

**Eine CAE Infrastruktur für LS-DYNA
unter Verwendung von
Microsoft Windows HPC Server 2008**

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A CAE Infrastructure for LS-DYNA Using Microsoft Windows HPC Server 2008

German LS-DYNA Forum 2008

September 30. – October 1., Bamberg



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Agenda

- *Company Information*
- *Introduction*
- *Administration and Usage*
- *Status*



Corporate Data

— *Year of founding* 1997 —

— *Employees* 29 —

— *Sales goal 2008* 2.2 Mio. EUR —



Service Portfolio

Systems and applications infrastructures

—— *Unix/Windows systems management*

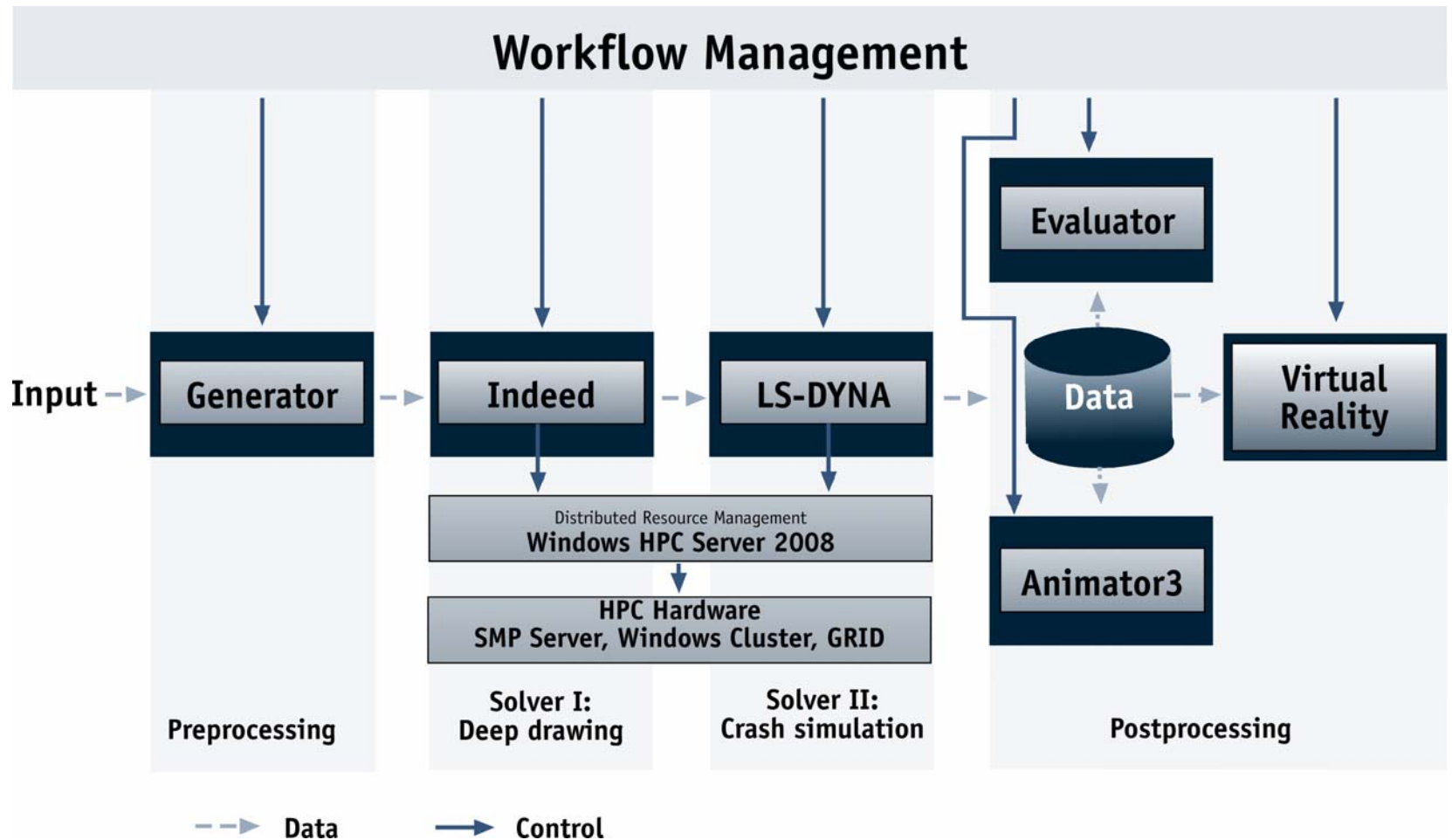
—— *High-performance computing*

—— *Technical data management*

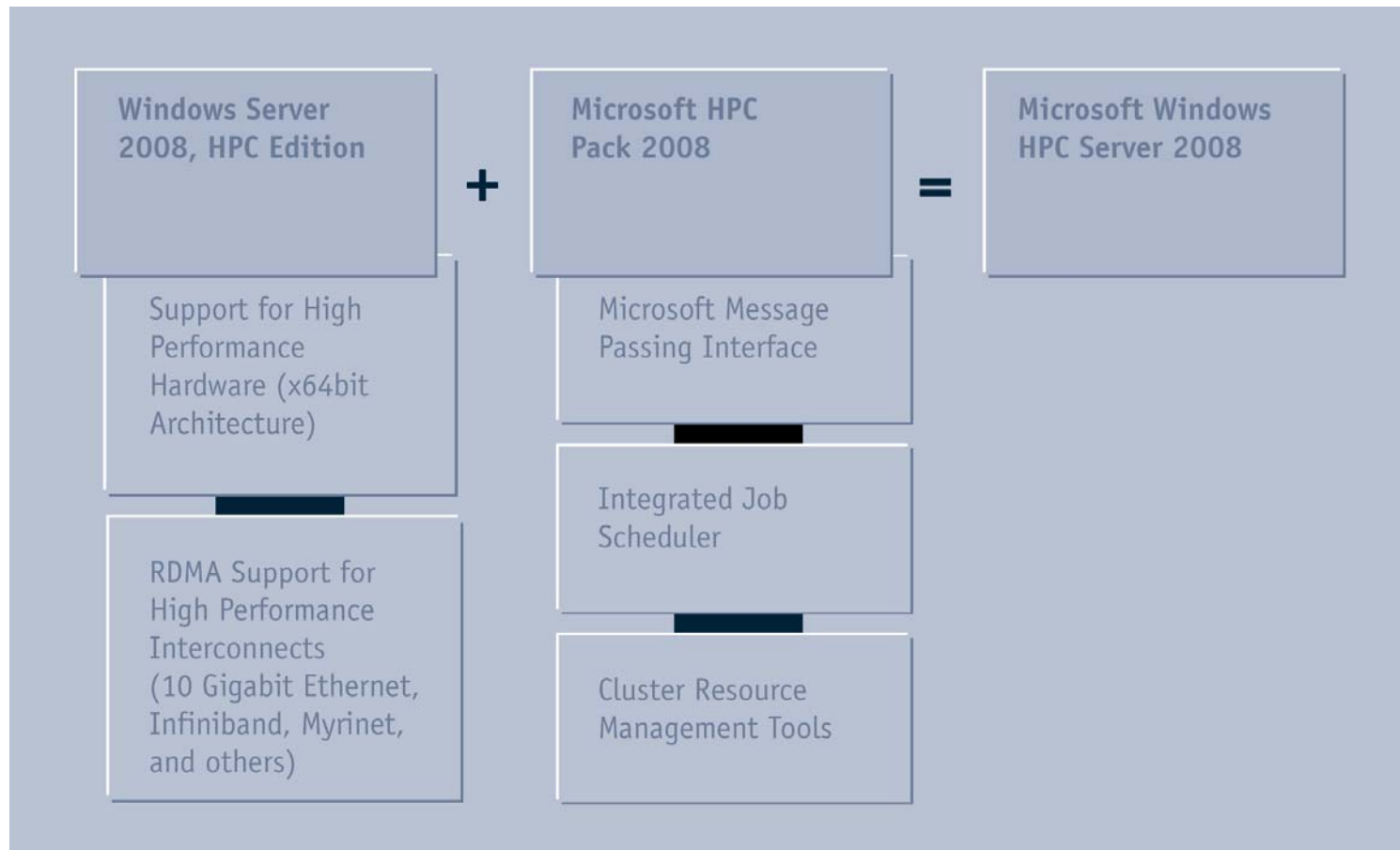


