resources       installp_bundle
xCATaixSSH     resources       installp_bundle
xCATaixSN      resources       installp_bundle
[p630n05][/]> lsnim -a location  xCATaixSSL
xCATaixSSL:
   location = /install/nim/installp_bundle/xCATaixSSL.bnd
[p630n05][/]> lsnim -a location  xCATaixSSH
xCATaixSSH:
   location = /install/nim/installp_bundle/xCATaixSSH.bnd
[p630n05][/]> lsnim -a location  xCATaixSN
xCATaixSN:
   location = /install/nim/installp_bundle/xCATaixSN.bnd
```

The Perl OpenSSH and OpenSSL packages should be installed on the nodes. The next step describes the installation of these packages.

This step is run on the xCAT MN.

30. Install the required Perl from the bundle files with the **nimnodecust** command, as shown in Example 4-29.

Note: The **nimnodecust** command will fail unless you update the `lpp_source` file with the latest package, because **mknimimage** does not copy non-BOS filesets over to the nodes.

a. Run the **nimnodecust** command and check, as shown in Example 4-29.

Example 4-29 Customizing the migrated nodes

```
# nimnodecust -s 539lpp_res -b xCATaixSSL,xCATaixSSH AIXNodes
Customizing nodes.....
.........

# xdsh AIXNodes "lslpp -L|grep perl"|xdshbak -c
HOSTS
-------------------------------------------------------------------------
virt-p5501_p1, virt-p5501_p2, virt-p5501_p3, virt-p5501_p4,
virt-p5501_p5, virt-p5501_p6
-------------------------------------------------------------------------
  perl.libext              2.1.0.10    C     F    Perl Library
Extensions
```

```
  perl.rte                  5.8.2.90    C     F    Perl Version 5
Runtime
  perl-IO-Socket-SSL          1.06-1    C     R    IO-Socket-SSL -
Nearly
  perl-Net_SSLeay.pm          1.30-1    C     R    Net_SSLeay.pm - Perl
extension
```

Important: Even if the MN (management node) has already been used to install SSH/SSL on the nodes, `lpp_source` needs to have the packages.

Note1: The **`nimnodecust`** command will install the RPMs (if available) and will not log the install messages. However, if **`nimnodecust`** fails on an RPM, the command will not notify or log any message, so we recommend a manual check (as shown in the previous example).

Note2: You can monitor the progress of **`nimnodecust`** by running **`tail -f /var/log/messages`** on the xCAT MN.

```
.snippet.
May  7 16:13:13 p630n05 auth|security:info sshd[160212]: Accepted
password for root from 172.16.253.38 port 2410
May  7 16:13:13 p630n05 auth|security:info sshd[196840]: Attempt
to write login records by non-root user (aborting)
May  7 16:13:13 p630n05 local4:err|error xCAT: nim -o cust -a
lpp_source=539image_lpp_source -a installp_flags=agQXY  -a
installp_bundle=xCATaixSSL  -a installp_bundle=xCATaixSSH
virt-p5501_p6
May  7 16:13:15 p630n05 daemon:debug mountd[102450]: re-reading
the file.
May  7 16:13:40 p630n05 daemon:notice bootpd[168028]: received
short packet
..snippet..
```

4.3.22 Removing the nodes from CSM

The next step removes the node from the CSM cluster.

This step is run on the CSM MS.

31. On the CSM MS, run the **`rmnode`** command on a single node, as shown in Example 4-30. To remove multiple nodes, you can use the **`-N`** flag.

Example 4-30 Output from rmnode on CSM MS

```
# rmnode -u -n virt-p5501_p4
```

```
virt-p5501_p4: Uninstalling CSM ..
Did not uninstall the Open Source prerequisites.
The remote shell (SSH or RSH) has not been unconfigured on the Managed
Nodes. To ensure security, you should unconfigure the remote shell on
the nodes manually.
```

Note: IBM.Sensor resource manager is not changed on the node. For differences, see 3.1.10, "RMC monitoring" on page 45.

This step is run on the CSM MS.

32. Disable the SSH login possibility from the CSM MS to the node:

   a. Remove the node(s) SSH host key from `known_hosts` on the CSM MS. If the SSH client option StrictHostKeyChecking is set to `ask` or `yes`, then this will cause **ssh** to ask a question or fail. This may affect scripts, which can hang or fail in the CSM cluster for this node, so the best way is to set it to `yes`. To enable the strict checking change the main **ssh** client config file `/etc/ssh/ssh_config` or create a config file in the root users `.ssh` directory as shown in Example 4-31.

Example 4-31 Disabling SSH session for unknown hosts

```
[p630n05][/]> grep StrictHostKeyChecking /etc/ssh/ssh_config
#   StrictHostKeyChecking ask
[p630n05][/]> echo "StrictHostKeyChecking yes" > ~/.ssh/config
[p630n05][/]> grep virt-p5501_p1 ~/.ssh/known_hosts
[p630n05][/]> ssh virt-p5501_p1 date
No RSA host key is known for virt-p5501_p1 and you have requested
strict checking.
Host key verification failed.
```

   b. The other solution would be to specify the hosts, which are allowed to use a public key at SSH connection time. It is possible to prepare the `authorized_keys` file, which will be distributed from the xCAT MN with this parameter. This file by default is located in the `/install/postscripts/_ssh` directory. After the setting is made the file has to be distributed via running the `aixremoteshell` xCAT postscript. See Example 4-32 for the description of the necessary parameter.

Example 4-32 Disabling SSH connection via host specification in the authorized_keys file

```
from="pattern-list"
              Specifies that in addition to public key
              authentication, the canonical name of the remote host
              must be present in the comma-separated list of
              patterns.  The purpose of this option is to optionally
              increase security: public key authentication by itself
```

```
          does not trust the network or name servers or anything
          (but the key); however, if somebody somehow steals the
          key, the key permits an intruder to log in from
          anywhere in the world.  This additional option makes
          using a stolen key more difficult (name servers and/or
          routers would have to be compromised in addition to
          just the key).
```

At this point the node is removed from the CSM cluster, so the remote commands initiated via the **dsh** command will not work. However, the commands that started directly using **ssh** can still start remote operations on the node, because we use a single root private and public key pair in the entire transitioning environment. It depends on your security requirements whether this has to be avoided.

4.3.23 Setting up syslog

33. By default, syslog is enabled in the postscripts table to point to the new MN. You may also consider exploiting the advantages of the latest syslog-ng, which provides message filtering, database integration, graphical front-end, while maintaining backward compatibility with syslog. To download and install syslog-ng, check the following:

    http://www.perzl.org/aix/index.php?n=Main.Syslog-ng

4.3.24 Prepare SSH keys for distribution to the nodes

This step is run on the xCAT MN.

34. If you are using the same SSH keys in the xCAT cluster as the CSM cluster, copy the keys to the directory `/install/postscripts/_ssh`, on the MN, so **updatenode** can provide the same keys to new or reinstalled nodes in the future.

4.3.25 Run the xcataixscript utility on the nodes

The **xcataixscript** utility is located in the `/install/postscripts` directory on the xCAT NM. It is usually run on the nodes when they are installed to perform post installation tasks for xCAT. We need to run this manually if the nodes have not been installed by xCAT. In this case, do the following.

This step is run on the xCAT MN.

35. Copy the script (utility) to the nodes and run it as shown in Example 4-33.

Example 4-33 Running the xcataixscript (script) on xCAT nodes

```
# xdcp AIXNodes /install/postscripts/xcataixscript /tmp
# xdsh AIXNodes perl /tmp/xcataixscript
# xdsh AIXNodes rm /tmp/xcataixscript
# xdsh AIXNodes grep xcat /etc/inittab
virt-p5502-p2: xcat:2:wait:/xcatpost/xcataixpost > /dev/console 2>&1
virt-p5502-p3: xcat:2:wait:/xcatpost/xcataixpost > /dev/console 2>&1
virt-p5502-p5: xcat:2:wait:/xcatpost/xcataixpost > /dev/console 2>&1
virt-p5502-p1: xcat:2:wait:/xcatpost/xcataixpost > /dev/console 2>&1
virt-p5502-p4: xcat:2:wait:/xcatpost/xcataixpost > /dev/console 2>&1
virt-p5502-p6: xcat:2:wait:/xcatpost/xcataixpost > /dev/console 2>&1
```

4.3.26 Configure and run postscripts with updatenode

xCAT uses the postscripts table to categorize the scripts that should be run on each node in the cluster. The table expects the scripts that are added to the table to be located in the /install/postscripts directory on the MN.

These steps are run on the xCAT MN.

36. Copy the customized script to `/install/postscripts` on the xCAT MN For example, **`TEST_Setup_RMC._AllNodes`** was used in our transition. **`TEST_Setup_RMC._AllNodes`** is used to create a GPFS RMC sensor for monitoring GPFS status.

37. Set the postscripts attribute and check the postscripts table (Example 4-34).

    The postscripts attribute can be set for a node or node group.

    For a custom script to run, it needs to be:

    a. Copied to the `/install/postscripts` directory on the xCAT MN.

    b. Defined in the postscripts table for the group AIXNodes.

Example 4-34 Set the postscripts attribute and check the postscripts table

```
# chdef -t group -o AIXNodes
postscripts="setupntp,TEST_Setup_RMC._AllNodes

# tabdump postscripts
#node,postscripts,comments,disable
"xcatdefaults","syslog,aixremoteshell",,
"service","servicenode",,
"AIXNodes","setupntp,TEST_Setup_RMC._AllNodes",,
```

This step is run on the xCAT MN.

38. Run **`updatenode AIXNodes`** with the scripts `syslog` and `setupntp`, as shown in Example 4-35.

Example 4-35 updatenode run on a single node

```
# updatenode virt-p5501_p4 "syslog,setupntp"
```

```
virt-p5501_p6: returned
```

4.3.27 Clean up CSM NTP configuration

This step is run on the xCAT MN.

39. xCAT 2 can be used to provide the NTP server configuration for the cluster nodes, so we decided to use this functionality. Therefore, the CSM NTP configuration needs to be removed from the nodes. To do this, delete `/etc/rc.d/rc2.d/S20xntpd` and `/etc/rc.d/rc2.d/K20xntpd` from the transitioned nodes.

4.3.28 Configure RMC monitoring

Note: Configuring RMC is optional.

RMC monitoring makes use of the monitoring functionality of RSCT. This is described in detail in 3.1.10, “RMC monitoring” on page 45.

This step is run on the xCAT MN.

40. Verify that the required RSCT code is installed on the xCAT MN and the nodes.
    a. On the xCAT MN and the nodes, check for RSCT 2.4.10.0 (or higher):
    ```
    # lslpp -l |grep rsct
    ```
    b. On the xCAT MN, check whether the xCAT-rmc RPM is installed:
    ```
    # rpm -qa | grep xCAT-rmc
    ```
41. Check the xCAT table configuration:
    c. Verify that each node is in the *osi* group:
    ```
    # tabdump nodetype
    ```
    d. Ensure that the MAC address value is correct for each node:
    ```
    # tabdump mac
    ```
42. Configure and enable xCAT RMC monitoring:
    e. Add rmcmon in the monitoring table:
    ```
    # monadd rmcmon -a
    ```
    This will also add the configrmcnode postscript into the postscripts table.
    f. Add AIXNodes to rmc (-r is for nodes that are already AIX running):
    ```
    # moncfg rmcmon AIXNodes -r
    ```

The first time **moncfg** is run with **-r**, it will call **recfgctnid** or **recfgct** to reconfigure the RSCT subsystems on the computing nodes. It will generate a new ct_node_id, which will wipe out all non-default RSCT data.

These steps are run on the xCAT MN.

g. Start monitoring:

```
# monstart rmcmon
```

Note: Steps e and f are only required for the initial configuration of RMC monitoring. These are not required when adding additional nodes to be monitored.

h. Check the IBM.Host and IBM.MCP classes, as shown in Example 4-36.

Example 4-36 Listing commands for 2nd RMC implementation

```
# moncfg rmcmon virt-p5501_p4 -r
Configuring the following nodes. It may take a while.
virt-p5501_p4
virt-p5501_p4: returned

# ssh virt-p5501_p4 lsrsrc IBM.MCP
Resource Persistent Attributes for IBM.MCP
resource 1:
        MNName           = "192.168.100.75"
        NodeID           = 6063043458768437806
        KeyToken         = "9.12.4.186"
        IPAddresses      =
{"192.168.100.253","9.12.4.186","fe80::20d:60ff:fe22:3c7f"}
        ActivePeerDomain = ""
        NodeNameList     = {"virt-p5501_p4"}
resource 2:
        MNName           = "virt-p5501_p4"
        NodeID           = 591561834286225135
        KeyToken         = "192.168.100.35"
        IPAddresses      = {"192.168.100.35"}
        ActivePeerDomain = ""
        NodeNameList     = {"virt-p5501_p4"}

# lsrsrc -a IBM.Host Name
Resource Persistent Attributes for IBM.Host
resource 1:
        Name = "virt-p5501_p4"
resource 2:
        Name = "virt-p5501_p3"
```

This step is run on the xCAT MN.

43. Run **updatenode** to create the GPFS sensor (GPFSState), as shown in Example 4-37.

Example 4-37 Update node creating GPFSState sensor

```
# updatenode virt-p5501_p4 TEST_Setup_RMC._AllNodes
virt-p5501_p4: returned

# ssh virt-p5501_p4 lssensor
Displaying sensor information:
Name
GPFSState
```

4.3.29 Configure replacement for CFM in xCAT

Note: This step is optional.

This step is run on the xCAT MN.

44. Configuration File Manager (CFM) is a useful tool in CSM to maintain configuration files across the whole cluster. At the time we wrote this book, xCAT V2 did not provide a similar tool to replace CFM, so we developed a tool called **xcfmupdatenode**, which provides functions similar to **cfmupdatenode** in CSM as a replacement. **xcfmupdatenode** only provides basic functions of **cfmupdatenode**. Here is its feature list:

   – Supports the noderange parameter - you may distribute files to noderange instead of the whole cluster.

   – Supports ._hostname or ._nodegrp extensions, but it cannot handle complicated file names and multiple version files with overlapped node range extensions. Do not use '._' in your file name unless you use ._hostname or ._nodegrp extensions.

   – Supports sample configuration files with._EmptyGroup, that are distributed to any node.

   – Supports pre/post scripts.

   – Supports links as in CSM CFM.

   a. Set up the `/cfmroot` directory and put the configuration files, links, and scripts that you want to copy to the cluster in it.

   b. Run the **xcfmupdatenode** command to copy the files over to the nodes and execute pre/post scripts.

   ```
   # xcfmupdatenode AIXNodes
   ```

Note: **xcfmupdatenode** is not automatically called when running **updatenode** or rebooting the nodes as in CSM. You need to run it manually. If you want **xcfmupdatenode** called automatically, you need to add it to the command script file, system startup scripts, or **cron** jobs.

4.3.30 Restore customized RMC monitoring data in the new cluster

Note: This is also optional, if you decide to use RMC.

xCAT can provide RMC-based monitoring of the nodes, but it is possible to create application-specific sensors, conditions and responses also, which is independent of xCAT monitoring. See 6.2, “Installing monitoring software in xCAT” on page 258.

For the following steps we will use the RMC data from the old CSM Management Server, so first copy the data you have backed up in 4.2.6, “Save RMC monitoring data” on page 31 over to the xCAT Management Node into a subdirectory of your choice.

Sensor creation

There can be some situations when the sensors disappear from the nodes at transition time. This is caused by **/usr/sbin/rsct/install/bin/recfgct**. In this case continue with the next steps to restore the configurations of the sensors.

If local sensors are used on the nodes, ensure that the sensor scripts are available on the transitioned nodes, and place them in the used file collection for future installations.

Add the sensor creation script in the postscripts attribute for the nodes where they are required. The default postscripts directory is `/install/postscripts`.

Start the appropriate postscripts command to recreate the sensors.

Restore the condition definitions

We created conditions to check the GPFS status on the nodes in the CSM cluster. Now we used the backup of these definitions to restore them on the xCAT Management Node. The backup files can contain some attribute name and value pairs, depending on the command it was created with, which cannot be used in the restore, so delete the following attributes if they exist:

- ActivePeerDomain

- NodeNameList

The condition definitions are saved into the file `/xCat2/RMC/new_conditions`. To restore, run the **`mkrsrc`** command, as shown in Example 4-38.

Example 4-38 Restoring conditions

```
[p630n05][/]> mkrsrc -f /xCat2/RMC/new_conditions IBM.Condition
[p630n05][/]> lscondition | grep GPFS
"GPFS daemon state"                "p630n05" "Not monitored"
"GPFS State"                       "p630n05" "Not monitored"
```

Restart the customized monitors

The conditions have to be assigned to a response, and the monitoring has to be started. It is possible to do this in one step via the **`startcondresp`** command or it can be done with the **`mkcondresp`** and **`startcondresp`** commands.

You could use any of the predefined responses or create a new response to notify about the occurrence of an event. In our scenarios we used the “Informational notifications” response from the CSM backup as shown in Example 4-39, which is also available by default on the new xCAT Management Server. The backup we used for redefining the monitors was created by the **`csmbackup`** command and moved to the xCAT MN in the `/xCat2/RMC/csmdata` directory.

Example 4-39 Restoring responses from CSM backup

```
# cd /xCat2/RMC/csmdata
# cat Association.csmbak|grep Active|grep GPFS|awk -F\" '{print
"mkcondresp \\\""$2"\\\" \\\""$4"\\\""}'|xargs -I {} ksh {}
# cat Association.csmbak|grep Active|grep GPFS|awk -F\" '{print
"startcondresp \\\""$2"\\\" \\\""$4"\\\""}'|xargs -I {} ksh {}
# lscondresp | grep GPFS
Displaying condition with response information:
Condition            Response                        Node      State
"GPFS daemon state"  "Informational notifications" "p630n05" "Active"
"GPFS State"         "Informational notifications" "p630n05" "Active"
```

4.4 Reverting a transitioned node back into CSM

This section describes how to revert a node from xCAT back to CSM.

4.4.1 Remove node from xCAT RMC monitoring

This step is run on the xCAT MN.

1. If you enabled xCAT RMC monitoring on the node, run **mondecfg** to disable it, as shown in Example 4-40.

Example 4-40 mondecfg run on node and check

```
# mondecfg rmcmon virt-p5501_p6 -r
De-configuring the following nodes. It may take a while.
virt-p5501_p6
virt-p5501_p6: done

# xdsh virt-p5501_p6 lsrsrc IBM.MCP
virt-p5501_p6: Resource Persistent Attributes for IBM.MCP
virt-p5501_p6: resource 1:
virt-p5501_p6:  MNName           = "192.168.100.77"
virt-p5501_p6:  NodeID           = 6063043458768437806
virt-p5501_p6:  KeyToken         = "9.12.4.186"
virt-p5501_p6:  IPAddresses      =
{"192.168.100.253","9.12.4.186","fe80::20d:60ff:fe22:3c7f"}
virt-p5501_p6:  ActivePeerDomain = ""
virt-p5501_p6:  NodeNameList     = {"virt-p5501_p6"}
```

Note: mondecfg performs the following actions:

- Removes node from IBM.MngNode on MN.
- Removes node from IBM.MngNodenetIF on MN.
- Removes entries from IBM.MCP on the client nodes.

4.4.2 Remove machine definition from NIM on xCAT MN

This step is run on the xCAT MN.

2. Remove the standalone machine definition from NIM and check, as shown in Example 41.

Example 41 Removing node from NIM and check

```
# xcat2nim -t node -r virt-p5501-p6
Error:  Could not remove the NIM definition for 'virt-p5501-p6'.
```

```
Error:  One or more errors occured.

Error: Return=1.
# nim -o deallocate -a subclass=all virt-p5501-p6

# xcat2nim -t node -r virt-p5501_p6
p630n05: NIM operations have completed successfully.

# lsnim -t standalone
virt-p5501_p3     machines       standalone
virt-p5501_p4     machines       standalone
virt-p5501_p2     machines       standalone
virt-p5501_p1     machines       standalone
virt-p5501_p5     machines       standalone

# xdsh virt-p5501_p6 cat /etc/niminfo
Error:  virt-p5501_p6 remote Command return code = 2.
Error: Error from xdsh. Return Code = 1
virt-p5501_p6: cat: cannot open /etc/niminfo
```

4.4.3 Remove secondary adapters script for the node in NIM

This step is run on the xCAT MN.

3. To remove the secondary adapters script from NIM for then node:
   a. Identify the location of the adapter definitions in the NIM Adapter resource, as in Example 4-42.

Example 4-42 Identify the location of the NIM adapter definition for the node

```
# lsnim -l Adapters
Adapters:
   class       = resources
   type        = adapter_def
   Rstate      = ready for use
   prev_state  = unavailable for use
   location    = /nimrepo/adapters
   alloc_count = 0
   server      = master
```

   b. Remove the adapter definition file for the specific node, as shown in Example 4-43.

Example 4-43 Remove NIM adapter definition file for the node

```
# ls /nimrepo/adapters
```

```
virt-p5501_p1.adapters  virt-p5501_p5.adapters
virt-p5502-p3.adapters
virt-p5501_p2.adapters  virt-p5501_p6.adapters
virt-p5502-p4.adapters
virt-p5501_p3.adapters  virt-p5502-p1.adapters
virt-p5502-p5.adapters
virt-p5501_p4.adapters  virt-p5502-p2.adapters
virt-p5502-p6.adapters

#rm /nimrepo/adapters/virt-p5501_p6.adapters
```

4.4.4 Remove node definition in xCAT

This step is run on the xCAT MN.

4. To remove the node definition from the xCAT database use the **rmdef** command, as shown in Example 4-44.

```
rmdef -t node -o <nodename>
```

Example 4-44 rmdef of the node virt-p5501_p6 from the xCAT 2 database

```
# rmdef -t node -o virt-p5501_p6
Object definitions have been removed.

# tabdump nodelist
#node,groups,status,appstatus,primarysn,comments,disable
"vios-p5502","AllDevices","defined",,,,
"vios-p5501","AllDevices","defined",,,,
"hmc-v7","HMCDevices,AllDevices","defined",,,,
"p550_itso1","fsp,all",,,,,
"virt-p5501_p3","p5501,GPFSNodes,LLNodes,AIXNodes,HMCNodes,AllNodes,Man
agedNodes,NIMNodes,compute,all","alive",,,,
"virt-p5501_p4","p5501,GPFSNodes,LLNodes,AIXNodes,HMCNodes,AllNodes,Man
agedNodes,NIMNodes,compute,all","alive",,,,
"virt-p5501_p2","GPFSQuorumNodes,GPFSNodes,p5501,LLNodes,AIXNodes,HMCNo
des,AllNodes,ManagedNodes,NIMNodes,compute,all,lpar,all","alive",,,,
"virt-p5501_p1","p5501,GPFSQuorumNodes,GPFSNodes,LLCMNodes,AIXNodes,HMC
Nodes,AllNodes,LLNodes,ManagedNodes,NIMNodes,compute,all,lpar,all","ali
ve",,,,
"virt-p5501_p5","GPFSNodes,LLNodes,AIXNodes,p5501,HMCNodes,AllNodes,Man
agedNodes,NIMNodes,compute,all,lpar,all,p5501_p5_p6","alive",,,,
```

Remove the node from the NIM group on xCAT MN

5. Remove the node from the NIM group using the **xcat2nim** command, as shown in Example 4-45.

```
xcat2nim -u -t group -o <groupname>
```

Example 4-45 Removing the node from the xCAT group

```
# xcat2nim -u -t group -o AIXNodes
p630n05: NIM operations have completed successfully.

# lsnim -l AIXNodes
AIXNodes:
   class   = groups
   type    = mac_group
   member1 = virt-p5501_p3
   member2 = virt-p5501_p4
   member3 = virt-p5501_p2
   member4 = virt-p5501_p1
   member5 = virt-p5501_p5
```

4.4.5 Remove node entry from the conserver configuration on xCAT

This step is run on the xCAT MN.

6. Run **makeconservercf** to remove the node definition in the `/etc/conserver.cf` file.

```
stopsrc conserver
startsrc conserver
```

This will remove console access from the xCAT MN.

4.4.6 Remove the xCAT aixpostscript from /etc/inittab

This step is run on the xCAT node.

7. Delete the following entry from `/etc/inittab`, using:

```
rmitab "xcat"
xcat:2:wait:/xcatpost/xcataixpost > /dev/console 2>&1
```

4.4.7 Add the node to the CSM cluster

This step is run on the CSM MS.

8. Using the file `lsnode.csmbak` created by the **csmbackup** command, in Example 4.2.3, prepare a new stanza file for the node you are moving back to CSM. Using this stanza file, define the node into CSM cluster, as shown in Example 4-46.

Example 4-46 definenode -f <filename>

```
# definenode -f lsnode.csmbak.virt-p5501_p6
Defining CSM Nodes:
virt-p5501_p6: Changing Mode from: "Managed" to: "PreManaged".
1 nodes have been defined successfully.
# lsnode -l virt-p5501_p6
 Hostname = virt-p5501_p6
 AdapterStanzaFile = /CSM_to_xCAT/mystanzafile.sec
 AllowManageRequest = 0 (no)
 CSMVersion =
 ChangedAttributes = {}
 ConfigChanged = 0 (no)
 ConsoleMethod = hmc
 ConsolePortNum =
 ConsoleRedirectionAfterPOST = 0
 ConsoleSerialDevice = ttyS0
 ConsoleSerialSpeed = 9600
 ConsoleServerName = hmc-v7
 ConsoleServerNumber =
 FWSvcProc =
 FWSysBIOS =
 HWControlNodeId = p5_1_p6
 HWControlPoint = hmc-v7
 HWModel = 550
 HWSerialNum = 106628E
 HWType = 9113
 HostRAIDEnabled = 0
 InstallAdapterDuplex = auto
 InstallAdapterGateway =
 InstallAdapterHostname = virt-p5501_p6
 InstallAdapterMacaddr = 7241E0007002
 InstallAdapterName =
 InstallAdapterNetmask = 255.255.255.0
 InstallAdapterSpeed = auto
 InstallAdapterType = ent
 InstallCSMVersion =
 InstallDisk =
 InstallDiskType =
 InstallDistributionName =
 InstallDistributionVersion = 5.3.9
 InstallImage =
 InstallKernelVersion =
 InstallMethod = nim
 InstallOSName = AIX
```

```
InstallPkgArchitecture =
InstallServer =
InstallServerAKBNode =
InstallServiceLevel =
InstallStatus = PreManaged
InstallTemplate =
LICManagedSystemLevel =
LICPowerSubsystemLevel =
LParID = 7
LastCFMUpdateTime =
ManagementServer = 192.168.100.36
Mode = PreManaged
NFSServer =
Name = virt-p5501_p6
NodeNameList = {p630n06}
PhysicalLocation =
PowerMethod = hmc
PowerStatus = 1 (on)
Properties = LLType|:|Node|:|GPFSType|:|Node
Status = 127 (unknown)
UUID =
UpdatenodeFailed = 0 (false)
UserComment =
```

4.4.8 Performing CSM post-installation tasks on the node

This step is run on the CSM MS.

9. Run **updatenode** on the redefined node:

```
updatenode -kvn <nodename>
```

Note: You may be asked for the password because the node entry has been removed from `~/.ssh/known_hosts` on the CSM MS.

10. Check the status of the node in the CSM cluster with **csmstat**, as shown in Example 4-47.

Example 4-47 csmstat showing the node is managed again

```
# csmstat
---------------------------------------------------------------------------------
Hostname          HWControlPoint     Status    PowerStatus    Network-Interfaces
---------------------------------------------------------------------------------
virt-p5501_p6     hmc-v7            on        on             en0-Online  en1-Online
..snippet..
```

4.4.9 Verify additional services

This step is run on the CSM MS.

11. Run **chrconsolecfg** to redefine the console definition for **rconsole**.
12. Check if **rconsole** works on the redefined node with:

```
rconsole
```

13. Check if **rpower** works.

4.4.10 Restore the syslog configuration if needed

This step is run on the CSM MS and the node.

14. If you use syslog in your CSM cluster, you may need to restore the syslog configuration from your backup. Manual editing of the configuration files may be required. Refer to CSM and syslog documentation.

4.4.11 Define resources in NIM on CSM MS

This step is run on the CSM MS.

If you intend to further customize and/or re-install the node, you need to add the node back into the CSM NIM environment.

15. Run the **csm2nimnodes** command to bring the node back into the CSM NIM configuration, as in Example 4-48.

Example 4-48 csm2nimnodes of reverted node

```
# csm2nimnodes -n virt-p5501_p6
Creating or updating 1 NIM client machine definition(s).
Please wait....

Created or updated 1 NIM client machine definition(s).

# lsnim -l virt-p5501_p6
virt-p5501_p6:
   class          = machines
   type           = standalone
   connect        = shell
   platform       = chrp
   netboot_kernel = mp
   if1            = master_net virt-p5501_p6 7241E0007002 ent
   net_settings1  = auto auto
   cable_type1    = N/A
   Cstate         = ready for a NIM operation
   prev_state     = ready for a NIM operation
   Mstate         = currently running
```

16. Run the **`csmsetupnim`** command on the node, as in Example 4-49:

Example 4-49 csmsetupnim on reverted node

```
# csmsetupnim -n virt-p5501_p6

# lsnim -l virt-p5501_p6
virt-p5501_p6:
   class          = machines
   type           = standalone
   connect        = shell
   platform       = chrp
   netboot_kernel = mp
   if1            = master_net virt-p5501_p6 7241E0007002 ent
   net_settings1  = auto auto
   cable_type1    = N/A
   Cstate         = ready for a NIM operation
   prev_state     = ready for a NIM operation
   Mstate         = currently running
   script         = osprereboot
   control        = master
```

4.4.12 Register the node with the NIM master on CSM MS

This step is run on the CSM MS.

17. Run the **`niminit`** command on the CSM MS, as shown in Example 4-50.

Example 4-50 Re-initialize to NIM master (CSM MS)

```
# dsh -n virt-p5501_p6 niminit -a master=p630n06 -a name=virt-p5501_p6

# dsh -n virt-p5501_p6 cat /etc/niminfo
virt-p5501_p6: #------------------ Network Install Manager
---------------
virt-p5501_p6: # warning - this file contains NIM configuration
information
virt-p5501_p6: #        and should only be updated by NIM
virt-p5501_p6: export NIM_NAME=virt-p5501_p6
virt-p5501_p6: export NIM_HOSTNAME=virt-p5501_p6
virt-p5501_p6: export NIM_CONFIGURATION=standalone
virt-p5501_p6: export NIM_MASTER_HOSTNAME=p630n06
virt-p5501_p6: export NIM_MASTER_PORT=1058
virt-p5501_p6: export NIM_REGISTRATION_PORT=1059
virt-p5501_p6: export NIM_SHELL="shell"
```

```
virt-p5501_p6: export
NIM_BOS_IMAGE=/SPOT/usr/sys/inst.images/installp/ppc/bos
virt-p5501_p6: export NIM_BOS_FORMAT=rte
virt-p5501_p6: export NIM_HOSTS=" 192.168.100.77:virt-p5501_p6
192.168.100.36:p630n06 "
virt-p5501_p6: export NIM_MOUNTS=""
virt-p5501_p6: export ROUTES=" default:0:192.168.100.60
"
```

18.Check whether the monitoring was reestablished on the node.

4.5 Steps for a same MS/MN transition

In this scenario we use the hardware and OS image used as CSM management server to migrate to an xCAT management node. The scenario diagram is shown in Figure 4-3.

Note: Although we tried this scenario in our environment, we highly recommend that you use a separate server (hardware, OS) for the xCAT management node.

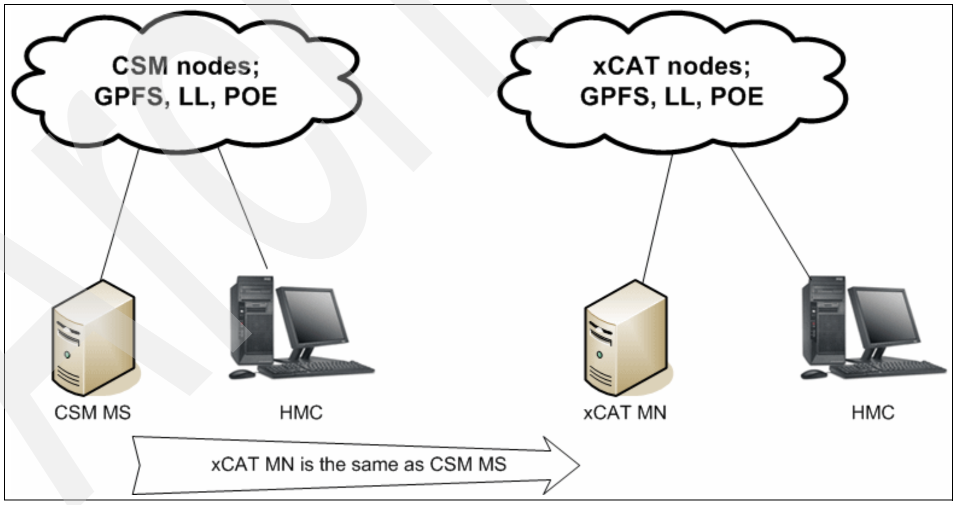

Figure 4-3 Scenario diagram

4.5.1 Installing xCAT

The xCAT software installation on the management node is done in two steps: Installing the dependency and installing the core filesets.

1. Install `dep-aix-2.2` and `core-aix-2.2`; see 4.3.1, “Preparing the xCAT 2 management node (MN) for transition” on page 84 for details.

4.5.2 Gathering CSM data using csm2xcat

Use the utility provided by xCAT to save site, device and node-related CSM data in stanza files, which xCAT can use later. For more details see 4.3.2, “Gather CSM data using the csm2xcat script on CSM MS” on page 89.

2. Run **`/opt/xcat/share/xcat/tools/csm2xcat`**. By default, data is stored in the `/tmp/csm2xcat` directory.

4.5.3 Building a nodelist file

It is useful to create a nodelist file containing the node names, which will be used by the utilities later, to speed up the transition.

3. Build the nodelist file using the following command:

   ```
   lsnode > /tmp/csm2xcat/nodelist_from_csm
   ```

4.5.4 Uninstalling CSM and cleaning up the nodes

The following command removes the CSM server-related filesets, and removes the CSM-related RMC classes and Resource Manager on the MS. If it is used with the parameter as shown in the example, then it also removes the CSM-related configuration files, log files, and RMC-related data from the node.

Note: Make sure that you have converted the secondary adapters from CSM into NIM before uninstalling CSM. This will be used in future steps.

4. Run the **`uninstallms -u`** command.

   This runs **`rmnode -u`** and then runs a removal on the CSM MS.

4.5.5 Remove CSM bin directory entry from the PATH environment

Some of the CSM customization still exists after the removal of CSM, so we have to change those. If this is to check the PATH and other variable settings, which was implemented in `/etc/environment`, `/etc/profile`, or in the profiles of individual AIX users:

5. Remove the entry `/opt/csm/bin` from PATH.

4.5.6 Setup remote shell in xCAT

We used SSH as remote command facility and set xCAT to perform automated SSH key distribution.

6. Update the site table to configure xCAT to use SSH and SCP:

```
chdef -t site useSSHonAIX=yes rsh=/usr/bin/ssh rcp=/usr/bin/scp
```

4.5.7 Set up NTP

xCAT can configure the NTP service for the nodes, but it does it in a different way than CSM did. In xCAT the NTP servers have to be listed in the site table, which will configure and start the NTP daemon on the nodes automatically, so we do not have to put the NTP daemon start/stop scripts into the `/etc/rc.d/rc2.d` directory. Because the scripts were part of the CSM file collection, we can remove them (or the link to them) from there as well.

7. Check if the NTP server is not the same as xCAT MN with:

   ```
   lsdef -t site -l
   ```

   If it needs to be changed, run:

   ```
   chdef -t site ntpservers=<NTP server IP>
   ```

8. Set timezone with:

   ```
   chdef -t site timezone=America/New_York
   ```

9. Remove CSM NTP configuration from `/cfmroot` with:

   ```
   rm /cfmroot/etc/rc.d/rc2.d/*ntp*
   ```

4.5.8 Define HMC and VIO servers in xCAT

It is possible to define the HMC and the VIO servers as devices in CSM. If they are defined, then the **csm2xcat** script creates the `device.stanza` file, which contains one entry for each. If they are not defined as devices, then we have to create a stanza file using **rscan**.

The next steps show how to define the HMC and VIO servers into xCAT.

10. Use the `device.stanza` file from **`csm2xcat`** with:

```
cat device.stanza | mkdef -z
```

11. Change the mgt attribute if not set in the `device.stanza` file with:

```
chdef -t node -o hmc-v7 mgt=hmc
```

12. Add username and password attributes to HMCs with:

```
chdef -t node -o hmc-v7 password=abc123 username=hscroot
```

    See 4.3.9, "Define HMC and VIO servers in xCAT" on page 93 for details.

4.5.9 Run rscan to gather xCAT data for node definition

The node definitions made combining the output of the **`csm2xcat`** utility and the file created by the **`rscan`** command. The **`rscan`** command connects to the HMC to get HW-related information.

13. Run **`rscan`** against each HMC to gather data:

```
rscan -z hmc-v7 > /tmp/csm2xcat/xcat_mystanzafile
```

    See 4.3.10, "Discovering HW in xCAT (rscan)" on page 94 for details.

4.5.10 Use the convert.sh tool to define nodes and CECs in xCAT

We created a utility to merge the stanza files from the **`csm2xcat`** utility and the output of the **`rscan`** tool. For details, see "Defining multiple nodes at once (scripting it)" on page 97.

14. Define the node using **`convert.sh`**:

```
# cat nodelist_from_csm|xargs -I {} ./convert.sh {} 192.168.100.36 \
> 192.168.100.36
```

15. Run **`lsdef -t node -l`** to check whether the definition is correct.

    See 4.3.11, "Defining the nodes (populating the tables)" on page 94 for details.

4.5.11 Setting up and testing the conserver

The remote console functionality is provided by the conserver daemon, which has to be configured using the following steps.

16. Run **`makeconservercf`** to generate a new conserver configuration file and restart the conserver daemon.

17. Test **rcons**:

```
# rcons <nodename>
```

See 4.3.12, “Configuring and testing conserver” on page 99 for details.

4.5.12 Testing rpower

The remote HW control functionality can be tested as shown in the following steps.

18. Test whether **rpower** works, as shown in Example 4-51.

Example 4-51 test rpower

```
# rpower AIXNodes state
virt-p5502-p6: Running
virt-p5502-p4: Running
virt-p5502-p2: Running
virt-p5502-p3: Running
virt-p5502-p5: Running
virt-p5502-p1: Running
```

4.5.13 Create operating system images

The next step configures the xCAT MN to use the AIX NIM functionality for operating system install, and software updates.

19. Since CSM already has NIM resources created, we decided to use the existing resources, just create the osimage definition in xCAT, and link to CSM NIM resources.
    a. check the resources created by CSM with the **lsnim** command, as shown in Example 4-52.

Example 4-52 Check resources created by CSM

```
# lsnim
master                   machines        master
boot                     resources       boot
nim_script               resources       nim_script
master_net               networks        ent
5300-04bid_ow            resources       bosinst_data
539lpp_res               resources       lpp_source
539spot_res              resources       spot
basic_res_grp            groups          res_group
virt-p5502-p5            machines        standalone
```

```
virt-p5502-p6           machines        standalone
virt-p5501_p3           machines        standalone
virt-p5501_p4           machines        standalone
virt-p5502-p1           machines        standalone
virt-p5502-p2           machines        standalone
virt-p5502-p3           machines        standalone
virt-p5502-p4           machines        standalone
openssl                 resources       installp_bundle
openssh                 resources       installp_bundle
osprereboot             resources       script
AIXNodes                groups          mac_group
gpfs32                  resources       installp_bundle
__smit_bundle_225748    resources       installp_bundle
LoadL                   resources       installp_bundle
poe                     resources       installp_bundle
Adapters                resources       adapter_def
AIX5391_mksysb          resources       mksysb
```

b. Decide which resource to use in xCAT; we used:

   `lpp_source: 539lpp_res`

   `spot: 539spot_res`

   `bosinst_data: 5300-04bid_ow`

   `installp_bundle: xCATaixSSL,xCATaixSSH`

Note: The resources listed here are the basic resources we need to install a computing node. You may also need other installp bundles such as GPFS and LoadLeveler if you want to install them via NIM.

c. Create xCAT **`installp`** bundles in NIM, as shown in Example 4-53.

Example 4-53 Creating NIM bundles

```
# mkdir -p /nimrepo/installp_bundle
# cp core-aix-2.2/*.bnd /nimrepo/installp_bundle/
# nim -o define -t installp_bundle -a server=master -a \
> location=/nimrepo/installp_bundle/xCATaixSN.bnd xCATaixSN
# nim -o define -t installp_bundle -a server=master -a \
> location=/nimrepo/installp_bundle/xCATaixSSL.bnd xCATaixSSL
# nim -o define -t installp_bundle -a server=master -a \
> location=/nimrepo/installp_bundle/xCATaixSSH.bnd xCATaixSSH
```

d. Copy xCAT filesets to `lpp_source`, as shown in Example 4-54.

Example 4-54 Update the lpp_source

```
# nim -o update -a packages=all -a source=/install/xCAT2/dep-aix-2.2 \
> 539lpp _res
# nim -o update -a packages=all -a source=/install/xCAT2/core-aix-2.2 \
> 539lpp _res
```

Note: If `lpp_source` is currently allocated for client use, you may need to deallocate it first.

e. Add an entry to the osimage table using the **`tabedit`** command:

```
# tabedit osimage
```

Append a new line to the file: "539image","NIM","AIX",,,,,
Save and quit.

f. Add an entry to the nimimage table using **`tabedit`**:

```
# tabedit nimimage
```

In the editor shell, append a new line to the file:
"539image","standalone","539lpp_res","539spot_res",,,,,,,,,"rte",,"5300-04bid_ow","xCATaixSSL,xCATaixSSH",,,,
Save and quit.

g. Check the operating system image definition, as shown in Example 4-55.

Example 4-55 Checking OS definition

```
# lsdef -t osimage -l

Object name: 539image
    bosinst_data=5300-04bid_ow
    imagetype=NIM
    installp_bundle=xCATaixSSL,xCATaixSSH
    lpp_source=539lpp_res
    nimmethod=rte
    nimtype=standalone
    osname=AIX
    spot=539spot_res
```

4.6 Define xCAT networks

In our scenario we have two networks: `cluser_net` for administration and external login, and `gpfs_net` for GPFS private I/O.

20. To define xCAT networks, run:

```
# mkdef -t network -o cluster_net net=192.168.100.0 \
> mask=255.255.255.0 gateway=192.168.100.60
# mkdef -t network -o gpfs_net net=192.168.200.0 mask=255.255.255.0
```

See Figure 4-1 on page 73 for the cluster diagram.

4.6.1 Creating NIM clients and group definitions

The NIM definitions are necessary for node installations and updates in the future.

21. Since we did not remove NIM client definitions created by CSM, we need not run **xcat2nim**. But if NIM machines have been removed, use **xcat2nim** to create NIM client definitions:

```
# xcat2nim -t node AIXNodes
```

22. Create or update the NIM group:

```
# xcat2nim -f -t group -o AIXNodes
```

    See 4.3.18, “Creating NIM client and group definitions” on page 103 for details.

4.6.2 Install xCAT dependency packages on computing nodes

Install any updates or prerequisite packages necessary for xCAT operation onto the nodes. We defined two NIM bundles which contain the basic xCAT prerequisites, and the next step shows how to install them onto the nodes.

23. Use the **nimnodecust** utility to install xCAT dependency packages via NIM installp bundles:

```
# nimnodecust -s 539lpp _res -b xCATaixSSL,xCATaixSSH AIXNodes
```

    See 4.3.21, “Install xCAT dependency packages on the client nodes” on page 106 for details.

4.6.3 Perform xCAT post-installation tasks on computing nodes

The xCAT post-installation customization is done by scripts, which are started by a master script at node boot time. This is enabled by an `/etc/inittab` entry, which is added by the following step.

24. Run **`xcataixscript`** on computing nodes.

    See Example 4-33 on page 109 for details.

4.6.4 Set up customization scripts

Node customization scripts are assigned top nodes in an xCAT table and placed into the `/install/postscripts` directory. The customization step itself can be initiated as shown in the next step.

25. Run the **`updatenode`** command for node customization.

    For details, see 4.3.26, “Configure and run postscripts with updatenode” on page 110.

4.6.5 Remove the CSM NTP configuration

If the CSM configuration contained the NTP setup, then we have to remove it here.

26. See 4.3.27, “Clean up CSM NTP configuration” on page 111 for details.

4.6.6 Set up xCAT RMC monitoring

RMC monitoring can be used to bring nodes up/down and to monitor/control applications as well.

27. See 4.3.28, “Configure RMC monitoring” on page 111 for details.

4.6.7 Configure replacement for CFM

We created a replacement for CSM file collection, because there was no solution provided in xCAT at the time of this writing.

28. See 4.3.29, “Configure replacement for CFM in xCAT” on page 113 for details.

4.7 Post transition checks

This section presents some post-transition checks you can use to verify that your cluster has been configured properly.

4.7.1 Checking administration tasks

- Check xCAT database content:
  - List node names as shown in Example 4-56.

Example 4-56 List node names

```
# nodels
vios-p5502
hmc-v7
p550_itso2
virt-p5502-p1
virt-p5502-p2
virt-p5502-p3
virt-p5502-p4
virt-p5502-p5
virt-p5502-p6
```

  - List one node definition as in Example 4-57.

Example 4-57 List node definition

```
# lsdef -t node -l virt-p5502-p1

Object name: virt-p5502-p1
    arch=ppc64
    cons=hmc

groups=p5502,GPFSQuorumNodes,LLNodes,AIXNodes,GPFSNodes,HMCNodes,All
Nodes,ManagedNodes,NIMNodes,compute,all,lpar,all
    hcp=hmc-v7
    id=2
    mac=46DA90002002
    mgt=hmc
    nodetype=lpar,osi
    os=AIX
    parent=p550_itso2
    postscripts=setupntp,TEST_Setup_RMC._AllNodes
    power=hmc
    pprofile=p1_profile
    profile=compute
    serial=106627E
    serialflow=hard
    serialport=ttyS0
    serialspeed=9600
    status=unreachable
    termserver=hmc-v7
    xcatmaster=192.168.100.36
```

– List node table content as in Example 4-58.

Example 4-58 List nodelist table

