IBM HACMP V5.2: Simpler, faster, goes the distance

Overview

Better protect your critical business applications from failures with the world-spanning capabilities of IBM High Availability Cluster Multi-Processing for AIX® 5L, V5.2 (HACMP V5.2).

For over a decade, IBM HACMP has provided reliable high availability services, monitoring customers’ pSeries® servers and dependably performing application failover to backup servers. The HACMP Extended Distance (HACMP/XD) feature provides real-time data mirroring and disaster recovery for critical business needs. The HACMP Smart Assist for WebSphere® feature brings additional high availability to end-user application environments.

Now you have a single, world-class source of protection for your mission-critical applications.

HACMP V5.2 offers streamlined, simplified, and automated features to better support your on demand business.

HACMP V5.2: Simpler. Faster. Goes the distance.

Simpler to configure and more flexible to maintain

- Two-node configuration wizard for common installations
- Cluster Test Tool
- Enhanced security mechanisms
- Web-based configuration and control facility for cluster management
- Optional feature HACMP Smart Assist for WebSphere

Faster event processing to speed application recovery

- Improved policy-based cluster manager provides streamlined resource movement and faster failover.
- Up to 40% improvement in basic cluster failover time helps minimize application downtime.
- Ability to define resource group interdependencies facilitates efficient failovers.

Goes the distance to provide availability across multiple sites

- AIX Logical Volume Manager (LVM) split mirroring for disaster recovery in SAN environments.
- Optional HACMP/XD feature that supports unlimited-distance geographic clustering and data mirroring options to enhance disaster recovery.
- New support for Enterprise Remote Copy Management Facility (eRCMF) with HACMP/XD for Enterprise Storage Subsystem (ESS) PPRC expands HACMP/XD’s capabilities.

Software withdrawal and service discontinuance: IBM HACMP V5.1

Effective March 31, 2005, IBM will withdraw from marketing the HACMP V5.1 program licensed under the IBM International Program License Agreement. Effective September 1, 2006, IBM will discontinue service.

Key prerequisites

- AIX 5L V5.1 or V5.2, or later
- pSeries servers with adequate slots for your disk and network adapters in a no-single-point-of-failure configuration

Planned availability date

July 16, 2004

At a glance

HACMP™ 5.2 offers robust high availability and disaster recovery, with streamlined configuration, improved ease-of-use, reduced cost of administration, greater flexibility of event handling, faster failover, and a new Web-based configuration and control facility for pSeries customers with mission-critical applications.

- Streamlined cluster configuration:
  - Two-node configuration wizard
  - Additional security features
- Reduced cost and improved ease of administration:
  - Cluster Test Tool
  - Show “Cluster Applications” Utility
- Greater flexibility of event handling
  - Internal policy-based cluster resource manager
  - Multiple application monitors
  - Customized control of resource behavior
- Web-based configuration and control facility
- AIX LVM split mirroring and ESS eRCMF support

The optional features HACMP Extended Distance (HACMP/XD) and HACMP Smart Assist for WebSphere provide complete high availability disaster recovery solutions for your business.

For ordering, contact:
Your IBM representative, an IBM Business Partner, or the Americas Call Centers at 800-IBM-CALL

Reference: RE001

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HACMP for AIX 5L provides the capability to greatly improve availability of applications needed to support on-demand businesses. HACMP 5.2 continues to demonstrate IBM’s cluster technology leadership, with new features to make the product even simpler, faster, and more flexible to integrate into IBM or third-party application environments. IBM continues its expansion of features to enhance extended distance implementations, including new AIX mirroring support for campus configurations.

HACMP provides base services for cluster membership, system management, configuration integrity and control, and failover and recovery for up to 32 servers or nodes. Easy-to-use status and monitoring facilities are included. Scalability provides these capabilities across entire clusters and allows customers to define their own HACMP events and monitor their applications. HACMP 5.2 fully supports administration of AIX 5L Enhanced Concurrent Mode, thus providing concurrent shared-access management for all supported disk subsystems.

HACMP provides ease-of-use features to speed configuration of your cluster for a variety of application environments. Whether your objective for availability is at the storage level (such as ESS or FASTT) volume group or logical volume level (such as LVM), at a clustered file system level (such as with GPFS), at the application level (such as DB2® or WebSphere), or at the site level (such as to support disaster recovery), HACMP has features and options to assist with successful integration into your environment. After your cluster is configured, a wealth of options ensures that changes are synchronized accurately across all systems and the cluster can be monitored easily with methods appropriate to your environment.