***A CAE Infrastructure for LS-DYNA
Using Microsoft Windows HPC
Server 2008***

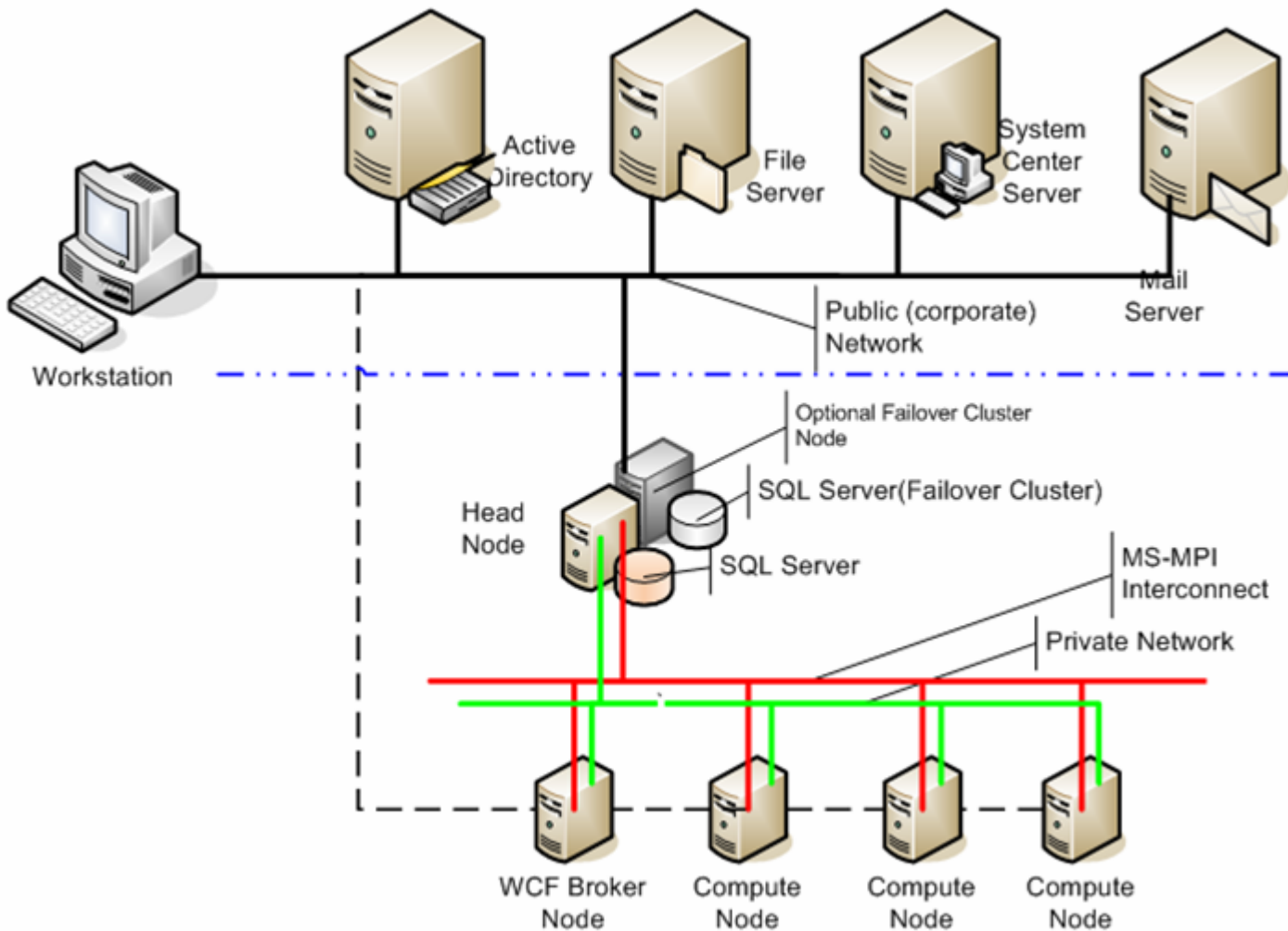
Introduction > CAE Workflow I



Introduction > Software Overview



Introduction > Component Overview



Requirements > Head Node

- CPU: EM64T/AMD64
- Windows 2008 Server, HPC Edition (Restricted to HPC workload)
- HPC Pack 2008

- DNS
- Active Directory
- DHCP

- File shares
 - *Applications*
 - *Tools*
- Network connections
 - *Internal*
 - *External*

Requirements > Compute Server

- CPU: EM64T/AMD64
- Windows 2008 Server, HPC Edition
- HPC Pack 2008
- Network connections
 - *Internal*
 - *External*
- Applications and tools (e.g. compiler)

Requirements > Clients

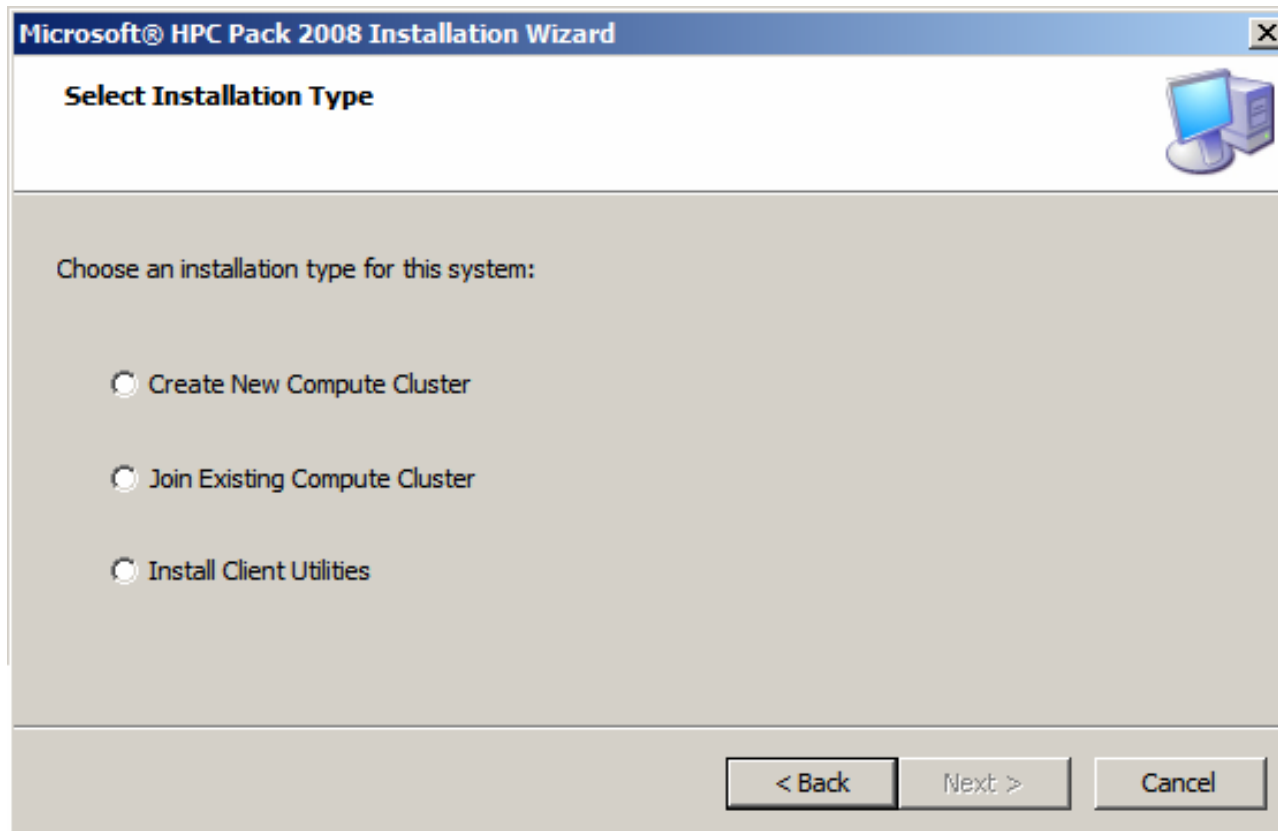
- CPU: IA32/EM64T/AMD64
- Windows XP Professional
- Windows Vista
- Windows Server 2003
- Windows Server 2008