```
# tabdump nodelist
#node,groups,status,appstatus,primarysn,comments,disable
"vios-p5502","AllDevices","defined",,,,
"hmc-v7","HMCDevices,AllDevices","defined",,,,
"p550_itso2","fsp,all",,,,,
"virt-p5502-p1","p5502,GPFSQuorumNodes,LLNodes,AIXNodes,GPFSNodes,HMCNo
des,AllNodes,ManagedNodes,NIMNodes,compute,all,lpar,all","unreachable",
,,,
"virt-p5502-p2","p5502,GPFSQuorumNodes,GPFSNodes,LLNodes,AIXNodes,HMCNo
des,AllNodes,ManagedNodes,NIMNodes,compute,all,lpar,all","unreachable",
,,,
"virt-p5502-p3","p5502,GPFSNodes,LLNodes,AIXNodes,HMCNodes,AllNodes,Man
agedNodes,NIMNodes,compute,all,lpar,all","unreachable",,,,
"virt-p5502-p4","p5502,GPFSNodes,LLNodes,AIXNodes,AllNodes,ManagedNodes
,NIMNodes,HMCNodes,compute,all,lpar,all","booting",,,,
"virt-p5502-p5","p5502,GPFSNodes,LLNodes,AIXNodes,HMCNodes,AllNodes,Man
agedNodes,NIMNodes,compute,all,lpar,all","unreachable",,,,
"virt-p5502-p6","p5502,GPFSNodes,LLNodes,AIXNodes,HMCNodes,AllNodes,Man
agedNodes,NIMNodes,compute,all,lpar,all","booting",,,,
```

– List node status if monitoring is configured and started as shown in Example 4-59.

Example 4-59 List monitored node status

```
[p630n05][/]> lsdef -t node -i name,status AIXNodes

Object name: virt-p5501_p4
    status=aja

Object name: virt-p5501_p2
    status=alive
```

```
Object name: virt-p5501_p1
    status=unreachable

Object name: virt-p5501_p8
    status=alive

Object name: virt-p5501_p6
    status=unreachable

Object name: virt-p5501_p5
    status=alive

Object name: virt-p5501_p3
    status=alive
```

– List HW information as in Example 4-60.

Example 4-60 List HW information

```
# tabdump vpd
#node,serial,mtm,asset,comments,disable
"vios-p5502","106627E","550-9113",,,
"p550_itso2","106627E","9113-550",,,
"virt-p5502-p1","106627E",,,,
"virt-p5502-p2","106627E",,,,
"virt-p5502-p3","106627E",,,,
"virt-p5502-p4","106627E",,,,
"virt-p5502-p5","106627E",,,,
"virt-p5502-p6","106627E",,,,
# tabdump nodehm
#node,power,mgt,cons,termserver,termport,conserver,serialport,serialspe
ed,serialflow,getmac,comments,disable
"hmc-v7",,"hmc",,,,,,,,,,
"p550_itso2",,"hmc",,,,,,,,,,
"virt-p5502-p1","hmc","hmc","hmc","hmc-v7",,,"ttyS0","9600","hard",,,
"virt-p5502-p2","hmc","hmc","hmc","hmc-v7",,,"ttyS0","9600","hard",,,
"virt-p5502-p3","hmc","hmc","hmc","hmc-v7",,,"ttyS0","9600","hard",,,
"virt-p5502-p4","hmc","hmc","hmc","hmc-v7",,,"ttyS0","9600","hard",,,
"virt-p5502-p5","hmc","hmc","hmc","hmc-v7",,,"ttyS0","9600","hard",,,
"virt-p5502-p6","hmc","hmc","hmc","hmc-v7",,,"ttyS0","9600","hard",,,
# tabdump ppc
#node,hcp,id,pprofile,parent,supernode,comments,disable
"p550_itso2","hmc-v7",,,,,,
"virt-p5502-p1","hmc-v7","2","p1_profile","p550_itso2",,,
"virt-p5502-p2","hmc-v7","3","p2-profile","p550_itso2",,,
"virt-p5502-p3","hmc-v7","4","p3-profile","p550_itso2",,,
"virt-p5502-p4","hmc-v7","5","p4-profile","p550_itso2",,,
"virt-p5502-p5","hmc-v7","6","p5-profile","p550_itso2",,,
"virt-p5502-p6","hmc-v7","7","p6-profile","p550_itso2",,,
# tabdump ppchcp
#hcp,username,password,comments,disable
"hmc-v7","hscroot","itsoadmin",,
```

- Check HW control.
  - Example 4-61 shows how to check power status.

Example 4-61 Power status

```
# rpower all state
virt-p5502-p6: Running
p550_itso2: Operating
virt-p5502-p4: Running
virt-p5502-p2: Running
virt-p5502-p3: Running
virt-p5502-p5: Running
virt-p5502-p1: Running
```

  - Example 4-62 shows the data collected by the **rscan** command.

Example 4-62 Collecting HW information

```
# rscan hmc-v7
type    name                      id      type-model  serial-number  address
hmc     hmc-v7                            7310-C03    KCWC22A        hmc-v7
fsp     550Q-AIX5.4WPAR Project           9133-55A    06F234G        10.0.0.250
lpar    rhel01                    5       9133-55A    06F234G
lpar    aix03                     4       9133-55A    06F234G
lpar    aix02                     3       9133-55A    06F234G
lpar    aix01                     2       9133-55A    06F234G
lpar    vios1                     1       9133-55A    06F234G
fsp     p550_itso1                        9113-550    106628E        10.0.0.253
lpar    virt-p5501_p8             9       9113-550    106628E
lpar    VIOS_xCAT                 8       9113-550    106628E
lpar    p5_1_p6                   7       9113-550    106628E
lpar    p5_1_p5                   6       9113-550    106628E
lpar    p5_1_p4                   5       9113-550    106628E
lpar    p5_1_p3                   4       9113-550    106628E
lpar    p5_1_p2                   3       9113-550    106628E
lpar    p5_1_p1                   2       9113-550    106628E
lpar    VIOS_p5_1                 1       9113-550    106628E
```

```
fsp     10.0.0.249                      0-0         10.0.0.249     10.0.0.249
fsp     p550_itso2                      9113-550    106627E        10.0.0.252
lpar    SAP_LYDIA               8       9113-550    106627E
lpar    p5_2_p6                 7       9113-550    106627E
lpar    p5_2_p5                 6       9113-550    106627E
lpar    p5_2_p4                 5       9113-550    106627E
lpar    p5_2_p3                 4       9113-550    106627E
lpar    p5_2_p2                 3       9113-550    106627E
lpar    p5_2_p1                 2       9113-550    106627E
lpar    VIOS_p5_2               1       9113-550    106627E
```

- The following examples show how to collect HW vital data.
  - Example 4-63 shows the data retrieved for a System p machine.

Example 4-63 Using the rvitals command against a System p machine

```
# rvitals p550_itso2 all
p550_itso2: System Temperature: Not available (No BPA)
p550_itso2: Frame Voltages:  Only available for BPA
p550_itso2: System State: Operating
p550_itso2: Current Power Status: on
p550_itso2: Current LCD1: refcode_num=0,refcode=
p550_itso2: Current LCD2: HSCL3397 The secondary service processor is
not available for the managed system.
```

  - Example 4-64 shows the data retrieved for a VIO server LPAR.

Example 4-64 Using rvitals against VIOS LPAR

```
# rvitals vios-p5502 all
vios-p5502: System Temperature: Not available (No BPA)
vios-p5502: Frame Voltages:  Only available for BPA
vios-p5502: System State: Running
vios-p5502: Current Power Status: on
vios-p5502: Current LCD1:
lpar_name=VIOS_p5_2,lpar_id=1,time_stamp=04/22/2009
19:30:02,refcode=,word2=03D00000,fru_call_out_loc_codes=
```

  - Example 4-65 shows data retrieved for a normal AIX LPAR.

Example 4-65 Using rvitals against AIX LPAR

```
# rvitals virt-p5502-p1 all
virt-p5502-p1: System Temperature: Not available (No BPA)
virt-p5502-p1: Frame Voltages:  Only available for BPA
virt-p5502-p1: System State: Running
virt-p5502-p1: Current Power Status: on
```

```
virt-p5502-p1: Current LCD1:
lpar_name=p5_2_p1,lpar_id=2,time_stamp=05/15/2009
19:23:38,refcode=,word2=03D00000,fru_call_out_loc_codes=
```

- Check remote and parallel command functionality.
  - Run **xdsh** to execute commands remotely on the nodes. Example 4-66 shows an error, as the `/etc/ssh/ssh_config` file has strict host key checking and the SSH `known_host` file for the root user does not have the host key for one of the nodes.

Example 4-66 Remote command execution

```
# xdsh virt-p5502-p1,virt-p5502-p6 date
virt-p5502-p1: Mon May 18 18:41:06  2009
virt-p5502-p6: Mon May 18 18:40:49  2009
virt-p5502-p6:
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

virt-p5502-p6: @    WARNING: REMOTE HOST IDENTIFICATION HAS CHANGED!
@

virt-p5502-p6:
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

virt-p5502-p6: IT IS POSSIBLE THAT SOMEONE IS DOING SOMETHING NASTY!

virt-p5502-p6: Someone could be eavesdropping on you right now
(man-in-the-middle attack)!

virt-p5502-p6: It is also possible that the RSA host key has just been
changed.

virt-p5502-p6: The fingerprint for the RSA key sent by the remote host
is
virt-p5502-p6: b6:d1:b1:ab:23:2f:67:20:73:bf:c4:e2:af:a1:b7:78.

virt-p5502-p6: Please contact your system administrator.

virt-p5502-p6: Add correct host key in /.ssh/known_hosts to get rid of
this message.

virt-p5502-p6: Offending key in /.ssh/known_hosts:4

virt-p5502-p6: Password authentication is disabled to avoid
man-in-the-middle attacks.
```

```
virt-p5502-p6: Keyboard-interactive authentication is disabled to avoid
man-in-the-middle attacks.

# grep Strict /etc/ssh/ssh_config
#   StrictHostKeyChecking ask
```

– There is an xCAT version of the **dshbak** command with the name of **xdshbak**. This is useful to present command output separated by nodes as is shown in Example 4-67. However, **dshbak** is still available; it is in the `csm.dsh` fileset which is installed to AIX nodes by default.

Example 4-67 Using xdshbak

```
# xdsh AIXNodes lslpp -l openssh.base.server|xdshbak -c
HOSTS:-------------------------------------------------------------------------
virt-p5502-p1, virt-p5502-p2, virt-p5502-p3, virt-p5502-p4,
virt-p5502-p5, virt-p5502-p6
-------------------------------------------------------------------------------
  Fileset                      Level  State      Description


-------------------------------------------------------------------------------
Path: /usr/lib/objrepos
  openssh.base.server     4.5.0.5301  COMMITTED  Open Secure Shell
Server

Path: /etc/objrepos
  openssh.base.server     4.5.0.5301  COMMITTED  Open Secure Shell
Server
```

- Check remote console functionality, as shown in Example 4-68.

  Example 4-68 Testing rcons

  ```
  # rcons virt-p5502-p1
  [Enter `^Ec?' for help]


  AIX Version 5
  Copyright IBM Corporation, 1982, 2008.
  Console login: [disconnect]
  ```

- Example 4-69 shows how to upgrade the firmware. The **rpower** command is used to check the power status, the **rinv** command is for HW inventory collection, and the **rflash** command upgrades the firmware on the machine.

The firmware package is copied to directory /tmp/csm2xcat/firmware before the upgrade process.

Example 4-69 Upgrading system firmware

```
# ls /tmp/csm2xcat/firmware
01SF240_358_201.rpm  01SF240_358_201.xml
#
# rflash p550_itso2 -p /tmp/csm2xcat/firmware  --activate disruptive
hmc-v7: copy files to hmc-v7 complete
hmc-v7: 9113-550*106627E: HSCF0178W Operation completed successfully
for p550_itso2 (9113-550*106627E).  Deferred Fixes are present in the
fixpack. :
hmc-v7: 9113-550*106627E: The following deferred fixes are present in
the fix pack.  Deferred fixes will be activated after the next IPL of
the system. :
hmc-v7: :
hmc-v7: 9113-550*106627E: An immediate IPL is not required, unless you
want to activate one of the fixes below now. :
hmc-v7: :
hmc-v7: 9113-550*106627E: :
hmc-v7: :
hmc-v7: 9113-550*106627E: A change was made to improve the reliability
of system memory.  This change reduces the likelihood of SRC B123E500
occurring, and also reduces the likelihood of a system crash with SRC
B1xxF667. (570250)<br><br>A problem was fixed that, under certain
rarely occurring circumstances, an application could cause a processor
to go into an error state, and the system to crash.
(665332/FW202372)<br><br> :
hmc-v7: :
hmc-v7: 9113-550*106627E:  :
hmc-v7: :
hmc-v7: 9113-550*106627E: :
hmc-v7: :
hmc-v7: 9113-550*106627E: LIC_RC = 0:
hmc-v7: Remote_command_rc = 0:
hmc-v7: Upgrade 9113-550*106627E from release level:01SF240 activated
level:261 to 01SF240_358_201.rpm successfully

#rpower AIXNodes state
virt-p5502-p6: Running
virt-p5502-p4: Running
virt-p5502-p2: Running
virt-p5502-p3: Running
virt-p5502-p5: Running
```

```
virt-p5502-p1: Running

#rinv p550 _itso2 firm
p550_itso2: Release Level  : 01SF240
p550_itso2: Active Level   : 358
p550_itso2: Installed Level: 358
p550_itso2: Accepted Level : 261
p550_itso2: Release Level Primary: 01SF240
p550_itso2: Level Primary  : 358

# rflash p550 _itso2 --commit
hmc-v7: copy files to hmc-v7 complete
hmc-v7: 9113-550*106627E: LIC_RC = 0:
hmc-v7: Remote_command_rc = 0:
hmc-v7: 9113-550*106627E:commit successfully!

#rinv p550 _itso2 firm
p550_itso2: Release Level  : 01SF240
p550_itso2: Active Level   : 358
p550_itso2: Installed Level: 358
p550_itso2: Accepted Level : 358
p550_itso2: Release Level Primary: 01SF240
p550_itso2: Level Primary  : 358

# rpower AIXNodes state
virt-p5502-p6: Running
virt-p5502-p4: Running
virt-p5502-p2: Running
virt-p5502-p3: Running
virt-p5502-p5: Running
virt-p5502-p1: Running
```

- Support for System p virtualization features is also integrated into xCAT. LPAR configuration and profile settings can be checked and changed via xCAT commands. The xCAT command **lsvm**, which is used in the example, has similar output as the **lssyscfg -prof -m <managed system>** command, which is available on the HMC.
  - Example 4-70 shows the LPAR configuration for a node.

Example 4-70 Query LPAR configuration

```
# lsvm virt-p5502-p1
virt-p5502-p1:
name=p1_profile,lpar_name=p5_2_p1,lpar_id=2,lpar_env=aixlinux,all_resou
rces=0,min_mem=1024,desired_mem=2048,max_mem=2048,proc_mode=shared,min_
```

```
proc_units=0.2,desired_proc_units=0.4,max_proc_units=0.4,min_procs=2,de
sired_procs=4,max_procs=4,sharing_mode=uncap,uncap_weight=128,"io_slots
=21020002/none/0,21040003/none/1",lpar_io_pool_ids=none,max_virtual_slo
ts=10,"virtual_serial_adapters=0/server/1/any//any/1,1/server/1/any//an
y/1",virtual_scsi_adapters=4/client/1/VIOS_p5_2/5/1,"virtual_eth_adapte
rs=2/0/1//0/1,3/0/2//0/1",hca_adapters=none,boot_mode=norm,conn_monitor
ing=0,auto_start=0,power_ctrl_lpar_ids=none,work_group_id=none,redundan
t_err_path_reporting=0
```

– Example 4-71 shows the configuration of a VIO server.

Example 4-71 Query VIO Server configuration

```
# lsvm vios-p5502
vios-p5502:
name=VIOS,lpar_name=VIOS_p5_2,lpar_id=1,lpar_env=vioserver,all_resource
s=0,min_mem=1152,desired_mem=2176,max_mem=3200,proc_mode=shared,min_pro
c_units=0.4,desired_proc_units=1.0,max_proc_units=1.0,min_procs=2,desir
ed_procs=4,max_procs=4,sharing_mode=uncap,uncap_weight=128,"io_slots=21
010002/none/1,21050002/none/1,21040002/none/1,21020002/none/0,21020003/
none/1,21030003/none/1,21010003/none/1",lpar_io_pool_ids=none,max_virtu
al_slots=40,"virtual_serial_adapters=0/server/1/any//any/1,1/server/1/a
ny//any/1","virtual_scsi_adapters=35/server/any//any/1,5/server/2/p5_2_
p1/4/0,6/server/3/p5_2_p2/4/0,8/server/4/p5_2_p3/4/0,9/server/5/p5_2_p4
/4/0,10/server/6/p5_2_p5/4/1,11/server/7/p5_2_p6/4/1,21/server/any//any
/0,22/server/any//any/0,23/server/any//any/0,24/server/any//any/0,25/se
rver/any//any/0,26/server/any//any/0","virtual_eth_adapters=32/1/2//1/0
,33/0/3//1/1,31/1/1//1/0",hca_adapters=none,boot_mode=norm,conn_monitor
ing=0,auto_start=0,power_ctrl_lpar_ids=none,work_group_id=none,redundan
t_err_path_reporting=0
```

– Check the scripts / LPCommand (customize with equivalent xCAT commands to replace the CSM ones), as shown in Example 4-72.

Example 4-72 Updating the CommandPath with xCAT command in LPCommands

```
# /usr/bin/lslpcmd
dsh
LPtest
csmstat
rpower

# /usr/bin/lslpcmd rpower
 Name = rpower
 ActivePeerDomain =
 CheckSum = 3193715954
 CommandPath = /opt/csm/bin/rpower
 ControlFlags = 1
 Description =
 FilterArg =
 FilterScript =
 Lock = 0
 NodeNameList = {p630n06}
 RunCmdName = rpower

# /usr/bin/chlpcmd rpower CommandPath=/opt/xcat/bin/rpower

# su - guest

$ runlpcmd rpower all state
virt-p5502-p6: Running
p550_itso2: Operating
virt-p5502-p4: Running
virt-p5502-p2: Running
virt-p5502-p3: Running
virt-p5502-p5: Running
virt-p5502-p1: Running
RC = 0
```

- Check node and domain status in case RMC monitoring is configured.
  - Example 4-73 shows that two nodes are not set up correctly, and shows the main reason of the problem as well. The IBM.MCP table does not have the entry for the xCAT MN.

Example 4-73 Check RMC monitoring

```
[p630n05][/]> lsrsrc -a IBM.Host Name
2610-431 Cannot enumerate resources for this command on node
virt-p5501_p1. The node is not currently in the cluster.
2610-431 Cannot enumerate resources for this command on node
virt-p5501_p6. The node is not currently in the cluster.
Resource Persistent Attributes for IBM.Host
resource 1:
        Name = "virt-p5501_p2"
resource 2:
        Name = "virt-p5501_p3"
resource 3:
        Name = "virt-p5501_p4"
resource 4:
        Name = "virt-p5501_p5"
[p630n05][/]> xdsh virt-p5501_p1 lsrsrc IBM.MCP
virt-p5501_p1: Resource Persistent Attributes for IBM.MCP
```

```
virt-p5501_p1: resource 1:
virt-p5501_p1:  MNName           = "192.168.100.72"
virt-p5501_p1:  NodeID           = 6063043458768437806
virt-p5501_p1:  KeyToken         = "192.168.100.253"
virt-p5501_p1:  IPAddresses      =
{"192.168.100.253","9.12.4.186","fe80::202:55ff:fe6a:4efc","fe80::20d:6
0ff:fe22:3c7f"}
virt-p5501_p1:  ActivePeerDomain = ""
virt-p5501_p1:  NodeNameList     = {"virt-p5501_p1"}
[p630n05][/]> xdsh virt-p5501_p2 lsrsrc IBM.MCP
virt-p5501_p2: Resource Persistent Attributes for IBM.MCP
virt-p5501_p2: resource 1:
virt-p5501_p2:  MNName           = "192.168.100.73"
virt-p5501_p2:  NodeID           = 6063043458768437806
virt-p5501_p2:  KeyToken         = "192.168.100.253"
virt-p5501_p2:  IPAddresses      =
{"192.168.100.253","9.12.4.186","fe80::202:55ff:fe6a:4efc","fe80::20d:6
0ff:fe22:3c7f"}
virt-p5501_p2:  ActivePeerDomain = ""
virt-p5501_p2:  NodeNameList     = {"virt-p5501_p2"}
virt-p5501_p2: resource 2:
virt-p5501_p2:  MNName           = "virt-p5501_p2"
virt-p5501_p2:  NodeID           = 591561834286225135
virt-p5501_p2:  KeyToken         = "192.168.100.35"
virt-p5501_p2:  IPAddresses      = {"192.168.100.35"}
virt-p5501_p2:  ActivePeerDomain = ""
virt-p5501_p2:  NodeNameList     = {"virt-p5501_p2"}
```

– Example 4-74 shows how to check the RMC domain status an all nodes in the cluster.

Example 4-74 Check RMC domain status

```
[p630n05][/]> /usr/sbin/rsct/bin/rmcdomainstatus -s ctrmc

Management Domain Status: Managed Nodes
  O A  0xea7241e0007002ea  0006  virt-p5501_p6
  I A  0xea7241e0006002ea  0005  virt-p5501_p5
  I A  0xea7241e0003002ea  0004  virt-p5501_p2
  O A  0xea7241e0002002ea  0003  virt-p5501_p1
  I A  0xea7241e0005003ea  0002  virt-p5501_p4
  I A  0xea7241e0004002ea  0001  virt-p5501_p3
```

- Check node installation via RTE/mksysb install (as verified in the CSM cluster before trans).
  - Additional steps:
    - GPFS commands
    - LL commands
    - RMC/RSCT customization
    - CSM pre/post/update scrips
- To collect the software inventory from a node and compare it with other nodes, use the **sinv** xCAT command, shown in Example 4-75.

Example 4-75 Perform software inventory comparison

```
# sinv -c "xdsh virt-p5502-p2 rpm -qa | grep perl | xcoll" -s
virt-p5502-p1 -p /tmp/sinv.template -o /tmp/s>
Error: DSH_TO_USERID not setup./n

Error: DSH_TO_USERID not setup./n

Building Report.

Command Complete.
Check report in /tmp/sinv.output.


# cat /tmp/sinv.template
```

Check the following services

- The syslog configuration is set via xCAT postscripts as shown in Example 4-76, where 192.168.100.36 is the IP address of the xCAT MN. The example also shows the `syslog daemon` configuration and status on the xCAT MN.

Example 4-76 Check syslog configuration

```
# tabdump postscripts
#node,postscripts,comments,disable
"xcatdefaults","syslog,aixremoteshell,configrmcnode",,
"service","servicenode",,
"AIXNodes","setupntp,TEST_Setup_RMC._AllNodes",,
# xdsh AIXNodes tail -1 /etc/syslog.conf
virt-p5502-p4: *.debug @192.168.100.36
virt-p5502-p3: *.debug @192.168.100.36
virt-p5502-p6: *.debug @192.168.100.36
```

```
virt-p5502-p1: *.debug @192.168.100.36
virt-p5502-p2: *.debug @192.168.100.36
virt-p5502-p5: *.debug @192.168.100.36
# lssrc -ls syslogd
Subsystem        Group            PID          Status
 syslogd         ras              123256       active
Syslogd Config   *.debug               /tmp/syslog.out         rotate
size 100k files 10
Syslogd Config   *.debug   /var/log/messages  rotate 1024K files 5
```

- NTP is configured via the xCAT site table and postscripts as shown in Example 4-77. We also see how to check the status of the NTP daemon.

Example 4-77 Check NTP configuration

```
# lsdef -t site -l -i ntpservers
Setting the name of the site definition to 'clustersite'.

Object name: clustersite
    ntpservers=192.168.100.36
# tabdump postscripts
#node,postscripts,comments,disable
"xcatdefaults","syslog,aixremoteshell,configrmcnode",,
"service","servicenode",,
"AIXNodes","setupntp,TEST_Setup_RMC._AllNodes",,
```

- Example 4-78 shows the result of the **dumpxCATdb** command. The files created can be restored with the **restorexCATdb** command.

Example 4-78 Saving xCAT DB

```
# mkdir /tmp/xCATdb
# dumpxCATdb -p /tmp/xCATdb
# ls -l /tmp/xCATdb
total 304
-rw-r--r--    1 root     system           91 May 19 16:12
bootparams.csv
-rw-r--r--    1 root     system           50 May 19 16:12
boottarget.csv
-rw-r--r--    1 root     system           60 May 19 16:12 chain.csv
-rw-r--r--    1 root     system           43 May 19 16:12 deps.csv
-rw-r--r--    1 root     system          115 May 19 16:12 eventlog.csv
-rw-r--r--    1 root     system           36 May 19 16:12 hosts.csv
-rw-r--r--    1 root     system           53 May 19 16:12 ipmi.csv
-rw-r--r--    1 root     system           89 May 19 16:12 iscsi.csv
-rw-r--r--    1 root     system          241 May 19 16:12 mac.csv
```

```
-rw-r--r--    1 root     system           53 May 19 16:12
monitoring.csv
-rw-r--r--    1 root     system           33 May 19 16:12
monsetting.csv
-rw-r--r--    1 root     system           30 May 19 16:12 mp.csv
-rw-r--r--    1 root     system           40 May 19 16:12 mpa.csv
-rw-r--r--    1 root     system          262 May 19 16:12 networks.csv
-rw-r--r--    1 root     system          397 May 19 16:12 nimimage.csv
-rw-r--r--    1 root     system          533 May 19 16:12 nodegroup.csv
-rw-r--r--    1 root     system          652 May 19 16:12 nodehm.csv
-rw-r--r--    1 root     system          976 May 19 16:12 nodelist.csv
-rw-r--r--    1 root     system           48 May 19 16:12 nodepos.csv
-rw-r--r--    1 root     system          492 May 19 16:12 noderes.csv
-rw-r--r--    1 root     system          477 May 19 16:12 nodetype.csv
-rw-r--r--    1 root     system           84 May 19 16:12
notification.csv
-rw-r--r--    1 root     system          127 May 19 16:12 osimage.csv
-rw-r--r--    1 root     system           40 May 19 16:12 passwd.csv
-rw-r--r--    1 root     system           35 May 19 16:12
performance.csv
-rw-r--r--    1 root     system          178 May 19 16:12 policy.csv
-rw-r--r--    1 root     system          165 May 19 16:12
postscripts.csv
-rw-r--r--    1 root     system          481 May 19 16:12 ppc.csv
-rw-r--r--    1 root     system           40 May 19 16:12 ppcdirect.csv
-rw-r--r--    1 root     system           73 May 19 16:12 ppchcp.csv
-rw-r--r--    1 root     system           35 May 19 16:12 prodkey.csv
-rw-r--r--    1 root     system          127 May 19 16:12
servicenode.csv
-rw-r--r--    1 root     system          295 May 19 16:12 site.csv
-rw-r--r--    1 root     system           50 May 19 16:12 switch.csv
-rw-r--r--    1 root     system           68 May 19 16:12 switches.csv
-rw-r--r--    1 root     system          126 May 19 16:12 vm.csv
-rw-r--r--    1 root     system          294 May 19 16:12 vpd.csv
-rw-r--r--    1 root     system           46 May 19 16:12 websrv.csv
# cat /tmp/xCATdb/site.csv
#key,value,comments,disable
"xcatdport","3001",,
"xcatiport","3002",,
"tftpdir","/tftpboot",,
"installdir","/install",,
"master","192.168.100.36",,
"domain","p630n06",,
"useSSHonAIX","yes",,
"consoleondemand","yes",,
"rsh","/usr/bin/ssh",,
"rcp","/usr/bin/scp",,
"ntpservers","192.168.100.36",,
```

- Check node deployment using **mksysb** backup images.

  We will create an **mksysb** image from one client node, and install it on another client node, to see whether the deployment function is working.

  – Create an **mksysb** image from a client node with the following command, as shown in Example 4-79.

  ```
  mknimimage -f -l /nimrepo -m mksysb  -n virt-p5502-p3 539xcatsysb
  spot=539spot_res
  ```

Example 4-79   Create an mksysb image from a client node

```
# mknimimage -f -l /nimrepo -m mksysb  -n virt-p5502-p3 539xcatsysb
spot=539spot_res
Creating a NIM mksysb resource called '539xcatsysb_mksysb'.  This could
take a while.

The following xCAT osimage definition was created. Use the xCAT lsdef
command
to view the xCAT definition and the AIX lsnim command to view the
individual
NIM resources that are included in this definition.

Object name: 539xcatsysb
        bosinst_data=539xcatsysb_bosinst_data
        imagetype=NIM
        mksysb=539xcatsysb_mksysb
        nimmethod=mksysb
        nimtype=standalone
        osname=AIX
        spot=539spot_res
```

4.7.2 HPC stack

Note: In our transition tests the HPC stack was not affected.

The way we perform CSM to xCAT transition helps minimize the impact of upper level applications, and ensures that the GPFS/LL/PE/HPC application does not get affected.

Our sample HPC application keeps running during the transition. The transition would not affect the HPC stack, so you may submit your jobs over the HPC stack while the CSM and xCAT transition takes place. Even so, we still highly recommend that you wait for running jobs to finish before transition, especially for critical jobs.

- Ensure that the HPC stack is working as expected after transition.
  a. Check the GPFS cluster status.
     i. Run **`mmgetstate -av`** from a node in the GPFS cluster; see Example 4-80 for details.

Example 4-80 check gpfs node status

```
# mmgetstate -av

 Node number  Node name        GPFS state
------------------------------------------
       1      virt-p5501_p1    active
       2      virt-p5501_p2    active
       3      virt-p5501_p3    active
       4      virt-p5501_p4    active
       5      virt-p5501_p5    active
       6      virt-p5501_p6    active
       7      virt-p5502-p1    active
       8      virt-p5502-p2    active
       9      virt-p5502-p3    active
      10      virt-p5502-p4    active
      11      virt-p5502-p5    active
      12      virt-p5502-p6    active
```

     ii. Verify that the file systems are mounted and accessible; see Example 4-81 for details.

Example 4-81 check GPFS file systems

```
# cd /gpfs1
# ls
home
# touch test.abc
# ls
home      test.abc
# rm test.abc
```

     iii. Check the `/var/adm/ras/mmfs.log.latest` and `/var/adm/ras/mmfs.log.previous` files, on each node, to see if there are any obvious failures during the transition.

b. Check the Loadleveler cluster status.

i. Run **llstatus** and **llq** from a node in the cluster, as shown in Example 4-82.

Example 4-82 Check Loadleveler status

```
$ llstatus
Name                      Schedd InQ  Act Startd Run LdAvg Idle
Arch      OpSys
virt-p5501_p1             Avail     0    0 Run      1 0.00  9999
R6000     AIX53
virt-p5501_p2             Avail     0    0 Run      1 0.03  9999
R6000     AIX53
virt-p5501_p3             Avail     0    0 Run      1 1.01  9999
R6000     AIX53
virt-p5501_p4             Avail     0    0 Run      1 1.00  9999
R6000     AIX53
virt-p5501_p5             Avail     0    0 Run      1 0.33  9999
R6000     AIX53
virt-p5501_p6             Avail     0    0 Run      1 1.01  9999
R6000     AIX53
virt-p5502-p1             Avail     1    1 Run      1 0.11     0
R6000     AIX53
virt-p5502-p2             Avail     0    0 Run      1 0.00  9999
R6000     AIX53
virt-p5502-p3             Avail     0    0 Run      1 1.00  9999
R6000     AIX53
virt-p5502-p4             Avail     0    0 Run      1 0.00  9999
R6000     AIX53
virt-p5502-p5             Avail     0    0 Run      1 0.04  9999
R6000     AIX53
virt-p5502-p6             Avail     0    0 Run      1 1.05  9999
R6000     AIX53

R6000/AIX53                12 machines      1  jobs     12
running tasks
Total Machines             12 machines      1  jobs     12
running tasks

The Central Manager is defined on virt-p5501_p1

The BACKFILL scheduler is in use

All machines on the machine_list are present.
$ llq
```

```
Id                       Owner      Submitted   ST PRI Class
Running on
------------------------ ---------- ----------- -- ---
------------ -----------
virt-p5502-p1.3.0       test1      5/20 17:13 R  50  No_Class
virt-p5501_p5

1 job step(s) in queue, 0 waiting, 0 pending, 1 running, 0 held,
0 preempted
```

ii. Submit a job with **llsubmit** and check if it queued with **llq**, and check if it runs later and the output file is correct. See Example 4-83 for details.

Example 4-83 check if you can submit jobs to Loadleveler

```
$ llsubmit hw.cmd
llsubmit: The job "virt-p5502-p1.4" has been submitted.
$ llq
Id                       Owner      Submitted   ST PRI Class        Running on
------------------------ ---------- ----------- -- --- ------------ -----------
virt-p5502-p1.3.0        test1       5/20 17:13 R  50  No_Class virt-p5501_p5
virt-p5502-p1.4.0        test1       5/20 17:18 I  50  No_Class

2 job step(s) in queue, 1 waiting, 0 pending, 1 running, 0 held, 0 preempted
......
Wait for jobs finish
......
$ llq
llq: There is currently no job status to report.
$ cat out.4.0
   2:[virt-p5502-p2] hello world
   3:[virt-p5501_p2] hello world
   7:[virt-p5502-p3] hello world
   0:[virt-p5502-p4] hello world
   5:[virt-p5501_p1] hello world
   8:[virt-p5501_p3] hello world
   9:[virt-p5501_p5] hello world
  10:[virt-p5501_p6] hello world
   6:[virt-p5501_p4] hello world
  11:[virt-p5502-p6] hello world
   1:[virt-p5502-p5] hello world
   4:[virt-p5502-p1] hello world
$
```

5

Installing xCAT 2 on a new cluster

In this chapter, we show the scenarios tested in our laboratory environment to install a new cluster from scratch. This cluster will be used to demonstrate the installation of xCAT, installation of a hierarchical cluster using service nodes, the installation and customizing of diskful and diskless nodes, and also demonstrate xCAT's ability to configure logical partitions (LPARs) on an IBM System p. We also demonstrate how to install and configure a General Parallel File System (GPFS) cluster using both diskful and diskless nodes.

The topics that are discussed are:

- Description of the test environment
- Installing and configuring xCAT 2
- Installing the nodes
- xCAT 2 with System p blades running AIX

5.1 Description of the test environment

The equipment we installed our xCAT cluster on is described below. The management node is an IBM pSeries 630 running AIX 6.1 TL2 SP3. The cluster nodes are defined in LPARs on two IBM Power 6 p550s and two IBM Power6 p570s. The p550s are connected to one Hardware Management Console and the p570s are connected to another. This will give us two hardware control points in our cluster.

Each managed system will have one virtual I/O LPAR and four AIX LPARs, with the exception of one that has a fifth LPAR that does not have any disk resources assigned to it. This LPAR will be used for our diskless exercises.

There are four networks with our cluster:

1. Flexible Service Processor Virtual Local Area Network (VLAN)
2. Public/General Access VLAN
3. Dynamic LPAR VLAN.
4. GPFS VLAN

The LPAR configurations were entirely virtual—in other words, there are no real adapters assigned to the LPARs. All LPARs are uncapped micro-partitions.

The nodes are all installed with AIX 6.1 TL2 SP3 and xCAT 2.2.

We decided to create a hierarchical cluster, in order to demonstrate the use of service nodes. Normally, in a cluster of this size, service nodes are not required. In large clusters with hundreds or thousands of nodes, service nodes are often desirable to relieve the load on the management node.

Figure 5-1 describes the cluster network topology used in our exercise.

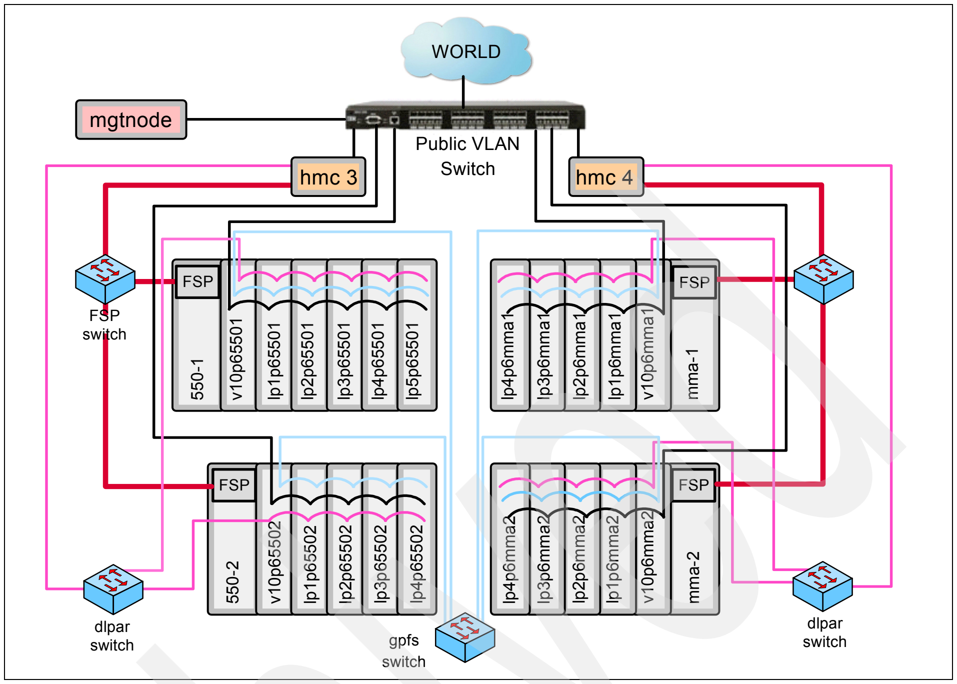

Figure 5-1 Cluster Network Topology used for this chapter

Figure 5-2 depicts the hierarchy used in our cluster.

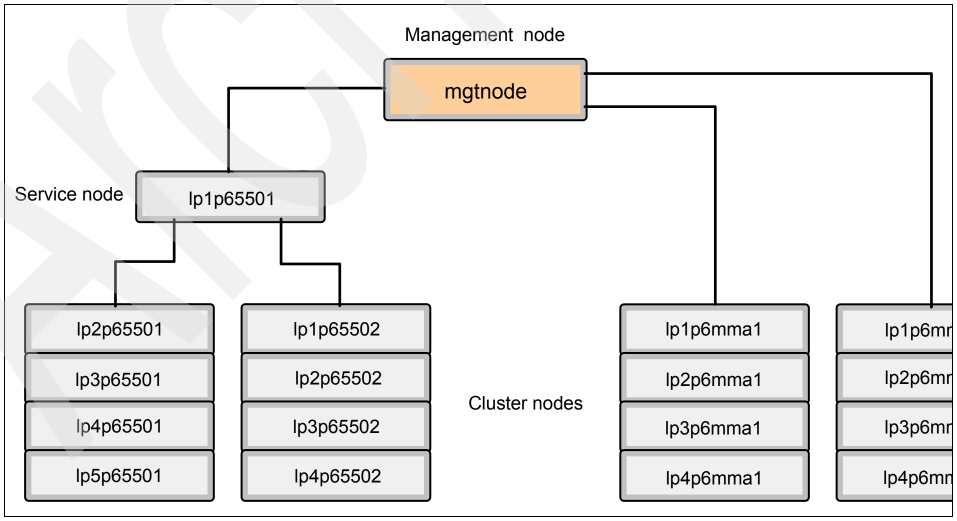

Figure 5-2 The hierarchical structure of our cluster

5.2 Installing and configuring xCAT 2

In this section we describe the steps we undertook on our lab equipment to install our xCAT cluster. These steps were:

- 5.2.1, “Preparing the management node” on page 156
- 5.2.3, “Additional configuration of the management node” on page 178
- 5.2.4, “Creation of LPARs and nodes” on page 186
- 5.2.4, “Creation of LPARs and nodes” on page 186
- 5.2.5, “Creation of NIM and xCAT install resources” on page 194
- 5.3.1, “Configure and install a service node” on page 198

5.2.1 Preparing the management node

The following steps were taken to prepare our management node for the installation and configuration of the xCAT software. AIX 6.1 and the latest maintenance (Technology Level 2 Service Pack 3) was applied. The Cluster Facing Network Adapters (in our case the Public VLAN) was configured with the IP address of the mgtnode and the `/etc/hosts` file was configured with all the hostnames and IP addresses of the cluster nodes for all VLANs.

Creating a new volume group and file system

It is highly recommended to create a new file system in a new volume group on the management node. At minimum, a new file system should be created. The file system `/install` was created in the rootvg of our management node.

Installing OpenSSL and OpenSSH

OpenSSL and OpenSSH are not installed by a standard install of AIX.

Install the latest versions of OpenSSL and OpenSSH from the AIX Expansion Pack, or alternately this software can also be downloaded from the following two sites:

OpenSSH can be downloaded from:

`http://sourceforge.net/projects/openssh-aix`

OpenSSL can be downloaded from:

`https://www14.software.ibm.com/webapp/iwm/web/preLogin.do?source=aixbp`

We unpacked the tar files into `/tmp/openssh` and installed OpenSSL and OpenSSH bff files using a standard **`smit install`** command.

Running the updtvpkg command

Since these are `installp` filesets you should run **`/usr/sbin/updtvpkg`** to make sure that the RPM reflection of what was installed by installp is updated. This makes it possible for RPM packages with a dependency on OpenSSL to recognize that the dependency is satisfied.

This command allows an RPM to consider one or more of its dependencies is satisfied when those dependencies were installed via "traditional" installp.

The output of our run of **`updtvpkg`** is shown in Example 5-1.

Example 5-1 Execution of updtvpkg

```
mgtnode #/usr/sbin/updtvpkg
Please wait...
mgtnode #
```

Downloading and extracting xCAT 2 packages

There are two packages that must be downloaded for the xCAT installation on the management node. These packages are:

- dep-aix-2.2-snap200903291204.tar
- core-aix-snap.tar

These two files can be downloaded from:

`http://xcat.sourceforge.net/aix/download.html`

At this site, there is the choice of downloading the stable release or the daily snapshot builds. We recommend that the daily snapshot builds be downloaded because these will contain the latest bug fixes. Once downloaded, we copied the files to `/tmp/xcat` on the management node, then unzipped and untarred the dependency tarball, as shown in Example 5-2.

Example 5-2 Unpacking the archive containing the dependency packages

```
mgtnode #gunzip dep-aix-2.2-snap200903291204.tar.gz
mgtnode #tar -xvf dep-aix-2.2-snap200903291204.tar
x bash-3.2-1.aix5.2.ppc.rpm, 1429004 bytes, 2792 tape blocks
x conserver-8.1.16-2.aix5.3.ppc.rpm, 222900 bytes, 436 tape blocks
x expect-5.42.1-3.aix5.1.ppc.rpm, 682184 bytes, 1333 tape blocks
x fping-2.4b2_to-1.aix5.3.ppc.rpm, 64102 bytes, 126 tape blocks
x net-snmp-5.4.2.1-1.aix5.3.ppc.rpm, 4279636 bytes, 8359 tape blocks
x net-snmp-devel-5.4.2.1-1.aix5.3.ppc.rpm, 2633096 bytes, 5143 tape
blocks
x net-snmp-perl-5.4.2.1-1.aix5.3.ppc.rpm, 416411 bytes, 814 tape blocks
```

```
x openslp-1.2.1-1.aix5.3.ppc.rpm, 63088 bytes, 124 tape blocks
x perl-Crypt-SSLeay-0.57-1.aix5.3.ppc.rpm, 158043 bytes, 309 tape
blocks
x perl-DBD-SQLite-1.13-1.aix5.3.ppc.rpm, 274998 bytes, 538 tape blocks
x perl-DBI-1.55-1.aix5.3.ppc.rpm, 771054 bytes, 1506 tape blocks
x perl-Digest-MD5-2.36-1.aix5.3.ppc.rpm, 40759 bytes, 80 tape blocks
x perl-Expect-1.21-1.aix5.3.ppc.rpm, 74339 bytes, 146 tape blocks
x perl-IO-Socket-SSL-1.06-1.aix5.3.ppc.rpm, 51463 bytes, 101 tape
blocks
x perl-IO-Stty-.02-1.aix5.3.ppc.rpm, 5686 bytes, 12 tape blocks
x perl-IO-Tty-1.07-1.aix5.3.ppc.rpm, 48055 bytes, 94 tape blocks
x perl-Net-Telnet-3.03-1.2.aix5.3.ppc.rpm, 51601 bytes, 101 tape blocks
x perl-Net_SSLeay.pm-1.30-1.aix5.3.ppc.rpm, 944752 bytes, 1846 tape
blocks
x tcl-8.4.7-3.aix5.1.ppc.rpm, 1479146 bytes, 2889 tape blocks
x tk-8.4.7-3.aix5.1.ppc.rpm, 1355246 bytes, 2647 tape blocks
x README, 3240 bytes, 7 tape blocks
x instoss, 915 bytes, 2 tape blocks
```

The unzipping and untarring of the xCAT core tarball is shown in Example 5-3.

Example 5-3 Unpackaging the xCAT core file for AIX

```
mgtnode #gunzip core-aix-snap.tar.gz
mgtnode #tar -xvf core-aix-snap.tar
x instxcat, 179 bytes, 1 media blocks.
x xCATaixSN.bnd, 951 bytes, 2 media blocks.
x xCATaixSSH.bnd, 198 bytes, 1 media blocks.
x xCATaixSSL.bnd, 212 bytes, 1 media blocks.
x perl-xCAT-2.2.1-snap200904221514.aix5.3.ppc.rpm, 276553 bytes, 541
media blocks.
x xCAT-2.2.1-snap200904221515.aix5.3.ppc.rpm, 98205 bytes, 192 media
blocks.
x xCAT-client-2.2.1-snap200904221514.aix5.3.ppc.rpm, 4639384 bytes,
9062 media blocks.
x xCAT-rmc-2.2.1-snap200904221516.aix5.3.ppc.rpm, 46845 bytes, 92 media
blocks.
x xCAT-server-2.2.1-snap200904221515.aix5.3.ppc.rpm, 437696 bytes, 855
media blocks.
mgtnode #
```

Installing xCAT 2 packages

Once we untarred the xCAT core and dependency files into `/tmp/xcat`, the installation of the software could be done. As a convenience, two scripts, **`instoss`** and **instxcat**, are supplied to assist in the installation of xCAT and its dependent RPMs. These scripts are executed out of the `/tmp/xcat` directory.

Note: It is important to install the dependency RPMs before installing the xCAT RPMs.

The installation of the open source software is shown in Example 5-4.

Example 5-4 Execution of the instoss command

```
mgtnode # cd /tmp/xcat
mgtnode #./instoss
perl-DBI ##################################################
bash ##################################################
perl-DBD-SQLite ##################################################
tcl ##################################################
tk ##################################################
expect ##################################################
conserver ##################################################
perl-Expect ##################################################
perl-IO-Tty ##################################################
perl-IO-Stty ##################################################
perl-IO-Socket-SSL ##################################################
perl-Net_SSLeay.pm ##################################################
perl-Digest-MD5 ##################################################
fping ##################################################
openslp ##################################################
perl-Crypt-SSLeay ##################################################
perl-Net-Telnet ##################################################
net-snmp ##################################################
net-snmp-devel ##################################################
net-snmp-perl ##################################################
mgtnode #
```

The installation of the xCAT core software is shown in Example 5-5.

Example 5-5 Execution of the instxcat command

```
mgtnode # cd /tmp/xcat
mgtnode #./instxcat
perl-xCAT
##################################################
xCAT-client
##################################################
```

```
xCAT-server
##################################################
xCAT
##################################################
Created /etc/xCATMN file.
Created /.ssh directory.
Added updates to the /.ssh/config file.
Created /install/postscripts/_ssh directory.
Generated /.ssh/id_rsa.pub.
Added /.ssh/id_rsa.pub to /.ssh/authorized_keys.
Copied /.ssh/id_rsa.pub to /install/postscripts/_ssh/authorized_keys.
ln -sf /opt/freeware/sbin/conserver /usr/sbin/conserver.
ln -sf /opt/freeware/bin/console /usr/bin/console.
Command failed: lssrc -a | grep conserver 2>&1. Error message: .
Add subsystem conserver.
Updated cluster site definition.
Created postscripts definition.
Created policy definition.
syslog has been set up.