The HACMP/XD option provides automated data backup and disaster recovery across geographically dispersed sites, enabling you to protect business-critical applications and provide 24 x 7 service to your customers and staff.

The HACMP Smart Assist for WebSphere option builds upon existing WebSphere availability strategies to deliver even higher levels of availability for your WebSphere environment by integrating the power of HACMP for AIX 5L for monitoring and recovering from failures of system-level services and components. Smart Assist expands HACMP auto-discovery features to simplify and streamline the configuration process.

HACMP is built upon the Reliable Scalable Cluster Technology (RSCT) features of AIX 5L to bring greater scalability. HACMP clusters with both nonconcurrent and concurrent access can contain up to 32 nodes. A node is an AIX 5L operating system image, and it may be a pSeries or RS/6000® server, an RS/6000 SP™ node, or an LPAR of an applicable pSeries system.

### Highlights of Version 5.2.0

HACMP V5.2 includes the following new or enhanced features:

- **New policy-based cluster manager delivers more responsive failover** — The policy-based cluster manager has been enhanced to provide more flexibility moving resources as a result of failures. All resource movement decisions are made by the cluster manager after evaluating resource dependencies. Since all policy decisions are made by the cluster manager, no end-user script modifications are required to manage or respond to failures of any supported resource.

- **Two-node configuration wizard** — The two-node configuration wizard simplifies the process for configuring an HACMP cluster that includes two nodes and associated volume groups, networks, service IP labels, and applications. The wizard guides you through the configuration process and provides online user assistance to help you enter correct information for the five entry fields. The two-node wizard is designed for users with little knowledge of HACMP who want to quickly set up a basic two-node cluster with one nonconcurrent resource group, one application server, volume groups, and one service label.

- **Test Tool for easier verification of cluster behavior** — You can use the Cluster Test Tool to test your new or changed HACMP configuration to evaluate how a cluster behaves under a set of specified circumstances, such as when a node or network becomes inaccessible, a resource group moves from one node to another, and so forth. You can let the test run unattended and evaluate results at a later time.

- **Improved security** — In addition to connection authentication to protect HACMP communications between cluster nodes, HACMP now provides additional security for HACMP messages sent between nodes. Message authentication ensures the origination and integrity of a message. Message encryption changes the appearance of the data as it is transmitted and returns it to its original form when received by a node that authenticates the message. HACMP supports MD5, DES, Triple DES, and AES.

- **Simplified Resource Groups definition methods** — In HACMP 5.2, all resource groups are configured in the same way as you configured custom resource groups in the previous release. All groups are referred to simply as resource groups.

- **More flexible policy for resource group startup** — This policy ensures that during a node or cluster startup, only one resource group is brought online on a node (node distribution) or on a node per network (network distribution). The start order for your resources can now be explicitly set with a more straightforward method.

- **Simpler configuration of complex clusters** — Configuring a resource group dependency allows for easier configuration and control for clusters with multi-tier applications where one application depends on the successful startup of another application, and both applications are required to be kept highly available with HACMP. Dependencies that you configure are explicitly specified using the SMIT interface and are established cluster-wide.
• **HACMP File Collections** — Provides an easy way to request that a list of files be kept in sync across the cluster. Using HACMP File Collections, you no longer have to manually copy an updated file to every cluster node, verify that the file is properly copied, and confirm that each node has the same version of it. HACMP also detects when a file in a file collection is deleted or if the file size is changed to zero, and logs a message to inform the administrator. Two predefined HACMP file collections are installed by default, to control system files and HACMP files.

• **Automatic cluster configuration checking by the cluster verification utility** — By default, HACMP 5.2 runs the verifier utility automatically on the node that is first in alphabetical order, once every 24 hours at midnight. HACMP notifies the cluster administrator if problems with the cluster configuration are detected. This action will reduce the risk that a change to the cluster may negatively impact a cluster event at a later time.

• **Web-based cluster management** — Now you can configure, monitor, and manage your cluster from a Web browser. HACMP 5.2 includes a Web-enabled user interface (WebSMIT) that provides consolidated access to the HACMP SMIT functions for configuration and management, a new interactive cluster status display, and links to the HACMP documentation. The WebSMIT interface is similar to the ASCII SMIT interface so you do not need to learn a new user interface or terminology. The Web-based Cluster Utilities use a Web browser and can therefore be accessed from any platform.