- HPC Pack 2008

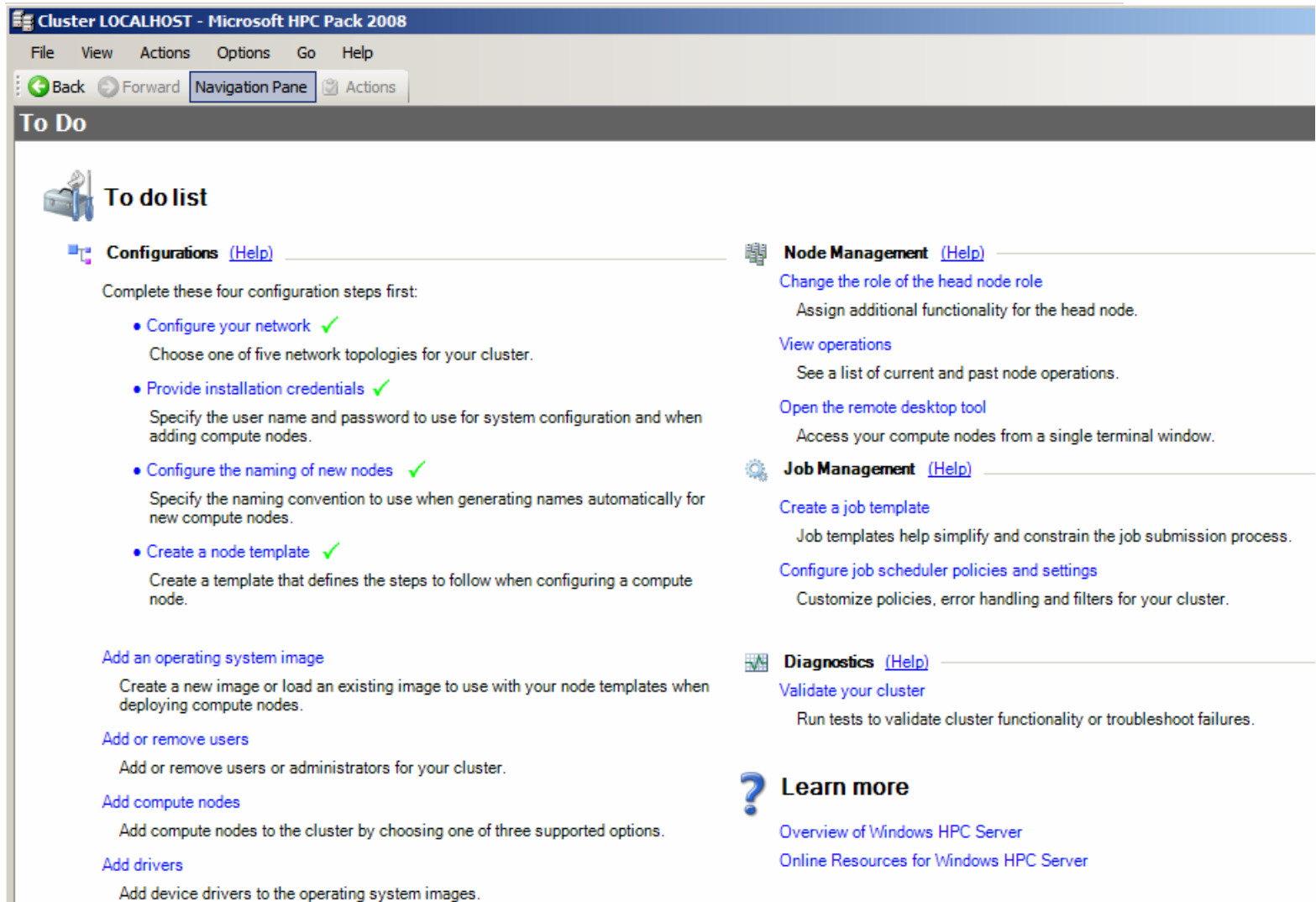
Requirements > Other Software

- Microsoft SQL Server 2005 (oder Microsoft SQL Server 2005 Express), on head node only
- Microsoft .NET Framework 3.0, for HPC Pack

Cluster Installation > HPC Pack



Cluster Installation > HPC Pack, Head Node



The screenshot shows the Microsoft HPC Pack 2008 interface for a cluster named 'LOCALHOST'. The window title is 'Cluster LOCALHOST - Microsoft HPC Pack 2008'. The menu bar includes 'File', 'View', 'Actions', 'Options', 'Go', and 'Help'. Below the menu bar is a navigation pane with 'Back', 'Forward', 'Navigation Pane', and 'Actions' buttons. The main content area is titled 'To Do' and contains a 'To do list' section with a list of tasks. The tasks are organized into four main categories: Configurations, Node Management, Job Management, and Diagnostics. Each category has a 'Help' link. The 'Configurations' category lists four tasks, all of which are marked as complete with a green checkmark. The 'Node Management' category lists three tasks. The 'Job Management' category lists two tasks. The 'Diagnostics' category lists one task. There is also a 'Learn more' section with a question mark icon and two links to overview and online resources.

Cluster LOCALHOST - Microsoft HPC Pack 2008

File View Actions Options Go Help

Back Forward Navigation Pane Actions

To Do

To do list

Configurations [\(Help\)](#)

Complete these four configuration steps first:

- **Configure your network** ✓
Choose one of five network topologies for your cluster.
- **Provide installation credentials** ✓
Specify the user name and password to use for system configuration and when adding compute nodes.
- **Configure the naming of new nodes** ✓
Specify the naming convention to use when generating names automatically for new compute nodes.
- **Create a node template** ✓
Create a template that defines the steps to follow when configuring a compute node.

[Add an operating system image](#)
Create a new image or load an existing image to use with your node templates when deploying compute nodes.

[Add or remove users](#)
Add or remove users or administrators for your cluster.

[Add compute nodes](#)
Add compute nodes to the cluster by choosing one of three supported options.

[Add drivers](#)
Add device drivers to the operating system images.