Setting up basic certificates.  Respond with a 'y' when prompted.

Running echo 'y
y
y
y' |/opt/xcat/share/xcat/scripts/setup-xcat-ca.sh 'xCAT CA'
        # NOTE use "-newkey rsa:2048" if running OpenSSL 0.9.8a or
higher
Generating a 2048 bit RSA private key
....+++
...................+++
writing new private key to 'private/ca-key.pem'
-----
/
Created xCAT certificate.
Created /install/postscripts/ca/certs directory.
Copied /etc/xcat/ca/* to /install/postscripts/ca directory.
Running echo 'y
y
y
y' |/opt/xcat/share/xcat/scripts/setup-server-cert.sh mgtnode
Generating RSA private key, 2048 bit long modulus
..+++
......+++
e is 65537 (0x10001)
```

```
/
Using configuration from openssl.cnf
Check that the request matches the signature
Signature ok
Certificate Details:
        Serial Number: 1 (0x1)
        Validity
            Not Before: Apr 24 19:46:07 2009 GMT
            Not After : Apr 19 19:46:07 2029 GMT
        Subject:
            commonName                = mgtnode
        X509v3 extensions:
            X509v3 Basic Constraints:
                CA:FALSE
            Netscape Comment:
                OpenSSL Generated Certificate
            X509v3 Subject Key Identifier:

4B:18:01:91:E7:F7:4D:15:7F:C2:BF:8C:29:5B:23:56:2B:6F:48:9B
            X509v3 Authority Key Identifier:

keyid:8F:B2:D6:48:E7:64:24:9F:AE:EF:7D:B9:96:0B:4B:1A:A1:5F:D6:BA

Certificate is to be certified until Apr 19 19:46:07 2029 GMT (7300
days)
Sign the certificate? [y/n]:

1 out of 1 certificate requests certified, commit? [y/n]Write out
database with 1 new entries
Data Base Updated
/
Created xCAT certificate.
Created /install/postscripts/cert directory.
Copied /etc/xcat/cert/* to /install/postscripts/cert directory.
Running echo 'y
y
y
y' |/opt/xcat/share/xcat/scripts/setup-local-client.sh root
Generating RSA private key, 2048 bit long modulus
.......................................................................
.....+++
...........................................................+++
e is 65537 (0x10001)
/
Using configuration from openssl.cnf
```

```
Check that the request matches the signature
Signature ok
Certificate Details:
        Serial Number: 2 (0x2)
        Validity
            Not Before: Apr 24 19:46:13 2009 GMT
            Not After : Apr 19 19:46:13 2029 GMT
        Subject:
            commonName                = root
        X509v3 extensions:
            X509v3 Basic Constraints:
                CA:FALSE
            Netscape Comment:
                OpenSSL Generated Certificate
            X509v3 Subject Key Identifier:

FE:EF:A2:2D:C0:92:28:E2:BF:FA:18:35:5D:0C:6A:97:E6:83:E0:0A
            X509v3 Authority Key Identifier:

keyid:8F:B2:D6:48:E7:64:24:9F:AE:EF:7D:B9:96:0B:4B:1A:A1:5F:D6:BA

Certificate is to be certified until Apr 19 19:46:13 2029 GMT (7300
days)
Sign the certificate? [y/n]:

1 out of 1 certificate requests certified, commit? [y/n]Write out
database with 1 new entries
Data Base Updated
/
Created xCAT certificate.
Created /install/postscripts/_xcat directory.
Copied /.xcat/* to /install/postscripts/_xcat directory.
Copied /etc/xcat/ca/certs* to /install/postscripts/ca/certs directory.
Starting xcatd.....
cat: 0652-050 Cannot open /etc/exports.
xCAT-rmc
##################################################
Stopping xcatd processes....
Starting xcatd.....
```
5. mgtnode #

Setting up the root user profile

During the execution of the **instxcat** command, the /etc/profile file was modified with xCAT environment variables and PATHs. We executed the /etc/profile in the current shell session (by preceding the command with a ".") using the **. /etc/profile** command.

Note: Make sure you do not have a **.profile** file that overwrites the PATH environment variable.

The changes to the /etc/profile file are shown in Example 5-6.

Example 5-6 xCAT install /etc/profile additions

```
# xCAT setup
XCATROOT=/opt/xcat
PATH=$PATH:$XCATROOT/bin:$XCATROOT/sbin
MANPATH=$MANPATH:$XCATROOT/share/man
export XCATROOT PATH MANPATH
```

Verifying the installation and prerequisites

Once the xCAT software was installed and the xcatd daemon was running, we ran some verification tests to ensure that the xCAT software was working.

These tests included:

- Check that the xcatd daemon is running, as shown in Example 5-7.

Example 5-7 Checking the xCAT daemon

```
mgtnode #ps -aef |grep xcat|grep -v grep
    root 172134      1   0   May 12      -  0:01 xcatd: SSL listener
    root 254024 172134   0   May 12      -  0:01 xcatd: install monitor
    root 295076 172134   0   May 12      -  0:19 xcatd: UDP listener
```

- Running the **lsdef -h** command and checking that the output returned is correct. Help information should be displayed.
- Running the **lsdef** command to retrieve some information from the xcat database.

The execution and results of these commands are shown in Example 5-8.

Example 5-8 Verification of xCAT install via lsdef -h command

```
mgtnode# lsdef -h
```

```
Usage: lsdef - List xCAT data object definitions.

  lsdef [-h | --help ] [-t object-types]

  lsdef [-V | --verbose] [-t object-types] [-o object-names]
    [ -l | --long] [-a | --all] [-z | --stanza ]
    [-i attr-list] [-w attr=val,[attr=val...]] [noderange]

The following data object types are supported by xCAT.

boottarget
eventlog
group
monitoring
network
node
notification
osimage
policy
site

Use the '-h' option together with the '-t' option to
get a list of valid attribute names for each object type.
mgtnode #
```

Example 5-9 shows data retrieved from the xCAT database.

Example 5-9 Execution of lsdef to retrieve data from the xCAT database

```
mgtnode #lsdef -t site -l
Setting the name of the site definition to 'clustersite'.

Object name: clustersite
    consoleondemand=yes
    domain=
    installdir=/install
    master=192.168.100.34
    tftpdir=/tftpboot
    useSSHonAIX=no
    xcatdport=3001
    xcatiport=3002
mgtnode #
```

The results of the previous commands show the successful installation of xCAT on the management node.

5.2.2 Switching xCAT SQLite database to MySQL

We decided to set up a hierarchical cluster to test the use of service nodes. In an xCAT cluster the single point of control is the xCAT management node. Service nodes are used to distribute the load (mainly node install and monitoring), and to provide sufficient scaling and performance so as to avoid the management node becoming a bottle neck. This is typically done on very large clusters. For an xCAT on AIX cluster there is a primary NIM master, which is typically on the management node. The service nodes are configured as additional NIM masters.

Note: Currently, the xCAT NIM configuration does not use the NIM hierarchical capabilities. Rather, it creates a NIM master for each subsequent service node.

All the xCAT commands for managing the cluster are run on the management node. The xCAT cluster software automatically handles the setup of the low-level service nodes and the distribution of the NIM resources to the service nodes. All the installation resources required for the cluster are managed from the primary NIM master. The NIM resources are automatically replicated to the service nodes when they are needed.

Sizing the service nodes

There can be one or more service nodes in an xCAT cluster. The number required will depend on many factors including the number of nodes in the cluster, the type of node deployment, the type of network, and so on. As a general “rule of thumb” you should plan on having at least one service node per 128 diskful cluster nodes. A service node can also be used to run user applications in most cases[1].

However, if you plan to use diskless nodes, due to resource requirements of the NIM server, you should consider allocating a service node for 32 compute nodes.

An xCAT service node must be installed with xCAT software as well as additional prerequisite software.

When using service nodes, the database that supports the xCAT database must be configured to support remote client access. The default supplied database, SQLite, does not support remote client access.

[1] In case you use diskless nodes, you may consider *not* running applications on your service node or NIM master.

Currently, xCAT only supports the MySQL database on AIX as a database with remote client access capability. xCAT with PostgreSQL is supported on Linux only.

MySQL for AIX is available directly from the MySQL Web site or from the xCAT sourceforge Web site.

http://xcat.sourceforge.net/aix/download.html

Go to the xcat-dep download page.

Creating a volume group and file system for xCAT

As the MySQL database could potentially be very active, we decided to create a new volume group and file system for the MySQL database. We recommend that this is done because it keeps the database separate from the operating system, avoids the database from being located in the / (root) file system and is generally considered a good practice.

MySQL is installed to the `/usr/local` file system. We created a new volume group and created the file system using the AIX smit tool. It is not necessary to create a new volume group, though it is highly recommended to create, at minimum, a new file system.

Installing MySQL

Once the software is downloaded from the sourceforge Web site, the `gzip` file was unzipped and untarred in the same `/tmp/xcat` directory that the xCAT software was untarred in.

We then ran the following commands to install the RPMs, shown in Example 5-10.

Example 5-10 Running rpm to install MySQL and its dependencies

```
mgtnode# rpm -i xcat-mysql-5.0-1.aix5.3.ppc.rpm
mgtnode# rpm -i perl-DBD-mysql-4.007-1.aix5.3.ppc.rpm
```

The xcat-mysql post processing unwraps the MySQL software into `/usr/local` and creates a symlink for the `/usr/local/mysql` directory. It will also update the PATH environment variable in the `/etc/profile` file.

The modified `/etc/profile` is shown in Example 5-11.

Example 5-11 /etc/profile post MYSQL install

```
# xCAT setup
XCATROOT=/opt/xcat
```

```
PATH=$PATH:$XCATROOT/bin:$XCATROOT/sbin
MANPATH=$MANPATH:$XCATROOT/share/man
export XCATROOT PATH MANPATH
PATH=$PATH:/usr/local/mysql:/usr/local/mysql/bin:/usr/local/mysql/lib:/
usr/local/mysql/include
export PATH
mgtnode #
```

Configuring MySQL

The MySQL daemon, `mysqld`, requires the creation of a userid and group. These are typically the user mysql and group mysql. Using the standard AIX commands, the group and user were created and a passwd assigned, as shown in Example 5-12.

Example 5-12 Creation of the mysql group and userid

```
mgtnode #mkgroup -A mysql
mgtnode #mkuser pgrp=mysql gecos='mysql user' mysql
mgtnode #passwd mysql
Changing password for "mysql"
mysql's New password:
Enter the new password again:
mgtnode #pwdadm -c mysql
```

Note: The **`smitty security`** command can also be used to create the userid and group.

Once the userid and group are created, the ownership of the newly installed MySQL software needs to be changed. The **`chown`** and **`chgrp`** commands are used to accomplish this.

Note: Ensure that the correct directory is the current working directory before issuing the recursive **`chown`** and **`chgrp`** commands.

The files' ownership is shown in Example 5-13.

Example 5-13 Change of directory and issue of chown and chgrp

```
mgtnode #cd /usr/local/mysql
mgtnode #ls -l
total 160
-rw-r--r--    1 503      staff         19071 Aug 04 2008  COPYING
-rw-r--r--    1 503      staff          5139 Aug 04 2008
EXCEPTIONS-CLIENT
```

```
-rw-r--r--    1 503      staff          8792 Aug 04 2008
INSTALL-BINARY
-rw-r--r--    1 503      staff          1410 Aug 04 2008  README
drwxr-xr-x    2 503      staff          4096 Aug 04 2008  bin
-rwxr-xr-x    1 503      staff           801 Aug 04 2008  configure
drwxr-x---    4 503      staff           256 Aug 04 2008  data
drwxr-xr-x    2 503      staff           256 Aug 04 2008  docs
drwxr-xr-x    3 503      staff          4096 Aug 04 2008  include
drwxr-xr-x    2 503      staff          4096 Aug 04 2008  lib
drwxr-xr-x    4 503      staff           256 Aug 04 2008  man
drwxr-xr-x    9 503      staff          4096 Aug 04 2008  mysql-test
drwxr-xr-x    2 503      staff           256 Aug 04 2008  scripts
drwxr-xr-x    3 503      staff          4096 Aug 04 2008  share
drwxr-xr-x    5 503      staff          4096 Aug 04 2008  sql-bench
drwxr-xr-x    2 503      staff          4096 Aug 04 2008  support-files
drwxr-xr-x    2 503      staff          4096 Aug 04 2008  tests
```

Change the files' ownership, as shown in Example 5-14.

Example 5-14 Changing mysql files ownership

```
mgtnode #chown -R mysql .
mgtnode #ls -l
total 160
-rw-r--r--    1 mysql    staff         19071 Aug 04 2008  COPYING
-rw-r--r--    1 mysql    staff          5139 Aug 04 2008
EXCEPTIONS-CLIENT
-rw-r--r--    1 mysql    staff          8792 Aug 04 2008
INSTALL-BINARY
-rw-r--r--    1 mysql    staff          1410 Aug 04 2008  README
drwxr-xr-x    2 mysql    staff          4096 Aug 04 2008  bin
-rwxr-xr-x    1 mysql    staff           801 Aug 04 2008  configure
drwxr-x---    4 mysql    staff           256 Aug 04 2008  data
drwxr-xr-x    2 mysql    staff           256 Aug 04 2008  docs
drwxr-xr-x    3 mysql    staff          4096 Aug 04 2008  include
drwxr-xr-x    2 mysql    staff          4096 Aug 04 2008  lib
drwxr-xr-x    4 mysql    staff           256 Aug 04 2008  man
drwxr-xr-x    9 mysql    staff          4096 Aug 04 2008  mysql-test
drwxr-xr-x    2 mysql    staff           256 Aug 04 2008  scripts
drwxr-xr-x    3 mysql    staff          4096 Aug 04 2008  share
drwxr-xr-x    5 mysql    staff          4096 Aug 04 2008  sql-bench
drwxr-xr-x    2 mysql    staff          4096 Aug 04 2008  support-files
drwxr-xr-x    2 mysql    staff          4096 Aug 04 2008  tests
mgtnode #chgrp -R mysql .
mgtnode #
mgtnode #ls -l
total 160
-rw-r--r--    1 mysql    mysql         19071 Aug 04 2008  COPYING
-rw-r--r--    1 mysql    mysql          5139 Aug 04 2008
EXCEPTIONS-CLIENT
-rw-r--r--    1 mysql    mysql          8792 Aug 04 2008
INSTALL-BINARY
-rw-r--r--    1 mysql    mysql          1410 Aug 04 2008  README
drwxr-xr-x    2 mysql    mysql          4096 Aug 04 2008  bin
-rwxr-xr-x    1 mysql    mysql           801 Aug 04 2008  configure
drwxr-x---    4 mysql    mysql           256 Aug 04 2008  data
drwxr-xr-x    2 mysql    mysql           256 Aug 04 2008  docs
drwxr-xr-x    3 mysql    mysql          4096 Aug 04 2008  include
drwxr-xr-x    2 mysql    mysql          4096 Aug 04 2008  lib
drwxr-xr-x    4 mysql    mysql           256 Aug 04 2008  man
drwxr-xr-x    9 mysql    mysql          4096 Aug 04 2008  mysql-test
drwxr-xr-x    2 mysql    mysql           256 Aug 04 2008  scripts
drwxr-xr-x    3 mysql    mysql          4096 Aug 04 2008  share
drwxr-xr-x    5 mysql    mysql          4096 Aug 04 2008  sql-bench
drwxr-xr-x    2 mysql    mysql          4096 Aug 04 2008  support-files
drwxr-xr-x    2 mysql    mysql          4096 Aug 04 2008  tests
mgtnode #
```

Note: The mysql userid may need its limits changed. We encountered `/usr/local/mysql/bin/mysqld`: Out of memory (needed 219486208 bytes).

The **`ulimit -m unlimited`** command was used to change this setting to unlimited. To make this change permanent, use **`smitty user.`**

The MySQL database directory needs to be created and the grant tables need to be initialized.

The **`/usr/local/mysql/scripts/mysql_install_db`** command is run to achieve this. This command is run from the root userid. The results are shown in Example 5-15.

Example 5-15   Execution of the mysql_install_db command

```
mgtnode #/usr/local/mysql/scripts/mysql_install_db --user=mysql
Installing MySQL system tables...
OK
Filling help tables...
OK

To start mysqld at boot time you have to copy
```

```
support-files/mysql.server to the right place for your system

PLEASE REMEMBER TO SET A PASSWORD FOR THE MySQL root USER !
To do so, start the server, then issue the following commands:
./bin/mysqladmin -u root password 'new-password'
./bin/mysqladmin -u root -h mgtnode password 'new-password'

Alternatively you can run:
./bin/mysql_secure_installation

which will also give you the option of removing the test
databases and anonymous user created by default.  This is
strongly recommended for production servers.

See the manual for more instructions.

You can start the MySQL daemon with:
cd . ; ./bin/mysqld_safe &

You can test the MySQL daemon with mysql-test-run.pl
cd mysql-test ; perl mysql-test-run.pl

Please report any problems with the ./bin/mysqlbug script!

The latest information about MySQL is available on the web at
http://www.mysql.com
Support MySQL by buying support/licenses at http://shop.mysql.com
mgtnode #
```

The next step is to change the database to run in ANSI-QUOTES mode. The `/etc/my.conf` file needs to be edited and the following line, as shown in Example 5-16, needs to be added to the *[mysqld]* section.

Note: First copy `/usr/local/mysql/support-files/my-large.cnf` to `/etc/my.cnf before editing /etc/my.cnf.`

Example 5-16 sql_mode = ANSI_QUOTES

```
mgtnode# cp /usr/local/mysql/support-files/my-large.cnf /etc/my.cnf
# The MySQL server
[mysqld]
port            = 3306
socket          = /tmp/mysql.sock
skip-locking
```

```
key_buffer = 256M
max_allowed_packet = 1M
table_cache = 256
sort_buffer_size = 1M
read_buffer_size = 1M
read_rnd_buffer_size = 4M
myisam_sort_buffer_size = 64M
thread_cache_size = 8
query_cache_size= 16M
sql_mode = ANSI_QUOTES
# Try number of CPU's*2 for thread_concurrency
thread_concurrency = 8
```

The root user needs to be the owner of the `/usr/local/mysql` files. However, the mysql user needs to own the data directory. This is shown in Example 5-17.

Example 5-17 Updating permissions for the database

```
mgtnode #pwd
/usr/local/mysql
mgtnode #ls -l
total 160
-rw-r--r--    1 mysql    mysql         19071 Aug 04 2008  COPYING
-rw-r--r--    1 mysql    mysql          5139 Aug 04 2008
EXCEPTIONS-CLIENT
-rw-r--r--    1 mysql    mysql          8792 Aug 04 2008
INSTALL-BINARY
-rw-r--r--    1 mysql    mysql          1410 Aug 04 2008  README
drwxr-xr-x    2 mysql    mysql          4096 Aug 04 2008  bin
-rwxr-xr-x    1 mysql    mysql           801 Aug 04 2008  configure
drwxr-x---    4 mysql    mysql           256 Apr 24 16:39 data
drwxr-xr-x    2 mysql    mysql           256 Aug 04 2008  docs
drwxr-xr-x    3 mysql    mysql          4096 Aug 04 2008  include
drwxr-xr-x    2 mysql    mysql          4096 Aug 04 2008  lib
drwxr-xr-x    4 mysql    mysql           256 Aug 04 2008  man
drwxr-xr-x    9 mysql    mysql          4096 Aug 04 2008  mysql-test
drwxr-xr-x    2 mysql    mysql           256 Aug 04 2008  scripts
drwxr-xr-x    3 mysql    mysql          4096 Aug 04 2008  share
drwxr-xr-x    5 mysql    mysql          4096 Aug 04 2008  sql-bench
drwxr-xr-x    2 mysql    mysql          4096 Aug 04 2008  support-files
drwxr-xr-x    2 mysql    mysql          4096 Aug 04 2008  tests
mgtnode #chown -R root .
mgtnode #chown -R mysql data
mgtnode #ls -l
total 160
```

```
-rw-r--r--    1 root     mysql         19071 Aug 04 2008  COPYING
-rw-r--r--    1 root     mysql          5139 Aug 04 2008
EXCEPTIONS-CLIENT
-rw-r--r--    1 root     mysql          8792 Aug 04 2008
INSTALL-BINARY
-rw-r--r--    1 root     mysql          1410 Aug 04 2008  README
drwxr-xr-x    2 root     mysql          4096 Aug 04 2008  bin
-rwxr-xr-x    1 root     mysql           801 Aug 04 2008  configure
drwxr-x---    4 mysql    mysql           256 Apr 24 16:39 data
drwxr-xr-x    2 root     mysql           256 Aug 04 2008  docs
drwxr-xr-x    3 root     mysql          4096 Aug 04 2008  include
drwxr-xr-x    2 root     mysql          4096 Aug 04 2008  lib
drwxr-xr-x    4 root     mysql           256 Aug 04 2008  man
drwxr-xr-x    9 root     mysql          4096 Aug 04 2008  mysql-test
drwxr-xr-x    2 root     mysql           256 Aug 04 2008  scripts
drwxr-xr-x    3 root     mysql          4096 Aug 04 2008  share
drwxr-xr-x    5 root     mysql          4096 Aug 04 2008  sql-bench
drwxr-xr-x    2 root     mysql          4096 Aug 04 2008  support-files
drwxr-xr-x    2 root     mysql          4096 Aug 04 2008  tests
mgtnode #
```

The MySQL server can now be started from the root userid using the command **`/usr/local/mysql/bin/mysqld_safe --user=mysql &`**, as shown in Example 5-18.

Example 5-18 Starting the MySQL server and display the running process

```
mgtnode #/usr/local/mysql/bin/mysqld_safe --user=mysql &
[1]     127340
mgtnode #Starting mysqld daemon with databases from
/usr/local/mysql/data

mgtnode #
mgtnode #ps -efa|grep my
root 127340 123146   0 16:47:49  pts/0  0:00 /bin/sh
/usr/local/mysql/bin/mysqld_safe --user=mysql
   mysql 160188 127340   0 16:47:50  pts/0  0:00
/usr/local/mysql/bin/mysqld --basedir=/usr/local/mysql
--datadir=/usr/local/mysql/data --user=mysql
--pid-file=/usr/local/mysql/data/mgtnode.pid --port=3306
--socket=/tmp/mysql.sock
mgtnode #
```

When the MySQL database needs to be shut down, use the command shown in Example 5-19.

Example 5-19 Shutting down MySQL

```
mgtnode #/usr/local/mysql/bin/mysqladmin -u root -p shutdown
Enter password:
STOPPING server from pid file /usr/local/mysql/data/mgtnode.pid
090424 16:52:44  mysqld ended
```

We add the following line to `/etc/inittab` to ensure that MySQL starts when the system is booted. We used the command in Example 5-20.

Example 5-20 Adding mysqld to /etc/inittab

```
mgtnode #mkitab -i ctrmc "mysql:2:once:/usr/local/bin/mysqld_safe
--user=mysql &"
mgtnode #cat /etc/inittab |tail
pconsole:2:once:/usr/bin/startsrc -s pconsole  > /dev/null 2>&1
xmdaily:2:once:/usr/bin/topasrec -L -s 300 -R 1 -r 6 -o
/etc/perf/daily/ -ypersistent=1 2>&1 >/dev/null #Start local binary
recording
ctrmc:2:once:/usr/bin/startsrc -s ctrmc > /dev/console 2>&1
mysql:2:once:/usr/local/bin/mysqld_safe --user=mysql &
ha_star:h2:once:/etc/rc.ha_star >/dev/console 2>&1
ntbl_reset:2:once:/usr/bin/ntbl_reset_datafiles
rcml:2:once:/usr/ml/aix61/rc.ml > /dev/console 2>&1
webserverstart:2:once:startsrc -s http4websm >/dev/null 2>&1
conserver:2:once:/opt/conserver/bin/conserver -d -i -m 64
xcatd:2:once:/opt/xcat/sbin/xcatd > /dev/console 2>&1
mgtnode #
```

The mysql Admin userid password needs to be changed. The command is shown in Example 5-21.

Example 5-21 Changing the mysql Admin password

```
mgtnode #/usr/local/mysql/bin/mysqladmin -u root password 'xxxxxxxx'
mgtnode #
```

Now that the MySQL database software is installed and configured, the xcatdb database needs to be created. The creation of the xcatdb database and the checking of the database after it has been created is shown in Example 5-22.

Example 5-22 Creating the xcatdb database

```
gtnode #mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
```

```
Your MySQL connection id is 1
Server version: 5.0.67-log MySQL Community Server (GPL)

Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> CREATE DATABASE xcatdb;
Query OK, 1 row affected (0.03 sec)

mysql> CREATE USER xcatadmin IDENTIFIED BY 'itsoadmin';
```

Note: The above MySQL command creates the userid xcatadmin with a password of itsoadmin.

```
Query OK, 0 rows affected (0.00 sec)

mysql> GRANT ALL on xcatdb.* to 'xcatadmin'@'mgtnode' IDENTIFIED BY
'itsoadmin';
```

Note: The above MySQL command grants the **management node** access to the MySQL **xCAT** database. This is the management nodes hostname.

```
Query OK, 0 rows affected (0.00 sec)

mysql> GRANT ALL on xcatdb.* to 'xcatadmin'@'lp1p65501' IDENTIFIED BY
'itsoadmin';
```

Note: The above MySQL command grants the **service node** “lp1p65501” node access to the MySQL **xCAT database**. This is the **service nodes** hostname.

```
Query OK, 0 rows affected (0.00 sec)

mysql> SELECT host,user FROM mysql.user;
+-----------+-----------+
| host      | user      |
+-----------+-----------+
| %         | xcatadmin |
| 127.0.0.1 | root      |
| localhost |           |
| localhost | root      |
| lp1p65501 | xcatadmin |
| mgtnode   |           |
| mgtnode   | root      |
| mgtnode   | xcatadmin |
+-----------+-----------+
8 rows in set (0.00 sec)

mysql>

mysql> SHOW DATABASES;
+--------------------+
| Database           |
+--------------------+
| information_schema |
| mysql              |
| test               |
| xcatdb             |
+--------------------+
4 rows in set (0.00 sec)

mysql> use xcatdb;
Database changed
mysql> SHOW TABLES;
Empty set (0.00 sec)

mysql> quit;
Bye
mgtnode #
```

Migrating xCAT data to MySQL

Once the database has been created, it is ready to have the xCAT data migrated from the default installed SQLite database to the newly set up MySQL database. The first step is to back up the xCAT database. This is important, even if there has not been any data added to xCAT, because during the install of xCAT the required default entries were added to the default SQLite database.

The output from this backup will be used as input to the restore to the new MySQL database.

The backup of the xCAT database is shown in Example 5-23.

Example 5-23 Backup of the xCAT database prior to migration

```
mgtnode #cd /tmp
mgtnode #mkdir xcatback
mgtnode #dumpxCATdb -p /tmp/xcatback
mgtnode #
```

Once the database has been successfully backed up, the `/etc/xcat/cfgloc` file must be updated to point xCAT to the new MySQL database. We found that the file did not exist so we just created it. The content of the file is shown in Example 5-24.

Example 5-24 The one line contained in /etc/xcat/cfgloc

```
mysql:dbname=xcatdb;host=mgtnode|xcatadmin|itsoadmin
```

The breakdown of the host parameter is <hostname> | <user> | <password>.

The new xCAT MySQL database is now ready to be restored. The database will be restored in bypass mode. Bypass mode will restore the database without the xcatd daemon being involved. The file created by the backup taken earlier is used for the restore.

The restore of the database is shown in Example 5-25.

Example 5-25 Restoring the xCAT database in bypass mode

```
mgtnode #XCATBYPASS=1 restorexCATdb -p /tmp/xcatback
mgtnode #
```

Restarting the xCAT daemon and verifying

With the xCAT database restored to the new MySQL one, the xcatd daemon needs to be restarted to start using it. The **`xcatstart`** command is used to accomplish this. This command will stop any running xcatd daemons and start them again.

The restart of the xcatd daemon is shown in Example 5-26.

Example 5-26 The restart of the xcatd daemon

```
mgtnode #xcatstart
Stopping xcatd processes....
Starting xcatd.....
mgtnode #
```

Note: To shut down the xcat daemons, use the **`xcatstop`** command.

We can verify that xCAT is now using the new MySQL database by issuing a command to xCAT with MySQL active.

We issued an xCAT command with MySQL active, as shown in Example 5-27.

Example 5-27 lsdef run while mysqld is active

```
mgtnode #lsdef -t site -l
Setting the name of the site definition to 'clustersite'.

Object name: clustersite
    consoleondemand=yes
    installdir=/install
    master=192.168.100.34
    tftpdir=/tftpboot
    useSSHonAIX=no
    xcatdport=3001
    xcatiport=3002
mgtnode #
```

To prove that xCAT is running on MySQL, the mysqld daemon is shut down and the same xCAT command is issued. We observed the communication failure message shown in Example 5-28.

Example 5-28 xCAT communication failure message

```
mgtnode #/usr/local/mysql/bin/mysqladmin -u root -p shutdown
Enter password:
STOPPING server from pid file /usr/local/mysql/data/mgtnode.pid
090424 17:23:37  mysqld ended

[1] +  Done                    /usr/local/mysql/bin/mysqld_safe
--user=mysql &
mgtnode #lsdef -t site -l
ERROR/WARNING: communication with the xCAT server seems to have been
ended prematurely
```

We restarted the mysqld daemon and retried the same command. We observed that the correct output is displayed, as shown in Example 5-29.

Example 5-29 Restart MySQL and re-issue the xCAT command

```
Tmgtnode #/usr/local/mysql/bin/mysqld_safe --user=mysql &
[1]     127226
mgtnode #Starting mysqld daemon with databases from
/usr/local/mysql/data
```

```
mgtnode #lsdef -t site -l
Setting the name of the site definition to 'clustersite'.

Object name: clustersite
    consoleondemand=yes
    installdir=/install
    master=192.168.100.34
    tftpdir=/tftpboot
    useSSHonAIX=no
    xcatdport=3001
    xcatiport=3002
mgtnode #
```

xCAT has now been successfully reconfigured to use the MySQL database.

5.2.3 Additional configuration of the management node

In this section we describe additional configuration tasks for the xCAT management node.

Cluster network definition

There needs to be an xCAT network definition for each network that contains cluster nodes.

You will need a name for the network and values for the following attributes:

net	The network address
mask	The network mask
gateway	The network gateway

In the laboratory infrastructure that we used, the cluster node management interfaces and the xCAT management node interfaces are on the same network. The network was defined with the **mkdef** command, shown in Example 5-30.

Example 5-30 Using the mkdef command to define the cluster network

```
mgtnode #mkdef -t network -o public net=192.168.100.0
mask=255.255.255.0 gateway=192.168.100.60
Object definitions have been created or modified.
```

Note: The xCAT definition should correspond to the NIM network definition. If multiple cluster subnets are needed, you will need an xCAT and NIM network definition for each one.

In our case, the cluster network is the same network NIM uses for installing AIX onto the LPARs and nodes.

Selecting remote command execution (cluster shell)

By default, xCAT will automatically set up Remote Shell (RSH) on all AIX cluster nodes. We decided to use Secure Shell (SSH) as our shell of choice. To enable xCAT to use SSH, the cluster site definition will need to be modified in the xCAT database. The command to make this change is shown in Example 5-31.

Example 5-31 Change site record to use SSH on AIX

```
mgtnode #chdef -t site -o clustersite useSSHonAIX=yes
Object definitions have been created or modified.

mgtnode #lsdef -t site -l
Setting the name of the site definition to 'clustersite'.

Object name: clustersite
    consoleondemand=yes
    installdir=/install
    master=192.168.100.34
    tftpdir=/tftpboot
    useSSHonAIX=yes
    xcatdport=3001
    xcatiport=3002
mgtnode #
```

Now that xCAT is configured to use SSH as its remote shell, the cluster nodes now need to have OpenSSL and OpenSSH installed. This will be accomplished via the Network Installation Manager (NIM) later on in the install process.

Configuring name resolution

xCAT requires name resolution. This can be provided by a simple `/etc/hosts file` that is kept in sync across all nodes, or optionally by using a Domain Name Server (DNS). For our simple cluster, we decided to use a simple `/etc/hosts` file.

There are many ways to create the hosts file. Because our cluster was small we created it by hand using **`vi`**. This can be very tedious if your cluster is very large. xCAT supplies the `makehosts` file which can assist with the creation of the

/etc/hosts file. This command relies on the nodes already being defined in the xCAT database.

For more details on Name Resolution and /etc/resolv.conf setup, go to:

https://xcat.svn.sourceforge.net/svn/root/xcat/xcat-core/trunk/xCAT-client/share/doc/xCAT2onAIX.pdf

The /etc/hosts file used in our cluster is shown in Example 5-32.

Example 5-32 The /etc/hosts file from the test cluster

```
127.0.0.1               loopback localhost      # loopback (lo0)
name/address
192.168.100.34  mgtnode p630n04
192.168.100.31  p630n01
# HMCs
192.168.100.110 hmc3
192.168.100.109 hmc4
######## Public VLAN ##############
# 550 1
192.168.100.50  viop65501
# lp1p65501 is service node for the both 550's . 570's dont have one.
192.168.100.51  lp1p65501
192.168.100.52  lp2p65501
192.168.100.53  lp3p65501
192.168.100.54  lp4p65501
192.168.100.55  lp5p65501
# 550 2
192.168.100.90  viop65502
192.168.100.91  lp1p65502
192.168.100.92  lp2p65502
192.168.100.93  lp3p65502
192.168.100.94  lp4p65502
# 570 1
192.168.100.170 viop6mma1
192.168.100.171 lp1p6mma1
192.168.100.172 lp2p6mma1
192.168.100.173 lp3p6mma1
192.168.100.174 lp4p6mma1
# 570 2
192.168.100.180 viop6mma2
192.168.100.181 lp1p6mma2
192.168.100.182 lp2p6mma2
192.168.100.183 lp3p6mma2
192.168.100.184 lp4p6mma2
```

```
######## GPFS VLAN ##############
# 550 1
10.2.1.50       viop65501-en2
10.2.1.51       lp1p65501-en2
10.2.1.52       lp2p65501-en2
10.2.1.53       lp3p65501-en2
10.2.1.54       lp4p65501-en2
10.2.1.55       lp5p65501-en2
# 550 2
10.2.1.90       viop65502-en2
10.2.1.91       lp1p65502-en2
10.2.1.92       lp2p65502-en2
10.2.1.93       lp3p65502-en2
10.2.1.94       lp4p65502-en2
# 570 1
10.2.1.170      viop6mma1-en2
10.2.1.171      lp1p6mma1-en2
10.2.1.172      lp2p6mma1-en2
10.2.1.173      lp3p6mma1-en2
10.2.1.174      lp4p6mma1-en2
# 570 2
10.2.1.180      viop6mma2-en2
10.2.1.181      lp1p6mma2-en2
10.2.1.182      lp2p6mma2-en2
10.2.1.183      lp3p6mma2-en2
10.2.1.184      lp4p6mma2-en2
######## dlpar VLAN ##############
# 550 1
10.1.1.50       viop65501-en1
10.1.1.51       lp1p65501-en1
10.1.1.52       lp2p65501-en1
10.1.1.53       lp3p65501-en1
10.1.1.54       lp4p65501-en1
10.1.1.55       lp5p65501-en1
# 550 2
10.1.1.90       viop65502-en1
10.1.1.91       lp1p65502-en1
10.1.1.92       lp2p65502-en1
10.1.1.93       lp3p65502-en1
10.1.1.94       lp4p65502-en1
# 570 1
10.1.1.170      viop6mma1-en1
10.1.1.171      lp1p6mma1-en1
10.1.1.172      lp2p6mma1-en1
```

```
10.1.1.173      lp3p6mma1-en1
10.1.1.174      lp4p6mma1-en1
# 570 2
10.1.1.180      viop6mma2-en1
10.1.1.181      lp1p6mma2-en1
10.1.1.182      lp2p6mma2-en1
10.1.1.183      lp3p6mma2-en1
10.1.1.184      lp4p6mma2-en1
```

It can be seen from Example 5-32 that we chose a simple naming scheme for the cluster nodes. We recommend that you choose a convention that is simple and scalable, such as with a number incrementing. Our naming convention is basically broken down as follows:

- lp = lpar
- 1 = lpar no.
- p6 = processor
- mma or 550 = machine type
- 1 = managed system number

Syslog setup

xCAT will automatically set up `syslog` on the management node and the cluster nodes when they are deployed (installed or booted). When `syslog` is set up on the nodes it will be configured to forward the logs to the management node.

If you do not wish to have `syslog` set up on the nodes you must remove the syslog script from the xcatdefaults entry in the xCAT postscripts table. You can change the xcatdefaults setting with the xCAT **`chtab`** or **`tabedit`** commands.

xCAT adds the following line to the `/etc/syslog.conf` file and starts the syslogd daemon as shown in Example 5-33.

Example 5-33 Entry in /etc/syslog.conf on the management node

```
*.debug   /var/log/messages  rotate 1024K files 5
```

On the cluster nodes, the contents of the `/etc/syslog.conf` file are shown in Example 5-34.

Example 5-34 /etc/syslog on a cluster node

```
# xCAT settings
*.debug @192.168.100.34
```

Note: In testing this procedure, we discovered that the syslog postscript will completely replace the `/etc/syslog.conf` file. If customizations were made to this file, they will be lost.

Setting root password for cluster nodes[2]

We decided not to do this optional step. However, xCAT can create an initial passwd for the root userid when the nodes are deployed.

We installed the nodes without the root passwd being set. After the nodes had been deployed we used the **`xdsh`** command to set the root passwd on the nodes, as shown in Example 5-35.

Example 5-35 Changing the root password on group aixnodes

```
mgtnode # xdsh aixnodes ‘echo “root:itsoadmin” | chpasswd -c’
```

Configuring NTP

It is very desirable in a cluster to keep the time on the nodes in sync. To enable the Network Time Protocol (NTP) services, we decided to use the management node as the time server. Time synchronization is highly recommended for system logging (problem determination) and for running jobs.

We then updated the ntpservers attribute in the site table so that NTP on the nodes will be configured to use the management node as their server. The **`chdef`** command sets this attribute in the sites table, as shown in Example 5-36.

Example 5-36 Setting the ntpservers attribute in the site table

```
mgtnode # chdef -t site ntpservers=mgtnode
Setting the name of the site definition to 'clustersite'.
Object definitions have been created or modified.
mgtnode #
```

To set up NTP on the management node we modified the `/etc/ntp.conf` file so that the management node becomes a time server. The file is shown in Example 5-37.

Example 5-37 Contents of management node /etc/ntp.conf

```
mgtnode # cat /etc/ntp.conf
server 127.127.1.0
fudge 127.127.1.0 stratum 2
driftfile /etc/ntp.drift
```

[2] This is an optional step

```
tracefile /etc/ntp.trace
```

The xntpd subsystem can then be started with the **startsrc -s xntpd** command.The line in the /etc/rc.tcpip file that starts the xntpd subsystem needs to be uncommented to ensure that the xnptd subsystem is started every time AIX is booted on the management node.

Change file limit for root

The default file size limit in AIX for the root userid is set to 1 GB. Some of the AIX/NIM resources being used and created can be very large. We changed the default file size limit for the root user to be unlimited.

We recommend that the file size limit be chosen appropriately. Unlimited may be undesirable in a production environment, but in our test environment it was OK. To change the file limit size, the **chuser** command was used:

```
mgtnode # chuser fsize=-1 root
```

Check policy definitions

When the xCAT software was installed it created several policy definitions. These policies can be listed with the **lsdef -t policy -l** command. The output from this command is shown in Example 5-38.

Example 5-38 Output of the lsdef -t policy -l command

```
mgtnode #lsdef -t policy -l

Object name: 4.5
    commands=getcredentials
    rule=allow

Object name: 1
    name=root
    rule=allow

Object name: 1.2
    name=mgtnode
    rule=allow

Object name: 4.4
    commands=getpostscript
    rule=allow
mgtnode #
```

It may be necessary to add additional policy definitions. For example, you will need a policy for the hostname that was used when xCAT was installed.

During the install of xCAT, the install procedure created the following policy for us so we did not have to explicitly create a policy for this. If this policy needs to be created, then the following command is used to determine the management node hostname:

```
mgtnode # openssl x509 -text -in /etc/xcat/cert/server-cert.pem
-noout|grep Subject:
```

The hostname of the management node is `mgtnode`, so we need a policy definition that can be created with the following command:

```
mgtnode # mkdef -t policy -o 8 name= mgtnode rule=allow
```

Note: The policy names are numeric; just pick a number that is not used.

Check system services

There are some systems services in AIX that xCAT relies upon. These services are bootp, tftp, nfs, rexec/rcmd. These are run from the inetd daemon. Check that at a minimum the bootp, ftp and tftp services are uncommented in `/etc/inetd.conf` and restart the inetd daemon with the **`refresh -s inetd`** command.

The Network File System (NFS) is also a requirement for xCAT. We ensured that the NFS server filesets are installed on the management node, as shown in Example 5-39.

Example 5-39 Ensuring that NFS is installed on the management node

```
mgtnode #lslpp -l|grep nfs
  bos.net.nfs.client        6.1.2.3  COMMITTED  Network File System
Client
  bos.net.nfs.server        6.1.1.0  COMMITTED  Network File System
Server
  bos.net.nfs.client        6.1.2.3  COMMITTED  Network File System
Client
mgtnode #
```

Note: The setup of the NIM Master will also make the changes to `/etc/inetd.conf` and restart the inetd daemon.

The management node should now be set up and ready for action.

5.2.4 Creation of LPARs and nodes

xCAT can assist with the creation of LPARs on our managed systems. Managed systems is the term used for machines that are controlled via the Hardware Management Console (HMC). The HMC is responsible for the management of LPARs and managed systems. The HMC will be the hardware control point for our nodes and LPARs, because it is responsible for LPAR creation and management, and for the power control of LPARs and managed systems.

The HMC must be defined to xCAT as a special type of cluster node.

We installed four LPARs on each managed system that we have in our lab. Each LPAR is analogous to an xCAT node, insofar as they are their own independent operating system.

The main commands to manage and deploy LPARs on the managed system are **mkvm** and **chvm**. The **rscan** command is used to discover existing LPARs on the HMCs. We used these commands to define the nodes to xCAT and to create the LPARs on the HMC.

Before we could use the **mkvm** command to create our LPARs, we had to understand what this command does. It works in two different ways.

- It can be used to duplicate an existing LPAR within the same managed system. When duplicating an existing LPAR, the **mkvm** command attempts to increment slot IDs by one. Our LPARs were all virtual, in other words they did not have any dedicated adapters and the **mkvm** command incremented the virtual slot IDs for our virtual Ethernet and SCSI adapters correctly. We recommend that the LPARs be checked for accuracy once they have been created. The **mkvm** command does not create any virtual resources with the Virtual I/O (VIO) servers so these will need to be created and assigned in the traditional manner. We chose to use this method to create our LPARs.
- The **mkvm** command can also take the LPAR definitions on one whole managed system and replicate these to another managed system. We did not use this method because the managed systems we were using already had some LPARs defined on them.

Defining the first LPAR and adding it to xCAT database

Because the **mkvm command** needs at least one LPAR on the managed systems to copy, we created the first LPARs to be cloned, lp1p65501 on system 550-1 and lp2p65502 on 550-2, on our managed systems using the traditional way via the HMC Web interface GUI.

Note: The lp1p65501 LPAR will be our service node for the 550 machines. lp2p65502 is just an ordinary node.

First we must define the HMC to xCAT. This step must be done before the creation of LPARs via **mkvm** can be done.

The **mkdef** command was used to define the HMC to xCAT as shown in Example 5-40. Note that the HMC user and password are passed in this command.

Example 5-40 Creation of the HMC definition to xCAT and display of results

```
mgtnode #mkdef -t node -o hmc3 groups="all" nodetype=hmc mgt=hmc
username=hscroot password=abc1234
Object definitions have been created or modified.

mgtnode #
mgtnode #lsdef -t node -o hmc3 -l

Object name: hmc3
    groups=all
    mgt=hmc
    nodetype=hmc
    password=abc1234
    username=hscroot
```

We can now use the **rscan** command to check which LPARs are currently defined on our HMC. The **rscan** command can write the results directly into the xCAT database or it can write the results out to a stanza file. The stanza file is just a temporary file that will be used to feed the **mkdef** command to populate the xCAT database. Once the database is populated, the stanza file can be deleted. We highly recommend that **rscan** write out to the stanza file so that it can be checked for any errors. The stanza file is read by the **mkdef** command to populate the xCAT database with node definitions.

We ran the **rscan** command with the **-z** flag and wrote the output to a temporary file:

```
mgtnode # rscan hmc3 -z > /tmp/mystanzafile
```

We checked the file for any obvious errors, of which there where none. The content of our stanza file is shown in Example 5-41.

Example 5-41 Contents of the rscan stanza file

```
mgtnode #vi /tmp/mystanzafile
mgtnode #

Server-8204-E8A-SN10FE411:
        objtype=node
        nodetype=fsp
        id=
        mtm=8204-E8A
        serial=10FE411
        hcp=hmc3
        pprofile=
        parent=
        groups=fsp,all
        mgt=hmc
        cons=
viop65501:
        objtype=node
        nodetype=lpar,osi
        id=2
        mtm=
        serial=
        hcp=hmc3
        pprofile=default
        parent=Server-8204-E8A-SN10FE411
        groups=lpar,all
        mgt=hmc
        cons=hmc
lp1p65501:
        objtype=node
        nodetype=lpar,osi
        id=3
        mtm=
        serial=
        hcp=hmc3
        pprofile=Default
        parent=Server-8204-E8A-SN10FE411
        groups=lpar,all
        mgt=hmc
        cons=hmc
Server-8204-E8A-SN10FE401:
        objtype=node
        nodetype=fsp
        id=
        mtm=8204-E8A
        serial=10FE401
        hcp=hmc3
        pprofile=
        parent=
        groups=fsp,all
        mgt=hmc
        cons=
viop65502:
        objtype=node
        nodetype=lpar,osi
        id=2
        mtm=
        serial=
        hcp=hmc3
        pprofile=default
        parent=Server-8204-E8A-SN10FE401
        groups=lpar,all
        mgt=hmc
        cons=hmc
lp1p65502:
        objtype=node
        nodetype=lpar,osi
        id=3
        mtm=
        serial=
        hcp=hmc3
        pprofile=Default
        parent=Server-8204-E8A-SN10FE401
        groups=lpar,all
        mgt=hmc
        cons=hmc
```

Note: The managed servers themselves are defined as cluster nodes within the xCAT database. They will be the “parents” of the LPARs and must be defined in xCAT and cannot be removed.

The **mkdef** command was run to add the nodes to the xCAT database. The **nodels** command was then used to show that the nodes were defined correctly, as shown in Example 5-42.

Example 5-42 Using a stanza file for defining nodes

```
mgtnode #cat /tmp/mystanzafile |mkdef -z
Object definitions have been created or modified.

mgtnode #nodels
hmc3
```

```
viop65502
lp1p65502
Server-8204-E8A-SN10FE411
lp1p65501
Server-8204-E8A-SN10FE401
viop65501
mgtnode #
```

Note: In Example 5-42, we left the VIO LPARs and nodes defined to xCAT. These probably do not have to be defined to xCAT because we are not going to manage the VIO servers in this cluster.

Clone the LPARs

In order to be able to use the **mkvm** command to create the LPARs on the managed system, the nodes must first be defined into xCAT using the /tmp/stanza file from the initial **rscan**. We modified this file to include the node definitions of the remaining LPARs as shown by the snippet in Example 5-43.

Example 5-43 Snippet of the modified stanza file

```
lp2p65501:
        objtype=node
        nodetype=lpar,osi
        mtm=
        serial=
        hcp=hmc3
        pprofile=Default
        parent=Server-8204-E8A-SN10FE411
        groups=lpar,all
        mgt=hmc
        cons=hmc
lp3p65501:
        objtype=node
        nodetype=lpar,osi
        mtm=
        serial=
        hcp=hmc3
        pprofile=Default
        parent=Server-8204-E8A-SN10FE411
        groups=lpar,all
        mgt=hmc
        cons=hmc
lp4p65501:
        objtype=node
```

```
nodetype=lpar,osi
mtm=
serial=
hcp=hmc3
pprofile=Default
parent=Server-8204-E8A-SN10FE411
groups=lpar,all
mgt=hmc
cons=hmc
```

Note: We removed the id= line from the stanza file. We allowed the **mkvm command** to update this field in the xCAT database during LPAR creation.

The stanza file with all our new node definitions was then fed into the **mkdef** command and the node definitions were created in the xCAT database. The output is shown in Example 5-44.

Example 5-44 Remaining nodes defined to xCAT

```
mgtnode #cat /tmp/mystanzafile|mkdef -z
Object definitions have been created or modified.

mgtnode #nodels
hmc3
viop65502
Server-8204-E8A-SN10FE411
lp1p65501
Server-8204-E8A-SN10FE401
viop65501
lp4p65501
lp3p65501
lp2p65501
mgtnode #
```

Once the nodes are defined in the xCAT database, the **mkvm** command can be run to define the LPARs on the HMC, as shown in Example 5-45.

Example 5-45 Execution of the mkevm command

```
mkvm lp2p65501-lp4p65501 -i 3 -l lp1p65501
lp2p65501: Success
lp3p65501: Success
lp4p65501: Success
```

The command in Example 5-45 on page 191 will create LPARs lp2p65501 through lp4p65501 starting at partition ID of 3. The LPARs will be modelled on lp1p65501. They will have the same memory allocations and CPU settings. The virtual adapter slot IDs will be incremented by 1 and the partition ID updated in the xCAT database.

We repeated the previous steps to add hmc4 and the LPARs on the IBM p570 (MMA) systems.

Create groups

Nodes can be added to groups. This allows many nodes to be administered with one single reference. We created the following node groups:

aixnodes -	all AIX nodes defined here
550nodes -	all nodes on the 550's
mmanode -	all nodes on the MMA systems

The node group creation is shown in Example 5-46.

Example 5-46 Creation of node groups

```
mgtnode # chdef -t node -p -o
lp1p65501,lp2p65501,lp3p65501,lp4p65501,lp1p65502,lp2p65502,lp3p65502,l
p4p65502 groups=aixnodes

or
mgtnode #mkdef -t group -o 550nodes
members="lp1p65501,lp2p65501,lp3p65501,lp4p65501,lp1p65502,lp2p65502,lp
3p65502,lp4p65502"

mgtnode #nodels 550nodes
lp1p65501
lp1p65502
lp2p65501
lp2p65502
lp3p65501
lp3p65502
lp4p65501
lp4p65502
lp5p65501
mgtnode #
```

In Example 5-46, the **chdef** command was issued with the **-p** flag, which instructs the **chdef** command to create the group if it does not exist. The alternate method is to use the **mkdef** command to create the group. We used the **nodels** command with the group name to list the nodes in that group.

Checking rpower

Once the HMC and LPARs are defined successfully into the xCAT database, we can check whether the hardware control point functionality is working.

We executed the **rpower** command with the stat option, as shown in Example 5-47.

Example 5-47 Checking node power status

```
mgtnode #rpower 550nodes stat
lp1p65502: Not Activated
lp4p65502: Not Activated
lp3p65502: Not Activated
lp2p65502: Not Activated
lp3p65501: Not Activated
lp2p65501: Not Activated
lp1p65501: Open Firmware
lp4p65501: Not Activated
```

Set up the console server

In order to be able to open remote consoles from the HMC on the management node, the conserver software needs to be configured. We ran the **makeconservercf** command, which configures the conserver software.

Note: The **makeconservercf** command must be run after every time a new node is added to the cluster.

Note: For System p nodes managed by an HMC, the cons attribute of the nodes should be set to hmc.

The conserver daemon may need to be started if it is not running. We issued the **conserver** command. Subsequent starts of the **conserver** program are run out of `/etc/inittab` when the management node is booted.

The **rcons** command is used to open a remote console session. The key stroke combination of *Ctrl-ec.* (Ctrl key, “**ec.**”) will close the session, as shown in Example 5-48.

Example 5-48 Closing the console

```
mgtnode #chdef -t node -o aixnodes cons=hmc
Object definitions have been created or modified.
mgtnode #makeconservercf
mgtnode #
conserver&
mgtnode #rcons lp1p65501
[Enter `^Ec?' for help]

PowerPC Firmware
 Version EL340_039
 SMS 1.7 (c) Copyright IBM Corp. 2000,2008 All rights reserved.
----------------------------------------------------------------------
 Main Menu
 1.   Select Language
 2.   Setup Remote IPL (Initial Program Load)
 3.   Change SCSI Settings
 4.   Select Console
 5.   Select Boot Options


........



-----------------------------------------------------------------------
 Navigation Keys:

X = eXit System Management Services
 ----------------------------------------------------------------------
 Type menu item number and press Enter or select Navigation key:
```

5.2.5 Creation of NIM and xCAT install resources

Now that the xCAT "base" is in place, we can start the AIX deployment. The cluster is a hierarchical cluster, with the management node taking care of the `mmanodes` group and the one service node on the 550-1. This service node will take care of the remaining 550 nodes. See the diagram in Figure 5-2 on page 155.

Set up NIM resources

The **`mknimimage`** command is used to create an xCAT `osimage` definition as well as any required NIM resources. When this command is invoked for the first time, it creates and sets up a NIM Master. The **`mknimimage`** command will not attempt to reinstall or reconfigure the NIM master if it has already been set up. We could have set up a NIM master manually, but we elected to let xCAT do it for us.

By default, **mknimage** will create the NIM master in the `/install` file system. This file system had been created in an earlier management node configuration.

The **mknimimage** command needs for initial setup access to AIX product media. This can be the AIX CDs or an existing `lpp_source` from another NIM master.

We had access to an existing NIM master (p630n01) and elected to use this as a source for the AIX filesets. The first run of **mknimimage** is shown in Example 5-49.

Example 5-49 Initial execution of mknimimage

```
mgtnode #mount p630n01:/nimrepo/LPP_SOURCE/AIX61 /mnt
mgtnode #cd /mnt
mgtnode #ls
RPMS      installp  usr

mgtnode #mknimimage -s /mnt 610BaseImage
Configuring NIM.

Creating a NIM lpp_source resource called '610BaseImage_lpp_source'.
This could take a while.

Creating a NIM SPOT resource. This could take a while.

The following xCAT osimage definition was created. Use the xCAT lsdef
command to view the xCAT definition and the AIX lsnim command to view
the individualNIM resources that are included in this definition.

Object name: 610BaseImage
        bosinst_data=610BaseImage_bosinst_data
        imagetype=NIM
        lpp_source=610BaseImage_lpp_source
        nimmethod=rte
        nimtype=standalone
        osname=AIX
        spot=610BaseImage

mgtnode #lsnim
master                        machines        master
boot                          resources       boot
nim_script                    resources       nim_script
master_net                    networks        ent
610BaseImage_bosinst_data     resources       bosinst_data
610BaseImage_lpp_source       resources       lpp_source
610BaseImage                  resources       spot
```

```
mgtnode #
```

Obtain MAC addresses

The MAC addresses of the install adapters need to be obtained and added to the xCAT database. These will then be added to the NIM machine definitions in a later step. The **getmacs** command is issued to obtain the MAC address of the first adapter that the management node can get access to. Be aware that this command will power off and power on any nodes that it is run against. The output of the **getmacs** command is shown in Example 5-50.

Example 5-50 Execution of the getmacs command

```
mgtnode #getmacs 550nodes


lp1p65501:
# Type  Location Code   MAC Address      Full Path Name  Ping Result
ent U8204.E8A.10FE411-V3-C11-T1 c21e426a440b /vdevice/l-lan@3000000b
virtual
ent U8204.E8A.10FE411-V3-C12-T1 c21e426a440c /vdevice/l-lan@3000000c
virtual

lp4p65501:
# Type  Location Code   MAC Address      Full Path Name  Ping Result
ent U8204.E8A.10FE411-V6-C11-T1 c21e41a6470b /vdevice/l-lan@3000000b
virtual
ent U8204.E8A.10FE411-V6-C12-T1 c21e41a6470c /vdevice/l-lan@3000000c
virtual

lp1p65502:
# Type  Location Code   MAC Address      Full Path Name  Ping Result
ent U8204.E8A.10FE401-V2-C11-T1 a2e316f38d0b /vdevice/l-lan@3000000b
virtual
ent U8204.E8A.10FE401-V2-C12-T1 a2e316f38d0c /vdevice/l-lan@3000000c
virtual

lp2p65502:
# Type  Location Code   MAC Address      Full Path Name  Ping Result
ent U8204.E8A.10FE401-V3-C11-T1 a2e318cdb00b /vdevice/l-lan@3000000b
virtual
ent U8204.E8A.10FE401-V3-C12-T1 a2e318cdb00c /vdevice/l-lan@3000000c
virtual

lp4p65502:
```

```
# Type  Location Code   MAC Address      Full Path Name  Ping Result
ent U8204.E8A.10FE401-V5-C11-T1 a2e31ace5b0b /vdevice/l-lan@3000000b
virtual
ent U8204.E8A.10FE401-V5-C12-T1 a2e31ace5b0c /vdevice/l-lan@3000000c
virtual

lp2p65501:
# Type  Location Code   MAC Address      Full Path Name  Ping Result
ent U8204.E8A.10FE411-V4-C11-T1 c21e4e94650b /vdevice/l-lan@3000000b
virtual
ent U8204.E8A.10FE411-V4-C12-T1 c21e4e94650c /vdevice/l-lan@3000000c
virtual

lp3p65502:
# Type  Location Code   MAC Address      Full Path Name  Ping Result
ent U8204.E8A.10FE401-V4-C11-T1 a2e31abae20b /vdevice/l-lan@3000000b
virtual
ent U8204.E8A.10FE401-V4-C12-T1 a2e31abae20c /vdevice/l-lan@3000000c
virtual

lp3p65501:
# Type  Location Code   MAC Address      Full Path Name  Ping Result
ent U8204.E8A.10FE411-V5-C11-T1 c21e49517e0b /vdevice/l-lan@3000000b
virtual
ent U8204.E8A.10FE411-V5-C12-T1 c21e49517e0c /vdevice/l-lan@3000000c
virtual
```

Creation of post-install scripts

By default, during the installation of xCAT many scripts are placed into the `/install/postscripts` directory. There is a set of xCAT customization scripts provided in this directory that can be used to perform optional tasks such as additional adapter configurations. We created some post-install scripts and copied and modified some of the supplied scripts to accomplish the following tasks:

- Copy the `/etc/hosts` file from the management node
- Configure en1 for the DLPAR network
- Configure en2 for the GPFS network
- Set up the NTP daemon to use the management node as a time server

Notes:

- The NIM install of AIX will configure en0 and the default gateway.
- The supplied configeth post-install script relies on the hostname to end in -en1 to designate which I/P address should be applied to the en1 adapter. Because this is a sample script, it could be modified (as we did) to configure en2 or en3, and so on.

xCAT runs some default scripts during node installs that can be listed by looking at the xcatdefaults entry in the xCAT postscripts database table.

In order to get xCAT to run our own scripts during the installs, the postscripts attribute on the node definition needed to be modified. We used the **`chdef` `command`** to achieve this. The script then needs to be put into the `/install/postscripts` directory and made executable. The `postscripts` attribute is a comma-separated list of scripts that we want to run. The scripts are executed in order from left to right. The **`chdef`** command is shown in Example 5-51.

Example 5-51 Use the chdef command to set postscripts to run

```
mgtnode# chdef -t node -o lp1p65501
postscripts=gethosts,setupntp,configen1,configen2
Object definitions have been created or modified.
```

5.3 Installing the nodes

This section provides information about installing the service nodes.

5.3.1 Configure and install a service node

The cluster we are installing is a hierarchical one. xCAT uses a service node to assist with the management of clusters. A service node is basically a helper node that off loads work from the management node. It will have its own xcatd daemon using the xCAT database on the management node, as well as its own NIM master. The installation of the service node will set up the NIM master and NIM resources will be copied when the service node is required to install nodes under its care.

Add a node to the service group

Service nodes must belong to the service group. We executed the **`mkdef`** command to create the group and add lp1p65501 to it, as shown in Example 5-52.

Example 5-52 Creation and adding node to the service group

```
mgtnode # mkdef -t group -o service members="lp1p65501"
Object definitions have been created or modified.
mgtnode #
```

Update attributes for service nodes

Any node that is going to be used as a service node must execute the servicenode postscript as part of its install. We modified the postscript attribute for lp1p65501 to include the servicenode post-install script, as shown in Example 5-53.

> **Note:** Using the **`-p`** means to add these values to the postscript attribute that is already set. If this flag is not used, the postscript attribute is overwritten with the new value specified in the **`chdef`** command.

Example 5-53 Setting the postscript attribute with chdef

```
mgtnode # chdef -p -t node -o lp1p65501 postscripts=servicenode
mgtnode #
```

There was only one service node in our cluster to worry about. If we had many we could have set the postscripts attribute on the service group definition. All members of the service group would then execute the servicenode scripts as part of their install.

The setupnameserver attribute *must* be explicitly set. We elected not to use a DNS server in our cluster, so we set this attribute to `no`, as shown in Example 5-54.

Example 5-54 Setting the setupnameserver attribute

```
mgtnode #chdef -t node -o lp1p65501 setupnameserver=no
```

Update attributes for non-service nodes

The remaining nodes on our 550s will be managed by the service node, lp1p65501. Two attributes need to be added to the node definitions in the xCAT database, the servicenode and xcatmaster attributes. The servicenode attribute is set to the name of the service node as known by the management node, and the xcatmaster attribute is the name of the service node as known by the node. In our case the values for these two attributes were the same. We set them as shown in Example 5-55.

Example 5-55 Setting xcatmaster and servicenode attributes for a node

```
mgtnode # chdef -t node -o lp2p65501 servicenode=lp1p65501
xcatmaster=lp1p65501
```

Add required service node software to NIM

Our service node required additional software to be installed. We needed to add the xCAT core software and the dependency software to the `lpp_source` of our osimage. We copied the required files from the `/tmp/xcat` directory we had untarred earlier into `lpp_source` by running the **`nim -o update`** command, as shown in Example 5-56.

Example 5-56 Running nim -o update to copy xCAT files to lpp_source

```
mgtnode #nim -o update -a packages=all -a source=/tmp/xcat
610BaseImage_lpp_source

/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/bash-3.2-1.aix
5.2.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/conserver-8.1.
16-2.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/expect-5.42.1-
3.aix5.1.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/fping-2.4b2_to
-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-5.4.2
.1-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-devel
-5.4.2.1-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-perl-
5.4.2.1-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-devel
-5.4.2.1-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-perl-
5.4.2.1-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/openslp-1.2.1-
1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Crypt-SSL
eay-0.57-1.aix5.3.ppc.rpm
```

```
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-DBD-SQLit
e-1.13-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-DBD-mysql
-4.007-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-DBI-1.55-
1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Digest-MD
5-2.36-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Expect-1.
21-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-IO-Socket
-SSL-1.06-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-IO-Stty-.
02-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-IO-Tty-1.
07-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Net_SSLea
y.pm-1.30-1.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Net-Telne
t-3.03-1.2.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-xCAT-2.2.
1-snap200904221514.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/tcl-8.4.7-3.ai
x5.1.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/tk-8.4.7-3.aix
5.1.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-2.2.1-sna
p200904221515.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-client-2.
2.1-snap200904221514.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-rmc-2.2.1
-snap200904221516.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-server-2.
2.1-snap200904221515.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCATaixSN.bnd
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCATaixSSH.bnd
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCATaixSSL.bnd
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-client-2.
2.1-snap200904221514.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-rmc-2.2.1
-snap200904221516.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-server-2.
2.1-snap200904221515.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xcat-mysql-2.2
-snap200903191456.tar
```

```
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xcat-mysql-5.0
-1.aix5.3.ppc.rpm
mgtnode #
```

We executed the same procedure for OpenSSL and OpenSSH. We had earlier untarred the openssl and openssh software into `/tmp/openssh` and executed the **`nim -o update`** command, as shown in Example 5-57.

Example 5-57 Copying OpenSSL and OpenSSH to lpp_source

```
mgtnode #nim -o update -a packages=all -a source=/tmp/openssh
610BaseImage_lpp_source

/install/nim/lpp_source/610BaseImage_lpp_source/installp/ppc/openssl.ma
n.en_US.0.9.8.600.I
/install/nim/lpp_source/610BaseImage_lpp_source/installp/ppc/openssl.li
cense.0.9.8.600.I
/install/nim/lpp_source/610BaseImage_lpp_source/installp/ppc/openssl.ba
se.0.9.8.600.I
/install/nim/lpp_source/610BaseImage_lpp_source/installp/ppc/openssh.ms
g.EN_US.4.7.0.5300.I
/install/nim/lpp_source/610BaseImage_lpp_source/installp/ppc/openssh.ma
n.en_US.4.7.0.5300.I
/install/nim/lpp_source/610BaseImage_lpp_source/installp/ppc/openssh.li
cense.4.7.0.5300.I
/install/nim/lpp_source/610BaseImage_lpp_source/installp/ppc/openssh.ba
se.4.7.0.5300.I
```

We needed to do more than copy the software to `lpp_source` in order for NIM to install it on the nodes. xCAT supplies NIM install bundles to assist with the installation of the software. These bundles are in the `/tmp/xcat` directory where we originally untarred the xCAT software.

We made a directory `/install/nim/installp_bundle` and copied the bundle files there. The bundle files end with *.bnd. Once the installp bundles were created in NIM, we updated the osimage's installp_bundle attribute, as shown in Example 5-58.

Example 5-58 Creating NIM bundles and updating osimage

```
mgtnode # cd /install/nim
mgtnode # mkdir installp_bundle
mgtnode #cd installp_bundle
mgtnode #cp /tmp/xcat/*bnd .
mgtnode #nim -o define -t installp_bundle -a server=master -a
location=/install/nim/installp_bundle/xCATaixSN.bnd xCATaixSN
```

```
mgtnode #nim -o define -t installp_bundle -a server=master -a
location=/install/nim/installp_bundle/xCATaixSSH.bnd xCATaixSSH
mgtnode #chdef -t osimage -o 610BaseImage
installp_bundle="xCATaixSN,xCATaixSSH"
Object definitions have been created or modified.
```

Note: In the **chdef** command in the above example, the xCATaixSN bundle must be specified before the xCATaixSSH bundle.

Initialize NIM resources for service nodes

We next used the **xcat2nim** command to create machine and group entries in the NIM master, as shown in Example 5-59.

Example 5-59 Execution of xcat2nim and listing of machine entries in NIM

```
mgtnode #xcat2nim -t node lp1p65501
mgtnode: NIM operations have completed successfully.
mgtnode #
mgtnode #lsnim -l lp1p65501
lp1p65501:
   class          = machines
   type           = standalone
   connect        = shell
   platform       = chrp
   netboot_kernel = 64
   if1            = master_net lp1p65501 c21e426a440b ent
   cable_type1    = N/A
   Cstate         = ready for a NIM operation
   prev_state     = ready for a NIM operation
   Mstate         = not running
mgtnode #
```

We next used the **nimnodeset** command to initialize the AIX standalone nodes. This command utilizes xCAT osimage information and runs the appropriate NIM commands, as shown in Example 5-60.

Example 5-60 Initializing NIM nodes

```
mgtnode #nimnodeset -i 610BaseImage lp1p65501
mgtnode: AIX/NIM nodes were initialized.
```

Initiate netboot

We then checked that the lp1p65501 node was indeed ready to be installed. Doing standard NIM checks we verified that the correct NFS exports were in place, that the `/etc/bootptab` file was correctly configured, and that `/tftpboot` contained the network boot image and correct *.info files.

Once we were satisfied all was in order, we initiated the boot of the node with the **`rnetboot`** command, as shown in Example 5-61.

Example 5-61 netbooting the nodes

```
mgtnode #rnetboot lp1p65501
lp1p65501: Success
```

Once we got the success message, we could open the remote serial console and observe the install with the **`rcons`** command.

We could also observe the progress of the install using the **`nim -l lp1p65501`** command.

Note: If the **`rcons`** command is active before the **`rnetboot`** command is initiated, the remote console will be forced into *spy* mode.

Verifying service node deployment

After the service node was installed and booted, we checked that all was OK. Some of these checks can include the following:

- ☐ Ethernet Adapter configured correctly?
- ☐ Time Zone correct?
- ☐ Can **`xdsh`** from the management node?
- ☐ Can execute **`lsdef -a`** ok from the service node?
- ☐ Check that xcatd is running.
- ☐ Check **`lsnim -l`** from the management node.
- ☐ Run **`lsnim`** on the service node to see that NIM master is set up.
- ☐ Run **`rpm -qa`** on the service node to see if the xCAT software is installed.
- ☐ Can **`ssh`** ok from the management node to the service node?

5.3.2 Installing diskful nodes from the service node

Once the service node install is successful, deployment can begin of the nodes managed by this service node. Refer back to Figure 5-1 on page 155 to note the nodes in our cluster managed by lp1p65501. The remaining nodes are installed in a very similar manner to how the service node was installed. The main difference is that the servicenode post-install script will not be executed.

Initialize AIX/NIM nodes

The nodes have previously been defined in the xCAT database. This can be checked with the **nodels** command.

The LPARs for the nodes have been created using the **mkvm** command and the VIO resources created and assigned to the virtual SCSI adapters of the VIO server and clients.

Note: The VIO resources, such as vdisks and virtual adapters, still have to be manually assigned via IOS commands on the VIO server.

We decided to use the same osimage as the service node for our compute node installs. This meant that we had to remove the installp_bundle xCATaixSN from the installp_bundle attribute on the osimage and replace it with the xCATaixSSL bundle. This was achieved as shown in Example 5-62.

Example 5-62 Remove xCATaixSN bundle and substitute xCATaixSSL

```
mgtnode #chdef -m -t osimage -o 610BaseImage installp_bundle=xCATaixSN

mgtnode #chdef -t osimage -o 610BaseImage
installp_bundle=xCATaixSSL,xCATaixSSH
Object definitions have been created or modified.

mgtnode #lsdef -t osimage -o 610BaseImage -l

Object name: 610BaseImage
    bosinst_data=610BaseImage_bosinst_data
    imagetype=NIM
    installp_bundle=xCATaixSSL,xCATaixSSH
    lpp_source=610BaseImage_lpp_source
    nimmethod=rte
    nimtype=standalone
    osname=AIX
    spot=610BaseImage
mgtnode #
```

Note: The **-m** flag (m for minus) on the **chdef** command in Example 5-62 will remove the attribute specified.

We could have created a new osimage for compute nodes and not have had to do this step.

We ran the **xcat2nim** command to add the remaining 550 nodes to the NIM master on the service node, lp1p65501, not to the NIM master on the management node, as shown in Example 5-63.

Example 5-63 Copying node definition from xCAT database and setting up NIM

```
mgtnode #xcat2nim -t node lp1p65502-lp4p65502
lp1p65501: NIM operations have completed successfully.
```

We then used the **nimnodeset** command to prepare NIM on the service node for the install of the remaining nodes, as shown in Example 5-64. This command can take quite a while to run because it needs to copy NIM resources to the service node from the management node and prepare the nodes for network boot on the service node.

Example 5-64 Executing nimnodeset for remaining 550 nodes

```
gtnode #nimnodeset -i 610BaseImage lp1p65502-lp4p65502
Copying NIM resources to the xCAT service nodes. This could take a
while.
CCopying NIM resources to the xCAT service nodes. This could take a
while.
Copying NIM resources to the xCAT service nodes. This could take a
while.
lp1p65501: AIX/NIM nodes were initialized.
```

Note: For the first execution of **nimnodeset** for a new node, the **-i <image to install>** flag specifying the image to use *must* be used. For subsequent executions the **-i** flag does not need to be used, unless you want to specify a different install image.

Initiate netboot

After **nimnodeset** has completed successfully, the nodes can be booted with the rnetboot command. This will power on the LPARs and install AIX. Prior to issuing the **rnetboot** command, we undertook the same NIM checks on the service node as outlined in “Initialize NIM resources for service nodes” on page 203.

Once we were satisfied that all was in order, we initiated the boot of the node using the **rnetboot** command, as shown in Example 5-65.

Example 5-65 netbooting the nodes

```
mgtnode #rnetboot lp1p65502-lp4p65502
lp1p65502: Success
lp2p65502: Success
lp3p65502: Success
lp4p65502: Success
```

Once we got the success message we could open the remote console and observe the install with the **rcons** command.

We could also observe the progress of the install with the **nim -l machine_name** command.

Verifying node deployment

After the remaining nodes were installed and booted, we checked that all was OK. Some of these checks can include the following:

- ☐ Ethernet Adapters configured correctly?
- ☐ Time Zone correct?
- ☐ Can **xdsh** from the management node?
- ☐ check **lsnim -l** from the service node and ensure machines Cstate is success.
- ☐ Run **lsnim** on the service node to see that NIM master is set up.
- ☐ Can **ssh** ok from the management node to the nodes?

5.3.3 Installing diskful nodes from the management node

The process we followed to install the MMA nodes was very similar to the process we used to install the p550 nodes via the service node. The difference was that the mma nodes will be defined to the NIM master on the management node, rather than on the service node.

Initialize AIX/NIM nodes

The nodes were previously defined in the xCAT database. This can be checked with the **nodels** command.

The LPARs for the nodes were created using the **mkvm** command and the VIO resources were created and assigned to the virtual SCSI adapters of the VIO server and clients.

Note: The VIO resources, such as vdisks and virtual adapters, still have to be manually assigned via IOS commands on the VIO server.

We checked the osimage to be used to ensure that the correct software bundles were assigned. These were changed in “Initialize AIX/NIM nodes” on page 205. We used the **lsdef** command as shown in Example 5-66 to check the osimage attributes.

Example 5-66 Checking osimage attributes

```
mgtnode #lsdef -t osimage -o 610BaseImage -l

Object name: 610BaseImage
    bosinst_data=610BaseImage_bosinst_data
    imagetype=NIM
    installp_bundle=xCATaixSSL,xCATaixSSH
    lpp_source=610BaseImage_lpp_source
    nimmethod=rte
    nimtype=standalone
    osname=AIX
    spot=610BaseImage
mgtnode #
```

We then executed the **nimnodeset** command against the mmanodes group to prepare NIM on the management node for the install of the remaining nodes, as shown in Example 5-67. This command can take quite a while to run because it needs to copy NIM resources to the service node from the management node and prepare the nodes for network boot on the service node.

Example 5-67 nimnodeset on the remaining mmanodes

```
mgtnode #nimnodeset mmanodes
mgtnode: AIX/NIM nodes were initialized.
mgtnode #
```

Note: No message is issued about copy NIM resources as was the case in the service node-based install. The execution of **nimnodeset** is also much faster when installing directly from the management node.

Initiate netboot

We then checked that the mmanodes were ready to be installed. Doing standard NIM checks we verified that the correct NFS exports were in place, that the `/etc/bootptab` file was correctly configured, and that `/tftpboot` contained the network boot image and correct *.info files.

Once we were satisfied that all was in order, we initiated the boot of the mmanodes group via the **rnetboot** command, as shown in Example 5-68.

Example 5-68 Conditioning nodes to boot

```
mgtnode #rnetboot mmanodes
lp1p65501: Success
```

Once we got the success message, we could open the remote serial console and observe the install using the **rcons** command.

Verify node deployment

After the mmanodes were installed and booted, we checked that all was OK. Some of these checks can include the following:

- Ethernet Adapters configured correctly?
- Time Zone correct?
- Can **xdsh** from the management node?
- Check **lsnim -l** from the service node and ensure that machines Cstate is successful.
- Run **lsnim** on the service node to see that NIM master is set up.
- Can **ssh** from the management node to the nodes?

5.3.4 Installing diskless nodes

The nodes we installed are all disk-based nodes. The disks were provided via the VIO server. xCAT leverages off the ability of NIM to serve diskless nodes.

For this exercise, we created an LPAR that only had virtual Ethernet defined to it. We did not define any virtual SCSI adapters at all. In a diskless node, the root file system and the `/usr` file system are NFS-mounted from the NIM master. For nodes managed directly from the management node, the NIM master used is the management node. If the node is managed via the service node, the NIM master on the service node is used as the nodes' NIM master.

For this sample, the LPAR lp5p65501 is created. This LPAR is managed via the service node, lp1p65501.

Creating LPAR and node definitions

The first diskless LPAR was created manually via the HMC. Once the diskless LPAR is created, the LPAR can be copied using the **mkvm command**.

For our cluster, we copied a diskful node with the **mkvm** command and then removed the virtual SCSI adapters manually with the HMC, as shown in Example 5-69.

The first step is to add the new LPAR to the `/etc/hosts` file on the management node and copy the `/etc/hosts` file to the service nodes. This can be achieved by running the **`updatenode`** command against the servicenode and executing the **`gethosts`** command that we had added to `/install/postscripts`.

Note: The **`gethosts`** script is a simple script we wrote to assist in the copy of `/etc/hosts` during node install. NIM will only set up `/etc/hosts` with the node's hostname and that of the NIM master. This script is shown here:

```
#!/bin/ksh
# Copy /etc/hosts from mgt node
# Get Master hostname from /etc/xcatinfo
MASTER=`cat /etc/xcatinfo|grep XCATSERVER|awk -F "=" '{print $2}'`
scp root@$MASTER:/etc/hosts /etc/hosts
```

We then made a copy of an existing LPAR by obtaining its profile using the **`lsvm`** command and piping the output to a stanza file. This file can be modified and the new LPAR created. In this exercise, we had to create the LPAR with virtual SCSI adapters because the **`mkvm`** command would not allow us to create an LPAR without them. These superfluous virtual SCSI adapters were removed manually with the HMC. We also removed the ID and MAC parameters from the stanza file.

When the stanza file is ready, the node needs to be added to the xCAT database prior to creating the new LPAR. We piped the updated stanza file to the **`mkdef`** command and then issued the **`mkvm`** command.

Example 5-69 Creation of diskless LPAR with the mkdef and mkvm commands

```
mgtnode # lsdef -z lp4p65501 > /tmp/file

vi /tmp/file

remove id, mac

update stanza name

mgtnode # cat /tmp/file|mkdef -z
mgtnode #
mgtnode # lsdef -z lp5p65501
# <xCAT data object stanza file>

lp5p65501:
    objtype=node
    cons=hmc
    groups=lpar,all,550nodes,aixnodes
    hcp=hmc3
    mgt=hmc
    nodetype=lpar,osi
    os=AIX
    parent=Server-8204-E8A-SN10FE411
    postscripts=gethosts,setupntp,configen1,configen2
    pprofile=Default
    profile=610BaseImage
    servicenode=lp1p65501
    status=booting
    xcatmaster=lp1p65501
mgtnode #

Create the lpar

mgtnode # mkvm lp5p65501 -i 7 -l lp4p65501
lp5p65501: Success
mgtnode #

Remove the vscsi adapter via HMC(diskless)
```

Note: Specify the new LPAR ID with the **-i** flag of the **mkvm** command. The **-i** flag tells **mkvm** which LPAR to use as a model for the new LPAR.

Preparing diskless node NIM resources

A diskless LPAR still needs to obtain its operating system from somewhere. This somewhere is the NIM master. In the case of the new diskless LPAR, lp5p65501, we will use the NIM master to provide the operating system resources the LPAR will need to function. The NIM master being used in this case is the servicenode, lp1p65501.

The NIM master will serve the network boot image, and via NFS, the root file system, the dump, paging, and the `/usr` files system, also known as the Shared Product Object Tree (SPOT).

The creation of the diskless SPOT was achieved by using the same `lpp_source` that was used in creating the diskless image. The **mknimage** command was used to create the diskless image, 610_diskless, as shown in Example 5-70.

Example 5-70 Creation of diskless image with the mkimage command

```
mgtnode # mknimimage -t diskless -s 610BaseImage_lpp_source
610_diskless
Creating a NIM SPOT resource. This could take a while.
```

```
The following xCAT osimage definition was created. Use the xCAT lsdef 
command
to view the xCAT definition and the AIX lsnim command to view the 
individual
NIM resources that are included in this definition.

Object name: 610_diskless
        dump=610_diskless_dump
        imagetype=NIM
        lpp_source=610BaseImage_lpp_source
        nimtype=diskless
        osname=AIX
        paging=610_diskless_paging
        root=610_diskless_root
        spot=610_diskless
mgtnode #
```

Installing OpenSSL and OpenSSH to the SPOT

All of the software that will need to run on the diskless node will need to be installed into the SPOT. On a diskful node, for example, OpenSSl and OpenSSH are installed as part of the node install to the local disks that are attached to the LPAR. For a diskless node, this is not possible, so the SPOT needs to be updated with the required software. OpenSSL and OpenSSH are installed to the SPOT using the **chcosi** command, as shown in Example 5-71. We made sure that OpenSSl was installed first.

Example 5-71 Installing OpenSSL and OpenSSH to the diskless SPOT

```
mgtnode #chcosi -i -s 610BaseImage_lpp_source -b xCATaixSSL 610_diskless
 Installing filesets ...

 Be sure to check the output from the SPOT installation
 to verify that all the expected software was successfully
 installed.  You can use the NIM "showlog" operation to
 view the installation log file for the SPOT.



+-----------------------------------------------------------------------------+
                    Pre-installation Verification...
+-----------------------------------------------------------------------------+
Verifying selections...done
Verifying requisites...done
Results...
```

```
SUCCESSES
---------
  Filesets listed in this section passed pre-installation verification
  and will be installed.

  Selected Filesets
  -----------------
  rpm.rte 3.0.5.42                            # RPM Package Manager

  << End of Success Section >>

+-----------------------------------------------------------------------------+
                   BUILDDATE Verification ...
+-----------------------------------------------------------------------------+
Verifying build dates...done
FILESET STATISTICS
------------------
    1  Selected to be installed, of which:
        1  Passed pre-installation verification
  ----
    1  Total to be installed

+-----------------------------------------------------------------------------+
                         Installing Software...
+-----------------------------------------------------------------------------+

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        rpm.rte 3.0.5.42


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```

```
Please wait...failed to stat /usr/local: No such file or directory

Finished processing all filesets.  (Total time:  11 secs).

+-----------------------------------------------------------------------------+
                                Summaries:
+-----------------------------------------------------------------------------+

Installation Summary
--------------------
Name                        Level           Part        Event       Result
-------------------------------------------------------------------------------
rpm.rte                     3.0.5.42        USR         APPLY       SUCCESS
rpm.rte                     3.0.5.42        ROOT        APPLY       SUCCESS

Validating RPM package selections ...

Please wait...failed to stat /usr/local: No such file or directory

perl-IO-Socket-SSL          ##################################################
perl-Net_SSLeay.pm          ##################################################

+-----------------------------------------------------------------------------+
                           RPM  Error Summary:
+-----------------------------------------------------------------------------+
The following errors during installation occurred:
failed to stat /usr/local: No such file or directory

+-----------------------------------------------------------------------------+
                    Pre-installation Verification...
+-----------------------------------------------------------------------------+
Verifying selections...done
Verifying requisites...done
Results...

SUCCESSES
---------
  Filesets listed in this section passed pre-installation verification
  and will be installed.

  Selected Filesets
  -----------------
  openssl.base 0.9.8.803                        # Open Secure Socket Layer
  openssl.license 0.9.8.803                     # Open Secure Socket License
  << End of Success Section >>

+-----------------------------------------------------------------------------+
                   BUILDDATE Verification ...
+-----------------------------------------------------------------------------+
Verifying build dates...done
FILESET STATISTICS
------------------
    2  Selected to be installed, of which:
        2  Passed pre-installation verification
  ----
    2  Total to be installed

+-----------------------------------------------------------------------------+
                         Installing Software...
+-----------------------------------------------------------------------------+

installp: APPLYING software for:
        openssl.license 0.9.8.803


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Filesets processed:  1 of 2  (Total time:  0 secs).

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Finished processing all filesets.  (Total time:  5 secs).

+-----------------------------------------------------------------------------+
                                Summaries:
+-----------------------------------------------------------------------------+

Installation Summary
--------------------
Name                        Level           Part        Event       Result
-------------------------------------------------------------------------------
openssl.license             0.9.8.803       USR         APPLY       SUCCESS
openssl.base                0.9.8.803       USR         APPLY       SUCCESS
openssl.base                0.9.8.803       ROOT        APPLY       SUCCESS

 Checking filesets and network boot images for SPOT "610_diskless".
 This may take several minutes ...

mgtnode #
mgtnode #chcosi -i -s 610BaseImage_lpp_source -b xCATaixSSH 610_diskless
 Installing filesets ...

 Be sure to check the output from the SPOT installation
 to verify that all the expected software was successfully
 installed.  You can use the NIM "showlog" operation to
 view the installation log file for the SPOT.


+-----------------------------------------------------------------------------+
                    Pre-installation Verification...
+-----------------------------------------------------------------------------+
Verifying selections...done
Verifying requisites...done
Results...

SUCCESSES
```

```
---------
  Filesets listed in this section passed pre-installation verification
  and will be installed.

  Selected Filesets
  -----------------
  openssh.base.client 5.0.0.5301             # Open Secure Shell Commands
  openssh.base.server 5.0.0.5301             # Open Secure Shell Server
  openssh.license 5.0.0.5301                 # Open Secure Shell License
  openssh.man.en_US 5.0.0.5301               # Open Secure Shell Documentat...
  openssh.msg.EN_US 5.0.0.5301               # Open Secure Shell Messages -...
  openssh.msg.en_US 5.0.0.5301               # Open Secure Shell Messages -...

  << End of Success Section >>

+-----------------------------------------------------------------------+
                   BUILDDATE Verification ...
+-----------------------------------------------------------------------+
Verifying build dates...done
FILESET STATISTICS
------------------
    6  Selected to be installed, of which:
        6  Passed pre-installation verification
  ----
    6  Total to be installed

+-----------------------------------------------------------------------+
                         Installing Software...
+-----------------------------------------------------------------------+

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        openssh.license 5.0.0.5301


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```

```
Filesets processed:  1 of 6  (Total time:  0 secs).

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        openssh.base.server 5.0.0.5301


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Successfully updated the Kernel Authorization Table.
Successfully updated the Kernel Role Table.
Successfully updated the Kernel Command Table.
Successfully updated the Kernel Device Table.
0513-071 The sshd Subsystem has been added.
Filesets processed:  3 of 6  (Total time:  14 secs).

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Filesets processed:  5 of 6  (Total time:  15 secs).
```

```
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Finished processing all filesets.  (Total time:  16 secs).