• **Show “Cluster Applications” utility** — This utility displays your cluster configuration from an application point of view. Cluster applications are listed first, followed by the topology components (nodes, disks, and networks) that service the application. There are ASCII and Web (CGI) versions — the Web version lets you expand and collapse sections of the display and the state of the cluster is indicated with different color keys (for example, green indicates online).

• **Resetting HACMP tunables values** — You can change the settings for a list of tunable values that were changed during the cluster maintenance and reset them to their default settings, or installation-time cluster settings. Resetting the tunable values to their defaults helps to troubleshoot cluster performance and assists third-party administrators (such as IBM support personnel) in case they take over the administration of a cluster.

• **Cluster-wide password change for users** — Users can now change their password across cluster nodes when authorized to do so. A new Cluster Password utility links to the AIX password utility to support this change. System administrators enable the Cluster Password utility on all nodes in a cluster or nodes in specified resource groups, then give specified users permission to change their password on particular nodes.

• **Online Planning Worksheets** — The Online Planning Worksheets application now lets you view a cluster definition for a local, active HACMP cluster, and create a worksheets file from a local, active cluster running HACMP 5.2, or later. You may also save a cluster definition in a worksheets file from SMIT or from Online Planning Worksheets.

• **Recovering Resource Groups on node startup** — In HACMP 5.2, an attempt is made to bring online the resource groups that are currently in the ERROR state, an action that required a manual intervention in prior releases. This further increases the chances of bringing the applications back online. When a node starts up, if a resource group is in the ERROR state on any node in the cluster, this node attempts to acquire the resource group. Note that the node must be included in the nodelist for the resource group.

• **Cluster verification with auto-corrective actions** — You can now authorize a corrective action before clverify continues error checking, when clverify detects conditions such as inconsistent information about the contents volume groups across nodes or missing cluster information in system files such as /etc/hosts or /etc/services.

• **Resource Monitoring and Control (RMC) subsystem replaces RSCT Event Management** — HACMP 5.2 interfaces with the RSCT Resource Monitoring and Control (RMC) subsystem instead of the Event Management subsystem for instances of Dynamic Node Priority, Application Monitoring, and User-Defined Events.

• **Multiple application monitors** — You can now configure multiple application monitors and associate them with one or more application servers. You can assign each monitor a unique name in SMIT. Prior to HACMP 5.2, for each application that is kept highly available, you could configure only one of the two types of monitors: a monitor to check whether a specific process is terminated in the cluster or a monitor to check the state of the application by the means of a customized script.

• **Application startup monitoring** — You can configure application monitors to function in the application startup monitoring mode. The monitors in this mode monitor the startup of the application server start script within the specified stabilization interval. Specifying the application startup monitoring mode is strongly recommended for applications included in resource groups on which other resource groups depend.

• **Communications performance enhancements** — Versions previous to HACMP 5.2 use Remote Procedure Calls (RPC) to pass information between the event scripts and cluster utilities of HACMP and the Cluster Manager. In HACMP 5.2, a faster and more robust inter-process communication (IPC) implementation replaces the use of the Remote Procedure Call Manager and its external utilities. Cluster events should take less time to complete than in previous releases.

• **Cross-Site® LVM mirroring** — In HACMP 5.2, you can set up disks located at two different sites for cross-site LVM mirroring (using a Storage Area Network [SAN], for example). Cross-Site LVM mirroring replicates data between the disk subsystems at each site for disaster recovery. HACMP 5.2 automatically synchronizes mirrors after a disk or node failure and subsequent reintegration. HACMP handles the automatic mirror synchronization even if one of the disks is in the PVREMOVED or PVMISSING state. The automatic synchronization is not possible for all cases, but you can use C-SPCC to synchronize the data from the surviving mirrors to stale mirrors after a disk/site failure and subsequent reintegation.

• **Extended Distance support for eRCMF** — HACMP/XD for ESS PPRC increases data availability for IBM TotalStorage® Enterprise Storage Server™ (ESS) volumes that use Peer-to-Peer Remote Copy (PPRC) to copy data to a remote site for disaster recovery purposes. With HACMP 5.2, you can use the (optional) Enterprise Remote Copy Management Facility (eRCMF) with HACMP/XD for ESS PPRC.
• Optional HACMP/XD feature for ESS/PPRC and IP-based mirroring configurations.