Node Management [\(Help\)](#)

[Change the role of the head node role](#)
Assign additional functionality for the head node.

[View operations](#)
See a list of current and past node operations.

[Open the remote desktop tool](#)
Access your compute nodes from a single terminal window.

Job Management [\(Help\)](#)

[Create a job template](#)
Job templates help simplify and constrain the job submission process.

[Configure job scheduler policies and settings](#)
Customize policies, error handling and filters for your cluster.

Diagnostics [\(Help\)](#)

[Validate your cluster](#)
Run tests to validate cluster functionality or troubleshoot failures.

? Learn more

[Overview of Windows HPC Server](#)

[Online Resources for Windows HPC Server](#)

Cluster Installation > Network Topology

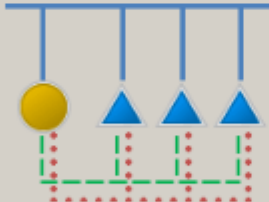
Network Configuration Wizard

Network Topology Selection

Choose a network topology for the cluster:

- 1. Compute nodes isolated on a private network
- 2. All nodes on enterprise and private networks
- 3. Compute nodes isolated on private and application networks
- 4. All nodes on enterprise, private, and application networks
- 5. All nodes only on an enterprise network

Topology No. 4



— Enterprise Network
- - - Private Network
... Application Network

● Head Node
▲ Compute Node

✘ 3 online network adapters are needed for this topology.

For more information, see [Understanding Network Topologies](#).

< Previous Next > Configure Cancel

Cluster Installation > Node Templates

The screenshot shows a Windows wizard window titled "Create Node Template". The window has a blue title bar with a close button. The main content area is titled "Specify Template Name". On the left side, there is a vertical navigation pane with the following items: "Specify Template Name" (highlighted in blue), "Select Deployment Type", "Select OS Image", "Local Administrator Password", "Windows Updates", and "Review". The main area contains the following text: "This wizard will guide you through the process of generating a node template. You can use node templates to deploy compute nodes." followed by "First, specify a name for the template, and optionally a description for it." Below this, there are two input fields: "Template name:" with the text "Node Template for Computeserver" and "Description (Optional):" with the text "Windows HPC Server 2008 for LS-DYNA". At the bottom of the window, there are four buttons: "< Previous", "Next >", "Create", and "Cancel".

Create Node Template

Specify Template Name

Specify Template Name

Select Deployment Type

Select OS Image

Local Administrator Password

Windows Updates

Review

This wizard will guide you through the process of generating a node template. You can use node templates to deploy compute nodes.

First, specify a name for the template, and optionally a description for it.

Template name:

Node Template for Computeserver

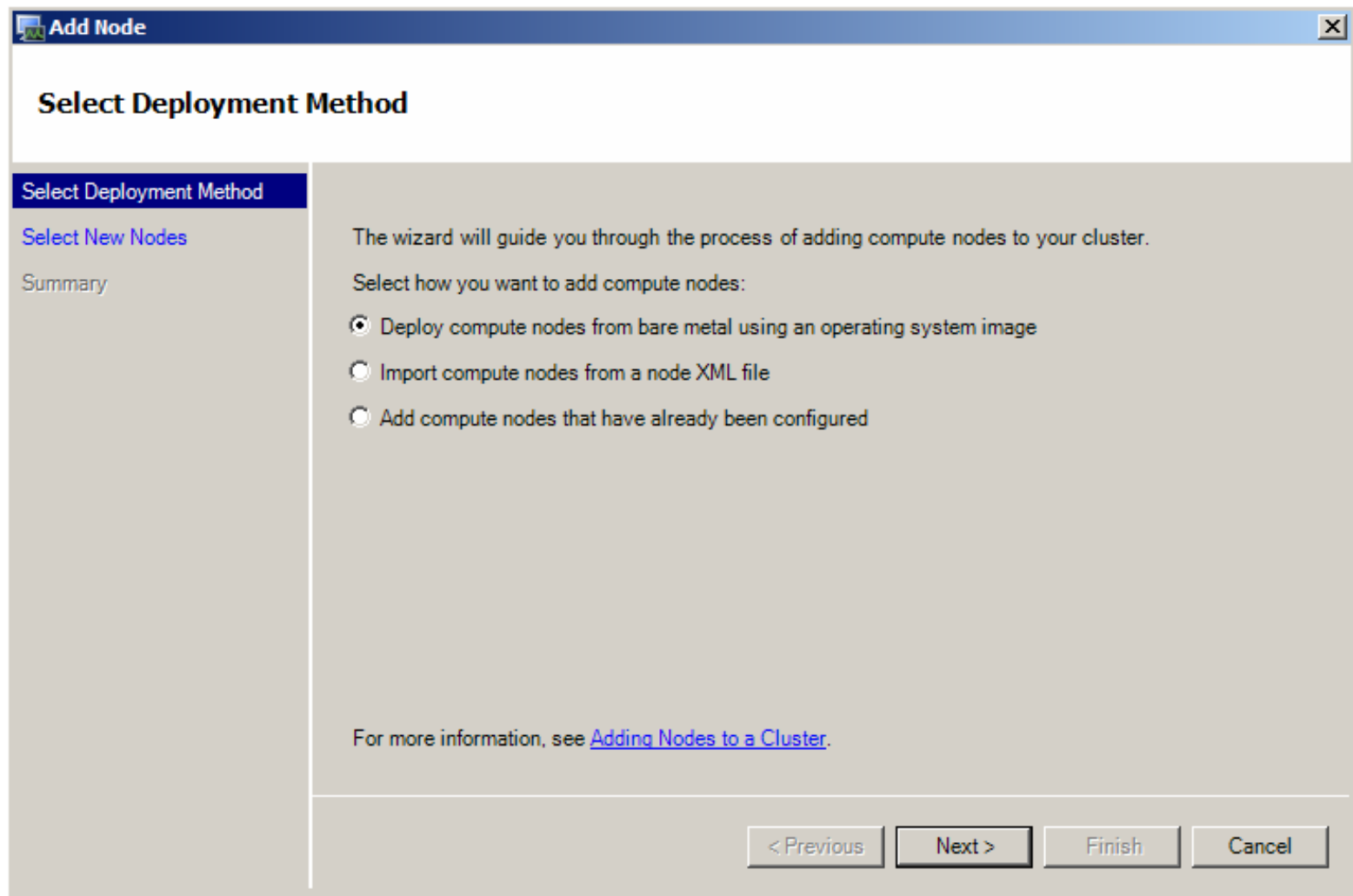
Description (Optional):