+-----------------------------------------------------------------------+
                                Summaries:
+-----------------------------------------------------------------------+

Installation Summary
--------------------
Name                        Level           Part        Event       Result
-----------------------------------------------------------------------
openssh.license             5.0.0.5301      USR         APPLY       SUCCESS
openssh.base.client         5.0.0.5301      USR         APPLY       SUCCESS
openssh.base.server         5.0.0.5301      USR         APPLY       SUCCESS
openssh.base.client         5.0.0.5301      ROOT        APPLY       SUCCESS
openssh.base.server         5.0.0.5301      ROOT        APPLY       SUCCESS
openssh.msg.en_US           5.0.0.5301      USR         APPLY       SUCCESS
openssh.msg.EN_US           5.0.0.5301      USR         APPLY       SUCCESS
openssh.man.en_US           5.0.0.5301      USR         APPLY       SUCCESS

 Checking filesets and network boot images for SPOT "610_diskless".
 This may take several minutes ...
```

```
mgtnode #
```

Note: The same bundle files that were used for the diskfull image installation were used for the installation of the OpenSSL and OpenSSH software to the diskless image.

Apply AIX maintenance to SPOT

Because the diskless SPOT was created using base AIX 6.1 `lpp_source`, the latest AIX TL level and Service Pack were applied using standard NIM procedures.

Run mkconservercf to refresh the console server

After every addition of a new node to xCAT, the **`mkconservercf`** command must be run to refresh the console server.

Obtain the boot network adapter MAC address

The MAC address of the LPAR's boot address is required. The **`getmacs`** command is run to obtain this information, as shown in Example 5-72.

Example 5-72 Obtaining the MAC address of the diskless LPAR

```
mgtnode #getmacs lp5p65501
lp5p65501:
# Type  Location Code   MAC Address      Full Path Name  Ping Result
ent U8204.E8A.10FE411-V7-C11-T1 c21e4f91050b /vdevice/l-lan@3000000b
virtual
ent U8204.E8A.10FE411-V7-C12-T1 c21e4f91050c /vdevice/l-lan@3000000c
virtual
ent U8204.E8A.10FE411-V7-C13-T1 c21e4f91050d /vdevice/l-lan@3000000d
virtual
```

Verifying the xCAT database entry

The entry for the new LPAR must be verified for accuracy. Of importance are the postscripts, which are executed every time the diskless LPAR node is booted. The items to check are:

- The MAC address
- Postscripts to be executed
- That the servicenode and xcatmaster settings are correct (in the case of nodes being managed via a servicenode)

The entry for lp5p65501 is shown in Example 5-73.

Example 5-73 lsdef of the diskless node/LPAR

```
mgtnode #lsdef -t node -o lp5p65501 -l

Object name: lp5p65501
    cons=hmc
    groups=aixnodes,lpar,all,550nodes
    hcp=hmc3
    id=7
    mac=c21e4f91050b
    mgt=hmc
    nodetype=lpar,osi
    os=AIX
    parent=Server-8204-E8A-SN10FE411
    postscripts=gethosts,setupntp,configen1,configen2
    pprofile=Default
    profile=610BaseImage
    servicenode=lp1p65501
    status=booting
    xcatmaster=lp1p65501
mgtnode #
```

Initializing NIM resources

The NIM resources needed to run the diskless LPAR must be initialized on the NIM master. In the case of the service nodes, the NIM resources must be copied and initialized on the service node NIM master. This is achieved with the **mkdsklsnode** command, as shown in Example 5-74.

Example 5-74 Execution of the mkdsklsnode command

```
mgtnode #mkdsklsnode -i 610_diskless lp5p65501
Copying NIM resources to the xCAT service nodes. This could take a
while.
Creating a SPOT resource on lp1p65501.  This could take a while.

lp1p65501: Initializing NIM machine 'lp5p65501'. This could take a
while. Wed May  6 09:10:17 EDT 2009


lp1p65501: AIX/NIM diskless nodes were initialized.

mgtnode #
```

Note: The `-i` flag of the **`mkdsklsnode`** command sets which osimage to use.

Verifying that the LPAR has been initialized correctly

There are some checks that can be done to verify that the LPAR is ready to be booted off of the NIM master. Items to check include:

- The `/etc/bootptab` file is correctly set up.
- NFS file systems are correctly exported.
- NIM shows that the diskless boot is enabled.

These checks are shown in Example 5-75.

Example 5-75 Verify that the LPAR is ready to boot

```
mgtnode # cat /etc/bootptab;
lp5p65501:bf=/tftpboot/lp5p65501:ip=192.168.100.55:ht=ethernet:ha=c21e4
f91050b:sa=192.168.100.51:sm=255.255.255.0:

mgtnode # lsnim -l lp5p65501

lp5p65501:
   class          = machines
   type           = diskless
   platform       = chrp
   netboot_kernel = mp
   if1            = master_net lp5p65501 c21e4f91050b
   cable_type1    = N/A
   Cstate         = diskless or dataless boot is enabled
   prev_state     = diskless resources are being initialized
   Mstate         = not running
   boot           = boot
   dump           = 610_diskless_dump
   paging         = 610_diskless_paging
   root           = 610_diskless_root
   spot           = 610_diskless
   control        = master
   Cstate_result  = success

mgtnode # exportfs

/install/postscripts
-sec=sys:krb5p:krb5i:krb5:dh,ro
/install/nim/spot/610_diskless/usr -ro,root=lp5p65501,access=lp5p65501
```

```
/install/nim/root/610_diskless_root/lp5p65501
-root=lp5p65501,access=lp5p65501
/install/nim/dump/610_diskless_dump/lp5p65501
-root=lp5p65501,access=lp5p65501
/install/nim/paging/610_diskless_paging/lp5p65501
-root=lp5p65501,access=lp5p6550
```

Open the console and initialize network boot

Once we were satisfied all was in order, we initiated the boot of the node via the **rnetboot** command.

Once we got the success message, we could open the remote serial console and observe the install using the **rcons** command. The LPAR should proceed to boot the network boot image, execute the postscripts, and the login prompt should be presented. Some checks can be done to ensure that the node has configured correctly.

- Ethernet Adapters configured correctly?
- Time Zone correct?
- Can **xdsh** from the management node?
- Check **lsnim -l** from the service node.
- Can **ssh** ok from the management node to the service node?

> **Note:** If the **rcons** command is active before the **rnetboot** command is initiated, the remote console will be forced into *spy* mode.

Timezone issue encountered

We encountered an issue with setting the time on our diskless node. While the NTP was set up correctly, the timezone was set incorrectly giving an invalid date, as shown in Example 5-76.

Example 5-76 Timezone issue encountered after initial diskless boot

```
mgtnode #xdsh 550nodes date
lp1p65501: Mon May 18 13:04:25 EDT 2009
lp2p65502: Mon May 18 13:04:25 EDT 2009
lp4p65502: Mon May 18 13:04:25 EDT 2009
lp1p65502: Mon May 18 13:04:26 EDT 2009
lp2p65501: Mon May 18 13:04:26 EDT 2009
lp3p65501: Mon May 18 13:04:26 EDT 2009
lp4p65501: Mon May 18 13:04:26 EDT 2009
lp3p65502: Mon May 18 13:04:26 EDT 2009
lp5p65501: Mon May 18 17:04:26 America/New York 2009
```

```
mgtnode #
```

In order to solve this issue, the following needed to be done.

We saw that the AIX fileset IC4UC.rte was not installed in the SPOT. This file was installed from our 610BaseImage_lppsource NIM resource. After the installation of this file set, the Olson format timezone had changed, but to CDT, not EDT as per the other nodes. This was corrected by modifying the `/install/nim/spot/610_diskless/usr/lpp/bos/inst_root/etc/environment` file in the SPOT with the correct timezone.

5.4 xCAT 2 with System p blades running AIX

This section presents xCAT deployment on non-HMC-controlled System p hardware.

5.4.1 xCAT on non-HMC-controlled System p hardware

In this section, we look into the install of xCAT2 onto non-HMC controlled System p hardware, and in particular onto System p blades mounted within IBM BladeCenter. In our example for this section we are using one System p blade as our xCAT2 management node, and a second System p blade as our compute node. The process for configuring and installing one or more compute blades is the same, so the use of only one compute blade in our example is not a limiting factor. Our example does not, however, cover the use of JS23 or JS43 Power6 blades or the added complexity of a VIO server.

As part of xCAT's operation it is necessary for the xCAT management node to be able to control hardware elements of the System p server, allowing the management node to power on or off, receive power, heat information, and most importantly help towards automatic discovery of the elements that make up the cluster. In a normal System p configuration, this connection would be to the HMCs that control the System ps that make up the cluster. However, with the System p blades, no HMCs are utilized, because this function is delegated to the blade center's own management interface, which unlike the HMC cannot manage logical partitions, but does control hardware functions such as power on/off, heat data and so on. For this reason it is necessary to explain a bit more about the IBM BladeCenter.

An IBM BladeCenter consists of two main functional elements: the blade chassis, with its power, cooling, management, and network switch modules, and a number of blades that make up the servers. Without going over the complete range of different blade centers, a normal blade center chassis may host between one to a maximum of 14 server blades, which in themselves can be a range of different servers, including Intel, AMD, Power, and Cell. For this book we are only interested in Power Blades, and in particular types JS20 and JS21. Detail information on IBM BladeCenter offerings can be found at:

http://www.ibm.com/systems/bladecenter

For practical implementation examples, check also *IBM BladeCenter Products and Technology*, SG24-7523.

The management element of a blade center consists of at least one management module. Two can be fitted for high availability, and up to four I/O modules. This management module communicates with the outside world via both an http GUI and a command line interface, from which the configuration of the blades and center can be managed.

With regards to xCAT only the Advanced Management Module (AMM) rather than the original Management Module (MM) is supported. The blade center also consists of I/O modules, which are a form of network switch, with each network port of a blade server connected via an internal back plane I/O module. Again, with regard to xCAT, because we need to utilize both the standard network ports fitted to a blade server, the blade center needs to be fitted with two I/O modules, allowing both an xCAT management network, and an application network. The first I/O module also has an added feature of creating a private network LAN which is utilized in creating a Serial Over Lan (SOL) interface to all the blade servers. This is particularly useful with Power Blades because they do not come with any graphics cards, and thus the SOL interface may be the only method to reach a blade that has no network port configured.

This SOL interface is utilized in xCAT to perform a remote console connection to the compute blades, via the command **`rcons`**. Due to issues with the way SOL shares a blade's eth0 network port and interference to the firmware's bootp process if also configured to use port eth0, it is necessary to set xCAT's install interface to be network port eth1 on the blades, and eth0 as the application interface. Figure 5-3 on page 227 depicts an xCAT network setup on our Blade Center cluster.

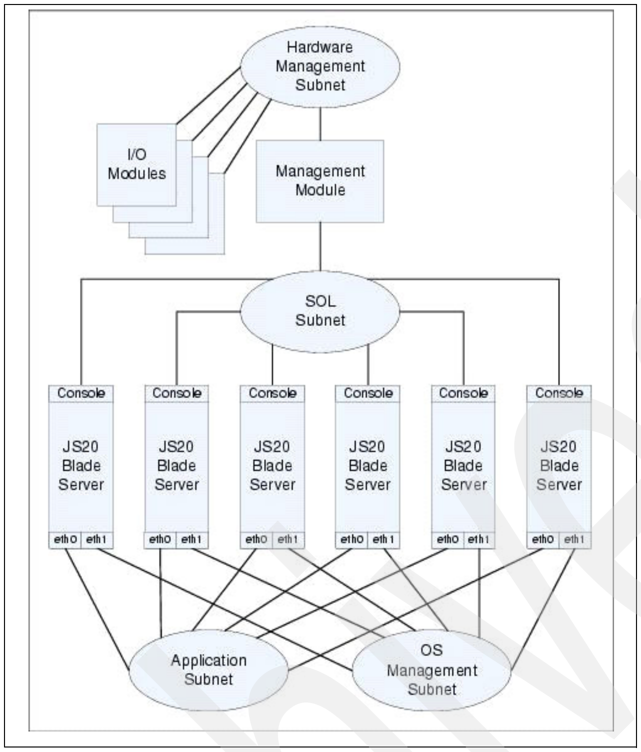

Figure 5-3 Blade Center cluster logical diagram

5.4.2 Installing the xCAT packages on the management node

The example used in this section consisted of two System P blades of type JS21 mounted in an IBM BladeCenter. The hostname of the xCAT management node was etsvc04 (10.69.44.182), and of the compute node etsvc03 (10.69.44.182). Only the management network will be configured in our case.

The BladeCenter's Advanced Management Module has been assigned an IP address of 10.69.44.150, and its I/O modules 10.69.44.151 and 10.69.44.152. Figure 5-4 shows the layout of our example equipment.

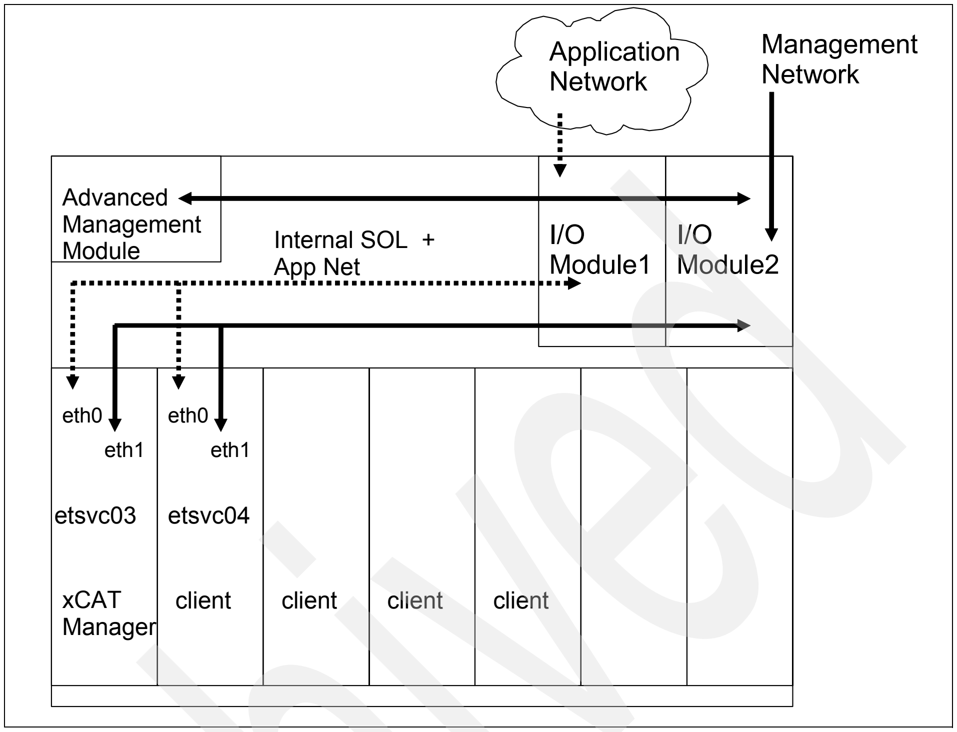

Figure 5-4 Blade Center internal connectivity diagram

Starting with the xCAT management node already installed with AIX and the OpenSSL packages, the following is an example of the procedure to install and configure the xCAT2 software. This example will also demonstrate using this xCAT management node to perform an AIX install on one or more compute nodes.

Use a Web browser to download the xCAT2 core and dependency packages from the sourceforge download site onto the management node into a temporary storage location such as `/tmp`. If the AIX for Linux Toolbox set has been installed, you can use the **gtar** command to unpack the file sets, otherwise use **gunzip** and then the AIX **tar** command.

Starting with the xCAT2 dependency packages, unpack the file into the temporary location:

```
# gtar -zxvf ./dep-aix-*.tar.gz
```

Then install these packages using the xCAT installer:

```
# ./instxcat
```

Next unpack the xCAT2 core file into the temporary location, and install via its installer:

```
# gtar -zxvf ./core-aix-2.2.1.tar.gz
# ./instxcat
```

During the install process, the system file `/etc/profile` will be updated to include the path to the xCAT commands. However, you will need to log out and relog in or execute this file to utilize this change.

To verify the install of the xCAT software and that the xCAT daemon has been started, issue the **lsdef** command, as shown in Example 5-77.

Example 5-77 Checking site definition

```
# lsdef -t site -l
Setting the name of the site definition to ‘clustersite’.

Object name: clustersite
   consoleondemand=yes
   domain=etsvc04
   installdir=/install
   master=10.69.44.182
   tftpdir=/tftpboot
   useSSHonAIX=no
   xcatdport=3001
   xcatiport=3002
```

This output is the initial information contained in the xCAT “site” table after installing the xCAT packages.

5.4.3 Configuring the xCAT management node

Before continuing with the next stage of the xCAT install process, it is necessary to check that a number of AIX services are running. These services are needed by xCAT to perform a number of its functions. Starting with the inetd service which handles the telnet, ftp, bootp, and tftpd, check that the service is running using the **lssrc** command, as shown in Example 5-78, in bold. Also check the NFS service.

Example 5-78 Checking services

```
# lssrc -ls inetd
Subsystem         Group            PID          Status
 inetd            tcpip            176392       active
Debug         Inactive
```

```
Signal        Purpose
 SIGALRM      Establishes socket connections for failed services
 SIGHUP       Rereads configuration database and reconfigures services
 SIGCHLD      Restarts service in case the service dies abnormally
Service       Command                  Arguments                Status
 wsmserver    /usr/websm/bin/wsmserver wsmserver -start         active
 xmquery      /usr/bin/xmtopas         xmtopas -p3              active
 time         internal                                          active
 daytime      internal                                          active
 time         internal                                          active
 daytime      internal                                          active
 ntalk        /usr/sbin/talkd          talkd                    active
 tftp         /usr/sbin/tftpd          tftpd -n                 active
 bootps       /usr/sbin/bootpd         bootpd /etc/bootptab     active
 exec         /usr/sbin/rexecd         rexecd                   active
 login        /usr/sbin/rlogind        rlogind                  active
 shell        /usr/sbin/rshd           rshd                     active
 telnet       /usr/sbin/telnetd        telnetd -a               active
 ftp          /usr/sbin/ftpd           ftpd                     active

# lssrc -g nfs
Subsystem         Group            PID          Status
biod              nfs              188436       active
nfsd              nfs              184460       active
rpc.mountd        nfs              229492       active
rpc.statd         nfs              225472       active
rpc.lockd         nfs              192608       active
nfsrgyd           nfs                           inoperative
gssd              nfs                           inoperative
```

xCAT can also be used to configure some of these AIX services. In our example, xCAT is also used to configure the DNS service. For this, add information needed to help set up DNS on the management node to the “site” table.

```
# chdef -t site domain=aixncc.mycluster.com \
> nameservers=etsvc04.mycluster.com nameservers=10.69.44.182 \
> forwarders=10.137.62.2
Setting the name of the site definition to ‘clustersite’.
Object definitions have been created or modified.
```

Create a `resolv.conf` file to contain the same domain and nameserver information:

```
# cat /etc/resolv.conf
search mycluster.com
nameserver 192.168.2.182
```

Then run the xCAT command **makedns** to create the required DNS file /etc/named.conf plus the /var/named directory files. Then start DNS:

```
# makedns
# startsrc -s named
```

Also, xCAT can be used to configure NTP on the compute nodes. This is achieved by setting the ntpservers attribute in the site table:

```
# chdef -t site ntpservers=etsvc04
Setting the name of the site definition to ‘clustersite’.
Object definitions have been created or modified.
```

During the install of the compute nodes, xCAT can configure the root password. The passwd xCAT table needs to be updated with the required info to perform this operation:

```
# chtab key=system passwd.username=root passwd.password=password
# tabdump passwd
key,username,password,comments,disable
system,root,password,,
```

During the install of xCAT, a table called *policy* was created, which contains a number of initial policy definitions, as shown in Example 5-79.

Example 5-79 Checking the initial policies

```
# lsdef -t policy -l

Object name: 4.5
   commands=getcredentials
   rule=allow

Object name: 1
   name=root
   rule=allow

Object name: 4.4
    commands=getpostscript
    rule=allow
```

An additional policy needs to be added to this table, representing the hostname when the openssl code was installed. To determine the required info, run the following command:

```
# openssl x509 -text -in /etc/xcat/cert/server-cert.pem -noout |\
> grep Subject
     Subject: CN=etsvc04
```

```
      Subject Public Key Info:
         X509v3 Subject Key Identifier:
```

Then use this information to update the policy table:

```
# mkdef -t policy -o 8 name=etsvc04 rule=allow
Object definitions have been created or modified.
```

5.4.4 Configuration and discovery of the cluster's resources

At this point in configuring the xCAT management node, we would start to populate the xCAT tables with the details of switches, service nodes, and finally the compute nodes. This procedure can be done either by entering the data into the tables, or via xCAT's automated discovery commands. When working with blades for xCAT to perform the automated discovery it needs to first know about the blade center's Advanced Management Module, often referred to as the AMM, and the blade center's I/O modules. Once the AMM has been configured in the xCAT tables, it will be utilized by xCAT commands such as **`rpower`**, **`rcons`**, and **`rbootseq`** to perform the hardware control management. Define the AMM as a node and add it to a center management group called grp_amm, using the command:

```
# nodeadd amm_centre, groups=all,grp_amm
```

Next, define the management attribute mgt in the nodehm table for all the AMMs in the center management group as type "blade" using the command:

```
# chdef -t node -o grp_amm mgt=blade
Object definitions have been created or modified.
```

Then define, in the mp table, the hardware control attribute mpa for the AMM as itself:

```
# chdef -t node -o amm_centre mpa=amm_centre
Object definitions have been created or modified.
```

On having defined the amm_centre, its IP address needs to be set in the hosts table via the command:

```
# chdef -t node -o amm_centre ip=10.69.44.150
Object definitions have been created or modified.
```

It is then possible to add this information into the xCAT management node's `/etc/hosts` file, as shown in Example 5-80.

Example 5-80 Static name resolution file (/etc/hosts) on xCAT MN

```
# makehosts
# cat /etc/hosts
# @(#)47       1.1  src/bos/usr/sbin/netstart/hosts, cmdnet, bos530 7/24/91 10:00:46
#
#  /etc/hosts
#
# Internet Address      Hostname        # Comments

127.0.0.1              loopback localhost      # loopback (lo0) # name/address
10.69.44.182    etsvc04   etsvc04.mycluster.com     # xcat management network
# (normally an address like 192.168.100.1
192.168.2.182  etsvc04pub # public network xcat servers management network
10.69.44.150    amm_centre amm_centre.mycluster.com # blade center Advanced
management
10.69.44.151    io1_centre                    # io module for the blade centre
10.69.44.152    io2_centre                    # io module for the blade centre
```

Next, enable the SNMP and SSH services for all AMMs in the center management group grp_amm, as shown in Example 5-81.

Example 5-81   Enabling SNMP and SSH on the BladeCenter AMM

```
# rspconfig grp_amm snmpcfg=enable sshcfg=enable
amm_centre: SNMP enable: OK
amm_centre: SSH enable: OK
# rspconfig grp_amm pd1=redwoperf pd2=redwoperf
amm_centre: pd2: redwoperf
amm_centre: pd1: redwoperf
```

Note: Make sure you have the latest firmware for the AMM and blades, otherwise you may experience issues with remote console and power control.

The procedure now needs to define to xCAT the networks in the configuration. Update the network table, where net attribute is the network's address, mask attribute the network mask, gateway attribute the network's gateway address, and the **-o** flag defines the xCAT network name assigned to these values. In our example we are using only one network, as shown in Example 5-82.

Example 5-82   Checking the network definition

```
# mkdef -t network -o xcat_ent1 net=10.69.44.0 mask=255.255.255.0
gateway=10.69.44.1
Object definitions have been created or modified.

# tabdump networks
#netname,net,mask,mgtifname,gateway,dhcpserver,tftpserver,nameservers,n
tpservers,logservers,dynamicrange,nodehostname,comments,disable
```

```
"xcat_ent1","10.69.44.0","255.255.255.0",,"10.69.44.1",,,,,,,,,
```

To finalize the communications with the blade center's AMM it is necessary to define a user name and password in the xCAT passwd table that already exists on the AMM, using the **chtab** command, and test using the **psh** command, as shown in Example 5-83.

Example 5-83 Checking AMM connection

```
# chtab key=blade passwd.username=USERID passwd.password=PASSWORD

# /opt/xcat/bin/psh -l USERID grp_amm info -T blade[1]

The output of which is,
amm_centre:
amm_centre: system> info -T blade[1]
amm_centre:
amm_centre: Name: JS22A
amm_centre: UUID: 29B8 AFE6 3B46 11D7 8B56 001A 6445 1976
amm_centre: Manufacturer: IBM (LW)
amm_centre: Manufacturer ID: 20301
amm_centre: Product ID: 137
amm_centre: Mach type/model: 4 PPC CPU Blade Server/799861X
amm_centre: Mach serial number: 06127AA
amm_centre: Manuf date: 15/08
amm_centre: Hardware rev: 0
amm_centre: Part no.: 46K6737
amm_centre: FRU no.: 46K6736
amm_centre: FRU serial no.: YL10W810403U
amm_centre: CLEI: Not Available
amm_centre: Unique ID 1: Not Available
.....snippet....
amm_centre: Unique ID 8: Not Available
amm_centre: MAC Address 1: 00:1A:64:45:19:78 -> 00:1A:64:45:19:79
amm_centre: MAC Address 2: Not Available
.....snippet....
amm_centre: MAC Address 8: Not Available
amm_centre: BIOS
amm_centre: Build ID:       EA320_046
amm_centre: Rel date:       05/29/08
amm_centre: Rev:            0818
amm_centre: Blade sys. mgmt. proc.
amm_centre: Build ID:       BOBT001
amm_centre: Rev:             1.10
amm_centre: Local Control
```

```
amm_centre: KVM:            Yes
amm_centre: Media Tray:     Yes
amm_centre: Power On Time: 76 days 0 hours 10 min 38 secs
amm_centre: Number of Boots: 0
amm_centre: Product Name: JS12/JS22 Express Blade Server, 1-2 dual-core
IBM POWER6™ CPU(s)
amm_centre:
amm_centre: *** ssh exited with error code 70
```

With the blade center AMMs defined, and communications established, it is now possible to utilize xCAT's automated discovery commands to retrieve information about the number and type of blades installed in the blade centers, managed by the AMMs. In our case the **rscan** command will investigate all blades managed by the AMMs in the grp_amm group, and this information will be written into the file `bld.stanza`, as shown in Example 5-84.

Example 5-84 Discovering BladeCenter information

```
# rscan grp_amm -z >bld.stanza

# cat bld.stanza
BCHBF_TechLab:
   objtype=node
   nodetype=mm
   id=0
   mtm=8852-4XG
   serial=99B1900
   mpa=amm_centre
   groups=mm,all
   mgt=blade
   cons=
JS22E:
   objtype=node
   nodetype=blade
   id=5
   mtm=7998-61X
   serial=061279A
   mpa=amm_centre
   groups=blade,all
   mgt=blade
   cons=blade
etsvc04:
   objtype=node
   nodetype=blade
   id=6
   mtm=8842-41X
   serial=KK01299
   mpa=amm_centre
   groups=blade,all
   mgt=blade
   cons=blade
HS20:
   objtype=node
   nodetype=blade
   id=7
   mtm=8678-41X
   serial=KBM3191
   mpa=amm_centre
   groups=blade,all
   mgt=blade
   cons=blade
etsvc03:
   objtype=node
   nodetype=blade
   id=10
   mtm=8844-51G
   serial=99A0317
   mpa=amm_centre
   groups=blade,all
   mgt=blade
   cons=blade
HS20B:
   objtype=node
   nodetype=blade
   id=13
   mtm=8843-E9U
   serial=KQKAP9M
   mpa=amm_centre
   groups=blade,all
   mgt=blade
   cons=blade
```

To define these blades as nodes to xCAT, run the **mkdef** command, and check that the blades have been added to the xCAT database, as shown in Example 5-85.

Example 5-85 Adding the nodes and checking

```
# cat bld.stanza | mkdef -z
Object definitions have been created or modified.
```

```
# lsdef blade
Object name: etsvc04
   cons=blade
   groups=blade,all
   id=6
   mgt=blade
   mpa=amm_centre
   mtm=8842-41X
   nodetype=blade
   serial=KK01299

Object name: HS20B
   cons=blade
   groups=blade,all
   id=13
   mgt=blade
   mpa=amm_centre
   mtm=8843-E9U
   nodetype=blade
   serial=KQKAP9M
Object name: HS20
   cons=blade
   groups=blade,all
   id=7
   mgt=blade
   mpa=amm_centre
   mtm=8678-41X
   nodetype=blade
   serial=KBM3191

Object name: JS22E
   cons=blade
   groups=blade,all
   id=5
   mgt=blade
   mpa=amm_centre
   mtm=7998-61X
   nodetype=blade
   serial=061279A

Object name: etsvc03
   cons=blade
   groups=blade,all
   id=10
```

```
mgt=blade
mpa=amm_centre
mtm=8844-51G
nodetype=blade
serial=99A0317
```

Once the compute blades have been defined into xCAT's tables, additional information can be added such as their IP address and their addition to subgroups. The following command adds our compute blade etsvc03 into the group grp_blade, and grp_rte:

```
# chdef -t node -o etsvc03 groups=grp_blade,grp_rte,blade,all
Object definitions have been created or modified.
```

And the next command defines etsvc03's IP address:

```
# chdef -t node -o etsvc03 ip=10.69.44.183
Object definitions have been created or modified.
```

To confirm, we have listed the xCAT tables, using the **tabdump** command, as shown in Example 5-86.

Example 5-86 Checking the contents of the nodelist table

```
# tabdump nodelist
#node,groups,status,appstatus,primarysn,comments,disable
“amm_centre”,”all,grp_amm”,,,,,
“io1_centre”,”switch”,,,,,
“etsvc04”,”blade,all”,,,,,
“HS20B”,”blade,all”,,,,,
“HS20”,”blade,all”,,,,,
“BCHBF_TechLab”,”mm,all”,,,,,
“JS22E”,”blade,all”,,,,,
“etsvc03”,”grp_blade,grp_rte,blade,all”,,,,,

# tabdump nodehm
#node,power,mgt,cons,termserver,termport,conserver,serialport,serialspe
ed,serialflow,getmac,comments,disable
“amm_centre”,,”blade”,,,,,,,,,,
“etsvc04”,,”blade”,”blade”,,,,,,,,,
“HS20B”,,”blade”,”blade”,,,,,,,,,
“HS20”,,”blade”,”blade”,,,,,,,,,
“BCHBF_TechLab”,,”blade”,,,,,,,,,,
“JS22E”,,”blade”,”blade”,,,,,,,,,
“etsvc03”,,”blade”,”blade”,,,,,,,,,

# tabdump hosts
```

```
node,ip,hostnames,comments,disable
"amm_centre","10.69.44.150",,,
"etsvc03","10.69.44.183",,,

# tabdump nodegroup
#groupname,grouptype,members,wherevals,comments,disable
"blade","static","static",,,
"mm","static","static",,,
"grp_rte","static","static",,,
"grp_blade","static","static",,,
```

At this point, run the **makehosts** command to add these new nodes into the `/etc/hosts` file on the management server, as shown in Example 5-87.

Example 5-87 Adding the configured nodes to the local IP name resolution file

```
# makehosts
# cat /etc/hosts
# @(#)47        1.1  src/bos/usr/sbin/netstart/hosts, cmdnet, bos530 7/24/91 10:00:46
#
#  /etc/hosts
#
# Internet Address      Hostname        # Comments

127.0.0.1               loopback localhost      # loopback (lo0) name/address

10.69.44.182     etsvc04   # management network for the moment due to problems

192.168.2.182   etsvc04pub      # temp public network xcat servers management network

10.69.44.150 amm_centre amm_centre.mycluster.com
10.69.44.151     io1_centre      # io module for the blade centre
10.69.44.152     io2_centre      # io module for the blade centre
10.69.44.183 etsvc03 etsvc03.mycluster.com
```

Add to the nodehm table that these new nodes are to be hardware-controlled via the blades center's AMM. The following command performs this for all nodes in the grp_blade group:

```
# chdef -t node -o grp_blade mgt=blade cons=blade
Object definitions have been created or modified.
```

The procedure now needs to define which networks will be utilized for the installation and management of these new nodes. This information goes into the noderes table, with the installnic attribute set as the network adapter interface on the node that will be utilized for the installation of the compute node, and the primarynic attribute as the network adapter interface that will be used for xCAT management.

In our example both these interfaces will be set to eth1 with the command:

```
# chdef -t node -o grp_blade installnic=eth1 primarynic=eth1
Object definitions have been created or modified.
```

To confirm:

```
# tabdump noderes
#node,servicenode,netboot,tftpserver,nfsserver,monserver,nfsdir,inst
allnic,primarynic,cmdinterface,xcatmaster,current_osimage,next_osima
ge,nimserver,comments,disable
“etsvc03”,,,,,,,”eth1”,”eth1”,,,,,,,
```

For the installation process to work, xCAT needs to know the mac address of the network interfaces that will be used to install the nodes. This information can be entered into the mac table by the user, who has gathered this information or it can be retrieved by xCAT’s discovery tools. In our example we used the discovery tool as shown to get the mac address for all nodes in the grp_blade group:

```
# getmacs grp_blade
etsvc03: mac.mac set to 00:11:25:C9:19:BB
```

Confirm that this info has been entered into the mac table, with the command:

```
# tabdump mac
#node,interface,mac,comments,disable
“etsvc03”,,”00:11:25:C9:19:BB”,,
```

Next, configure the console mechanism that is used during node installs with the command:

```
# makeconservercf
```

5.4.5 Configuring NIM resources and installing compute nodes

The basic xCAT management configuration has now been completed. The next stage in our example is to get xCAT to configure NIM on the management node. We will not go into detail of this process because it is already covered in other areas of this book. We do, however, list the commands that were run on our xCAT management node, so that you may follow the process. In our example we will be performing an “rte” install method and the AIX install files have been placed into the temporary directory `/export/temp`.

The command to configure NIM and create a group of NIM resources called 537lpp are shown in Example 5-88.

Example 5-88 Creating NIM resources

```
# mknimimage -V -s /export/temp 537lpp
   Configuring NIM.
   Running: ‘nim_master_setup -a mk_resource=no -a device=/export/temp’
   Running: ‘/usr/sbin/nim -o define -t bosinst_data -a server=master
-a location=/install/nim/bosinst_data/537lpp_bosinst_data
537lpp_bosinst_data  2>&1’
   Creating a NIM lpp_source resource called ‘537lpp_lpp_source’.  This
could take a while.
   Creating a NIM SPOT resource. This could take a while.

   Running: ‘/usr/sbin/nim -o define -t resolv_conf -a server=master -a
location=/install/nim/resolv_conf/537lpp_resolv_conf/resolv.conf
537lpp_resolv_conf  2>&1’
The following xCAT osimage definition was created. Use the xCAT lsdef
command to view the xCAT definition and the AIX lsnim command to view
the individual NIM resources that are included in this definition.
   Object name: 537lpp
      bosinst_data=537lpp_bosinst_data
      imagetype=NIM
      lpp_source=537lpp_lpp_source
      nimmethod=rte
      nimtype=standalone
      osname=AIX
      resolv_conf=537lpp_resolv_conf
      spot=537lpp
```

Create the NIM client definitions that align with the nodes in the grp_rte group, in our example node etsvc03, as shown in Example 5-89.

Example 5-89 Creating NIM client definitions

```
# xcat2nim -t node grp_rte
   etsvc04: NIM operations have completed successfully.
# lsnim
   master                   machines       master
   boot                     resources      boot
   nim_script               resources      nim_script
   master_net               networks       ent
   537lpp_bosinst_data      resources      bosinst_data
   537lpp_lpp_source        resources      lpp_source
   537lpp                   resources      spot
   537lpp_resolv_conf      resources       resolv_conf
   etsvc03                 machines        standalone
# lsnim -l etsvc03
   etsvc03:
     class          = machines
     type           = standalone
     connect        = shell
          platform       = chrp
     netboot_kernel = mp
     if1            = master_net etsvc03 001125C919BB ent
     cable_type1    = N/A
     Cstate         = ready for a NIM operation
     prev_state     = ready for a NIM operation
     Mstate         = not running
```

At this time, no NIM resources have yet been allocated to node etsvc03:

```
   # lsnim -c resources etsvc03
```

Next, allocate the required NIM resources to node etsvc03 to perform an “rte” install, using the **nimnodeset** command, as shown in Example 5-90.

Example 5-90 Allocating install resources for xCAT nodes

```
# nimnodeset -V -i 537lpp grp_rte
etsvc04: Running- ‘/usr/sbin/nim -o bos_inst  -a accept_licenses=”yes”
-a source=”rte” -a lpp_source=”537lpp_lpp_source” -a
bosinst_data=”537lpp_bosinst_data” -a boot_client=”no” -a
resolv_conf=”537lpp_resolv_conf” -a spot=”537lpp” -a
script=xcataixscript  etsvc03 2>&1’
etsvc04: AIX/NIM nodes were initialized.
```

Using the xCAT command, set the boot sequence of the node to network as its first option:

```
   # rbootseq grp_blade net,hd
   etsvc03: net,hd0,none,none
```

Then power on the node with the **rpower** command:

```
   # rpower grp_blade reset
   etsvc03: reset
```

The node etsvc03 will power up and start the AIX install process. The following NFS resources were created and exported from the xCAT management node, as shown in Example 5-91.

Example 5-91 Checking exported file systems on the NIM master

```
# showmount -e etsvc04
export list for etsvc04:
/install/postscripts                                 (everyone)
/install/nim/lpp_source/537lpp_lpp_source            etsvc03.mycluster.com
/install/nim/bosinst_data/537lpp_bosinst_data        etsvc03.mycluster.com
/install/nim/resolv_conf/537lpp_resolv_conf/resolv.conf etsvc03.mycluster.com
/install/nim/spot/537lpp/usr                         etsvc03.mycluster.com
/install/nim/scripts/xcataixscript                   etsvc03.mycluster.com
/export/nim/scripts/etsvc03.script                   etsvc03.mycluster.com
```

Part 3

Managing

In this part we provide information on some of the most common tasks you may encounter in day to day administration of an xCAT cluster.

6

xCAT 2 - advanced administrative topics

This chapter introduces and describes some of the common administrative tasks you may encounter in an xCAT environment, such as:

- Using xCAT 2 to perform additional SW installation tasks
- Installing monitoring software in xCAT
- Installing additional software using xCAT postscripts
- xCAT 2's distributed commands
- Using xCAT to upgrade System p firmware
- Adding GPFS to a diskless xCAT cluster
- PowerVM deployment and management using xCAT
- Databases - SQLite and MySQL
- Clustering security
- Updating xCAT using latest development snaphots
- Data to gather for support

6.1 Using xCAT 2 to perform additional SW installation tasks

Software installations and updates can be done using NIM functionality for software products in AIX bff or RPM package formats.

Other software installations can be managed with postscripts, if the install should be made at install time, or running remote commands from the management node at a later time. The packages to be installed can be placed into a file collection, distributed and installed when necessary. Alternately, you can use an NFS repository, if the files are needed only for the time of install.

For NIM install the `lpp_source` file has to be updated. This means that the filesets have to be added into the NIM `lpp_source` resource.

In this section we describe NIM update and install.

6.1.1 Updating OpenSSL and OpenSSH on xCAT nodes

After the update packages with all prerequisites have been downloaded to the xCAT MN (made available via NFS), perform the following steps to update the nodes. If the SW to be updated is part of regular AIX or the cluster functionality depends on it, then the update should be done first on the xCAT MN.

Note: As a NIM master, the xCAT MN has to be at least the same OS level as the nodes it serves.

The filesets for the OpenSSH and OpenSSL are already listed in two NIM `installp_bundle` collections, so we can use these bundles for the NIM customizing of the node.

Step 1: Preparing the NIM lpp_source

To preserve the existing `lpp_source` (for future reference), but allow also installing and updating of nodes with new releases, we need to create a replica of the existing `lpp_source` that will also hold the updates.

In this example we replicate the existing `lpp_source` to a new `lpp_source` for the update. However, to reduce the amount of disk space, we will add hard links to the original install files (`lpp_source`).

- Collect information about the `lpp_source` NIM resource, which will be updated as shown in Example 6-1 on page 249.

Example 6-1 Listing lpp_source attributes

```
[p630n05][/]> lsnim -t lpp_source
539image_lpp_source         resources       lpp_source
[p630n05][/]> lsnim -l 539image_lpp_source
539image_lpp_source:
   class       = resources
   type        = lpp_source
   arch        = power
   Rstate      = ready for use
   prev_state  = unavailable for use
   location    = /install/nim/lpp_source/539image_lpp_source
   simages     = yes
   alloc_count = 0
   server      = master
```

- A new directory is created with all the subdirectories which exist in the location of the original `lpp_source`, as shown in Example 6-2.

Example 6-2 Replicate the directory structure of the base lpp_source

```
[p630n05][/]> mkdir /install/nim/lpp_source/539image_lpp_source_update
[p630n05][/]> find /install/nim/lpp_source/539image_lpp_source -type
d|cut -d/ -f6-|awk '{print "/install/nim/lp
p_source/539image_lpp_source_update/"$1}'|xargs -I {} mkdir {}
```

- Create hard links to the files in the base `lpp_source`. Example 6-3 shows a command to do this.

Example 6-3 Create links to base lpp_source files

```
[p630n05][/]> find /install/nim/lpp_source/539image_lpp_source -type
f|xargs -I {} echo {} {}|sed "s/539image_lp
p_source/539image_lpp_source_update/2"|awk -F/ '{for (i=1;i<=NF;i++)
{if (i<(NF-1)) {printf $i"/"} else {if (i==
(NF-1)) {printf $i} else {printf "\n"}}}}'|awk '{print "ln "$1"
"$2}'|xargs -I {} ksh {}
```

- Create a new `lpp_source` NIM resource, as shown in Example 6-4.

Example 6-4 Creating lpp_source NIM resource for the updates

```
[p630n05][/]> nim -o define -t lpp_source -a server=master -a
arch=power -a location=/install/nim/lpp_source/539
image_lpp_source_update 539image_lpp_source_update
```

- Update the new lpp_source with the filesets for OpenSSH and OpenSSL, which are placed in the /tmp/csm2xcat/openssh directory. Example 6-5 shows the content of the directory and the command to update an lpp_source. The **nim** command copies the files into the lpp_source location and updates the .toc file as well.

Example 6-5 Updating the lpp_source

```
[p630n05][/]> ls -l /tmp/csm2xcat/openssh
total 26816
-rw-r-----    1 root     system      4745216 May 13 10:48 openssh.base
-rw-r-----    1 root     system       181248 May 13 10:48
openssh.license
-rw-r-----    1 root     system       121856 May 13 10:48
openssh.man.en_US
-rw-r-----    1 root     system        14336 May 13 10:48
openssh.msg.en_US
-rw-r-----    1 root     system      6294528 May 13 10:48 openssl.base
-rw-r-----    1 root     system        28672 May 13 10:48
openssl.license
-rw-r-----    1 root     system      2331648 May 13 10:48
openssl.man.en_US
[p630n05][/]> nim -o update -a source=/tmp/csm2xcat/openssh -a
gencopy_flags=X -a packages=ALL 539image_lpp_source_update

/install/nim/lpp_source/539image_lpp_source_update/installp/ppc/openssl
.man.en_US.0.9.8.600.I
/install/nim/lpp_source/539image_lpp_source_update/installp/ppc/openssl
.license.0.9.8.600.I
/install/nim/lpp_source/539image_lpp_source_update/installp/ppc/openssl
.base.0.9.8.600.I
/install/nim/lpp_source/539image_lpp_source_update/installp/ppc/openssh
.msg.EN_US.4.7.0.5300.I
/install/nim/lpp_source/539image_lpp_source_update/installp/ppc/openssh
.man.en_US.4.7.0.5300.I
/install/nim/lpp_source/539image_lpp_source_update/installp/ppc/openssh
.license.4.7.0.5300.I
/install/nim/lpp_source/539image_lpp_source_update/installp/ppc/openssh
.base.4.7.0.5300.I
```

Step 2: Creating a new xCAT NIM image and osimage

You can create a new xCAT osimage from the new lpp_source for future use, as shown in Example 6-6 on page 251. The source is the existing updated lpp_source, and the type should be rte. The command will create an osimage definition as well, based on the nimimage.

Example 6-6 Creating xCAT nimimage and osimage

```
[p630n05][/]> mknimimage -m rte -s 539image_lpp_source_update
539image_update
Using existing bosinst_data resource named
'539image_update_bosinst_data'.

Creating a NIM SPOT resource. This could take a while.

The following xCAT osimage definition was created. Use the xCAT lsdef
command
to view the xCAT definition and the AIX lsnim command to view the
individual
NIM resources that are included in this definition.