This optional feature of HACMP V5 offers, in one package, multiple technologies for achieving long distance data mirror, failover, and resynchronization:

- HACMP/XD supports IBM Enterprise Storage Subsystem (ESS) Peer-to-Peer Remote Copy (PPRC), providing automatic failover of disks that are configured as PPRC pairs, creating a powerful disaster recovery solution for customers on ESS. HACMP/XD automates the management of PPRC, minimizes recovery time after an outage, and monitors your clustered environment to ensure mirroring of critical data is maintained at all times.

- HACMP/XD IP-based mirroring provides the well-known unlimited distance data mirroring of the current IBM HAGEO product. HACMP/XD delivers a fully integrated copy of HAGEO V2.4, allowing a cluster of pSeries or RS/6000 computers to be placed in two widely separated geographic locations, each maintaining an exact replica of the application and data. Data synchronization during production, failover, recovery, and restoration is provided.

• Optional HACMP Smart Assist for WebSphere

The new HACMP Smart Assist helps you configure HACMP to improve the availability of four services associated with WebSphere environments:

- WebSphere Application Servers
- WebSphere Application Server Network Deployment (Deployment Manager)
- DB2
- Tivoli® Directory Server (TDS)

HACMP and Smart Assist increase the availability of a WebSphere solution by:

- Monitoring the Deployment Manager and automatically restarting it on backup servers
- Monitoring critical services (such as a TDS server) and automatically restarting them on backup servers if they fail
- Ensuring that all necessary system resources (for example, storage devices and IP addresses) are configured and made available on backup servers in support of application migration

For an overall description of the HACMP V5.2 product, refer to the HACMP V5 Product description and key features section.

Accessibility by people with disabilities

The following features support use by people with disabilities:

- Operation by keyboard alone

Section 508 of the U.S. Rehabilitation Act

HACMP V5.2 is capable as of July 16, 2004, when used in accordance with IBM’s associated documentation, of satisfying the applicable requirements of Section 508 of the Rehabilitation Act, provided that any assistive technology used with the product properly interoperates with it.

Product positioning

The prospective customer for HACMP solutions is any enterprise with requirements to keep business-critical applications and systems operational 7 days per week, 24 hours per day. A HACMP solution provides the means to recover from any unplanned server hardware and application failures, and also gives you the means to take down an individual server (node) for planned maintenance and upgrades without having to take down the entire cluster.

High availability is a growing business need across all industries. The following industries are prime opportunities for HACMP solutions:

- Finance/Banking: Nearly 100% require high availability; federal regulations mandate backup sites.
- Retail (including online and catalog sales): Back-end office operations and business intelligence (BI) operations.
- Healthcare/Insurance: BI, data mining, data warehousing, and claimant data.
- Telco/Utilities/Media: Continuous operation of networks and switching equipment.
- Distribution/Process: Round-the-clock operation; just-in-time delivery.
- Manufacturing: Continuous access to operational/plant logistics data.
- Education: Administration data and central data mirroring/backup.

HACMP opportunities exist in these industries for the following applications:

- Database/OLTP (DB)
- Enterprise Resource Planning (ERP)
- Network computing (NC)
- Business intelligence (BI)
- Any customer application that utilizes any combination of disks and networks

The HACMP/XD feature is a must for customers with business-critical data who want to mirror data between separate sites to aid in disaster recovery protection. This applies to businesses of any size, with multiple sites or regional operations, or wherever decentralization of data is desired.

HACMP is an attractive and affordable high availability solution for small and medium-sized enterprises, and for small and medium-sized business units of large enterprises. High availability should be a fundamental buying criterion for business-critical and e-business applications.

In addition to providing high availability, HACMP 5.2.0 can also be configured to provide loosely coupled multiprocessing services. These configurations allow workload to be spread across multiple pSeries systems, sharing the disk and processor resources of the clustered nodes. This clustered approach, along with the capability of application failover and recovery/restart of the HACMP 5.1 configured machine, offers additional levels of high availability processing for customer-critical environments. The Concurrent Resource Manager function of HACMP 5.2.0 provides an open API that applications can utilize to get concurrent access to a shared disk.
Positioning of HACMP relative to other cluster servers:
HACMP is a robust offering for mission-critical availability for up to 32 nodes. It is IBM’s strategic high availability offering designed and tuned for pSeries servers running AIX 5L.

Advantages of HACMP relative to competitive products:

- HACMP provides a broader range of configuration options over all platforms, including a greater number of nodes (32), node interconnect protocols, storage systems, and disk interconnects, allowing increased flexibility of configurations.
- HACMP leads the industry in unlimited-distance geographic clustering to support data mirrors and disaster recovery.
- HACMP is cluster technology proven over a decade of service.
- A rich skills base has developed in the industry for implementation and support of HACMP.
- HACMP supports pSeries servers, with the most advanced autonomic features in the industry; pSeries reduces downtime and support costs.
- HACMP is fully aligned with IBM’s on demand business strategy to deliver necessary IT infrastructure to meet constantly changing business needs.