Windows HPC Server 2008 for LS-DYNA

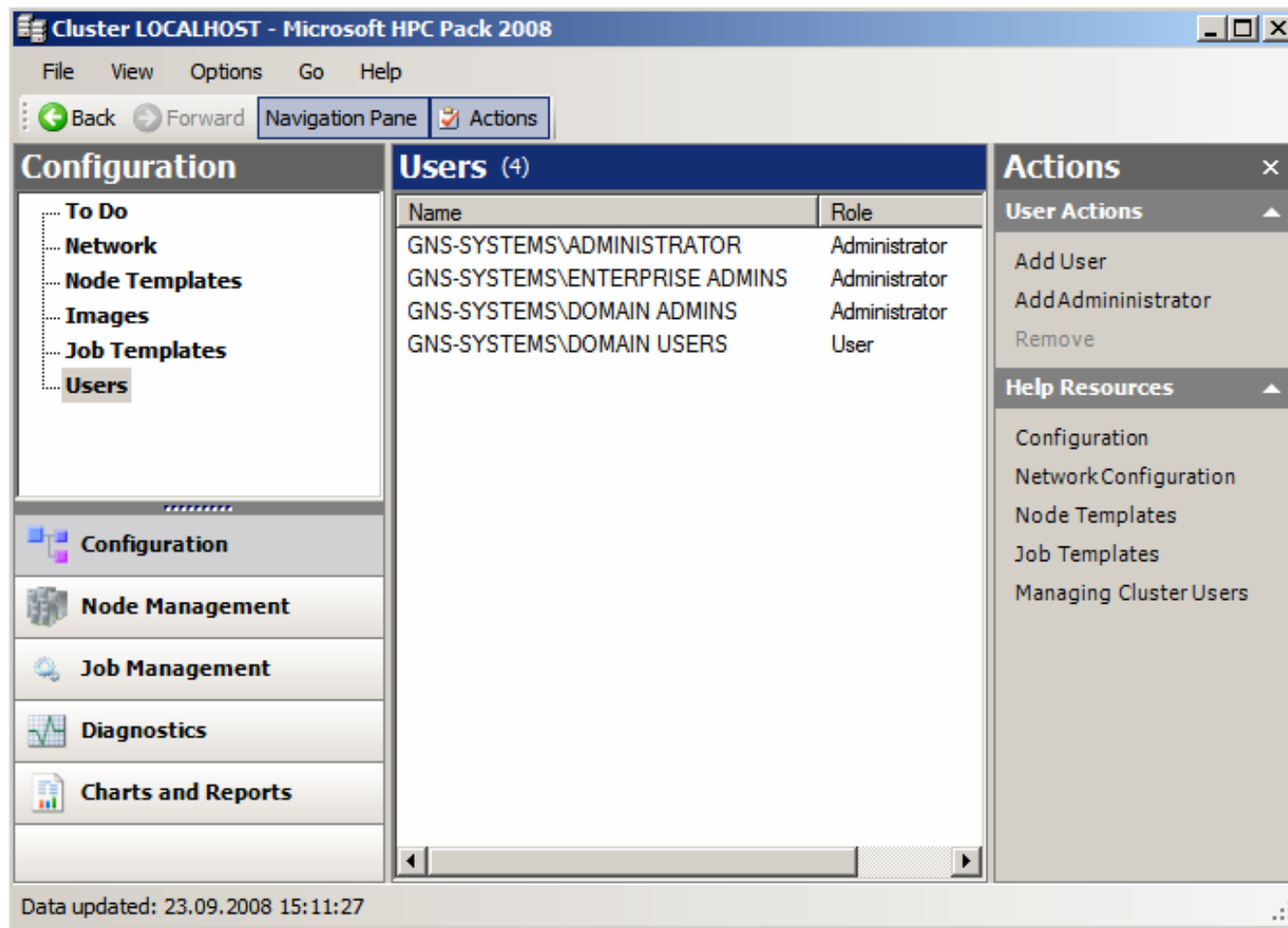
For more information, see [Understanding Node Templates](#).

< Previous Next > Create Cancel

Cluster Installation > Image Deployment



Cluster Installation > Adding Users



The screenshot shows the Microsoft HPC Pack 2008 configuration tool for a cluster named LOCALHOST. The interface is divided into several panes:

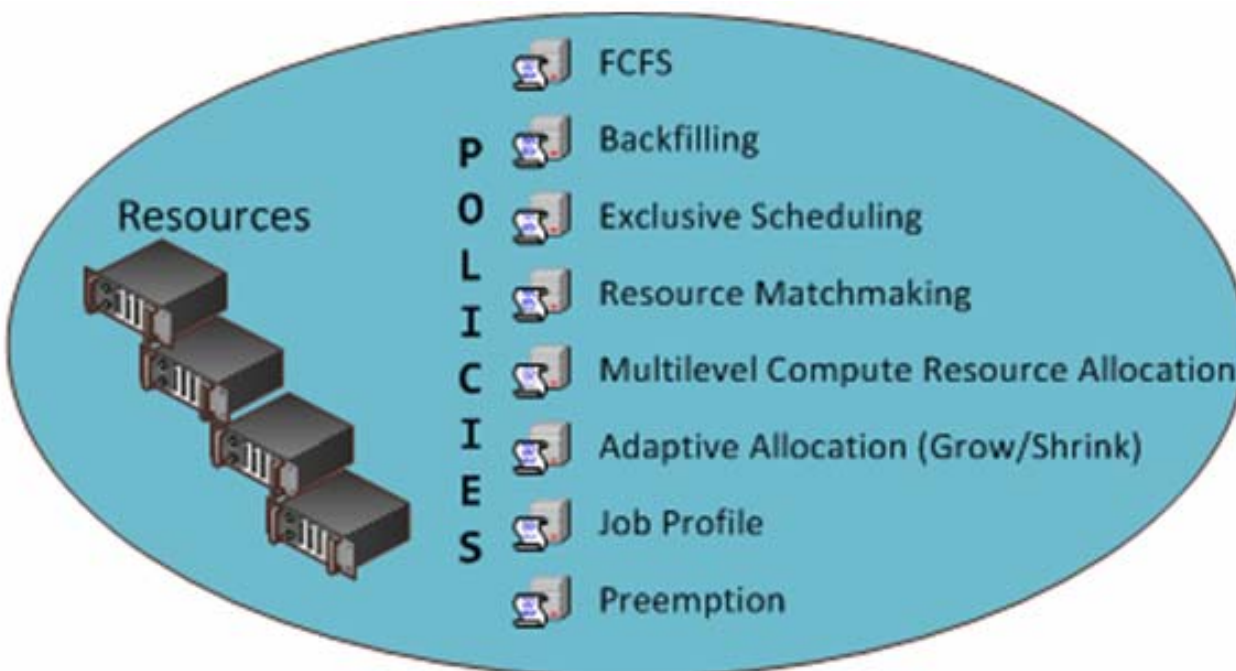
- Configuration:** A sidebar on the left with a tree view containing: To Do, Network, Node Templates, Images, Job Templates, and Users (selected).
- Users (4):** A central table listing the cluster's users.
- Actions:** A right-hand pane with sections for User Actions (Add User, Add Administrator, Remove) and Help Resources (Configuration, Network Configuration, Node Templates, Job Templates, Managing Cluster Users).
- Bottom Panel:** A navigation bar with icons and labels for Configuration, Node Management, Job Management, Diagnostics, and Charts and Reports.

The Users table contains the following data:

Name	Role
GNS-SYSTEMS\ADMINISTRATOR	Administrator
GNS-SYSTEMS\ENTERPRISE ADMINS	Administrator
GNS-SYSTEMS\DOMAIN ADMINS	Administrator
GNS-SYSTEMS\DOMAIN USERS	User

Data updated: 23.09.2008 15:11:27

Cluster Configuration > Scheduling



Cluster Configuration > Job Templates II

Job Template Editor

Name:

Description:

Job Template Details:

Minimum Cores	The minimum number of processors on which this job can run.
Maximum Cores	The maximum number of processors on which this job can run.
Minimum Nodes	The minimum number of nodes on which this job can run.
Maximum Nodes	The maximum number of nodes on which this job can run.
Minimum Sockets	The minimum number of sockets on which this job can run.
Maximum Sockets	The maximum number of sockets on which this job can run.
Unit Type	The granularity at which to schedule resources for the job. The...
Exclusive	If True, no other jobs can be run on a compute node at the sam...
Run Until Canceled	If True, this job will run until it is cancelled or its runtime is expire...
Priority	The priority of the job.
Auto Calculate M...	If enabled, the scheduler will automatically calculate the maxim...
Auto Calculate Mi...	If enabled, the scheduler will automatically calculate the minimu...
FailOnTaskFailure	If True, then failure of any task in the job will cause the entire jo...