Object name: 539image_update
        bosinst_data=539image_update_bosinst_data
        imagetype=NIM
        lpp_source=539image_lpp_source_update
        nimmethod=rte
        nimtype=standalone
        osname=AIX
        spot=539image_update
[p630n05][/]> tabdump osimage
#imagename,imagetype,osname,osvers,osdistro,osarch,comments,disable
...
"539image_update","NIM","AIX",,,,,
[p630n05][/]> tabdump nimimage
#imagename,nimtype,lpp_source,spot,root,dump,paging,resolv_conf,tmp,hom
e,shared_home,res_group,nimmethod,script,bosinst_data,installp_bundle,m
ksysb,fb_script,comments,disable
...
"539image_update","standalone","539image_lpp_source_update","539image_u
pdate",,,,,,,,,"rte",,"539image_update_bosinst_data",,,,,
[p630n05][/]> lsnim
...
539image_lpp_source_update      resources       lpp_source
539image_update_bosinst_data    resources       bosinst_data
539image_update                 resources       spot
...
```

Step 3: NIM customization to update the SW on the nodes

Example 6-7 on page 252 shows the command to run node customization for one of our xCAT nodes. This will install the latest version of the OpenSSL and OpenSSH filesets, which basically means updating those filesets.

Example 6-7 Install updates to the nodes via NIM customization

```
[p630n05][/]> nimnodecust -s 539image_lpp_source_update -b
xCATaixSSL,xCATaixSSH virt-p5501_p6
```

Note: It is a good practice to install the update only onto a part of the cluster nodes and run required tests before a full deployment. Because we use NIM to update nodes, this may require the creation of additional `lpp_sources` to keep the production NIM resources unchanged. For details, refer to *NIM from A to Z in AIX 5L*, SG24-7296.

6.1.2 Installing new software

Installing new software requires the following steps:

1. Download the filesets to a local directory.
2. Update the `lpp_source`. This step adds the additional filesets to the `lpp_source`. This is necessary because both the NIM commands and the xCAT **`nimnodecust`** command use an `lpp_source` for the installation.
3. Install the new SW to the target nodes.
   - Using basic NIM commands requires two steps:
     i. Allocate the `lpp_source` to the NIM clients.
     ii. Run NIM node customization.
   - Run the xCAT **`nimnodecust`** command to allocate the NIM resources and install the new filesets in one step.

6.1.3 Installing additional software using xCAT postscripts

In this section we look at the process of utilizing xCAT to perform the installation and configuration of additional cluster software. This includes both IBM and non-IBM software such as IBM POE and open source packages like OpenPBS, Torque, and Maui. This demonstrates that xCAT can be a powerful tool for creating a complete operational cluster, with the compute node containing the base operating system, monitoring tools, scheduling software, math libraries, and parallel programming languages.

There are within xCAT a number of methods for tailoring the install of the compute nodes.

One simple method utilized in Linux is to alter the install kickstart file, found in xCAT's `/opt/xcat/install/{OS }` directories. Then define this file as a profile attribute to an xCAT install command such as **`rinstall`**.

With AIX we can utilize a `bosinst_data` file to help tailor which IBM software packages are installed during an initial compute node build. However, unlike a Linux kickstart file which can execute additional commands, an AIX `bosinst_data` file cannot do this. In AIX, NIM functionality overcomes this limitation, allowing the administrator to define additional scripts which NIM will execute "post-first-reboot."

It is this process that is utilized by xCAT to execute a script during a node software install. The script `xcataixscript`, found by default in `/install/nim/scripts`, is executed automatically by NIM on the compute nodes after their first reboot. The function of the script is to allow xCAT to perform what is known in xCAT terms as its *postscripts* mechanism.

Within xCAT there is a default table called postscripts (`/etc/prostscripts.sqlite`), which is a comma-separated list of script file names that should be executed on the service or compute nodes after the completion of the basic operating system install.   An actual script that matches the name entered into the process table needs to be placed in xCAT's postscripts directory, which in a default install can be found at `/install/postscripts`.

A sample listing of default scripts in `/install/postscripts` is shown in Example 6-8.

Example 6-8   Default xCAT postscripts

```
#ls /install/postscripts
addsiteyum          enablesysreq        remoteshell         updateflag.awk
aixremoteshell      getcredentials.awk  resyslog            upflagx64.exe
allowcred.awk       getpostscript.awk   serialconsole       upflagx86.exe
ca                  hardeths            servicenode         uploadboot
cert                hostkeys            setiscsiparms.awk   _xcat
code                locallibs           setupLDAP           xcataixpost
confGang            locktftpdir.awk     setupntp            xcataixscript
configeth           makesshgkh          _ssh                xcatclient
configrmcnode       mountpost           syncclock           xcatdsklspost
cvs_template.pl     nfsmounts           syslog              xcatdsklspost.aix
cvs_template.sh     otherpkgs           umountpost          xcatpostinit
enabledebug         reboot              unlocktftpdir.awk   xcatserver
```

A listing of the xCAT's default postscripts table is shown in Example 6-9.

Example 6-9 The default contents of the postscripts table

```
# tabdump postscripts
#node,postscripts,comments,disable
"xcatdefaults","syslog,aixremoteshell",,
"service","servicenode",,
```

As can be seen in Example 6-9, by default the postscripts table contains a default group called *xcatdefaults*, which for AIX contains two default scripts, `syslog`, used for setting up the syslog, and `aixremoteshell`, used to set up a remote shell on the compute nodes. The corresponding scripts can be found in the postscript directory, which also contains a number of additional standard scripts that perform configuration changes to the basic operating system.

Its worth noting that none of these additional scripts will be executed on the compute nodes without a corresponding entry in the postsripts table. In our example we will add setupntp, a script that can be used to configure the NTP daemon on the compute nodes, to use the xCAT management node as their NTP source. Thus we will add setupntp to the xcatdefaults group in the postscripts table:

```
# chdef -t node -o xcatdefaults \ >
> postscripts="syslog,aixremotesh,setupntp"
Object definitions have been created or modified.
```

Installing AIX packages using xCAT postscripts

Consider an additional case, where you need to perform configuration only on one or a subset of all the compute nodes. By adding either a new group or node to the postscripts table, it is possible to perform additional configuration above that set on the xCATS default list.

In the example below, one node will be installed with additional software. In this case, to make it a simple example, this additional code will be the Openssl and Openssh packages from AIX. First we need to add the name of a new script to the postscripts table for our node:

```
# chdef -t node -o etsvc03 postscripts=""aixOpensslinstall"
Object definitions have been created or modified.
```

Then you need to create a new script in the `/install/postscripts` directory, as shown in Example 6-10.

Example 6-10 Postscript for installing OpenSSH

```
#!/bin/ksh
```

```
echo "start aixOpensslinstall script" >>/tmp/aixOpensslinstall.log
logger -t xcat "start aixOpensslinstall script"

RESNAME=$NODE

NFSSERVER=$MASTER
POSTDIR=/post
POST_DIR=${INSTALLDIR}${POSTDIR}

logger -t xcat "Install: mounting /post"
mkdir $POSTDIR >>/tmp/aixOpensslinstall.log 2>&1
mount $NFSSERVER:$POST_DIR $POSTDIR >>/tmp/aixOpensslinstall.log 2>&1

sleep 2

installp -aXg -Y -d$POSTDIR/otherpkgs/AIX openssl.man.en_US
openssl.license openssl.base >>/tmp/aixOpensslinst
all.log  2>&1
installp -aXg -Y -d$POSTDIR/otherpkgs/AIX openssh.msg.en_US
openssh.license openssh.base openssh.base.server o
openssh.base.client >>/tmp/aixOpensslinstall.log 2>&1

unmount $POSTDIR
```

It is worth noting a few items from the script shown in Example 6-10, which is a korn shell, but scripts can also be Perl-based. The variables NODE and MASTER are taken from NIM settings. The script makes use of both local logging via a file in `/tmp` (this is the compute nodes' `tmp` directory), and remote logging back to the xCAT master. With the command **`logger -t xcat "start aixOpensslinstall script"`** create an entry on the xCAT management node's **`/var/log/messages`** file.

The script then mounts an NFS directory called `/install/post` from the xCAT management node, and performs an installp of the Openssl and Openssh packages, which have been copied into `/install/post/otherpkgs/AIX`.

Now on the next install of our test node etsvc03, on top of the basic AIX install, xCAT will also run both the `setupntp` and the `aixOpensslinstall` scripts.

The output from `/var/log/messages` on the xCAT master is shown in Example 6-11.

Example 6-11 Postscripts execution output for NTP and SSH

```
00:27:16 etsvc03 syslog:info Message forwarded from etsvc03: syslogd:
restart
00:27:16 etsvc03 user:notice Message forwarded from etsvc03: xCAT:
Install: syslog setup
00:27:17 etsvc03 user:notice Message forwarded from etsvc03: xcat:
Install: Setup NTP
00:27:17 etsvc03 user:notice Message forwarded from etsvc03: xcat:
ntpdate -t5 etsvc04
00:27:40 etsvc03 daemon:notice Message forwarded from etsvc03:
xntpd[225460]: 3.4y
00:27:40 etsvc03 user:notice Message forwarded from etsvc03: xcat:
start aixOpensslinstall script
00:27:40 etsvc03 user:notice Message forwarded from etsvc03: xcat:
Install: mounting /post
00:28:37 etsvc03 auth|security:info Message forwarded from etsvc03:
sshd[258230]: Server listening on 0.0.0.0 port 22.
```

In Example 6-11, we could add any number **`installp`** commands in the script. Thus, additional packages such as IBM Parallel Operating Environment (POE), and IBM LoadLeveler could be installed.

Installing non-IBM software using xCAT postscripts

In the following example of xCAT's postscript mechanism, a non-IBM package will be installed and configured, in this case the open source scheduler Torque.

First we needed to download the Torque package to the xCAT master from the following Web site:

`http://www.clusterresources.com/pages/products/torque-resource-manager.php`

As is the default with a lot of open source packages, the executables have not been built and require compiling for your particular platform, in our case AIX. The process of building these executables will not be covered in our example. Thus, having built the executables, we installed one of the servers, in our case our xCAT management node, which is also our master scheduler.

Next, the compute nodes need to be configured as executable hosts. So in our test system, we will re-install our compute node etsvc03, and utilize the postscript process to install and configure the Torque client code.

First add the name of our new script to the postscript table:

```
# chdef -t node -o etsvc03 postscripts=”"aixOpensslinstall, aixtorque”
Object definitions have been created or modified.
```

Then create this new script in the `/install/postscript` directory. A sample script is shown in Example 6-12.

Example 6-12 Torque install postscript

```
#!/bin/ksh

echo "start aixtorque script" >>/tmp/aixtorque.log
logger -t xcat "start aixtorque script"

RESNAME=$NODE

NFSSERVER=$MASTER
POSTDIR=/post
POST_DIR=${INSTALLDIR}${POSTDIR}

logger -t xcat "Install: mounting /post"
mkdir $POSTDIR >>/tmp/aixtorque.log 2>&1
mount $NFSSERVER:$POST_DIR $POSTDIR >>/tmp/aixtorque.log 2>&1

sleep 2

rpm -ivh $POSTDIR/otherpkgs/AIX/tar-1.13-4.aix4.3.ppc.rpm
>>/tmp/aixtorque.log 2>&1

cd / >>/tmp/aixtorque.log 2>&1
gtar -zxvf
$POSTDIR/otherpkgs/AIX/torque-package-devel-aix5-powerpc.tar.gz
>>/tmp/aixtorque.log 2>&1
gtar -zxvf
$POSTDIR/otherpkgs/AIX/torque-package-mom-aix5-powerpc.tar.gz
>>/tmp/aixtorque.log 2>&1

cd /var/spool/torque >>/tmp/aixtorque.log 2>&1
chmod 777 spool undelivered >>/tmp/aixtorque.log 2>&1
chmod o+t spool undelivered >>/tmp/aixtorque.log 2>&1
echo $MASTER >> /var/spool/torque/server_name

unmount $POSTDIR
```

Again, a few notes about this script. Like the last, it uses the NFS directory `/install/post/otherpkgs/AIX` to host the software to be installed. In this case the packages are gzip'ed tarballs . We also install the AIX version of the open source **`tar`** command, allowing both the unzip and untar in one process.

Then, due to errors in the torque package creation, we need to alter permissions of the torque spool directory. Finally, we need to add the name of the torque manager to a config file in the spool directory.

Having redone the xCAT install for our compute node etsvc03, we notice at the correct point in the install process in the message logs on the xCAT master:

```
01:20:18 etsvc03 user:notice Message forwarded from etsvc03: xcat:
start aixtorque script
01:20:18 etsvc03 user:notice Message forwarded from etsvc03: xcat:
Install: mounting /post
```

And on the compute node, in `/tmp` our local log file `aixtorque.log`, with the news that our install worked.

As shown, the xCAT postscripts install mechanism is a powerful tool, and any software package that does not require an interactive install or configure process should, with the right script, be able to be installed on the nodes.

6.2 Installing monitoring software in xCAT

Two monitoring infrastructures are introduced in xCAT 2.0. For a diagram on how monitoring is plugged into xCAT, see Figure 6-1.

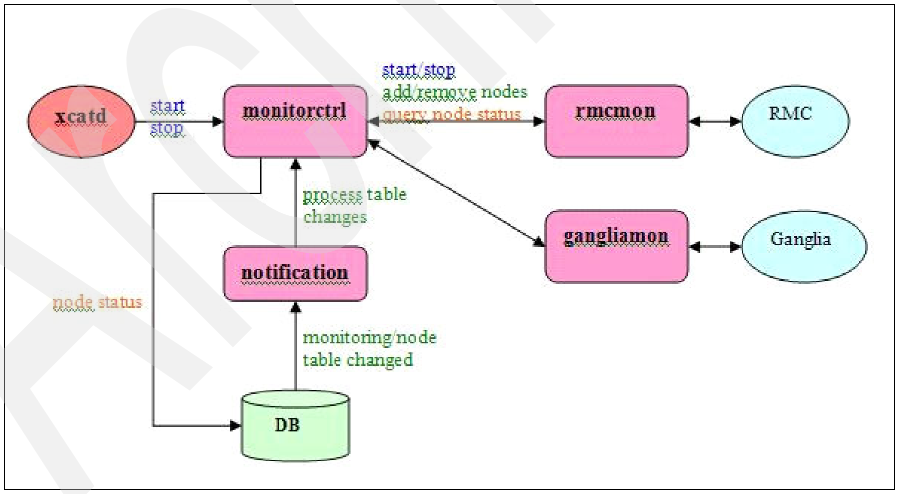

Figure 6-1 xCAT monitoring plug-in diagram

1. The xCAT Monitoring Plug-in Infrastructure allows you to plug in one or more third-party monitoring software such as RMC, Ganglia, and Performance Pilot to monitor the xCAT cluster.
2. The xCAT Notification Infrastructure allows you to watch for the changes in xCAT database tables.

With xCAT 2.0, you can also integrate third-party monitoring software into your xCAT cluster. The idea is to use monitoring plug-in modules that act as bridges to connect xCAT and the third-party software.

IBM Reliable Scalable Clustering Technology (RSCT)

The IBM Resource Monitoring and Control (RMC) subsystem (part of RSCT) is our recommended software for monitoring xCAT clusters. RMC is part of the IBM Reliable Scalable Cluster Technology (RSCT) that provides a comprehensive clustering environment for AIX and Linux. The RMC subsystem and the core resource managers that ship with RSCT enable you to monitor various resources of your system and create automated responses to changing conditions of those resources. RMC also allows you to create your own conditions (monitors), responses (actions) and sensors (resources).

Other monitoring software

Other monitoring software with plug-ins for xCAT in AIX environment is:

1. Ganglia - An open source monitoring suite for HPC environments
2. Performance Pilot - A family of products from SGI for system-level performance monitoring and management services
3. Nagios is an open source computer and network monitoring software. It provides host (hardware, OS) and services (software) monitoring.

In xCAT, there are seven commands available for monitoring purposes, located in `/opt/xcat/bin`:

`monls`	Lists the current or all the monitoring plug-in names, their status and description.
`monadd`	Adds a monitoring plug-in to the monitoring table. This will also add the configuration scripts for the monitoring plug-in, if any, to the postscripts table.
`monrm`	Removes a monitoring plug-in from the monitoring table. It also removes the configuration scripts for the monitoring plug-in from the postscripts table.
`moncfg`	Configures the third-party monitoring software on the management server and the service node for the given nodes to include the nodes into the monitoring domain. It does all the

necessary configuration changes to prepare the software for monitoring the nodes. The **`-r`** option will configure the nodes as well.

`mondecfg`	Deconfigures the third-party monitoring software on the management server and the service node for the given nodes to remove the nodes from the monitoring domain. The **`-r`** option will deconfigure the nodes as well.
`monstart`	Starts third-party software on the management server and the service node for the given nodes to monitor the xCAT cluster. It includes starting the daemons. The **`-r`** option will start the daemons on the nodes as well.
`monstop`	Stops third-party software on the management server and the service node for the given nodes from monitoring the xCAT cluster. The **`-r`** will stop the daemons on the nodes as well.

6.2.1 Defining monitoring servers

You can skip this section if you have a small number of nodes to monitor, or if you prefer, the management node (mn) can handle the monitoring loads. For a large cluster, it is recommended that you dedicate some nodes as monitoring aggregation points. These nodes are called monitoring servers. You can use the service nodes (sn) as the monitoring servers, which are defined by the monserver column of the noderes table.

The data in the monserver column is comma-separated pairs of host names or IP addresses. The first host name or IP address represents the network adapter that connects to the mn. The second host name or IP address represents the network adapter that connects to the nodes. If no data is provided in the monserver column, the values in the servicenode and xcatmaster columns in the same table will be used. If none is defined, the mn will be used as the monitoring server.

In the example depicted in Figure 6-2, the nodes in group2 have a dedicated monitoring server (monsv02) while the nodes in group1 use their service node as the monitoring server (sn01).

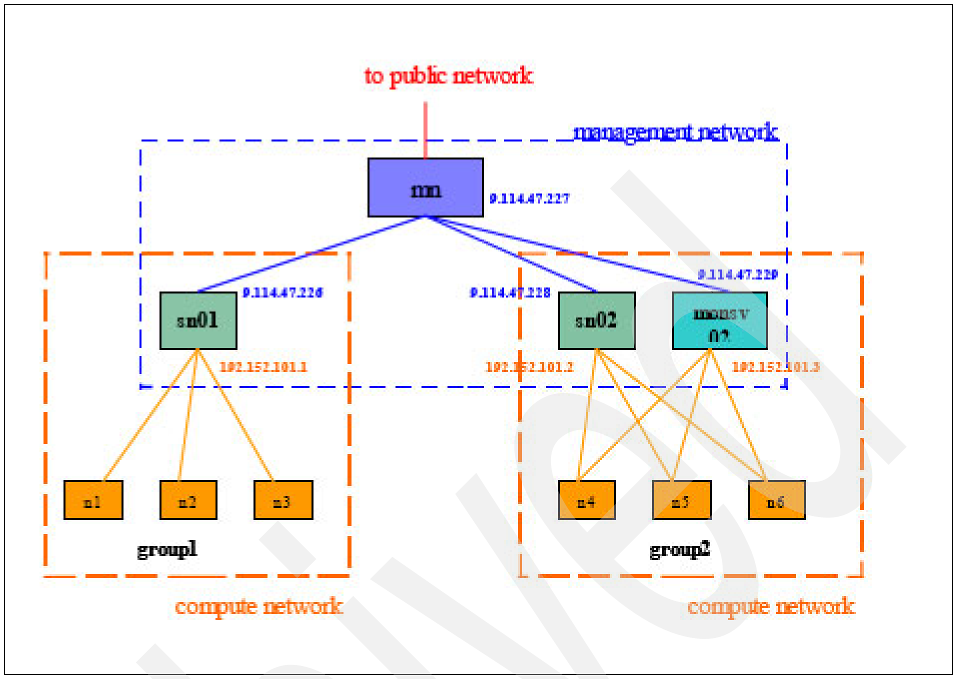

Figure 6-2 Hierarchical cluster monitoring

The node name resolution data for the cluster depicted in Figure 6-2 is shown in Table 6-1.

Table 6-1 Cluster IP table

Node	Monitoring servers	Service node	xCAT MN
sv01		192.168.100.34	192.168.100.34
sv02		192.168.100.34	192.168.100.34
monsv02		192.168.100.34	192.168.100.34
group1		sv01	192.168.101.1
group2	monsv02, 192.168.100.3	sv02	192.168.101.2

Use the command **`tabdump noderes`** to examine output. Output is in the csv format. Use **`tabedit noderes`** to edit.

6.2.2 Configure and start monitoring during node deployment

1. Define the nodes in the xCAT cluster. See Chapter 5, “Installing xCAT 2 on a new cluster” on page 153 for details.
2. Install the third-party monitoring software on the management node. See 6.2.4 for RMC, 6.2.5 for Ganglia, 6.2.6 for Performance Pilot.
3. Add the third-party monitoring plug-in software into the images for the service node and the compute node. This involves copying the software onto the `/install/post/otherpkgs/<osver>/<arch>` directory and adding the package names in the “other package” list for the image profile for the nodes. The image profile is located in **`/install/custom/<install|netboot>/<os>`** and it defaults to **`/opt/xcat/share/xcat/<install|netboot>/<os>.`** Refer to the xCAT 2 document *How to Install Additional Software* for details.
4. Add the monitoring plug-in, say xxx, to the monitoring table. Use the **`monadd xxx [-n] [-s]`** command, where **`[-n]`** specifies that the third-party software will also be used as the tool to feed the node status table. The **`[-s]`** flag is for the plug-in specific settings. The node configuration scripts for this monitoring plug-in are added to the postscripts table by this command. Use the **`monls xxx -d`** command to check for the configuration script names for the monitoring plug-in.
5. Configure monitoring software on the management server for the given nodes with **`moncfg xxx <nodes>`** where **`<nodes>`** are the nodes to be monitored.
6. Deploy the nodes **`nodeset`**, **`netboot`**, **`genimage`**, **`packimage`**, **`rpower`**, and so on. Check Chapter 5, “Installing xCAT 2 on a new cluster” on page 153 for details on how to deploy diskless or diskfull nodes. The deployment process will run the configuration scripts for the monitoring plug-in, which will configure and prepare the nodes for monitoring.
7. Start the monitoring after the nodes are up with **`monstart xxx`**. If the cluster has hierarchy, then do step 5 and 6 for the monitoring servers first and then repeat them for the compute nodes. Refer to 6.2.1, “Defining monitoring servers”. Now the cluster is set up for monitoring using the third-party software xxx. You can stop the monitoring at any time with the **`monstop`** command, for example, **`monstop xxx`** or **`monstop xxx -r`** (**`-r`** will stop all the daemons on the nodes as well).

6.2.3 Configure and start monitoring on a running node

This section describes how to add monitoring capability after a node is up and running. For nodes that have local disks, follow Step 2 through Step 7 described in the previous section, 6.2.2, “Configure and start monitoring during node deployment". The only exception is Step 6, where instead of deploying the nodes, you need to run the following command:

```
updatenode <noderange> (runs all the postscripts)
```

or

```
updatenode <noderange> otherpkgs,cfg1,cfg2... (run specific
postscripts)
```

where `otherpkgs` is used to install the new software and `cfg1`, `cfg2`, and so on are the configuration scripts for the monitoring plug-in. To list the configuration script names, use the **`monls xxx -d`** command.

> **Note:** Run the **`updatenode <noderange> cfg1,cfg2`**.. command only if the third-party monitoring software has already been installed.

For diskless nodes, you need to regenerate the image (update the SPOT) and deploy the nodes again. Follow steps 2 through 7 as described in 6.2.2, "Configure and start monitoring during node deployment".

6.2.4 Enable RMC monitoring

As previously mentioned, Resource Monitoring and Control (RMC) is the IBM recommended software for monitoring xCAT clusters, and rmcmon is xCAT's monitoring plug-in module for RMC.

The rmcmon plug-in is responsible for automatically setting up a monitoring domain for RMC and creates predefined conditions, responses, and sensors on the management node, the service node (if used), and the remaining nodes. Also, rmcmon provides node reachability status updates on the xCAT nodelist table via RMC's node status monitoring.

Why RMC?

Here are highlights of the RMC monitoring technology:

- Each RMC client defines its own meaningful events. In other words, each client can specify what resource state should result in an event notification. This specification can be a simple threshold for one resource metric to a complex relationship of several metrics of the same resource.
- Resources to be monitored can be specified using "patterns." Any resource that matches that pattern is monitored. Furthermore, any new resources that match the pattern are automatically monitored when they are created. Event notifications indicate that new resources are now being monitored.

- Events are generated when monitored resources are removed from the cluster.
- Events are generated when monitoring is stopped due to some failure and generated when monitoring is recovered.
- Resource data is obtained via efficient local polling (function calls) or provided via callbacks using OS hooks.
- Command line interfaces are provided to easily enable monitoring and to have scripts executed to process events.
- Support for customer-defined resources to monitor customer-unique data. Sensor resources obtain data via execution of a script.
- All intra-cluster network traffic is reliable (acks, retries) UDP using a single well known port.
- Client connections to RMC are typically Unix Domain Sockets, whereas connections to remote clusters are realized via TCP.
- The only steady state network traffic is small UDP packets for heartbeat.
- Out of the box security for authentication, authorization and message protection.
- Ships with, and is automatically installed by AIX. RMC is used for HMC<->LPAR communication for Dynamic LPAR and Service Focal Point™. No customer set-up required.

With xCAT, RSCT provides two new resource classes, IBM.MngNode and IBM.MCP. These classes are analogous to CSM's IBM.ManagedNode and IBM.ManagementServer, respectively, and contain sufficient information to create and modify a management domain.

So that system administrators do not have to write RMC applications, RSCT provides the Event Response Resource Manager (IBM.ERRM) to do monitoring.

This resource manager implements three resource classes:

- IBM.Condition
- IBM.EventResponse
- IBM.Association

As you may already know, the IBM.Sensor resource class provides a way to monitor resources for which no resource manager exists. A Sensor resource is simply the specification of a script whose output is assigned to a set of dynamic attribute values. The Sensor script is invoked at some periodic interval or on demand. A command interface can also be used to supply the dynamic attribute values.

Enabling RMC monitoring

Follow these steps:

1. RSCT is shipped with the AIX operating system. However, you need to make sure that the level of software is supported by xCAT. For AIX 5.3, you need at least RSCT 2.4.9.0, which ships with AIX 5.3.0.80 or greater. For AIX 6.1, you need at least RSCT 2.5.1.0, which ships with AIX 6.1.1.0 or greater. To check the RSCT level on the Management Node (MN):

   ```
   /usr/sbin/rsct/install/bin/ctversion  -or-   lslpp -l | grep rmc
   ```

2. Confirm that xCAT-rmc has been installed on the Management Node.

   ```
   rpm -qa | grep rmc
   ```

   This rpm was included in one of the bundle files that are included in the xCAT for AIX tar file that is available from the xCAT Web site.

3. Setting up xCAT DB.

   Make sure that all the nodes and service nodes that need to have RMC installed have `osi` in the nodetype column of the nodetype table.

   ```
   tabdump nodetype
   ```

   Make sure that the mac column of the mac table for the nodes and the service nodes is populated because the mac address will be used as an RMC nodeid for the node.

   ```
   tabdump mac
   ```

4. Setting up the xCAT hierarchy.

   Skip this if you have a flat cluster (non-hierarchical, not using service nodes).

   In displaying tabdump noderes, the monserver column of the noderes table is used to define a monitoring server for a node. `monserver` is a comma-separated pair of hostnames or IP addresses. The first one is the monitoring server name or IP known by the mn. The second one is the same host known by the node.

   ```
   chdef -t node -o node5 monserver=9.114.46.47,192.168.52.118
   ```

   If monserver is not set, the default is the servicenode and xcatmaster pair in the noderes table.

5. Add rmcmon in the monitoring table.

   ```
   monadd rmcmon
   ```

   or

   ```
   monadd rmcmon -n
   ```

   This will also add the `configrmcnode` postscript into the postscripts table. The second command registers the rmc plug-in module to monitor the xCAT cluster and also have it feed the node liveness status to xCAT's nodelist table. Note that to allow monitoring of node liveness you need to have RSCT 2.4.10.0 or greater on an AIX 5.3 system or RSCT 2.5.2.0 or greater on AIX 6.1 for this feature to work.

6. Create resources for the IBM.MngNode class to include each node managed by the management node.

   ```
   moncfg rmcmon nodes
   ```

7. Deploy the nodes and the service nodes as described in the *xCAT 2 cookbook*. This process will automatically set up the RMC monitoring domain. To verify, list all the nodes managed by the Management Node:

   ```
   # lsrsrc -a IBM.Host Name
   Resource Persistent Attributes for IBM.Host
   resource 1:
   Name = "node1"
   resource 2:
   Name = "node2"
   ```

   Use the **xdsh** command to check the nodes managed by the monitoring servers:

   ```
   xdsh monserver_name lsrsrc -a IBM.Host Name
   ```

8. Start RMC monitoring.

   Now that nodes are installed and configured, you can start the RMC monitoring:

   ```
   monstart rmcmon
   ```

   The **monstart** command actually creates a set of predefined conditions, responses and sensors on the Management Node and the monitoring servers. To verify:

   ```
   lscondition
   lsresponse
   lssensor
   ```

Note: When run from a management (or service) node, you no longer have to set the CT_MANAGEMENT_SCOPE variable to get results from all nodes in the managed (xCAT) domain.

The **-a** flag sets the scope to include all nodes in the xCAT managed domain.

Examples (from the management node):

To see resources on the local node only:

```
lscondition
```

To see resources on all nodes in the domain:

```
lscondition -a
```

To see IBM.Host data from all nodes:

```
lsrsrc  -a IBM.Host
```

Now you can pick and choose the conditions to monitor using the **startcondresp** command which associates a condition with a response. A condition can be associated with more than one response.

```
startcondresp AnyNodeVarSpaceUsed EmailRootAnyTime
```

If you have monitoring servers, also turn on the condition with _H in the name.

```
startcondresp AnyNodeVarSpaceUsed_H EmailRootAnyTime
```

Conditions without _H in the name are designed to monitor the nodes that are managed by the Management Node, whereas conditions with _H in the names are for the nodes managed by the monitoring servers. These nodes are grandchildren of the Management Node.

With RMC, you can create your own conditions, responses and sensors for monitoring. For details on configuring and using resource monitoring, refer to *RSCT Administration Guide*.

6.2.5 Enable monitoring with Ganglia

Ganglia is a tool to monitor performance on a small group of LPARs and can also be used on a large cluster of machines. Ganglia is not an IBM product, it is an open source project:

http://ganglia.info/

There are two main processes associated with Ganglia:

1. Data handling - Ganglia meta-data daemon gmetad, which runs on the management node (and service or monitor node, if applicable).
2. Data gathering - Ganglia monitor daemon gmond, which runs on the management node (and service or monitor node, if applicable) and all compute nodes that are to be monitored by Ganglia.

The following prerequisites are required for installing Ganglia on the xCAT management node:

- **Round Robin Database**: rrdtool
  (rrdtool also needs to be installed on any service or monitor nodes present in the cluster.)
- **Web Server**: Apache 2
- **Web Scripting Language**: PHP 5

Obtaining and installing RPMs

The following steps are presented with the assumption that the xCAT cluster has been configured and is operational.

1. Obtain and install the rrdtool database RPM for the management node and any service or monitor nodes present in the cluster.

   The rrdtool RPM is available from:

   `http://www.perzl.org/aix/index.php?n=Main.Rrdtool`

   Note that the URL also notes that there are package dependencies for rrdtool:

   ```
   libart_l
   gpllibpng
   freetype2z
   libperl 5.8.2
   ```

   They can be obtained from this Web page and also from the AIX-Linux Affinity Web site:

   `http://www.ibm.com/servers/aix/products/aixos/linux/download.html`

2. Obtain and install the PHP RPM for the management node.
   (PHP is an HTML-embedded scripting language.)
   Obtain it from:

   `http://www.perzl.org/aix/index.php?n=Main.Php`

   Also note the package dependencies on this page.

   Obtain and install Apache (httpd) RPM for the management node:

   `http://www.perzl.org/aix/index.php?n=Main.Apache`

Also note the package dependencies on this page.

3. Obtain and install Ganglia RPMs for AIX for the management node:

   http://www.perzl.org/ganglia/ganglia-files-v3.0.7.html

   - v3.0.7 is the latest available on this site.
   There are later releases of source files available at:

   http://ganglia.info/

   But for AIX you will need to compile these source files.

   The following RPMs will be installed on the management node:

   – ganglia-gmetad-3.0.7-1.aix5.3.ppc.rpm
   – ganglia-gmond-3.0.7-1.aix5.3.ppc.rpm
   – ganglia-web-3.0.7-1.noarch.rpm

4. If using service (or monitor) nodes, they should also have the following packages installed:

   – ganglia-gmetad-3.0.7-1.aix5.3.ppc.rpm
   – ganglia-gmond-3.0.7-1.aix5.3.ppc.rpm

   Note that ganglia-web does not need to be installed on a service or monitor node.

5. gmond is the only RPM to be installed on the compute nodes: ganglia-gmond-3.0.7-1.aix5.3.ppc.rpm

   You may wish to nfs mount the directory from the management node (or service node) that contains the ganglia-gmond RPM and install from that directory using the **xdsh** command:

   ```
   xdsh <noderange> mount mgtnode:/install/ganglia/rpms /mnt
   ```

   then

   ```
   xdsh <noderange>  rpm -ihv
   /mnt/ganglia-gmond-3.0.7-1.aix5.3.ppc.rpm
   ```

Post RPM install steps

After Ganglia installation is complete, the following steps need to be done on the management node:

1. Setting up xCAT DB

   Make sure all the nodes and service nodes that are to have Ganglia installed have `osi` in the nodetype column of the nodetype table.

   ```
   tabdump nodetype
   ```

2. Make sure that `gangliamon` is added to the monitoring table using the command:

   ```
   monadd gangliamon
   ```

   This command will also add the `confGang` configuration scripts to the postscripts table. You can confirm with:

   ```
   tabdump monitoring
   ```

3. Run the **`updatenode`** command to all nodes to be monitored:

   ```
   updatenode <noderange>
   ```

   This step runs the `confGang` postscript (/install/postscripts) on all the nodes. It configures Ganglia on the nodes.

4. It is necessary to edit the default /etc/gmond.conf on the management node to update the cluster name. Here, we have made a change to name = clustersite. (The default is "unspecified".)

Note:

```
/* If a cluster attribute is specified, then all gmond hosts are
wrapped inside
* of a <CLUSTER> tag.  If you do not specify a cluster tag, then
all <HOSTS> will
 * NOT be wrapped inside of a <CLUSTER> tag. */
cluster {
  name = "clustersite"
```

If unsure as to what your cluster name is, do this:

```
lsdef -t site
```

Controlling Ganglia

Configure Ganglia on the management node and the service node(s).

```
moncfg gangliamon
```

There is no need to specify the **`-r`** option because the nodes are configured during the deployment phase.

To start Ganglia on the cluster:

```
monstart gangliamon -r
```

The **`-r`** flag will ensure that the Ganglia daemon (gmond) on the node is started.

To stop Ganglia on the cluster:

```
monstop gangliamon -r
```

You can control nodes individually with the **gmond** control script:

```
/etc/rc.d/init.d/gmond
```

Options are:

```
start
stop
restart
status
```

Example:

```
/etc/rc.d/init.d/gmond stop
```

For more details about using Ganglia for system monitoring, go to the Ganglia home page at:

http://ganglia.info

6.2.6 Other software monitoring options

As of this writing, there are at least two other open source system monitoring options available for AIX systems using xCat. Both require their source code to be compiled on AIX.

- Performance Co-Pilot - An open source application support for system-level performance monitoring and performance management. See:

  http://oss.sgi.com/projects/pcp/

- Nagios - An open source application for monitoring of network services and host resources. See:

  http://www.nagios.org/

6.3 xCAT 2's distributed commands

One of the most powerful elements of xCAT is its mechanism for running distributed commands. Two commands, **xdsh** and **xdcp**, become very strong tools for the administrators and users of the cluster, allowing both the movement of data between the xCAT management node and one or all nodes of the cluster.

These commands also allow the users to simultaneously execute commands and scripts over a range of nodes in the cluster, the screen output of which is collected and displayed back on the source node that issued the distributed command.

It is worth noting that due to the nature of the way **xdsh** works, it cannot be used with any interactive commands.

The first example is of a simple use of the **xdsh** command to execute an AIX command across all the nodes. Here the user is passing an xCAT group as the parameter for the range of nodes to perform the command:

```
# xdsh lp1p65501 date
```

It could be that you need to execute a command only on a range of nodes that do not make up a complete group. Here you can define a starting target node and the end target node, and **xdsh** (and **xdcp**) will understand that you wish to execute the command on all the nodes between. Here is an example, with `lp1p65501` as the starting node, and lp1p65502 as the end node:

```
# xdsh lp1p65501-lp1p65502 date
```

Another alternative is to just pass a list of nodes as the parameter that the command will execute on. Also in this example, the command on the remote nodes will be executed as another user rather than the user who has initiated the **xdsh** command on the source node:

```
# xdsh -l user { with list }
```

It is not just single commands that can be executed. A sequence of commands can be passed as the parameter, or a script and variables can be specified:

```
# xdsh lp1p65501 date;ps
# xdsh -e script
```

Like **xdsh**, the xCAT command **xdcp** can utilize either a group, list, or range of nodes, but this time as either the source or target parameter. As with any copy command you have the starting file location and the target file location, but now with **xdcp** there is the added complexity of both a source node (or nodes) and a target node (or nodes). In the first example we will copy a single file, such as `/etc/hosts`, to all the compute nodes in the cluster:

```
# xdcp all /etc/hosts  /etc/
```

And in this second example we will copy a single file, in our case a log file, from a range of nodes back to the management node:

```
# xdcp lp1p65501-lp1p65503 -P /etc/hosts /tmp/hosts.dir
# ls /tmp/hosts.dir
hosts._lp1p65501     hosts._lp1p65502    hosts._lp1p65503
```

As you can see from the example, when copying multiple files back which all have the same file name but happen to be on different nodes, we could have a potential problem with the files overwriting each other. xCAT solves this problem by adding the name of the node as an extension to the original file name.

The **xdcp** command is not limited to single files, however. It can be utilized to copy a complete directory from a single source to multiple destination nodes, or multiple sources back to a single destination. Again, like in the file instance, here xCAT adds the hostname to the directory name.

With both **xdsh** and **xdcp**, if there are a large number of target nodes, it is possible to add a fanout parameter, which means the network does not get overloaded due to the amount of data being passed over it:

```
# xdcp -f fanout
```

Consolidating distributed command output

Another little-known command of xCAT is **xdshbak**, which can be used to format data coming back from the remote nodes. The example below shows how **xdshbak** can be utilized with an **xdsh** command:

```
# xdsh lp1p65501,lp1p65502,lp1p65503 cat /etc/hosts | xdshbak
```

In addition to specifying command parameters and flags, the following is a list of environment variables you can use with the distributed commands:

DSH_CONTEXT
DEVICETYPE
DSH_ENVIRONMENT
DSH_FANOUT
DSH_NODE_OPTS
DSH_NODE_RCP
DSH_NODE_RSH
DSH_PATH
DSH_SYNTAX
DSH_TIMEOUT

For more details, check the man pages for **xdsh**, **xdcp** and **xdshback**.

6.4 Using xCAT to upgrade System p firmware

xCAT can be used to maintain and update the firmware of the IBM System p managed systems that are under xCAT management.

The **rflash** command is used from the management node to initiate system firmware updates.

The **rflash** command initiates firmware updates on supported xCAT nodes. Licensed Internal Code (also known as microcode) updates are performed on supported HMC-attached POWER5™ and POWER6 pSeries nodes.

The command scans the specified directory structure for firmware update package files applicable to the given nodes and components. And then it will automatically select the latest version for the upgrade. The firmware update files include the microcode update package and associated XML files. They can be downloaded from:

http://www.ibm.com/support/fixcentral

The POWER5 and POWER6 systems contain several components that use Licensed Internal Code. The **rflash** command supports two of these components: the managed system (also known as the Central Electronics Complex, or CEC) and the power subsystem (also known as the Bulk Power Assembly (BPA) or Bulk Power Controller (BPC)). Some POWER5-managed systems can be attached to a power subsystem. These power subsystems can support multiple managed systems. When the **rflash** command is invoked, xCAT will determine the managed system or power subsystem associated with that CEC and perform the update.

The **rinv** command can be used to determine the current firmware level, as shown in Example 6-13.

Example 6-13 Use the rinv command to display current firmware levels

```
mgtnode #rinv lp1p65501 firm
lp1p65501: Release Level  : 01EL340
lp1p65501: Active Level   : 39
lp1p65501: Installed Level: 39
lp1p65501: Accepted Level : 37
lp1p65501: Release Level Primary: 01EL340
lp1p65501: Level Primary  : 39
mgtnode #
```

We can also use the **rinv** command to display the firmware of groups of nodes. In Example 6-14 we used the **rinv** command to show the firmware levels of the nodes in the fsp group.

Example 6-14 Using rinv to display firmware levels in a node group

```
mgtnode #rinv fsp firm
Server-8204-E8A-SN10FE401: Release Level  : 01EL340
```

```
Server-8204-E8A-SN10FE401: Active Level   : 39
Server-8204-E8A-SN10FE401: Installed Level: 39
Server-8204-E8A-SN10FE401: Accepted Level : 37
Server-8204-E8A-SN10FE401: Release Level Primary: 01EL340
Server-8204-E8A-SN10FE401: Level Primary  : 39
Server-8204-E8A-SN10FE411: Release Level  : 01EL340
Server-8204-E8A-SN10FE411: Active Level   : 39
Server-8204-E8A-SN10FE411: Installed Level: 39
Server-8204-E8A-SN10FE411: Accepted Level : 37
Server-8204-E8A-SN10FE411: Release Level Primary: 01EL340
Server-8204-E8A-SN10FE411: Level Primary  : 39
9117-MMA-SN101F170-L10: Release Level  : 01EM340
9117-MMA-SN101F170-L10: Active Level   : 39
9117-MMA-SN101F170-L10: Installed Level: 39
9117-MMA-SN101F170-L10: Accepted Level : 37
9117-MMA-SN101F170-L10: Release Level Primary: 01EM340
9117-MMA-SN101F170-L10: Level Primary  : 39
9117-MMA-SN100F6A0-L9: Release Level  : 01EM340
9117-MMA-SN100F6A0-L9: Active Level   : 39
9117-MMA-SN100F6A0-L9: Installed Level: 39
9117-MMA-SN100F6A0-L9: Accepted Level : 37
9117-MMA-SN100F6A0-L9: Release Level Primary: 01EM340
9117-MMA-SN100F6A0-L9: Level Primary  : 39
mgtnode #
```

We then executed the **rflash** command against two LPARs, one on each managed system we wished to update. We chose to update the 9117-MMA systems. The **rflash** command figures out which managed system to update based upon the managed system the LPAR is running on. The **rflash** command will communicate to the HMC that owns the managed system and the update will be executed from the HMC in the background. Once the update has finished, the **rflash** command returns the results, as shown in Example 6-15.

Example 6-15 Executing the rflash command for multiple systems

```
mgtnode #rflash lp1p6mma1,lp1p6mma2 -p /install/fw/mma/340_061_039
--activate concurrent
hmc4: lp1p6mma1 is a Lpar on MTMS 9117-MMA*101F170
hmc4: lp1p6mma2 is a Lpar on MTMS 9117-MMA*100F6A0
hmc4: copy files to hmc4 complete
hmc4: 9117-MMA*100F6A0: HSCF0178W Operation completed successfully for
9117-MMA-SN100F6A0-L9 (9117-MMA*100F6A0).  Deferred Fixes are present
in the fixpack. :
hmc4: :
```

```
hmc4: 9117-MMA*100F6A0: The following deferred fixes are present in the
fix pack.  Deferred fixes will be activated after the next IPL of the
system. :
hmc4: :
hmc4: 9117-MMA*100F6A0: An immediate IPL is not required, unless you
want to activate one of the fixes below now. :
hmc4: :
hmc4: 9117-MMA*100F6A0: :
hmc4: :
hmc4: 9117-MMA*100F6A0: A problem was fixed that caused the advanced
system management interface (ASMI) menus to become unresponsive, and
the system to appear to hang, when a GX adapter slot reservation was
attempted when the system was at service processor standby.
(684093/FW252934)<br><br>On systems running system firmware release
EM340, a problem was fixed that caused the system to checkstop during
the "hot add" of a GX I/O adapter card. (692444/FW474712)<br><br> :
hmc4: 9117-MMA*100F6A0:  :
hmc4: :
hmc4: 9117-MMA*100F6A0: :
hmc4: :
hmc4: 9117-MMA*100F6A0: LIC_RC = 0:
hmc4: 9117-MMA*101F170: HSCF0178W Operation completed successfully for
9117-MMA-SN101F170-L10 (9117-MMA*101F170).  Deferred Fixes are present
in the fixpack. :
hmc4: :
hmc4: 9117-MMA*101F170: The following deferred fixes are present in the
fix pack.  Deferred fixes will be activated after the next IPL of the
system. :
hmc4: :
hmc4: 9117-MMA*101F170: An immediate IPL is not required, unless you
want to activate one of the fixes below now. :
hmc4: :
hmc4: 9117-MMA*101F170: :
hmc4: :
hmc4: 9117-MMA*101F170: A problem was fixed that caused the advanced
system management interface (ASMI) menus to become unresponsive, and
the system to appear to hang, when a GX adapter slot reservation was
attempted when the system was at service processor standby.
(684093/FW252934)<br><br>On systems running system firmware release
EM340, a problem was fixed that caused the system to checkstop during
the "hot add" of a GX I/O adapter card. (692444/FW474712)<br><br> :
hmc4: 9117-MMA*101F170:  :
hmc4: :
hmc4: 9117-MMA*101F170: :
hmc4: :
```

```
hmc4: 9117-MMA*101F170: LIC_RC = 0:
hmc4: Remote_command_rc = 0:
hmc4: Upgrade 9117-MMA*101F170 from release level:01EM340 activated
level:39 to 01EM340_061_039.rpm successfully
hmc4: Upgrade 9117-MMA*100F6A0 from release level:01EM340 activated
level:39 to 01EM340_061_039.rpm successfully
```

The **rflash** command can take a while to process, depending on the number of managed systems that need to be updated. The two MMA systems that we updated took around 20 minutes.

In the previous example, there were deferred fixes. This means that some firmware fixes will only be activated at the next system power cycle.

We then executed the **rinv** command again to verify the firmware levels on the MMA systems, as shown in Example 6-16.

Example 6-16 Checking firmware levels using the rinv command

```
mgtnode #rinv fsp firm
Server-8204-E8A-SN10FE401: Release Level  : 01EL340
Server-8204-E8A-SN10FE401: Active Level   : 39
Server-8204-E8A-SN10FE401: Installed Level: 39
Server-8204-E8A-SN10FE401: Accepted Level : 37
Server-8204-E8A-SN10FE401: Release Level Primary: 01EL340
Server-8204-E8A-SN10FE401: Level Primary  : 39
Server-8204-E8A-SN10FE411: Release Level  : 01EL340
Server-8204-E8A-SN10FE411: Active Level   : 39
Server-8204-E8A-SN10FE411: Installed Level: 39
Server-8204-E8A-SN10FE411: Accepted Level : 39
Server-8204-E8A-SN10FE411: Release Level Primary: 01EL340
Server-8204-E8A-SN10FE411: Level Primary  : 39
9117-MMA-SN101F170-L10: Release Level  : 01EM340
9117-MMA-SN101F170-L10: Active Level   : 61
9117-MMA-SN101F170-L10: Installed Level: 61
9117-MMA-SN101F170-L10: Accepted Level : 39
9117-MMA-SN101F170-L10: Release Level Primary: 01EM340
9117-MMA-SN101F170-L10: Level Primary  : 61
9117-MMA-SN100F6A0-L9: Release Level  : 01EM340
9117-MMA-SN100F6A0-L9: Active Level   : 61
9117-MMA-SN100F6A0-L9: Installed Level: 61
9117-MMA-SN100F6A0-L9: Accepted Level : 39
9117-MMA-SN100F6A0-L9: Release Level Primary: 01EM340
9117-MMA-SN100F6A0-L9: Level Primary  : 61
```

```
mgtnode #
```

We observed that the new installed and active levels have changed. Once we were satisfied that the firmware was operating, we could permanently accept the firmware update using the **rflash** command with the **--commit** option, as shown in Example 6-17.

Example 6-17 Using rflash to commit a firmware update

```
mgtnode #rflash lp1p6mma1,lp2p6mma2 --commit
hmc4: copy files to hmc4 complete
hmc4: 9117-MMA*100F6A0: LIC_RC = 0:
hmc4: 9117-MMA*101F170: LIC_RC = 0:
hmc4: Remote_command_rc = 0:
hmc4: 9117-MMA*101F170:commit successfully!
hmc4: 9117-MMA*100F6A0:commit successfully!
mgtnode #
```

IBM System p machines have two sides that hold firmware. The temporary side is generally used when the system is started. The permanent side generally has an older copy of firmware. If you commit the firmware update, then the permanent and temporary sides will have the same firmware level. There is no need to commit the firmware to the permanent side. It may be advisable to keep the older level of firmware in the permanent side should the need ever arise to restore to it.

The **rflash** command does some checking before applying the updates to ensure that the correct files are being applied. If we tried to flash the IBM 550 systems with MMA microcode, then an error would be shown, as in Example 6-18.

Example 6-18 Trying to flash with wrong file

```
mgtnode #rflash lp1p65501 -p /install/fw/mma/340_061_039 --activate
concurrent
hmc3: lp1p65501 is a Lpar on MTMS 8204-E8A*10FE411
hmc3: 8204-E8A*10FE411: There isn't a package suitable for
8204-E8A*10FE411
hmc3: Failed to upgrade the firmware of 8204-E8A*10FE411 on hmc3
mgtnode #
```

We corrected the location of the file and retried the **rflash** command, as shown in Example 6-19, and **rflash** completed satisfactorily.

Example 6-19 Running rflash with the correct flash file