MaxCores

Default Value	1
Max Value	32
Min Value	1

Max Value
The max value for this Job Term. Jobs which indicate a value larger than this will be rejected by scheduler.

Save

Add

- Job Name
- Exclusive
- FailOnTaskFailure
- Preemptable
- Auto Calculate Maximum
- Auto Calculate Minimum
- Run Until Canceled
- Priority
- Project
- Run Time
- Licenses
- Unit Type
- Minimum Cores
- Minimum Nodes
- Minimum Sockets
- Maximum Cores
- Maximum Nodes
- Maximum Sockets
- Node Ordering
- Node Groups
- Requested Nodes
- Service Name

Job Submission > Job Console

The screenshot shows the Microsoft HPC Pack 2008 Job Console interface. The window title is "Cluster LOCALHOST - Microsoft HPC Pack 2008". The menu bar includes File, View, Actions, Options, Go, and Help. Below the menu bar are navigation buttons for Back and Forward, and tabs for Navigation Pane and Actions.

The main area is titled "Active (0)" and contains a filter section with fields for Job Name, Owner, Submit Time, and Project Name. Below the filter is a table with columns for Job ID, Job Name, State, Owner, Priority, and Submit Time. The table is currently empty.

On the right side, there is an "Actions" panel with a "Pivot To" dropdown menu. The panel is divided into sections: "Job Submission" and "Job Actions".

- Job Submission:**
 - New Job
 - Single-Task Job
 - Parametric Sweep Job
 - Create New Job From Description File
- Job Actions:**
 - View Job
 - Modify Job
 - Add Task To Job
 - Copy Job
 - Submit Job
 - Cancel Job
 - Requeue Job
 - Export Job

At the bottom of the main area, there is a checkbox labeled "Expand parametric tasks".

The status bar at the bottom left shows "Data updated: 23.09.2008 15:18:12".

Job Submission > Job Definition

Create New Job

Job Details

Job name:

Job template:

Project:

Priority:

Job run options

Do not run this job for more than:

Days: Hours: Minutes:

Run job until cancelled or run time expires

Fail the job if any task in the job fails

Job resources

Select the type of resource to request for this job:

Enter the minimum and/or maximum of the selected resource type that this job is allowed to use:

Minimum: Auto calculate

Maximum: Auto calculate

Use assigned resources exclusively for this job

No other jobs will be allowed to run on the selected nodes while the job is running.

Job Submission > Task Definition

Task Details and I/O Redirection [X]

Task name:

Command line:

Work directory:
 Browse...

Standard input:
 Browse...

Standard output:
 Browse...

Standard error:
 Browse...

Specify the minimum and maximum number of resources to use for this job. The job resource type is set to core.

Minimum: Maximum:

Save Cancel

Job Submission > External Tools

XJGen JobMaker -- XJGen v0.4_ke by GNS Systems GmbH

File Job Help

Lsdyna 1.3 for Windows

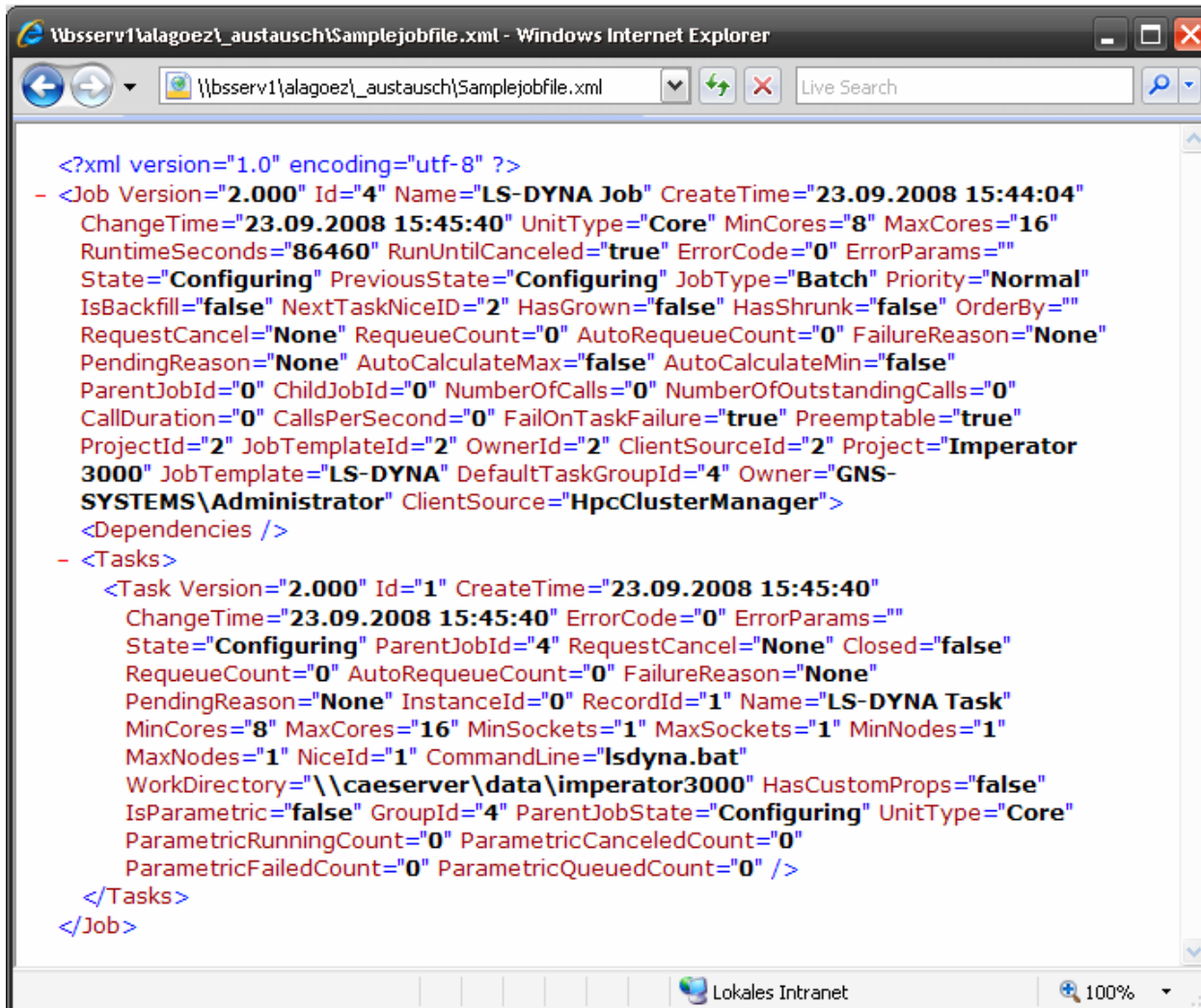
General Parameter Section		Application Specific Parameter Section	
Jobname:	beamfree	Precision:	s
Program Version:	971.R3.2	Multiprocessor Type:	mpp
Host Type/Architecture:	win-x64	Memory Words:	
Number of CPUs:	16	Memory2 Words:	<
At [YYYY]MMDDhhmm:		Stress Initialisation File:	...
Depend on Job:		VDA Geometry File:	...
Queue:	autoselect	Interface Segment Infile:	...
Mail Notification:		Interface Segment Outfile:	
		Dump File:	
		Interface Force File:	
		Restart:	no
		Restart File:	...
		Additional Cmdline Options:	

Workstation Parameter Section	
User ID on Supercomputers:	Ciesla
Workstation Name:	ntws3
User ID on Workstation:	Ciesla
Workstation Input Path:	E:/work
Workstation Output Path:	E:/work

Show Job Write Job Submit Job Exit

Ready

Job Submission > Job File



```
<?xml version="1.0" encoding="utf-8" ?>
- <Job Version="2.000" Id="4" Name="LS-DYNA Job" CreateTime="23.09.2008 15:44:04"
  ChangeTime="23.09.2008 15:45:40" UnitType="Core" MinCores="8" MaxCores="16"
  RuntimeSeconds="86460" RunUntilCanceled="true" ErrorCode="0" ErrorParams=""
  State="Configuring" PreviousState="Configuring" JobType="Batch" Priority="Normal"
  IsBackfill="false" NextTaskNiceID="2" HasGrown="false" HasShrunk="false" OrderBy=""
  RequestCancel="None" RequeueCount="0" AutoRequeueCount="0" FailureReason="None"
  PendingReason="None" AutoCalculateMax="false" AutoCalculateMin="false"
  ParentJobId="0" ChildJobId="0" NumberOfCalls="0" NumberOfOutstandingCalls="0"
  CallDuration="0" CallsPerSecond="0" FailOnTaskFailure="true" Preemptable="true"
  ProjectId="2" JobTemplateId="2" OwnerId="2" ClientSourceId="2" Project="Imperator
  3000" JobTemplate="LS-DYNA" DefaultTaskGroupId="4" Owner="GNS-
  SYSTEMS\Administrator" ClientSource="HpcClusterManager">
  <Dependencies />
- <Tasks>
  <Task Version="2.000" Id="1" CreateTime="23.09.2008 15:45:40"
  ChangeTime="23.09.2008 15:45:40" ErrorCode="0" ErrorParams=""
  State="Configuring" ParentJobId="4" RequestCancel="None" Closed="false"
  RequeueCount="0" AutoRequeueCount="0" FailureReason="None"
  PendingReason="None" InstanceId="0" RecordId="1" Name="LS-DYNA Task"
  MinCores="8" MaxCores="16" MinSockets="1" MaxSockets="1" MinNodes="1"
  MaxNodes="1" NiceId="1" CommandLine="lsdyna.bat"
  WorkDirectory="\\caeserver\data\imperator3000" HasCustomProps="false"
  IsParametric="false" GroupId="4" ParentJobState="Configuring" UnitType="Core"
  ParametricRunningCount="0" ParametricCanceledCount="0"
  ParametricFailedCount="0" ParametricQueuedCount="0" />
</Tasks>
</Job>
```

Monitoring > Job Queue

Cluster LOCALHOST - Microsoft HPC Pack 2008

File View Actions Options Go Help

Back Forward Navigation Pane Actions

Job Management

- All Jobs
 - Configuring
 - Active
 - Finished**
 - Failed
 - Canceled
- My Jobs
 - Configuring
 - Active
 - Finished
 - Failed
 - Canceled
- Job Templates
 - Default
 - LS-DYNA
- Clustrun Commands
- Pivoted View

Configuration

Node Management

Job Management

Diagnostics

Charts and Reports

Finished (2)

Filter: Job Name Owner Submit Time Project Name

Job ID	Job Name	State	Owner	Priority	Submit Time	Requested Resources
7	LS-DYNA	Finished	GNS-SYSTEMS\Adminis...	Normal	23.09.2008 15:58:32	Auto-Auto Cores
6	LS-DYNA	Finished	GNS-SYSTEMS\Adminis...	Normal	23.09.2008 15:56:26	Auto-Auto Cores

Job Name : LS-DYNA Expand parametric tasks

Task Job Details Activity Log

Task ID	Task Name	State	Command Line	Requested Resources	Start Time
1	LS-DYNA Task	Finished	lsdyna.bat	1-1 Cores	23.09.2008 15:58:33

Data updated: 23.09.2008 15:58:33

Cluster Administration

The screenshot displays the Microsoft HPC Pack 2008 Cluster Administration console. The main window is titled "Cluster LOCALHOST - Microsoft HPC Pack 2008" and features a menu bar (File, View, Actions, Options, Go, Help) and a toolbar with navigation and action buttons.

Node Management Panel: This panel on the left provides a hierarchical view of the cluster nodes. It is organized into several categories:

- By Group:** Includes HeadNodes, ComputeNodes, and WCFBrokerNodes.
- By State:** Shows counts for Online (1), Offline (0), Unknown (0), Provisioning (0), Starting (0), Draining (0), Removing (0), and Rejected (0).
- By Node Template:** Lists Default ComputeNode Template and HeadNodeTemplate.
- By Health:** Shows counts for OK (1), Unreachable (0), Ongoing Operation (0), Diagnostic Failed (0), and Provisioning Failed (0).
- Operations:** A section for managing node operations.

Nodes (1) Table: The central pane displays a table of nodes. The table has columns for Netbios Name, State, Node Health, Node Template, and Location. One node is listed:

Netbios Name	State	Node Health	Node Template	Location
WIN-G8GYP32QPOT	Online	OK	HeadNode Template	

Node Details Panel: Below the table, the details for the selected node "Node WIN-G8GYP32QPOT" are shown. It indicates "Executing operations: 0" and provides tabs for Properties, Network, Metrics, and Operations. The Properties tab is active, showing the following information:

- Groups:** ComputeNodes, HeadNodes
- Node Template:** HeadNodeTemplate
- State:** Online
- Location:**
- Core:** Intel(R) Xeon(R) CPU E5320 @ 1.86GHz, Intel(R) Xeon(R) CPU E5320 @ 1.86GHz
- Memory:** 1023 MB
- System Type:** Microsoft Windows NT 6.0.6001 Service Pack 1
- Disks:** A:\, C:\, D:\, E:\
- Product Key:**

Actions Panel: The right-hand pane contains a list of actions that can be performed on the selected nodes. These include:

- Jobs for the selected nodes
- Failed diagnostics for node
- Operations for the node
- Node Actions:** Bring Online, Take Offline, Reboot, Run Command, Add Node, Re-image, Maintain, Change Role..., Delete, Reject, Assign Node Template, Edit, Export Node XML, Run Diagnostics, View Performance Charts, Open Event Viewer, Remote Desktop.
- Help Resources:** Node Management, Node States and Operations, Grouping ComputeNodes, Node List and Heat Map Views.

Bottom Panel: A navigation pane on the left side of the main window includes buttons for Configuration, Node Management (which is selected), Job Management, Diagnostics, and Charts and Reports. At the bottom left, a status bar indicates "Data updated: 23.09.2008 16:00:38".