```
mgtnode #rflash lp1p65501 -p /install/fw/550/340_061_039 --activate
concurrent
hmc3: lp1p65501 is a Lpar on MTMS 8204-E8A*10FE411
hmc3: copy files to hmc3 complete
hmc3: 8204-E8A*10FE411: HSCF0178W Operation completed successfully for
Server-8204-E8A-SN10FE411 (8204-E8             A*10FE411).  Deferred
Fixes are present in the fixpack. :
hmc3: :
hmc3: 8204-E8A*10FE411: The following deferred fixes are present in the
fix pack.  Deferred fixes will be              activated after the
next IPL of the system. :
hmc3: :
hmc3: 8204-E8A*10FE411: An immediate IPL is not required, unless you
want to activate one of the fixes be             low now. :
hmc3: :
hmc3: 8204-E8A*10FE411: :
hmc3: :
hmc3: 8204-E8A*10FE411: Deferred fix information is not available. :
hmc3: 8204-E8A*10FE411:  :
hmc3: :
hmc3: 8204-E8A*10FE411: :
hmc3: :
hmc3: 8204-E8A*10FE411: LIC_RC = 0:
hmc3: Remote_command_rc = 0:
hmc3: Upgrade 8204-E8A*10FE411 from release level:01EL340 activated
level:39 to 01EL340_061_039.rpm succe             ssfully
mgtnode #
```

6.5 Adding GPFS to a diskless xCAT cluster

There are a number of ways that GPFS can be configured in an xCAT 2 cluster to provide the diskless nodes access to the GPFS file systems. We identified two configurations that would ensure that the diskless nodes have access to data via GPFS:

1. As shown in Figure 6-3 on page 280, we have an xCAT 2 cluster that has the following configuration:
   - xCAT 2 management node
     - Has access to the SAN disk used for the GPFS file system.
     - Performs the role of Primary GPFS configuration server.

- Performs the role of the cluster quorum node.
- Performs the role of NSD server.
- Performs the role of cluster manager node.
- Performs the role of file system manager.

– Diskless xCAT 2 cluster nodes

– Common administration network

– GPFS I/O network

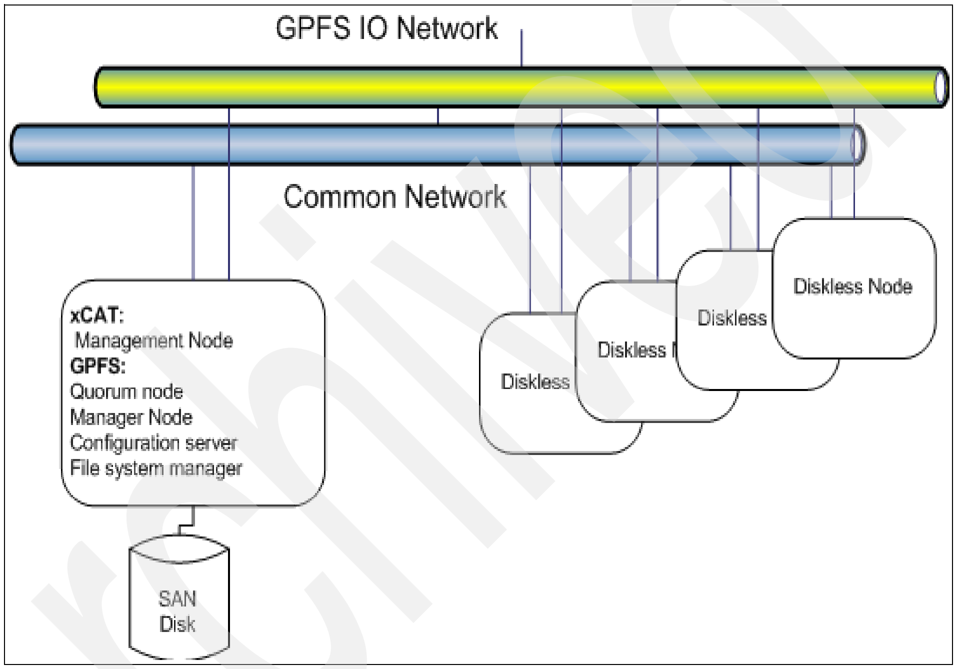

Figure 6-3 Single node quorum GPFS cluster with xCAT MN providing disk (NSD) access and cluster quorum

2. As shown in Figure 6-4 on page 281, we have an xCAT 2 cluster that has the following configuration:

   – Access to a separate GPFS cluster that is presenting its GPFS file systems remotely, via GPFS multi-cluster, over SSL. The file system manager is located in this remote cluster.

   – xCAT 2 management node that does the following:

   - Performs the role of Primary GPFS configuration server.
   - Performs the role of cluster quorum node.

- Performs the role of cluster manager node.

– Diskless xCAT 2 cluster nodes

– Common administration network

– GPFS I/O network

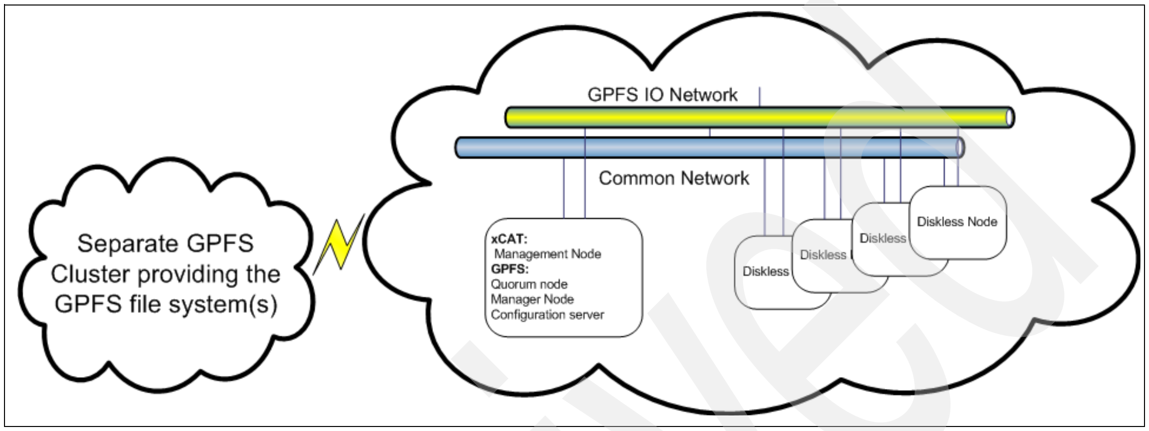
GPFS IO Network
Common Network
Separate GPFS Cluster providing the GPFS file system(s)
xCAT: Management Node GPFS: Quorum node Manager Node Configuration server
Diskless
Diskless
Diskless
Diskless Node

Figure 6-4 xCAT GPFS cluster (single node quorum) and remote GPFS cluster providing file system

The xCAT 2 diskless nodes could, potentially, be changing state from *active* to *down* in the GPFS cluster quite frequently. Therefore, it makes sense for the xCAT 2 MN to perform the server, management, and quorum roles in the GPFS cluster because its state should not change, during normal production. Also, if the xCAT 2 MN is in a down state, it is very likely that the diskless nodes will not be running anyway.

Note: From an administration perspective it is easier to use the same SSH keys on the xCAT 2 MN and the diskless nodes.

When using a multi-cluster environment, the SSL key is stored in `/var/mmfs/gem/mmsdrfs` after it has been configured.

6.5.1 Configuring GPFS from scratch on diskless nodes

Our cluster contains both diskful and diskless nodes. We have an existing GPFS cluster that is running on the diskful nodes. We wanted to integrate the diskless node we created in 5.3.4, “Installing diskless nodes” on page 209 into this GPFS cluster. The new diskless node name is lp5p65501. In the following exercise, we will use the same NIM resources as described in 5.2.5, “Creation of NIM and xCAT install resources” on page 194.

The GPFS code needs to be installed to the diskless node. This is achieved by updating the SPOT that the node uses for its remote `/usr` file system. Using the same `lpp_source` in our NIM master that we used to install GPFS to the diskless nodes, the GPFS filesets were installed. We encountered a prereq issue with the installation of GPFS into the SPOT, as shown in Example 6-20.

Example 6-20 Updating the diskless SPOT with the GPFS filesets prereq error

```
Requisite Failures
  ------------------
  SELECTED FILESETS:  The following is a list of filesets that you asked to
  install.  They cannot be installed until all of their requisite filesets
  are also installed.  See subsequent lists for details of requisites.

    gpfs.base 3.2.0.0                         # GPFS File Manager
    gpfs.base 3.2.1.11                        # GPFS File Manager

  MISSING REQUISITES:  The following filesets are required by one or more
  of the selected filesets listed above.  They are not currently installed
  and could not be found on the installation media.

    xlC.aix50.rte 8.0.0.0                     # Base Level Fileset

  << End of Failure Section >>
```

We are attempting to install GPFS into a SPOT that is at AIX 6.1, yet it requires `xlC.aix50.rte`! We solved the prerequisite problem in the previous example by installing into the SPOT the fileset called `xlC.sup.aix50.rte.9.0.0.1`.

After this fileset was installed, GPFS installation into the SPOT was successful. as shown in the snippet in Example 6-21.

Example 6-21 Successful installation of GPFS into the diskless SPOT

```
-----------------
  gpfs.base 3.2.1.11                          # GPFS File Manager

  << End of Success Section >>

+-----------------------------------------------------------------------------+
                          Committing Software...
+-----------------------------------------------------------------------------+

installp: COMMITTING software for:
        gpfs.base 3.2.1.11
```

```
Finished processing all filesets.  (Total time:  21 secs).

+-----------------------------------------------------------------------------+
                                Summaries:
+-----------------------------------------------------------------------------+

Pre-installation Failure/Warning Summary
----------------------------------------
Name                      Level           Pre-installation Failure/Warning
-------------------------------------------------------------------------------
gpfs.base                 3.2.1.10        To be superseded by 3.2.1.11


Installation Summary
--------------------
Name                        Level           Part        Event       Result
-------------------------------------------------------------------------------
gpfs.base                   3.2.0.0         USR         APPLY       SUCCESS
gpfs.base                   3.2.0.0         ROOT        APPLY       SUCCESS
gpfs.base                   3.2.1.11        USR         APPLY       SUCCESS
gpfs.base                   3.2.1.11        ROOT        APPLY       SUCCESS
gpfs.base                   3.2.1.11        USR         COMMIT      SUCCESS
gpfs.base                   3.2.1.11        ROOT        COMMIT      SUCCESS

 Checking filesets and network boot images for SPOT "610_diskless".
 This may take several minutes ...
```

Note: In order to update the SPOT on a running diskless node, the node can be powered off and the NIM SPOT de-allocated, because an active SPOT cannot be updated. We used this method because it was convenient for us to do so. This may not be optimal in a production environment. One solution is to create a new SPOT or osimage via **mknimimage** and at a convenient time, to run **rmdsklsnode** and reassign the node to the new SPOT using **mkdsklsnode** and reboot it. The rmdsklsnode will not remove the node from xCAT, it just removes the NIM resources that are assigned to it.

Once our diskless node has been booted with the updated SPOT, we issue the **mmaddnode** command from an existing node in our GFPS cluster, as shown in Example 6-22.

Example 6-22 Adding a diskless node to the GPFS cluster

```
lp2p65501 #mmaddnode -N lp5p65501-en2
```

After the node has been added, GPFS was started up on the new diskless node, as shown in Example 6-23.

Example 6-23 Starting GPFS on the diskless node

```
lp2p65501 #mmstartup -N lp5p65501-en2
Tue May 19 16:11:14 EDT 2009: mmstartup: Starting GPFS ...
```

We issued the **mmgetstate** command to display the state of GPFS on the diskless node, as shown in Example 6-24.

Example 6-24 Displaying GPFS status via mmgetstate

```
lp2p65501 #mmgetstate -aL

 Node number  Node name       Quorum  Nodes up  Total nodes  GPFS state  Remarks
------------------------------------------------------------------------------------
       1      lp2p65501-en2      2        3         16        active      quorum node
       2      lp3p65501-en2      2        3         16        active
       3      lp4p65501-en2      2        3         16        active
       4      lp1p65502-en2      2        3         16        active
       5      lp2p65502-en2      2        3         16        active      quorum node
       6      lp3p65502-en2      2        3         16        active
       7      lp4p65502-en2      2        3         16        active
       8      lp1p6mma1-en2      2        3         16        active
       9      lp2p6mma1-en2      2        3         16        active      quorum node
      10      lp3p6mma1-en2      2        3         16        active
      11      lp4p6mma1-en2      2        3         16        active
      12      lp1p6mma2-en2      2        3         16        active
      13      lp2p6mma2-en2      2        3         16        active
      14      lp3p6mma2-en2      2        3         16        active
      15      lp4p6mma2-en2      2        3         16        active
      16      lp5p65501-en2      2        3         16        active
```

As can be seen in the previous example, the diskless node lp5p65501 is now part of the GPFS cluster.

The last remaining task is to mount our GPFS file system onto the node. The **mmmount** command is issued from an existing GPFS node, as shown in Example 6-25. Note the output of the **df** command on the diskless node before and after the **mmmount** command is issued.

Example 6-25 Mounting the GPFS file system

```
# df
Filesystem    512-blocks      Free %Used    Iused %Iused Mounted on
```

```
lp1p65501:/install/nim/root/610_diskless_root/lp5p65501   26869760   9584912   65%
54745     5% /
lp1p65501:/install/nim/spot/610_diskless/usr   26869760   9584912   65%    54745
5% /usr

mmmount command is issued on an exiting GPFS Node:
lp2p65501 #mmmount /gpfs1 -N lp5p65501-en2
Tue May 19 16:12:46 EDT 2009: mmmount: Mounting file systems ...
lp2p65501 #

# df
Filesystem    512-blocks      Free %Used    Iused %Iused Mounted on
lp1p65501:/install/nim/root/610_diskless_root/lp5p65501   26869760   9584776   65%
54751     5% /
lp1p65501:/install/nim/spot/610_diskless/usr   26869760   9584776   65%    54751
5% /usr
/dev/gpfs1     251658240 247448576    2%    39730    32% /gpfs1
#
```

We can verify that GPFS is running using one of the following methods:

- Run the **mmgetstate -av** command from one GPFS node.
- Issue the **mmdf** command from an existing GPFS node.
- Create a directory in the GPFS file system on one node and read from that directory on the diskless node.
- Use the **mmlsmount all -L** command.

Note: Every time GPFS nodes are booted, the version of the /var/mmfs/gen/mmsdrfs file is verified with the configuration data servers (the version line has the tag "%%9999%%:00_VERSION_LINE"). If the version number is not the latest, /var/mmfs/gen/mmsdrfs is copied from the configuration server the node communicates with (the default is the primary server). The process that initiates this check is **/usr/lpp/mmfs/bin/mmautoload**, which is called from /etc/inittab at AIX startup. By default, the inittab entry shown below is added when the base GPFS code is installed:

```
mmfs:2:once:/usr/lpp/mmfs/bin/mmautoload >/dev/console 2>&1
```

6.5.2 How to recover GPFS membership

In case the NFS-exported directory of a diskless node is deleted on the NIM master, the node will need to be recreated, following Steps 1 to 12 in 5.3.4, "Installing diskless nodes" on page 209.

However, instead of performing Step 13, you can run **mmsdrrestore** from the reinstalled node to get the node back into the GPFS cluster.

This command will request a new copy of the `/var/mmfs/gen/mmsdrfs` file from the node that **mmsdrrestore** is directed to (it is recommended to use the primary or secondary configuration data server).

Note: The administrator will need to know what nodes are configured to perform the roles of primary and secondary configuration server. The nodes can be identified by running the **mmlscluster** command on a working node in the same GPFS cluster, as shown in Example 6-26.

Example 6-26 Checking the cluster configuration

```
# mmlscluster
GPFS cluster information
========================
GPFS cluster name:         CSMtoxCAT.virt-p5501_p1
GPFS cluster id:           13882456113010480887
GPFS UID domain:           CSMtoxCAT.virt-p5501_p1
Remote shell command:      /usr/bin/ssh
Remote file copy command:  /usr/bin/scp
GPFS cluster configuration servers:
-----------------------------------
Primary server:    virt-p5501_p1
Secondary server:  virt-p5502-p1
```

The node will then be aware of the GPFS cluster it is a member of and **mmstartup** will complete successfully, as shown in Example 6-27.

Example 6-27 Restoring the /var/mmfs/gen/mmsdrfs file on a diskless node

```
# mmlscluster
mmlscluster: 6027-1382 This node does not belong to a GPFS cluster.
mmlscluster: 6027-1639 Command failed.  Examine previous error messages to determine
cause.

# mmsdrrestore -p virt-p5501_p1 -R /usr/bin/scp
Thu May 21 17:50:10  2009: 6027-1664 mmsdrrestore: Processing node virt-p5501_p5
mmsdrrestore: Node virt-p5501_p5 successfully restored.

[p630n05][/]> lsdef -t node -l -z -o virt-p5501_p6 >
/tmp/vio_xcat/virt-p5501_p8.stanza

# mmlscluster
```

```
[p630n05][/]> vi /tmp/vio_xcat/virt-p5501_p8.stanza
"virt-p5501_p8.stanza" 25 lines, 582 characters
# <xCAT data object stanza file>
GPFS cluster information
========================
  GPFS cluster name:         CSMtoxCAT.virt-p5501_p1
  GPFS cluster id:           13882456113010480887
  GPFS UID domain:           CSMtoxCAT.virt-p5501_p1
  Remote shell command:      /usr/bin/ssh
  Remote file copy command:  /usr/bin/scp

virt-p5501_p8:
GPFS cluster configuration servers:
-----------------------------------
  Primary server:    objtype=nodevirt-p5501_p1
  Secondary server:  virt-p5502-p1

 Node  Daemon node name            IP address       Admin node name      Designation
-------------------------------------------------------------------------------------
   1   virt-p5501_p1                 192.168.100.72   virt-p5501_p1    quorum-manager
   2   virt-p5501_p2                 192.168.100.73   virt-p5501_p2    quorum-manager
   4   virt-p5501_p4                 192.168.100.75   virt-p5501_p4
   5   virt-p5501_p5                 192.168.100.76   virt-p5501_p5
   6   virt-p5501_p6                 192.168.100.77   virt-p5501_p6
   7   virt-p5502-p1                 192.168.100.82   virt-p5502-p1    quorum-manager
   8   virt-p5502-p2                 192.168.100.83   virt-p5502-p2    quorum-manager
   9   virt-p5502-p3                 192.168.100.84   virt-p5502-p3
  10   virt-p5502-p4                 192.168.100.85   virt-p5502-p4
  13   virt-p5502-p5                 192.168.100.86   virt-p5502-p5
  14   virt-p5502-p6                 192.168.100.87   virt-p5502-p6
  15   virt-p5501_p3                 192.168.100.74   virt-p5501_p3

# mmstartup
Thu May 21 17:50:19  2009: 6027-1642 mmstartup: Starting GPFS ...

# mmgetstate

 Node number  Node name        GPFS state
------------------------------------------
       5      virt-p5501_p5    active
```

Note: The **`mmsdrestore`** command can be used for diskful nodes too if the `/var/mmfs/gen/mmsdrfs` file is removed for some reason.

6.6 PowerVM deployment and management using xCAT

In this section we demonstrate some of the features built into xCAT, which can help deploying VIO Servers and LPARs, and enable automatic configuration of them.

In our scenario we created LPARs with virtualized I/O, so no physical adapters and disks were attached to the client LPARs.

6.6.1 VIO Server backup and restore methods

Table 6-2 shows the possible methods to back up and install a VIO Server.

Table 6-2 VIO Server backup and install methods

Backup	Media	Restore
To tape	Tape	From tape
To DVD	DVD-RAM	From DVD
To remote file system mksysb image	mksysb image	From AIX NIM server and a standard mksysb system installation
To remote file system	nim_resources.tar	From an HMC using NIM on Linux (NIMOL) facility and installios command

We describe the last two scenarios in Table 6-2.

Method 1

Using the mksysb image. Backup is made to a local file system, and transferred to our NIM master. The backup is in AIX mksysb format. Standard NIM mksysb installation can be used to install the server. For this method we have to prepare the xCAT and NIM environment to have the necessary install resources for the VIO Server node.

Method 2

Using the NIMOL image. Backup is made to a local file system and transferred to our NIM server. The backup contains all necessary NIM resources in a tar file, which can be installed with a simple command, **installios**. In this case the steps to prepare the NIM environment are not needed.

The tasks necessary for the deployment are broken to common and unique tasks, based on the method chosen for the backup and restore. These tasks are:

- Common tasks: Create an LPAR for the VIO Server based on 6.6.2, “Common tasks to create the LPAR for the VIO Server” on page 289.
- Depending on the method chosen, prepare a backup from an existing VIO Server or from the install DVD (see 6.6.3 and 6.6.4).
- Depending on the method chosen, install the new VIO Server (see 6.6.3 and 6.6.4).
- Common tasks: Finish the configuration; see 6.6.5, “Common tasks after the VIO Server is installed” on page 302.

6.6.2 Common tasks to create the LPAR for the VIO Server

Create the VIO LPAR

Create the new VIO Server LPARs based on the requirement in your environment.

Be aware that the mksysb or the NIMOL image which is saved can have several logical volumes in the rootvg that was backed up, so allocate sufficient disk space for the restore.

Use the method, which is shown in 6.6.6, “LPAR deployment” on page 305, to clone an existing LPAR.

Run rscan to get LPAR data

Collect the LPAR information using the **rscan** command. Redirect the command output to a file for using it as a base stanza file for further configuration.

Create a new node in xCAT for the VIO Server

Example 6-28 shows additional attributes and the definition of the VIO Server. After the node was defined we recreated the conserver configuration file and restarted the daemon to enable starting a remote console session to the LPAR.

Example 6-28 Create a new xCAT node for VIOS

```
# cat VIO_xCAT.stanza
VIOS_xCAT:
    objtype=node
    id=8
    hcp=hmc-v7
    pprofile=vios_xcat
    parent=p550_itso1
    groups=lpar,all
    mgt=hmc
    groups=AllDevices
    mtm=550-9113
    nodetype=ioserver,lpar,osi
    power=hmc
    os=AIX
    arch=ppc64
    serial=106628E
    serialspeed=9600
    serialflow=hard
    serialport=ttyS0
    cons=hmc
    termserver=hmc-v7
    xcatmaster=192.168.100.35

# cat VIO_xCAT.stanza | mkdef -z
Object definitions have been created or modified.

# lsdef -t node -o VIOS_xCAT -l

Object name: VIOS_xCAT
    arch=ppc64
    cons=hmc
    groups=AllDevices
    hcp=hmc-v7
    id=8
    mac=000255d39ce0
    mgt=hmc
    mtm=550-9113
    nodetype=ioserver,lpar,osi
    os=AIX
    parent=p550_itso1
    power=hmc
    pprofile=vios_xcat
    serial=106628E
    serialflow=hard
    serialport=ttyS0
    serialspeed=9600
    xcatmaster=192.168.100.35
# makeconservercf
# stopsrc -s conserver
0513-044 The conserver Subsystem was requested to stop.
# startsrc -s conserver
0513-059 The conserver Subsystem has been started. Subsystem PID is
307514.
```

Gather the adapter data and set the MAC address of the VIOS

The adapter information can be gathered by the **getmacs** command in xCAT as shown in Example 6-29. Use the MAC address for the physical adapter for initial installation. Later, after the VIO Server is installed and we configure Shared Ethernet Adapter on the physical adapter that was used to install it, we will have to detach the interface first.

Example 6-29 Collect the MAC address for VIOS

```
# getmacs VIOS_xCAT
VIOS_xCAT:
# Type  Location Code   MAC Address      Full Path Name  Ping Result
ent U9113.550.106628E-V8-C2-T1 7241e0008002 /vdevice/l-lan@30000002
virtual
ent U787B.001.DNW1375-P1-C2-T1 000255d39ce0
/pci@800000020000003/pci@2,6/ethernet@1  physical
```

After the adapter info is displayed, it can be stored with:

```
mkdef -t node -f -o VIOS_xCAT mac=000255d39ce0
```

6.6.3 Method 1 - using mksysb restore

Creating a VIO Server backup image (mksysb)

The image can be copied either from the VIO install DVD or you can create a new backup in mksysb format on the VIO Server and copy it to the NIM. Either way an NIM mksysb resource has to be created to point to the backup file to enable future use.

Steps for creating a new mksysb image for an existing VIO Server onto the NIM server (in our case this is the xCAT MN):

- Create a new directory for the NIM mksysb images on the xCAT MN: `/install/nim/images`.
- NFS export the directory on the NIM server, allowing root access as shown in Example 6-30.

Example 6-30 Exporting the backup file system on NIM server

```
# exportfs -v
/install/nim/images
-sec=sys:krb5p:krb5i:krb5:dh,rw,root=vios-p5501
```

NFS mount the /install/nim/images directory on the VIO Server

- For mksysb image creation run the following command; the results are shown in Example 6-31.

```
backupios -file /mnt/vios-p5501.mksysb -mksysb -nosvg
```

Example 6-31 Creating an mksysb image on a VIO Server

```
$ mount p630n05:/install/nim/images /mnt
$ backupios -file /mnt/vios-p5501.mksysb -mksysb -nosvg

/mnt/vios-p5501.mksysb  doesn't exist.

Creating /mnt/vios-p5501.mksysb
Backup in progress.  This command can take a considerable amount of
time
to complete, please be patient...


Creating information file (/image.data) for rootvg.

Creating list of files to back up.....
Backing up 66931 files..............................
57432 of 66931 files (85%)....
66931 of 66931 files (100%)
0512-038 savevg: Backup Completed Successfully.
$ unmount /mnt
```

- Unmount the directory.

Create the mksysb NIM resource

- Check the backup file on the NIM server and unexport the directory:

```
exportfs -i -u /install/nim/images
```

- Create an mksysb NIM resource using the mksysb backup file:

```
nim -o define -t mksysb -a server=master -a
location=/install/nim/images/vios-p5501.mksysb vios-1521-mksysb
```

- Check the mksysb resource, shown in Example 6-32.

Example 6-32 List the attributes of the NIM mksysb resource

```
# lsnim -l vios-1521-mksysb
vios-1521-mksysb:
   class          = resources
   type           = mksysb
   Rstate         = ready for use
   prev_state     = unavailable for use
   location       = /install/nim/images/vios-p5501.mksysb
   version        = 5
   release        = 3
   mod            = 8
   oslevel_r      = 5300-08
   alloc_count    = 0
   server         = master
   extracted_spot = vios-1521-spot
```

Create a SPOT NIM resource for the installation

- The command for SPOT creation from an mksysb image is:

  ```
  nim -o define -t spot -a server=master -a
  location=/install/nim/spot -a source=vios-1521-mksysb -a
  installp_flags=-aQg vios-1521-spot
  ```

- Check the SPOT, as shown in Example 6-33.

Example 6-33 Query the attributes of the NIM SPOT resource

```
# lsnim -l vios-1521-spot
vios-1521-spot:
   class         = resources
   type          = spot
   plat_defined  = chrp
   arch          = power
   Rstate        = ready for use
   prev_state    = verification is being performed
   location      = /install/nim/spot/vios-1521-spot/usr
   version       = 5
   release       = 3
   mod           = 8
   oslevel_r     = 5300-08
   alloc_count   = 0
   server        = master
   if_supported  = chrp.mp ent
   Rstate_result = success
   mksysb_source = vios-1521-mksysb
```

Extract the bosinst.data file and create a NIM resource

To perform automated installation we need a customized `bosinst_data` NIM resource.

The bosinst.data file is saved in the mksysb. It is possible to restore it and create a NIM resource using the commands shown in Example 6-34.

Example 6-34 Restore the bosinst.data file from an mksysb image

```
# cd /install/nim/images
# restorevgfiles -r -f /install/nim/images/vios-p5501.mksysb
./bosinst.data
New volume on /install/nim/images/vios-p5501.mksysb:
 Cluster 51200 bytes (100 blocks).
    Volume number 1
    Date of backup: Tue Dec 29 23:59:51 America 1970
    Files backed up by name
    User root
x         5178 ./bosinst.data
    total size: 5178
    files restored: 1
# sed "s/PROMPT = yes/PROMPT = no/" bosinst.data >
vios-p5501.bosinst.data
# nim -o define -t bosinst_data -a server=master -a
location=/install/nim/images/vios-p5501.bosinst.data
vios-p5501-bosinst_data
# lsnim|grep vios
vios-1521-mksysb            resources       mksysb
vios-1521-spot              resources       spot
vios-p5501-bosinst_data     resources       bosinst_data
```

The default bosinst_data file, which is restored from the mksysb, contains an entry which would show a prompt and wait for manual intervention. To avoid this we had to change the value of the PROMPT variable to no. Also, the target disk entry should be inserted, otherwise the installation will stop and ask for a target disk.

Create an osimage on xCAT MN

In Example 6-35 we use the existing NIM resources to define an xCAT osimage.

Example 6-35 Create the xCAT nimimage and osimage

```
# mknimimage -m mksysb spot=vios-1521-spot mksysb=vios-1521-mksysb
bosinst_data=vios-p5501-bosinst_data vios_1521_osimage
The following xCAT osimage definition was created. Use the xCAT lsdef
command to view the xCAT definition and the AIX lsnim command to view
the individual NIM resources that are included in this definition.

Object name: vios_1521_osimage
        bosinst_data=vios-p5501-bosinst_data
        imagetype=NIM
        mksysb=vios-1521-mksysb
        nimmethod=mksysb
        nimtype=standalone
        osname=AIX
        spot=vios-1521-spot
```

There is another solution, which would define the necessary NIM resources and the osimage into xCAT, if only the mksysb file name is given for the xCAT command **mknimimage**.

Prepare the NIM client for the VIO Server and install via NIM

When the VIO Server is installed using normal NIM operations, the mksysb, `bosinst_data` and SPOT NIM resources have to be created manually. After creation they have to be allocated to the VIO Server node and a BOS installation has to be initiated.

Create the NIM client

We created the NIM client from the xCAT node using the **xcat2nim** command, as shown in Example 6-36, which shows a failure because the MAC address was defined for a NIM client used by the installios example. After removal of that client, **xcat2nim** ran successfully.

Example 6-36 Creating the NIM client for VIOS

```
# xcat2nim -V VIOS_xCAT
 Assuming an object type of 'node'.

Error:  Could not create a NIM definition for 'VIOS_xCAT'.

Error: 0042-001 nim: processing error encountered on "master":
   0042-083 m_mkmac: network hardware addresses must be unique
        and "000255d39ce0" is already being used by the
        machine "installios_client"

Error:  One or more errors occured.

Error: Return=1.

# installios -u
Removing installios_client object definition...done
Removing installios_spot object definition...done
Removing installios_mksysb object definition...done
Removing installios_bosinst object definition...done
Removing file /export/installios/mksysb/installios_mksysb...done
Removing file /export/installios/installios_bosinst.data...done
Removing directory /export/installios/mksysb...done
Removing directory /export/installios/spot...done
Removing directory /export/installios/bundle...done
Removing directory /export/installios/lpp_source...done
Removing file /export/installios/VIO_IMAGE...done
# lsnim
master                      machines        master
boot                        resources       boot
nim_script                  resources       nim_script
cluster_net                 networks        ent
539image_bosinst_data       resources       bosinst_data
539image_lpp_source         resources       lpp_source
539image                    resources       spot
xCATaixSSL                  resources       installp_bundle
xCATaixSSH                  resources       installp_bundle
xCATaixSN                   resources       installp_bundle
Adapters                    resources       adapter_def
virt-p5501_p3               machines        standalone
AIXNodes                    groups          mac_group
virt-p5501_p4               machines        standalone
virt-p5501_p2               machines        standalone
virt-p5501_p1               machines        standalone
virt-p5501_p6               machines        standalone
virt-p5501_p5               machines        standalone
xcataixscript               resources       script
vios-1521-mksysb            resources       mksysb
vios-1521-spot              resources       spot
vios-p5501-bosinst_data     resources       bosinst_data
# xcat2nim -V VIOS_xCAT
 Assuming an object type of 'node'.

 The following definitions were created:

VIOS_xCAT

# lsnim -l VIOS_xCAT
VIOS_xCAT:
   class          = machines
   type           = standalone
   connect        = shell
   platform       = chrp
   netboot_kernel = mp
   if1            = cluster_net VIOS_xCAT 000255d39ce0 ent
   cable_type1    = N/A
   Cstate         = ready for a NIM operation
   prev_state     = ready for a NIM operation
   Mstate         = currently running
```

Set up the VIO Server for network boot

xCAT provides an interface to the necessary NIM functions to install NIM clients. We used this to install the VIO Server, shown in Example 6-37.

Example 6-37 Set the VIOS NIM client to run bosinst

```
# nimnodeset -i vios_1521_osimage VIOS_xCAT
p630n05: AIX/NIM nodes were initialized.

# lsnim -l VIOS_xCAT
VIOS_xCAT:
   class          = machines
   type           = standalone
   connect        = shell
   platform       = chrp
   netboot_kernel = mp
   if1            = cluster_net VIOS_xCAT 000255d39ce0 ent
   cable_type1    = N/A
   Cstate         = BOS installation has been enabled
   prev_state     = ready for a NIM operation
   Mstate         = currently running
   boot           = boot
   bosinst_data   = vios-p5501-bosinst_data
   mksysb         = vios-1521-mksysb
   nim_script     = nim_script
   script         = xcataixscript
   spot           = vios-1521-spot
   control        = master
```

Tip: You may experience issues with passing gateway information to the node to be installed as a result of the NIM network route information. Example 6-38 shows how the bootp is configured in our case.

To resolve the routing problem we unset the route1 attribute for the NIM network we used, and deleted the gateway from the xCAT network definition using the following commands:

```
nim -o change -a routing1= cluster_net
chdef -t network -o cluster_net gateway=0.0.0.0
```

Example 6-38 bootp configuration in our environment

```
Manual netboot without route information:

BOOTP: chosen-network-type = ethernet,auto,rj45,auto
BOOTP: server   IP =       192.168.100.35
BOOTP: requested filename =
BOOTP: client   IP =       192.168.100.78
BOOTP: client   HW addr =   0 2 55 d3 9c e0
BOOTP: gateway  IP =       0.0.0.0
BOOTP: device    /pci@800000020000003/pci@2,6/ethernet@1
BOOTP: loc-code  U787B.001.DNW1375-P1-C2-T1

Automatic netboot with route information in NIM network:

BOOTP: chosen-network-type = ethernet,auto,rj45,auto
BOOTP: server   IP =       192.168.100.35
BOOTP: requested filename =
BOOTP: client   IP =       192.168.100.78
BOOTP: client   HW addr =   0 2 55 d3 9c e0
BOOTP: gateway  IP =       192.168.100.60
BOOTP: device    /pci@800000020000003/pci@2,6/ethernet@1
BOOTP: loc-code  U787B.001.DNW1375-P1-C2-T1
```

Network boot the VIO Server

Run the **`rnetboot`** command to NIM install the node.

Note: The post-install scripts are not started, because the VIO Server runs a restricted version of AIX.

6.6.4 Method 2 - using NIMOL

Create a VIO backup

The image has to be created from an existing VIO Server. The steps are:

- Create a new directory for the NIM mksysb images on the xCAT MN: `/install/nim/images`.
- NFS export the directory on the NIM server allowing root access, as shown in Example 6-39.

Example 6-39 Exporting the NIM backup space for the NIMOL image

```
# exportfs -v
/install/nim/images
-sec=sys:krb5p:krb5i:krb5:dh,rw,root=vios-p5501
```

- Mount the `/install/nim/images` directory over NFS on the existing VIO Server.
- Create the NIMOL image using the following command:

  ```
  backupios -file /mnt -nosvg
  ```

- Unmount the directory.

Installing the VIO Server

If we use the **`installios`** command to install the VIO Server, then no additional NIM settings would be necessary.

Note: Use this method only if a NIMOL backup is already available from an existing VIO Server, because it requires some additional manual steps.

In our scenario the MAC address was not set by the **`installios`** command, so the bootp failed. To resolve this we performed a NIM **`bosinst`** operation and initiated a manual network boot from a virtual terminal window. These steps are shown in Example 6-40.

Example 6-40 Install the VIOS using the installios command

```
# installios -h hmc-v7 -s p550_itso1 -p VIOS_xCAT -r vios_xcat -S
255.255.255.0 -i 192.168.100.78 -g 192.168.100.35 -d
/install/nim/images/nim_resources.tar -P 1000 -D full -n -m
00:02:55:d3:9c:e0
Creating the /export/installios/mksysb directory.
Creating the /export/installios/spot directory.
Creating the /export/installios/bundle directory.
Creating the /export/installios/lpp_source directory.
Creating the /export/installios/VIO_IMAGE directory.
Preparing to copy install images (this will take several minutes)...
Defining installios_client object...done
Defining installios_mksysb object...done
Defining installios_spot object...done
Defining installios_bosinst object...done
Initiating install...failed
Initiating network boot...# Connecting to VIOS_xCAT
# Connected
# Checking for power off.
```

```
# Power off complete.
# Power on VIOS_xCAT to Open Firmware.
# Power on complete.
# Client IP address is 192.168.100.78.
# Server IP address is 192.168.100.35.
# Gateway IP address is 192.168.100.35.
# Subnetmask IP address is 255.255.255.0.
# Getting adapter location codes.
lpar_netboot: 1000/full settings are not supported on this adapter
# /pci@800000020000003/pci@2,6/ethernet@1 ping successful.
# Network booting install adapter.
# bootp sent over network.
lpar_netboot: The network boot ended in an error.
failed

# lsnim
master                    machines        master
boot                      resources       boot
nim_script                resources       nim_script
cluster_net               networks        ent
...
installios_client         machines        standalone
installios_mksysb         resources       mksysb
installios_spot           resources       spot
installios_bosinst        resources       bosinst_data

# lsnim -l installios_client
installios_client:
   class          = machines
   type           = standalone
   comments       = Client for installios
   connect        = shell
   platform       = chrp
   netboot_kernel = mp
   if1            = cluster_net VIOS_xCAT 0
   net_settings1  = 1000 full
   cable_type1    = N/A
   Cstate         = ready for a NIM operation
   prev_state     = ready for a NIM operation
   Mstate         = not running
   bosinst_data   = installios_bosinst
   mksysb         = installios_mksysb
   spot           = installios_spot
   control        = master
```

When we checked the `bootptab` file we found that it was empty, so this was the reason why the NIM server did not respond for the bootp request coming from the LPAR.

We added the MAC address manually via the **`smitty nim`** menu and set the VIO Server to network boot using mksysb. After this we initiated a network boot via **`rcons`** as shown in Example 6-41.

Example 6-41 Check the NIM client definition for VIOS

```
# lsnim -l installios_client
installios_client:
   class          = machines
   type           = standalone
   comments       = Client for installios
   connect        = shell
   platform       = chrp
   netboot_kernel = mp
   if1            = cluster_net VIOS_xCAT 000255d39ce0
   net_settings1  = 1000 full
   cable_type1    = N/A
   Cstate         = BOS installation has been enabled
   prev_state     = ready for a NIM operation
   Mstate         = not running
   boot           = boot
   bosinst_data   = installios_bosinst
   mksysb         = installios_mksysb
   nim_script     = nim_script
   spot           = installios_spot
   control        = master
```

The network install of the VIO Server was successful. The NIMOL resources can be removed, as shown in Example 6-42.

Example 6-42 Remove NIMOL resources

```
# installios -u
Removing installios_client object definition...done
Removing installios_spot object definition...done
Removing installios_mksysb object definition...done
Removing installios_bosinst object definition...done
Removing file /export/installios/mksysb/installios_mksysb...done
Removing file /export/installios/installios_bosinst.data...done
Removing directory /export/installios/mksysb...done
Removing directory /export/installios/spot...done
Removing directory /export/installios/bundle...done
Removing directory /export/installios/lpp_source...done
Removing file /export/installios/VIO_IMAGE...done
```

6.6.5 Common tasks after the VIO Server is installed

The following tasks are common and independent of the method used to install the operating system on the VIO Server.

Create the necessary virtual device mapping (LPAR resources)

After the installation the remote console facility is working from the xCAT MN, so it is possible to log in and do the additional customizing steps.

Note: If the installation used the network interface that is planned to be part of a Shared Ethernet Adapter configuration, then the interface has to be de-configured before the SEA setup. This will break the IP connection, so use the remote console to log in and finish the VIO setup.

1. Change the VIO Server to allow the VIO clients to access the server side Virtual SCSI adapter, which can be done in advance knowing the plans for the client LPAR names and adapter setup. Example 6-43 shows the LPAR attributes and how to change the necessary ones.

Example 6-43 List and change the LPAR definition for the VIOS

```
[p630n05][/]> lsvm VIOS_xCAT
VIOS_xCAT:
name=vios_xcat,lpar_name=VIOS_xCAT,lpar_id=8,lpar_env=vioserver,all_res
ources=0,min_mem=512,desired_mem=1024,max_mem=2048,proc_mode=shared,min
_proc_units=0.1,desired_proc_units=0.4,max_proc_units=0.8,min_procs=1,d
esired_procs=1,max_procs=1,sharing_mode=uncap,uncap_weight=128,"io_slot
s=21040003/none/1,21030003/none/1",lpar_io_pool_ids=none,max_virtual_sl
ots=10,"virtual_serial_adapters=0/server/1/any//any/1,1/server/1/any//a
ny/1",virtual_scsi_adapters=none,virtual_eth_adapters=2/0/1//2/1,hca_ada
pters=none,boot_mode=norm,conn_monitoring=0,auto_start=0,power_ctrl_lpa
r_ids=none,work_group_id=none,redundant_err_path_reporting=0

[p630n05][/]> chvm VIOS_xCAT
virtual_scsi_adapters=3/server/9/virt-p5501_p8/4/1
VIOS_xCAT: Success

[p630n05][/]> lsvm VIOS_xCAT
```

```
VIOS_xCAT:
name=vios_xcat,lpar_name=VIOS_xCAT,lpar_id=8,lpar_env=vioserver,all_res
ources=0,min_mem=512,desired_mem=1024,max_mem=2048,proc_mode=shared,min
_proc_units=0.1,desired_proc_units=0.4,max_proc_units=0.8,min_procs=1,d
esired_procs=1,max_procs=1,sharing_mode=uncap,uncap_weight=128,"io_slot
s=21040003/none/1,21030003/none/1",lpar_io_pool_ids=none,max_virtual_sl
ots=10,"virtual_serial_adapters=0/server/1/any//any/1,1/server/1/any//a
ny/1",virtual_scsi_adapters=3/server/9/virt-p5501_p8/4/1,virtual_eth_adapte
rs=2/0/1//2/1,hca_adapters=none,boot_mode=norm,conn_monitoring=0,auto_s
tart=0,power_ctrl_lpar_ids=none,work_group_id=none,redundant_err_path_r
eporting=0
```

2. Create a logical volume, which will serve as the rootvg for the client LPAR as shown in Example 6-44.

Example 6-44 Create an LV that stores the client rootvg

```
$ mklv -lv p8_rootvg rootvg 64
p8_rootvg
```

3. Map the LV to the server side virtual SCSI adapter, as shown in Example 6-45.

Example 6-45 Change virtual device mappings

```
$ lsmap -all
SVSA            Physloc                                      Client Partition ID
--------------- -------------------------------------------- ------------------
vhost0          U9113.550.106628E-V8-C3                      0x00000000

VTD                   NO VIRTUAL TARGET DEVICE FOUND

$ mkvdev -vdev p8_rootvg -vadapter vhost0 -dev p8_rootvg_dev
p8_rootvg_dev Available

$ lsmap -all
SVSA            Physloc                                      Client Partition ID
--------------- -------------------------------------------- ------------------
vhost0          U9113.550.106628E-V8-C3                      0x00000000

VTD                   p8_rootvg_dev
Status                Available
LUN                   0x8100000000000000
Backing device        p8_rootvg
Physloc
```

4. Example 6-46 shows how to save the TCP/IP configuration.

Example 6-46 Saving TCP/IP configuration

```
$ netstat -state -num
Name  Mtu   Network     Address            Ipkts Ierrs    Opkts Oerrs  Coll
en0   1500  link#2      0.2.55.d3.9c.e0        0     0        8     8     0
en0   1500  192.168.100 192.168.100.78         0     0        8     8     0
lo0   16896 link#1                           181     0      181     0     0
lo0   16896 127         127.0.0.1            181     0      181     0     0
lo0   16896 ::1                              181     0      181     0     0
$ netstat -routinfo -num
Routing tables
Destination        Gateway           Flags     Wt  Policy  If   Cost Config_Cost

Route Tree for Protocol Family 2 (Internet):
default            192.168.100.60    UG         1    -   en0       0    0
127/8              127.0.0.1         U          1    -   lo0       0    0
192.168.100.0      192.168.100.78    UHSb       1    -   en0       0    0 =>
192.168.100/24     192.168.100.78    U          1    -   en0       0    0
192.168.100.78     127.0.0.1         UGHS       1    -   lo0       0    0
192.168.100.255    192.168.100.78    UHSb       1    -   en0       0    0

Route Tree for Protocol Family 24 (Internet v6):
::1                ::1               UH         1    -   lo0       0    0
```

5. Remove the TCP/IP configuration to free up the physical Ethernet adapter using the command **`rmtcpip -f -interface en0`**.
6. Example 6-47 shows how to create a Shared Ethernet Adapter.

Example 6-47 Creating Shared Ethernet Adapter

```
$ mkvdev -sea ent0 -vadapter ent1 -default ent1 -defaultid 666
ent2 Available

$ lsmap -all -net
SVEA   Physloc
------ --------------------------------------------
ent1   U9113.550.106628E-V8-C2-T1

SEA                   ent2
Backing device        ent0
Status                Available
Physloc               U787B.001.DNW1375-P1-C2-T1
```

7. Configure TCP/IP onto the SEA adapter using the saved information, as shown in the following example:

   ```
   mktcpip -hostname VIOS_xCAT -inetaddr 192.168.100.78 -interface
   en2 -start -gateway 192.168.100.60 -netmask 255.255.255.0
   ```

6.6.6 LPAR deployment

xCAT is able to extract the configuration of an existing LPAR with the profile data and create a new LPAR from it. We used this functionality to duplicate an existing LPAR in the following examples.

Note: The following commands could be integrated in a script for multiple node and LPAR creation and setup.

1. Save the definition on an existing LPAR and edit the stanza file (the changed attributes are shown in italic), as shown in Example 6-48.

Example 6-48 Cloning the LPAR definition

```
[p630n05][/]> lsdef -t node -l -z -o virt-p5501_p6 >
/tmp/vio_xcat/virt-p5501_p8.stanza

[p630n05][/]> vi /tmp/vio_xcat/virt-p5501_p8.stanza
"virt-p5501_p8.stanza" 25 lines, 582 characters
# <xCAT data object stanza file>

virt-p5501_p8:
    objtype=node
    arch=ppc64
    cons=hmc

groups=p5501,AIXNodes,HMCNodes,AllNodes,ManagedNodes,NIMNodes,compute,a
ll,lpar,all
    hcp=hmc-v7
    id=
    mac=7241E0007002
    mgt=hmc
    nodetype=lpar,osi
    os=AIX
    parent=p550_itso1
    postscripts=setupntp,TEST_Setup_RMC._AllNodes
    power=hmc
    pprofile=p6_profile
    profile=539image
```

```
serial=106628E
serialflow=hard
serialport=ttyS0
serialspeed=9600
status=alive
termserver=hmc-v7
xcatmaster=192.168.100.35
```

2. Create the new node using the stanza file:

   ```
   cat /tmp/vio_xcat/virt-p5501_p8.stanza|mkdef -z
   ```

3. Configure the conserver daemon as shown in other examples.
4. Create a new LPAR via copying an existing LPAR definition and profile data:

   ```
   mkvm virt-p5501_p8 -i 9 -l virt-p5501_p6
   ```

5. Verify that the new LPAR is allowed to connect to the server side SCSI adapters. The server side adapter setup should be done before node deployment to avoid VIO reboots, which could disturb the already active VIO client nodes. Change the LPAR's virtual SCSI adapter to connect to the correct server side adapter:

   ```
   chvm virt-p5501_p8 virtual_scsi_adapters=4/client/8/VIOS_xCAT/3/1
   ```

6. Configure the Virtual Ethernet adapter:

   ```
   chvm virt-p5501_p8 virtual_eth_adapters=2/0/666//0/1
   ```

7. In our scenario we had to change the minimum memory requirements as well, which is possible using the following command:

   ```
   chvm virt-p5501_p8 min_mem=256
   ```

8. Once this step is completed, normal xCAT node installation can be done as explained in 5.3, "Installing the nodes" on page 198.

6.7 Databases - SQLite and MySQL

Due to its modular implementation, xCAT stores cluster data in an external database. Currently, SQLite and MySQL are supported. DB2® may be supported in the future.

The default database used for xCAT is SQLite. If you have a flat cluster (no hierarchical cluster management), SQLite can be used out of the box.

However, if you need to implement hierarchical management (due to the cluster size), you need to use a database that provides remote client access via the network. Currently, the only supported database that also provides client network access is MySQL.

In 5.2.2, “Switching xCAT SQLite database to MySQL” on page 165 we describe how to configure MySQL as xCAT database.

6.8 Clustering security

This section provides information about security aspects that you should consider for your HPC environment. Most of the security aspects are rather general and valid for most IT environments, thus we will emphasize only the aspects particular to an HPC environment.

6.8.1 Security considerations in an HPC environment

The ultimate goal of HPC is to provide the necessary compute resources for running customer jobs. If the resources are not managed properly, the cluster may not fulfill requirements up to (or as close as possible to) its designed potential. In this respect, security of a cluster becomes an important component of the cluster availability.

Besides actual customer data security, any operation that would prevent the cluster from running useful customer loads needs to be addressed and controlled. Generally, administrative operations improperly executed can render the cluster useless. Thus, these operations need to be properly implemented, scheduled, and audited.

In addition, any access to a cluster via its networks needs to be secured for the same reasons: data security and cluster availability.

HPC clusters, in general, are designed to minimize or eliminate any overhead that may take CPU cycles away from customer compute jobs. For this reason, cluster nodes are tightly connected with high throughput networks, and share a common storage infrastructure.

Because the cluster nodes are tightly connected, if one node becomes unavailable for any reason, then the job that runs on the set of nodes to which the failing node belongs has a very good chance to fail.

The failing node may be the result of an improper administrative action, or even an external attack over the network. Furthermore, we can say that if one node in an HPC cluster is compromised, the entire cluster is exposed and may be compromised. Thus, a combination of security measures and techniques must be employed to resolve the overall security of an HPC cluster, as follows:

- Networking security
  - External network - firewall
  - Internal network - administrative network separation
- Node security
  - Hardware - securing access to physical nodes
  - Hardening OS and communication software
- Overall cluster security
  - Securing physical console access
  - Employing access control and auditing infrastructure and procedures for administrative tasks
  - Controlling and restricting access to job execution and scheduling

Important: Cluster security should be treated globally, and every individual security method or aspect should be correlated inside the HPC environment.

6.8.2 Networking security

External network

The most common technique is to isolate the cluster networks using a firewall infrastructure. For this reason you need to understand what access is needed to and from inside the cluster (services, applications, users, and so on). Firewalls are common to IT infrastructure and are available in commercial or open source implementations.

Internal network - administrative network separation

Internal cluster network infrastructure should provide network separation at the VLAN level for different cluster functions:

- Hardware control VLAN
- Storage VLAN
- Application (compute) VLAN(s)
- User Access VLAN
- Cluster management VLAN(s)

Also, the cluster nodes should only be connected to the networks they require for their functionality:

- Management node
- Storage nodes
- Front-end/user access (login) nodes

- Compute nodes

For example, a front-end/user access (login) node requires a connection to the user access and storage VLANs, optionally to the cluster management VLAN, but does not need to be connected to the hardware management VLAN, or to the application VLAN.

6.8.3 Remote command execution security

Because the cluster acts as a single entity, a centralized control and command execution mechanism is implemented. This is generally used for administrative tasks, but can also be used for job control and monitoring.

Remote command and copy tasks require secure access, that is, only authorized identities (users, services) should be allowed to remotely execute commands or copy files onto the cluster nodes.

xCAT implements a secure access control mechanism for administrative commands using SSL and policies.

6.8.4 xCAT access control via SSL and policies

xCAT provides a policy-based access control for database tables and commands. To enable this feature there is a policy table in the database, which lists the rules that control the access.

The default policy table looks like the one in Example 6-49.

Example 6-49 Listing default policy table

```
# tabdump policy
#priority,name,host,commands,noderange,parameters,time,rule,comments,di
sable
"1","root",,,,,,"allow",,
"4.4",,,"getpostscript",,,,"allow",,
"4.5",,,"getcredentials",,,,"allow",,
```

The policy names to be added are basically specifying the priority order, which is checked when a command is executed.

xCAT uses SSL to encrypt the communication and to administer the identities of the users and the server itself. This is why the installation of OpenSSL packages is a prerequisite for xCAT setup.

At the xCAT manage node installation SSL certificates are created for the server and for the root user.

Server certificates are stored in the /etc/xcat/certs directory, as shown in Example 6-50.

Example 6-50 Listing server certificate files

```
# ls -l /etc/xcat/cert
total 56
-rw-------    1 root     system         1135 May 08 18:44 ca.pem
-rw-------    1 root     system         4147 May 08 18:44 server-cert.pem
-rw-------    1 root     system         5822 May 08 18:44 server-cred.pem
-rw-------    1 root     system         1675 May 08 18:44 server-key.pem
-rw-------    1 root     system          887 May 08 18:44 server-req.pem
```

Certificate files for the root and any other users are stored in the .xcat subdirectory under the users' $HOME.

To enable a new user to run any xCAT operation, the following steps need to be done:

1. Create the AIX user (see Example 6-51).

   Example 6-51 Creating a new user

   ```
   # mkuser lniesz
   # su - lniesz
   $ id
   uid=205(lniesz) gid=1(staff)
   ```

2. As root user, create SSL certificates for the user starting the xCAT script as root with the username as parameter as shown in Example 6-52. The script is interactive and asking approvals for overwriting already existing certifications and other options as well!

Example 6-52 Creating SSL certificates for a new AIX user

```
# /opt/xcat/share/xcat/scripts/setup-local-client.sh lniesz
-n /home/lniesz/.xcat already exists, delete and start over (y/n)?
y
Generating RSA private key, 2048 bit long modulus
........................................+++
....................+++
e is 65537 (0x10001)
/opt/xcat/share/xcat/scripts
Using configuration from openssl.cnf
Check that the request matches the signature
```

```
Signature ok
Certificate Details:
        Serial Number: 4 (0x4)
        Validity
            Not Before: May 20 18:58:31 2009 GMT
            Not After : May 15 18:58:31 2029 GMT
        Subject:
            commonName                = lniesz
        X509v3 extensions:
            X509v3 Basic Constraints:
                CA:FALSE
            Netscape Comment:
                OpenSSL Generated Certificate
            X509v3 Subject Key Identifier:
                9E:6B:04:63:15:45:F0:2D:01:3D:B9:F5:0A:A8:CF:4B:3D:E5:F3:31
            X509v3 Authority Key Identifier:
                keyid:DC:5B:E0:10:B1:06:A0:9A:30:4E:D3:82:FE:24:14:86:83:5A:67:CC

Certificate is to be certified until May 15 18:58:31 2029 GMT (7300 days)
Sign the certificate? [y/n]:y


1 out of 1 certificate requests certified, commit? [y/n]y
Write out database with 1 new entries
Data Base Updated
/opt/xcat/share/xcat/scripts
```

3. Test the access before adding the policy.

   ```
   $ id
   uid=205(lniesz) gid=1(staff)
   $ nodels
   Error: Permission denied for request
   ```

4. Create a policy definition that allows the requested operations, as shown in Example 6-53. We added a policy to allow actions only on the AIXNodes group, and tested what happens if the user wants to run commands against other devices as well.

   Example 6-53 Create policy definition

   ```
   # mkdef -t policy -o 8 name=lniesz rule=allow
   Object definitions have been created or modified.
   ```

5. Test the access again:

   ```
   $ id
   ```

```
uid=205(lniesz) gid=1(staff)
$ nodels
vios-p5502
hmc-v7
p550_itso2
virt-p5502-p1
virt-p5502-p2
virt-p5502-p3
virt-p5502-p4
virt-p5502-p5
virt-p5502-p6
```

Note: The policy handling feature was not fully implemented in the xCAT version that we tested at the time of writing this book. Check the man pages for policy and the xCAT documentation for updates.

After the access is granted for the user, xCAT will log each attempt the user tries to run an xCAT command as shown in Example 6-54. The example shows that the user was able to run xCAT commands. However, the remote SSH session is blocked on the nodes.

Example 6-54 Syslog entries for user access

```
May 20 19:17:32 p630n06 local4:err|error xCAT: xCAT: Allowing nodels for lniesz from
loopback
May 20 19:17:47 p630n06 local4:err|error xCAT: xCAT: Allowing xdsh for lniesz from
loopback
May 20 19:17:47 p630n06 user:info syslog: ifconfig -a
May 20 19:17:47 p630n06 user:info syslog: /usr/sbin/ifconfig -a
May 20 19:18:07 virt-p5502-p1 auth|security:info Message forwarded from
virt-p5502-p1: sshd[344166]: Invalid user lniesz from 192.168.100.36
May 20 19:18:07 virt-p5502-p1 auth|security:info Message forwarded from
virt-p5502-p1: syslog: ssh: failed login attempt for UNKNOWN_USER from p630n06
May 20 19:18:07 virt-p5502-p1 auth|security:info Message forwarded from
virt-p5502-p1: sshd[344166]: Failed none for invalid user lniesz from 192.168.100.36
port 33278 ssh2
May 20 19:29:02 p630n06 local4:err|error xCAT: xCAT: Allowing lsvm for lniesz from
loopback
```

Note: However the xCAT access is granted to the user, SSH authentication is still required and checked to run remote commands on xCAT nodes.

6.8.5 Securing RSCT and RMC

RSCT security functions ensure that the cluster software components can properly authenticate the identity of associated peers, clients, and subcomponents. Because a program could attempt to imitate a cluster component, cluster components must be able to verify program identities. Instead of only requiring each party to verify the identity of the other when a connection is established, RSCT security uses a message authentication process for identification.

6.8.6 HW control and remote console security

The HW control and console access infrastructure provide their own security (authentication and access control) mechanisms. xCAT provides a set of tools (including database storage) for managing access to HW control and consoles

6.8.7 Users and passwords

Generally, users and passwords are used for administrative tasks. Users can also be defined for the job management and scheduling infrastructure. Follow the guidelines and policies implemented in your IT environment.

6.8.8 Application security

Besides system, network and cluster security, applications also may provide their own security (authentication, authorization, and access control) methods. These methods may also employ encryption techniques, such as Secure Socket Layer and others. Refer to the application documentation for integrating and administrating application security into the overall cluster environment.

6.9 Updating xCAT using latest development snaphots

New releases of xCAT are being released continuously. The latest builds or snapshots are released frequently. As part of our cluster maintenance, and to squash some bugs encountered, we decided to update our xCAT to the latest snapshot.

6.9.1 Determine the currently installed level

The level of xCAT installed on our management server can be determined by using the **rpm** command shown in Example 6-55.

Example 6-55 Use rpm to determine current xCAT level

```
mgtnode #rpm -qa|grep xCAT
perl-xCAT-2.2.1-snap200904221514
xCAT-client-2.2.1-snap200904221514
xCAT-server-2.2.1-snap200904221515
xCAT-2.2.1-snap200904221515
xCAT-rmc-2.2.1-snap200904221516
```

6.9.2 Obtain the latest code

The latest snapshot or release of xCAT can be obtained from the sourceforge Web site AT:

http://xcat.sourceforge.net/aix/download.html

There are two types of downloads:

- The stable release: this is the release of xCAT at the version level.
- The snapshot: this is the same release as the stable one, but with bug fixes contained.

Our intent was to update our 2.2.1 version to the latest available snapshot.

We obtained the tar files and unpacked them as in "Downloading and extracting xCAT 2 packages" on page 157.

6.9.3 Backing up the xCAT database

Before updating the software, it is recommended to make a backup of the xCAT database, just in case you have to restore.

We backed up the xCAT database as shown in Example 6-56.

Example 6-56 Backing up the xCAT database

```
mgtnode # dumpxCATdb -p /tmp/xcatback_210509
 Input path must exist
mgtnode # mkdir /tmp/xcatback_210509
mgtnode # dumpxCATdb -p /tmp/xcatback_210509
```

6.9.4 Updating dependency RPMs

We executed the **instoss** command (out of the directory we untarred the xCAT tar files to) to update any dependency RPMs that xCAT may require. None of the dependency files that we had already installed required updating. as shown in Example 6-57 on page 315.

Example 6-57 Executing instoss to update dependency RPMs

```
mgtnode # cd /tmp/xcat_210509
mgtnode # ./instoss
package perl-DBI-1.55-1 is already installed
package bash-3.2-1 is already installed
package perl-DBD-SQLite-1.13-1 is already installed
package tcl-8.4.7-3 is already installed
package tk-8.4.7-3 is already installed
package expect-5.42.1-3 is already installed
package conserver-8.1.16-2 is already installed
package perl-Expect-1.21-1 is already installed
package perl-IO-Tty-1.07-1 is already installed
package perl-IO-Stty-.02-1 is already installed
package perl-IO-Socket-SSL-1.06-1 is already installed
package perl-Net_SSLeay.pm-1.30-1 is already installed
package perl-Digest-MD5-2.36-1 is already installed
package fping-2.4b2_to-1 is already installed
file /usr/local/bin/slptool from install of openslp-xcat-1.2.1-1
conflicts with file from package openslp-1.2.1-1
package perl-Crypt-SSLeay-0.57-1 is already installed
package perl-Net-Telnet-3.03-1.2 is already installed
package net-snmp-5.4.2.1-1 is already installed
package net-snmp-devel-5.4.2.1-1 is already installed
package net-snmp-perl-5.4.2.1-1 is already installed
```

We then executed the **instxcat** script out of the same directory that the new snapshot tar file had been untarred to, as shown in Example 6-58.

Example 6-58 Executing instxcat to update xCAT

```
mgtnode # ./instxcat
perl-xCAT                  ##################################################
xCAT-client                ##################################################
xCAT-server                ##################################################
Stopping xcatd processes....
Starting xcatd.....
xCAT                       ##################################################
Created /etc/xCATMN file.
```

```
Could not remove ssh keys from /install/postscripts/hostkeys directory. They may not
exist.
Could not remove ssh keys from /etc/xcat/hostkeys directory. They may not exist.
Generating SSH1 RSA Key...
Generating SSH2 RSA Key...
Generating SSH2 DSA Key...
/bin/cp /etc/xcat/hostkeys/*.pub /install/postscripts/hostkeys/. is successful
Copied /.ssh/id_rsa.pub to /install/postscripts/_ssh/authorized_keys.
syslog has been set up.
Created /install/postscripts/ca/certs directory.
Copied /etc/xcat/ca/* to /install/postscripts/ca directory.
Created /install/postscripts/cert directory.
Copied /etc/xcat/cert/* to /install/postscripts/cert directory.
Created /install/postscripts/_xcat directory.
Copied /.xcat/* to /install/postscripts/_xcat directory.
Copied /etc/xcat/ca/certs* to /install/postscripts/ca/certs directory.
Stopping xcatd processes....
Starting xcatd.....
xCAT-rmc                   ##################################################
Stopping xcatd processes....
Starting xcatd.....
mgtnode#
```

6.9.5 Verify the install

After the **instxcat** command completed, we determined the new level of xCAT using the **rpm** command, as shown in Example 6-59.

Example 6-59 Determine the new level of xCAT

```
mgtnode # rpm -qa|grep xCAT
xCAT-2.2.1-snap200905150859
xCAT-server-2.2.1-snap200905150859
xCAT-rmc-2.2.1-snap200905150900
perl-xCAT-2.2.1-snap200905150858
xCAT-client-2.2.1-snap200905150858
```

The date and time of the snapshot build is in the name of the RPM file.

Finally, we checked whether we could execute some xCAT commands such as **lsdef** and **xdsh**, as shown in Example 6-60.

Example 6-60 Testing the new xCAT commands

```
mgtnode # xdsh aixnodes date
```

```
lp1p6mma1: Wed May 20 15:43:29 EDT 2009
lp3p6mma1: Wed May 20 15:43:35 EDT 2009
lp2p6mma1: Wed May 20 15:43:29 EDT 2009
lp2p6mma2: Wed May 20 15:43:35 EDT 2009
lp1p6mma2: Wed May 20 15:43:35 EDT 2009
lp3p6mma2: Wed May 20 15:43:35 EDT 2009
lp4p6mma1: Wed May 20 15:43:29 EDT 2009
lp4p6mma2: Wed May 20 15:43:35 EDT 2009
lp1p65501: Wed May 20 15:43:35 EDT 2009
lp3p65502: Wed May 20 15:43:35 EDT 2009
lp1p65502: Wed May 20 15:43:35 EDT 2009
lp2p65501: Wed May 20 15:43:35 EDT 2009
lp2p65502: Wed May 20 15:43:35 EDT 2009
lp3p65501: Wed May 20 15:43:35 EDT 2009
lp4p65502: Wed May 20 15:43:35 EDT 2009
lp4p65501: Wed May 20 15:43:35 EDT 2009
lp6p65501: Wed May 20 15:43:35 EDT 2009
lp7p65501: Wed May 20 15:43:35 EDT 2009
lp5p65501: Wed May 20 15:43:35 EDT 2009

mgtnode # lsdef -t node lp1p65501

Object name: lp1p65501
    cons=hmc
    groups=550nodes,all,lpar,service,aixnodes
    hcp=hmc3
    id=3
    mac=c21e426a440b
    mgt=hmc
    nodetype=lpar,osi
    os=AIX
    parent=Server-8204-E8A-SN10FE411
    postscripts=gethosts,servicenode,setupntp,configen1,configen2
    pprofile=Default
    profile=610BaseImage
    setupnameserver=no
    status=booting
mgtnode #
```

Update the NIM lpp_source

The NIM `lpp_source` resource needs to be updated with the new code. We executed the NIM command shown in Example 6-61.

Example 6-61 Updating NIM lpp_source resource

```
mgtnode # nim -o update -a packages=all -a source=/tmp/xcat_210509
610BaseImage_lpp_source

/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/bash-3.2-1.aix5.2.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/conserver-8.1.16-2.aix5.3.pp
c.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/expect-5.42.1-3.aix5.1.ppc.r
pm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/fping-2.4b2_to-1.aix5.3.ppc.
rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-5.4.2.1-1.aix5.3.pp
c.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-devel-5.4.2.1-1.aix
5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-perl-5.4.2.1-1.aix5
.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-devel-5.4.2.1-1.aix
5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-perl-5.4.2.1-1.aix5
.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/openslp-xcat-1.2.1-1.aix5.3.
ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Crypt-SSLeay-0.57-1.aix
5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-DBD-SQLite-1.13-1.aix5.
3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-DBI-1.55-1.aix5.3.ppc.r
pm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Digest-MD5-2.36-1.aix5.
3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Expect-1.21-1.aix5.3.pp
c.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-IO-Socket-SSL-1.06-1.ai
x5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-IO-Stty-.02-1.aix5.3.pp
c.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-IO-Tty-1.07-1.aix5.3.pp
c.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Net_SSLeay.pm-1.30-1.ai
x5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Net-Telnet-3.03-1.2.aix
5.3.ppc.rpm
```

```
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-xCAT-2.2.1-snap20090515
0858.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/tcl-8.4.7-3.aix5.1.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/tk-8.4.7-3.aix5.1.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-2.2.1-snap200905150859.
aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-client-2.2.1-snap200905
150858.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-rmc-2.2.1-snap200905150
900.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-server-2.2.1-snap200905
150859.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCATaixSN.bnd
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCATaixSSH.bnd
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCATaixSSL.bnd
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-client-2.2.1-snap200905
150858.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-rmc-2.2.1-snap200905150
900.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-server-2.2.1-snap200905
150859.aix5.3.ppc.rpm
mgtnode #
```

6.9.6 Updating xCAT on a service node

Because we have a hierarchical cluster, the service nodes will also need to be updated with the same updated code as the management node.

The service node is a special case. It is normally set up during the initial install of xCAT via the post installscript called `servicenode`. However, we found that this script did not update the xCAT RPMs when executed.

We updated the RPMs on the service node manually. We did not run `instxcat` on the service node, just the **rpm** command against the currently installed RPMs as shown in Example 6-62. We obtained the syntax for the **rpm** command from the **instxcat** script.

Example 6-62 Updating the RPMs on the service node

```
lp1p65501 # rpm -qa|grep xCAT
perl-xCAT-2.2.1-snap200904221514
xCAT-client-2.2.1-snap200904221514
xCAT-rmc-2.2.1-snap200904221516
xCAT-server-2.2.1-snap200904221515
lp1p65501 #cat instxcat
```

```
# xCAT on AIX - install script
rpm -Uvh perl-xCAT-2.2.1-*rpm
rpm -Uvh xCAT-client-2.2.1-*rpm
rpm -Uvh --nodeps xCAT-server-2.2.1-*rpm
rpm -Uvh xCAT-2.2.1-*rpm
rpm -Uvh xCAT-rmc-2.2.1-*rpm
lp1p65501 #rpm -Uvh perl-xCAT-2.2.1-*rpm
perl-xCAT                  ##################################################
lp1p65501 #rpm -Uvh xCAT-client-2.2.1-*rpm
xCAT-client                ##################################################
lp1p65501 #rpm -Uvh --nodeps xCAT-server-2.2.1-*rpm
xCAT-server                ##################################################
Stopping xcatd processes....
Starting xcatd.....
lp1p65501 #rpm -Uvh xCAT-rmc-2.2.1-*rpm
xCAT-rmc                   ##################################################
Stopping xcatd processes....
Starting xcatd.....
lp1p65501 #rpm -qa|grep xCAT
xCAT-rmc-2.2.1-snap200905150900
xCAT-server-2.2.1-snap200905150859
perl-xCAT-2.2.1-snap200905150858
xCAT-client-2.2.1-snap200905150858
lp1p65501 #
```

The next step was to update the `lpp_source` on the service node. The service node is the NIM master for the nodes that are managed via the service node. The **`nim`** command was issued as shown in Example 6-63. This is the same command that was issued on the management node. The source directory is the directory that the xCAT tarfiles were unwrapped into.

Example 6-63 Updating the lpp_source on the service node

```
lp1p65501 #nim -o update -a packages=all -a source=/tmp/newxcat
610BaseImage_lpp_source

/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/bash-3.2-1.aix5.2.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/conserver-8.1.16-2.aix5.3.pp
c.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/expect-5.42.1-3.aix5.1.ppc.r
pm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/fping-2.4b2_to-1.aix5.3.ppc.
rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-5.4.2.1-1.aix5.3.pp
c.rpm
```

```
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-devel-5.4.2.1-1.aix
5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-perl-5.4.2.1-1.aix5
.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-devel-5.4.2.1-1.aix
5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/net-snmp-perl-5.4.2.1-1.aix5
.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/openslp-xcat-1.2.1-1.aix5.3.
ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Crypt-SSLeay-0.57-1.aix
5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-DBD-SQLite-1.13-1.aix5.
3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-DBI-1.55-1.aix5.3.ppc.r
pm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Digest-MD5-2.36-1.aix5.
3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Expect-1.21-1.aix5.3.pp
c.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-IO-Socket-SSL-1.06-1.ai
x5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-IO-Stty-.02-1.aix5.3.pp
c.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-IO-Tty-1.07-1.aix5.3.pp
c.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Net_SSLeay.pm-1.30-1.ai
x5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-Net-Telnet-3.03-1.2.aix
5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/perl-xCAT-2.2.1-snap20090515
0858.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/tcl-8.4.7-3.aix5.1.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/tk-8.4.7-3.aix5.1.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-2.2.1-snap200905150859.
aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-client-2.2.1-snap200905
150858.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-rmc-2.2.1-snap200905150
900.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-server-2.2.1-snap200905
150859.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCATaixSN.bnd
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCATaixSSH.bnd
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCATaixSSL.bnd
```

```
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-client-2.2.1-snap200905
150858.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-rmc-2.2.1-snap200905150
900.aix5.3.ppc.rpm
/install/nim/lpp_source/610BaseImage_lpp_source/RPMS/ppc/xCAT-server-2.2.1-snap200905
150859.aix5.3.ppc.rpm
lp1p65501 #
```

We then verified that we could contact the xCAT database on the management node with the **lsdef** command from the service node, as shown in Example 6-64.

Example 6-64 Contacting the xCAT database on the management node

```
lp1p65501 #lsdef -t node lp7p65501

Object name: lp7p65501
    cons=hmc
    groups=aixnodes,lpar,all,550nodes
    hcp=hmc3
    id=9
    mac=c21e44c4a60b
    mgt=hmc
    nodetype=lpar,osi
    os=AIX
    parent=Server-8204-E8A-SN10FE411
    postscripts=gethosts,setupntp,configen1,configen2
    pprofile=Default
    profile=610_diskless
    servicenode=lp1p65501
    status=booted
    xcatmaster=lp1p65501
lp1p65501 #
```

We then issued the **xdsh** command from the management node to ensure that we still had SSH working. We then encountered the problem shown in Example 6-65.

Example 6-65 Problem with xdsh

```
mgtnode #xdsh aixnodes date
lp2p6mma2: Wed May 20 15:51:28 EDT 2009
lp1p6mma1: Wed May 20 15:51:22 EDT 2009
lp2p6mma1: Wed May 20 15:51:22 EDT 2009
lp3p6mma1: Wed May 20 15:51:28 EDT 2009
lp4p6mma2: Wed May 20 15:51:28 EDT 2009
```

```
lp1p65501: Wed May 20 15:51:28 EDT 2009
lp1p65501: @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

lp1p65501: @    WARNING: REMOTE HOST IDENTIFICATION HAS CHANGED!     @

lp1p65501: @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

lp1p65501: IT IS POSSIBLE THAT SOMEONE IS DOING SOMETHING NASTY!

lp1p65501: Someone could be eavesdropping on you right now (man-in-the-middle
attack)!

lp1p65501: It is also possible that the RSA host key has just been changed.

lp1p65501: The fingerprint for the RSA key sent by the remote host is
lp1p65501: 01:81:4a:f7:8c:63:0a:e2:24:64:7c:fe:cc:e7:08:f2.

lp1p65501: Please contact your system administrator.

lp1p65501: Add correct host key in /.ssh/known_hosts to get rid of this message.

lp1p65501: Offending key in /.ssh/known_hosts:7

lp1p65501: Password authentication is disabled to avoid man-in-the-middle attacks.

lp1p65501: Keyboard-interactive authentication is disabled to avoid man-in-the-middle
attacks.

lp1p6mma2: Wed May 20 15:51:28 EDT 2009
lp3p6mma2: Wed May 20 15:51:28 EDT 2009
lp4p6mma1: Wed May 20 15:51:22 EDT 2009
lp3p65502: Wed May 20 15:51:29 EDT 2009
lp4p65502: Wed May 20 15:51:29 EDT 2009
lp3p65501: Wed May 20 15:51:29 EDT 2009
lp7p65501: Wed May 20 15:51:29 EDT 2009
lp4p65501: Wed May 20 15:51:29 EDT 2009
lp2p65501: Wed May 20 15:51:29 EDT 2009
lp2p65502: Wed May 20 15:51:29 EDT 2009
lp1p65502: Wed May 20 15:51:29 EDT 2009
lp6p65501: Wed May 20 15:51:29 EDT 2009
lp5p65501: Wed May 20 15:51:29 EDT 2009
```

This issue was caused by new host keys being generated during the upgrade. We corrected this problem by removing the `/.ssh/known_hosts` files on the management node and then retested the command. The errors received with the first run of **xdsh** are normal. The test was successful, as shown in Example 6-66.

Example 6-66 After rebuilding know_hosts

```
mgtnode #xdsh aixnodes date
lp2p6mma1: Wed May 20 15:54:19 EDT 2009
lp2p6mma1: Warning: Permanently added 'lp2p6mma1,192.168.100.172' (RSA) to the list
of known hosts.
lp3p6mma1: Wed May 20 15:54:25 EDT 2009
lp3p6mma1: Warning: Permanently added 'lp3p6mma1,192.168.100.173' (RSA) to the list
of known hosts.
lp1p65501: Wed May 20 15:54:25 EDT 2009
lp1p65501: Warning: Permanently added 'lp1p65501,192.168.100.51' (RSA) to the list of
known hosts.
lp4p6mma1: Wed May 20 15:54:19 EDT 2009
lp4p6mma1: Warning: Permanently added 'lp4p6mma1,192.168.100.174' (RSA) to the list
of known hosts.
lp2p6mma2: Wed May 20 15:54:25 EDT 2009
lp2p6mma2: Warning: Permanently added 'lp2p6mma2,192.168.100.182' (RSA) to the list
of known hosts.
lp1p6mma2: Wed May 20 15:54:25 EDT 2009
lp1p6mma2: Warning: Permanently added 'lp1p6mma2,192.168.100.181' (RSA) to the list
of known hosts.
lp1p6mma1: Wed May 20 15:54:24 EDT 2009
lp2p6mma1: Wed May 20 15:54:24 EDT 2009
lp1p65501: Wed May 20 15:54:30 EDT 2009
lp3p6mma1: Wed May 20 15:54:30 EDT 2009
lp4p6mma1: Wed May 20 15:54:24 EDT 2009
lp2p6mma2: Wed May 20 15:54:30 EDT 2009
lp1p6mma2: Wed May 20 15:54:30 EDT 2009
lp3p6mma2: Wed May 20 15:54:30 EDT 2009
lp4p6mma2: Wed May 20 15:54:30 EDT 2009
lp3p65502: Wed May 20 15:54:30 EDT 2009
lp3p65501: Wed May 20 15:54:30 EDT 2009
lp5p65501: Wed May 20 15:54:30 EDT 2009
lp4p65502: Wed May 20 15:54:30 EDT 2009
lp2p65501: Wed May 20 15:54:30 EDT 2009
lp1p65502: Wed May 20 15:54:30 EDT 2009
lp4p65501: Wed May 20 15:54:30 EDT 2009
lp2p65502: Wed May 20 15:54:30 EDT 2009
lp7p65501: Wed May 20 15:54:30 EDT 2009
lp6p65501: Wed May 20 15:54:30 EDT 2009
```

We went through the same checklists that are in “Open the console and initialize network boot” on page 224 to verify everything was operating satisfactorily.

6.10 Data to gather for support

Here we list the information that could be useful in case we have an xCAT-related problem.

- xCAT management node
  - Operating system-related data available on base AIX install:
    - Collect system **snap** using the commands in Example 6-67.

Example 6-67 Preparing snap data

```
[p630n05][/]> snap -r
Nothing to clean up
[p630n05][/]> snap -gtc
/var/adm/ras/trcfile: No such file or directory
Checking space requirement for general
information.......................................................
..................................................................
......................... done.
.********Checking and initializing directory structure
Creating /tmp/ibmsupt directory tree... done.
Creating /tmp/ibmsupt/svCollect directory tree... done.
Creating /tmp/ibmsupt/client_collect directory tree... done.
Creating /tmp/ibmsupt/tcpip directory tree... done.
Creating /tmp/ibmsupt/general directory tree... done.
Creating /tmp/ibmsupt/general/diagnostics directory tree... done.
Creating /tmp/ibmsupt/pcixscsi directory tree... done.
Creating /tmp/ibmsupt/sissas directory tree... done.
Creating /tmp/ibmsupt/testcase directory tree... done.
Creating /tmp/ibmsupt/other directory tree... done.
********Finished setting up directory /tmp/ibmsupt

Checking Space requirement for svCollect
The script svCollect is not executable in /usr/lib/ras/snapscripts
Checking Space requirement for client_collect
Checking space requirement for tcpip
information.................................................. done.
Checking for enough free space in filesystem... done.

/var/adm/ras/trcfile: No such file or directory
```

```
Gathering general system
information.........................................................
....................................................................
......................... done.
Gathering platform/scanout information.done.
Gathering svCollect data
The script svCollect is not executable in /usr/lib/ras/snapscripts
Gathering client_collect data
Gathering pcixscsi system information....... done.
Gathering sissas system information...... done.
Gathering tcpip system
information...................................................... done.

Creating compressed pax file...
Starting pax/compress process... Please wait... done.

-rw-------    1 0       0           980237 May 20 14:40 snap.pax.Z
```

- RMC data, if the RMC monitoring is configured: use the **`ctsnap`** command, which creates a zipped tar file in the `/tmp/ctsupt` directory by default.
- System log, if the AIX syslog facility is used: check the location of the system log as shown in Example 6-68 and save the log file.

Example 6-68 Listing syslog daemon configuration

```
[p630n05][/]> lssrc -ls syslogd
Subsystem         Group            PID          Status
 syslogd          ras              123240       active
Syslogd Config   *.debug   /var/log/messages  rotate 1024K files 5
```

xCAT data to be saved

- xCAT database backup using the **`dumpxCATdb`** command, which saves all database tables in comma-separated files.
- xCAT postscripts from the default location `/install/postscripts`.
- File collection information and setup if used in the environment.

▶ xCAT node

– Operating system-related data available on base AIX install:

- Collect system **`snap`** using the commands in Example 6-67.
- RMC data, if any local RSCT class data is changed on the nodes: use the **`ctsnap`** command, which creates a zipped tar file in the `/tmp/ctsupt` directory by default.

  - System log, if the AIX syslog facility is used and local log files are created on the nodes: check the location of the system log as shown in Example 6-68 and save the log file.

- VIO Servers
  - If you have VIO Servers, run the **snap** command to collect all necessary information.
  - For a quick check run the following commands:
    - **lsmap -all**: lists disk virtualization mapping.
    - **lsmap -all -net**: lists Ethernet virtualization mapping.
- HMC
  - Version of the software installed on HMC using the **lshmc -V** command as shown in Example 6-69. The example shows the command initiated from an SSH remote shell, for which the remote login has to be enabled without password.

Example 6-69 Query HMC version

```
# ssh hscroot@hmc-v7 lshmc -V
"version= Version: 7
 Release: 3.4.0
 Service Pack: 0
HMC Build level 20081014.1
","base_version=V7R3.3.0
"
```

  - System plans created on HMC can also be useful, if we have to investigate LPAR configuration-related issues. Use the following command to create the system plan file:

```
mksysplan -m ‘managed system” -f “filename”
```

  - Check the DLPAR capability of the managed LPARs using:

```
lspartition -dlpar
```

For convenience, we also created Table 6-3 which gives an overview of the data that should be gathered.

Table 6-3 Gathering support data

Machine type	Data source	Command	Gathered data
xCAT MN	Operating system	snap -gtc	General AIX snap data with TCP/IP configuration

Machine type	Data source	Command	Gathered data
		ctsnap	RSCT database, logs and configuration information
		lssrc -ls syslogd	System log type and target location, configuration is included in snap
		lssrc -ls inetd	Search for bootp and tftp subservers, whether the services are enabled or not
	xCAT	dumpxCATdb	xCAT database content
		tar -cvf xCAT_postscripts.tar /install/postscripts	xCAT postscripts, be careful with the extraction
xCAT node	Operating system	snap -gtc	General AIX snap data with TCP/IP configuration
		ctsnap	RSCT database, logs and configuration information
		lssrc -ls syslogd	System log type and target location
VIO Server	Operating system	snap	General AIX snap and PowerVM™ related data
	PowerVM	lsmap -all	Storage virtualization
		lsmap -all -net	Ethernet virtualization
HMC	Operating system and HMC SW	lshmc -V	Installed SW versions

Machine type	Data source	Command	Gathered data
	Managed systems	mksysplan -m “managed system” -f “filename”	Partition configuration
	LPARs	lspartition -dlpar	Shows DLPAR capabilities of the LPARs

Part 4

Appendixes

A

Configuring syslog-ng

Note: The package versions and the steps presented in this Appendix were tested at the date of this writing (June 2009). Current versions and steps may differ significantly in your environment.

In a large environment, managing the data logged by all systems may be very difficult because there are several administrators that have different responsibilities and, as a consequence, they may be monitoring different events of the same servers.

Another challenge on a centralized logging system is to sort the data based on different criteria. In this section we briefly explain how to set up the syslog-ng to use a database as a back end and a Web interface for sorting the data.

In Figure A-1 on page 334 we describe how the logging data flows:

1. The servers (syslog clients) are sending log information using the syslog protocol. Currently, most of the servers or devices send data using UDP port 514, which is clear text. Servers with syslog-ng installed can also send the log information using TCP port 514, which is more reliable. Also, syslog-ng can encrypt the information.
2. The syslog servers can receive information using both protocols (UDP or TCP).
3. All logs are sent to a MySQL database server using a database client.

4. The php-syslog-ng front end queries the database for requested information based on the filters that the user (admin) defined.
5. The query result is presented using Web protocol. The php-syslog-ng front end supports authentication and SSL communication (through a Web server).

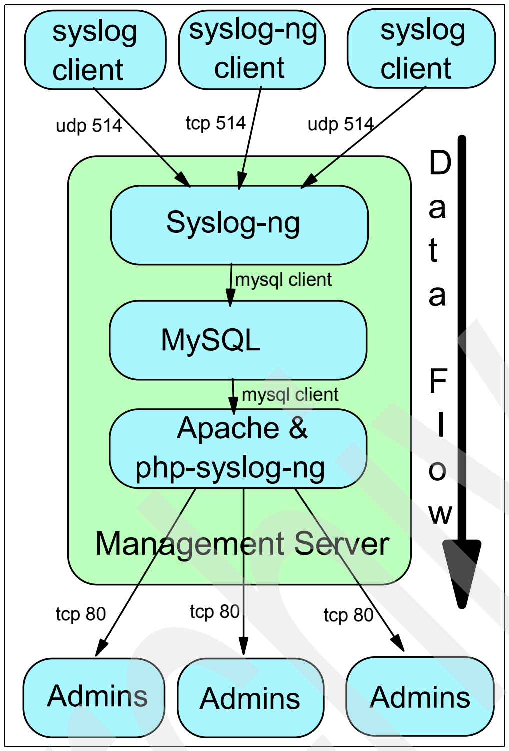

Figure A-1 Syslog data flow

Our scenario consists of these major tasks:

- Installing the required packages on *SuSe Enterprise Linux Server*
- Configuring MySQL as back-end database and creating the necessary tables
- Installing and configuring the php-syslong-ng Web interface
- Customizing the managing scripts

Important: Our scenario does not cover any security or performance settings. We recommend to address these aspects in your production environment.

On *SuSe Enterprise Linux Server* 11 the following packages need to be installed (all packages and their dependencies are located on the distribution DVDs):

```
mysql
php5-mysql
php5-zlib
apache2-mod_php5
php5
phpzlib
php-gd
```

Configuring php-syslog-ng on SLES 11

The following steps describe the system preparation for the php-syslog-ng front end:

1. Start up the MySQL database by using:

   ```
   chkconfig mysql on
   /etc/init.d/mysql start
   ```

2. Configure the syslog-ng to log the data in MySQL by adding the setting shown in Example A-1 in `/etc/syslog-ng/syslog-ng.conf`.

Note: Some of the lines in the example frame are longer that one 80-character row, so they show as multiple rows. In the configuration file the lines marked with "\" at the end represent one row.

Example A-1 Syslog-ng to MySQL configuration

```
destination d_mysql {
  program("/usr/bin/mysql --reconnect -f -T --user=syslogadmin --password=itsoadmin\
syslog >> /var/log/db_log.log 2>&1"
  template("INSERT INTO logs (host, facility, priority, level, tag, datetime,\
program, msg) VALUES ( '$HOST', '$FACILITY', '$PRIORITY', '$LEVEL', '$TAG',
'$YEAR-$MONTH-$DAY $HOUR:$MIN:$SEC','$PROGRAM', '$MSG' );\n") template-escape(yes));
};
log { source (itso); destination (d_mysql);};
b
```

3. Download the php-syslog-ng packages from the link at:

   http://code.google.com/p/php-syslog-ng/

   and unpack the package in `/srv/www/syslog`.

4. Create an Apache configuration file for the directory `/srv/www/syslog`. The file is located in directory `/etc/apache2/conf.d/syslog.conf` and is shown in Example A-2. Reload the Apache configuration with:

   ```
   /etc/init.d/apache2 reload
   ```

Example A-2 Apache configuration file for directory /srv/www/syslog

```
Alias /syslog "/srv/www/syslog"
<Directory "srv/www/syslog">
 Options -Indexes FollowSymLinks MultiViews
 AllowOverride None
 Order allow,deny
 Allow from all
</Directory>
```

5. Make the following configuration files and directories writable:

   ```
   mgtIBlnx:/srv/www/syslog/html # chmod -R 777 jpcache
   mgtIBlnx:/srv/www/syslog/html # chmod -R 777 config
   ```

6. For some performance increase, modify the file `/etc/php5/apache2/php.ini` with:

   ```
   memory_limit = 128M
   max_execution_time = 300
   ```

   and restart the Apache daemon.

7. The scripts shown in Example A-3 need to be added in `crontab`.

Example A-3 Logrotate and cache reload scripts in crontab

```
@daily php /srv/www/syslog/scripts/logrotate.php >> /var/log/syslog/logrotate.log
@daily find /srv/www/syslog/html/jpcache/ -atime 1 -exec rm -f '{}' ';'
*/5 * * * * php /srv/www/syslog/scripts/reloadcache.php >>\
/var/log/syslog/reloadcache.log
```

   We chose to install the php-syslog-ng in a different path than default. In this case the scripts have to be modified to use the new path.

8. We chose not to use authentication, but for a production system we recommend that it be set up.

9. *SuSe Enterprise Linux Server* is using *apparmor* for audit purposes. Modify the file `/etc/apparmor.d/sbin.syslog-ng` as shown in Example A-4, in order to allow the syslog-ng daemon to write in the MySQL database.

Example A-4 Apparmor setting

```
#include <tunables/global>
```

```
#define this to be where syslog-ng is chrooted
@{CHROOT_BASE}=""

/sbin/syslog-ng {
  #include <abstractions/base>
  #include <abstractions/consoles>
  #include <abstractions/nameservice>
  #include <abstractions/mysql>

  capability chown,
  capability dac_override,
  capability fsetid,
  capability fowner,
  capability sys_tty_config,

  /usr/bin/mysql rmix,
  /etc/my.cnf r,
  /bin/bash rmix,
  /dev/log w,
  /dev/syslog w,
  /dev/tty10 rw,
  /dev/xconsole rw,
  /etc/syslog-ng/* r,
  @{PROC}/kmsg r,
  /etc/hosts.deny r,
  /etc/hosts.allow r,
  /sbin/syslog-ng mr,
  # chrooted applications
  @{CHROOT_BASE}/var/lib/*/dev/log w,
  @{CHROOT_BASE}/var/lib/syslog-ng/syslog-ng.persist rw,
  @{CHROOT_BASE}/var/log/** w,
  @{CHROOT_BASE}/var/run/syslog-ng.pid krw,

}
```

10. Reload the apparmor with:

    ```
    apparmor_parser -r /etc/apparmor.d/sbin.syslog-ng
    ```

11. Connect to the Web server. In our case the link is:

    `http://192.168.100.111/syslog/html/`

12. Follow the on-line wizard to configure php-syslog-ng.

Note: The `crontab` scripts will rotate the tables and create a new table for each day. However, there is the table `all_logs` that contains all the information since the system was started. Other scripts need to be developed in order to archive the information from the database.

Configuring php-syslog-ng using a Web wizard

1. Using a Web browser connect to:

   `http://192.168.100.111/syslog/html`

2. In the next step, accept the license.
3. Configure basic settings such as the DB hostname, database user access for reading and writing access.
4. Set up the site name.
5. Set up the URL path for php-syslog-ng application and click Next. Pay attention to the / (backslashes) at the end of the Site URL path. Choose a convenient password.
6. The fourth step is a summary.
7. Connect to:

   `http://192.168.100.111/syslog/html`

   and log on using admin user and the chosen password. The User Guide for the php-syslog-ng can be accessed at:

   `http://192.168.100.111/syslog/html/userguide.doc`

Configuring php-syslog-ng on AIX

In order to run php-syslog-ng on AIX, most of the packages needs to be compiled. The following procedure explains the general steps:

1. Install the IBM HTTP server.
2. Download, install and configure the MySQL server for AIX as described in:

   `http://www.ibm.com/developerworks/aix/library/au-mysql.html#short`

3. Download, install and configure PHP as described in:

   `http://www.ibm.com/developerworks/wikis/display/WikiPtype/aixopen`

4. Install bash because the scripts are written in bash.
5. Install the scripts in crontab as shown in Example A-3 on page 336.
6. Run the wizard as described in "Configuring php-syslog-ng using a Web wizard" on page 338.

Additional considerations

- Syslog-ng can work with other databases such as DB2 or PostgreSQL, even on different systems. See:

  http://www.postgresql.org/

- The database will grow in time. Proper management for limiting the database size is strongly recommended.
- The front-end php-syslog-ng is a multi-user system, each with different access policies.

B

Additional material

This book refers to additional material that can be downloaded from the Internet as described below.

Locating the Web material

The Web material associated with this book is available in softcopy on the Internet from the IBM Redbooks Web server. Point your Web browser at:

`ftp://www.redbooks.ibm.com/redbooks/SG24-7766`

Alternatively, you can go to the IBM Redbooks Web site at:

`ibm.com/redbooks`

Select the **Additional materials** and open the directory that corresponds with the IBM Redbooks form number, SG24-7766.

Using the Web material

The additional Web material that accompanies this book includes the following files:

File name	*Description*

sg247766.zip	????Zipped Code Samples

System requirements for downloading the Web material

The following system configuration is recommended:

Hard disk space:	1MB minimum
Operating System:	Windows/Linux/AIX

How to use the Web material

Create a subdirectory (folder) on your workstation, and unzip the contents of the Web material zip file into this folder.

Related publications

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

IBM Redbooks

For information about ordering these publications, see "How to get Redbooks" on page 343. Note that some of the documents referenced here may be available in softcopy only.

- *IBM BladeCenter Products and Technology*, SG24-7523
- *NIM from A to Z in AIX 5L*, SG24-7296
- *xCAT 2 Guide for the CSM System Administrator*, REDP-4437
- *HPC Clusters Using InfiniBand on IBM Power Systems Servers*, SG24-7767

Online resources

These Web sites are also relevant as further information sources:

- xCAT homepage:

  `http://xcat.sourceforge.net/`
- IBM Enhanced/Elite Support for xCAT:

  `http://www-03.ibm.com/systems/clusters/support/xcat/index.html`

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