Cluster Administration > Diagnostics

Cluster LOCALHOST - Microsoft HPC Pack 2008

File View Actions Options Go Help

Back Forward Navigation Pane Actions

Diagnostics

- Tests
 - Scheduler
 - Services
 - Connectivity
 - System Configuration
 - SOA
- Test Results
 - Running
 - Success
 - Warning
 - Failure
 - FailedToRun
 - Complete

Pivoted View

- Configuration
- Node Management
- Job Management
- Diagnostics
- Charts and Reports

Tests (15)

Test Name	Description	Test Suite
Domain Connectivity	Basic test to check connectivity with Active Directory.	Connectivity
Application Configurations R...	Reports on the applications installed on the node.	System Configuration
Firewall Configurations Report	Reports on the firewall rules that are enabled on the node.	System Configuration
Installed Patches Report	Reports on the installed patches for each compute node.	System Configuration
DNS Name Resolution	Checks if nodes are able to resolve the names of the other nodes appropriat...	Connectivity
Network Configurations Rep...	Reports on the network configuration of the node.	System Configuration
Pending Patches	Checks if there are any outstanding patches for the compute node.	System Configuration
Internode Connectivity	Performs a ping test from each node to the other.	Connectivity
Patches Required	Compares the patches installed on the node with the patches listed in the no...	System Configuration
Service Configurations Report	Reports on all the services that are running on the node.	System Configuration
Service Errors	Checks the event log on the node for recent HPC service events.	Services
All Services Running	Checks if the HPC services are running on the node.	Services
Job Submission Test	Runs a simple test job on the node.	Scheduler
SOA Model Latency	Runs a simple Service Oriented Application (SOA) functional test.	SOA
SOA Service Configurations...	Reports on all the Service Oriented Application (SOA) services that are install...	SOA

Data updated: 23.09.2008 16:02:26

Cluster Administration > Reporting

Cluster LOCALHOST - Microsoft HPC Pack 2008

File View Actions Options Go Help

Back Forward Navigation Pane Actions

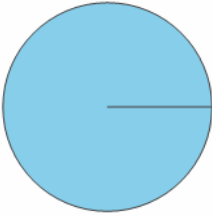
Charts and Reports

Monitoring Charts

- Monitoring Charts
- Reports
 - Node Availability
 - Job Resource Usage
 - Job Throughput
 - Job Turnaround


Summary

Node State



Online

Job Throughput



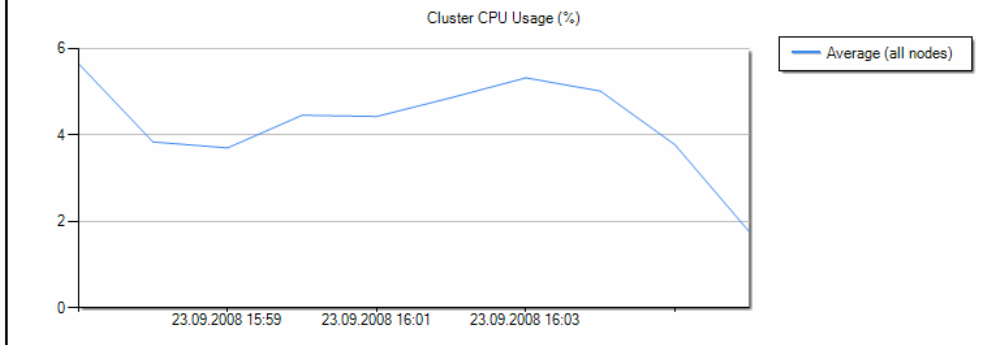
Default Queued Finished Running
Failed Canceled

Chart details

Metric: Cluster Disk Through Add

X axis (minutes): 10 Y axis: 0 - 0 Refresh

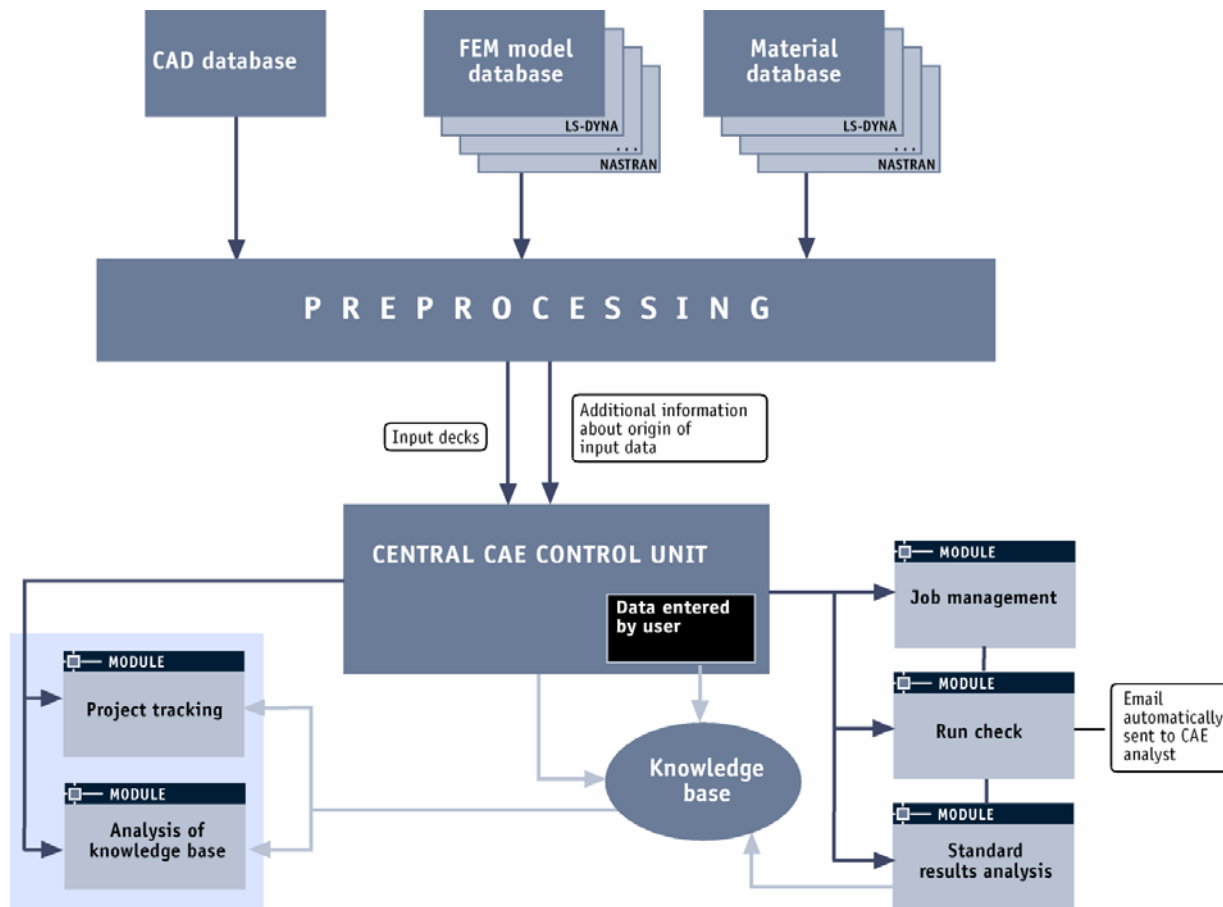
Cluster CPU Usage (%)



Average (all nodes)

Data updated: 23.09.2008 16:02:26

Process Integration > Integrated CAE Environment



Process Integration > Other Functionalities

- **Creation and provision of user functions**
- **Compilation procedures**
- **Database access**
- **Job dependencies**
- **Access to results**
 - *Copy data to workstation*
 - *Access via file share*
 - *Remote access (Remote Desktop)*
 - *Web service*

Status > Advantages

- **Windows operating system and utilities**
 - *Active Directory security context*
- **Integration with Windows client application software**
- **Complete basic HPC software infrastructure**
 - *MPI*
 - *Scheduler*

Status > Disadvantages

- Productive use in industry is limited
- Limited hardware support
 - *x86_64*
- Large effort to perform migration

Summary

- **Complete software infrastructure for technical high performance computing**
- **Tools for cluster configuration and management**
- **Tools and methods for job submission and monitoring**
- **Immediately usable for small to medium-sized environments**

Thank You!