Statement of direction

IBM intends to continue to enhance and promote HACMP to lead the high availability and disaster recovery marketplace.

IBM intends to provide the following new HACMP/XD support by fourth quarter 2004:

- SAN Volume Controller (SVC-PPRC)
- Geographic LVM

Refer to the Product positioning section for information regarding IBM’s position and investment in the high availability and disaster recovery markets.

All statements regarding IBM’s plans, directions, and intent are subject to change or withdrawal without notice.

Reference information

Refer to Software Announcement 202-003, dated January 8, 2002.

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Product description and key features

Overview of high availability and data backup/recovery options

<table>
<thead>
<tr>
<th>Offering of backup data</th>
<th>Technology</th>
<th>Maximum distance between primary/backup processors/DASD</th>
</tr>
</thead>
<tbody>
<tr>
<td>HACMP(TM) AIX/LVM Mirror SAN</td>
<td>15 km; may be extended with DWDM(1) or CWDM(2)</td>
<td></td>
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<tr>
<td>HACMP with XD Feature:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HACMP/XD PPRC Remote ESS ESCON(R)</td>
<td>103 km (&gt;103 km by special order; latency impact over 40 km)</td>
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<tr>
<td></td>
<td>Fibre Channel</td>
<td>300 km</td>
</tr>
<tr>
<td></td>
<td>eRCMF ESCON or Fibre Channel</td>
<td>&gt;103 km</td>
</tr>
<tr>
<td>HACMP/XD IP Any remote site IP-based</td>
<td>Unlimited distance; must consider latency &gt; 40 km</td>
<td></td>
</tr>
</tbody>
</table>

1 DWDM: Dense Wave Division Multiplexors
2 CWDM: Coarse Wave Division Multiplexors

- **Workload distribution**
  With an HACMP mutual takeover configuration, applications and their workloads are assigned to specific servers. For example, in a two-node HACMP cluster, one server may be designated to be the application server and the second server may be designated to be a database server. Segmenting the application processing to one server and the database processing to the second server utilizes both servers in a productive manner and maximizes application throughput and investments in hardware and software.

- **Workload balancing**
  In addition to providing high availability, HACMP 5.2.0 can also be configured to provide loosely coupled multiprocessing services. These configurations allow workload to be spread across multiple pSeries systems, sharing the disk and processor resources of the clustered nodes. This clustered approach, along with the capability of application failover and recovery/restart of the HACMP configured machine, offers additional levels of high availability processing for customer-critical environments.

- **Scalable growth**
  HACMP software is scalable to address a broad range of business-critical, high availability application needs. With HACMP, two to 32 servers may be configured for high availability. HACMP offers built-in growth and helps protect investments in cluster hardware, software, services, and training.

- **System management**
  HACMP provides a rich set of leadership system management tools to reduce cluster configuration and administration time. These tools include:
  - Cluster Single Point of Control (C-SPOC)
  - AIX System Management Interface Tool (SMIT)
  - A command line interface

Enhanced cluster system management is available through a Simple Network Management Protocol (SNMP) client or through Tivoli® NetView® for AIX.

Administration of single and multiple clusters is enhanced through Cluster Snapshots, Event Summaries, and Event Emulation. These tools allow system managers and application developers to easily configure, replicate, test, and manage pSeries high availability clusters.

- **Easy upgrade/migration**
  Nondisruptive hardware and software upgrades can be performed with HACMP. The cluster configuration can be expanded or modified without service disruption through Dynamic Reconfiguration options. Version Compatibility and Dynamic Reconfiguration eliminate the most common causes of scheduled cluster downtime.

Recovery flexibility

HACMP clusters can be configured to meet complicated application availability and recovery needs. HACMP configurations can include mutual takeover or standby takeover recovery processes. Mutual takeover configurations allow all servers to be active information processors and to perform as backup servers for failed servers. A standby configuration designates a server to be an idle or passive backup for a failed server in the cluster.

HACMP can be tailored to specify which server in the cluster will take over the application of the failed server and to specify which application has priority on the takeover server. HACMP recovery processes also allow you to specify which server the application should be assigned to, after recovery, resynchronization, and reintegration of the failed server into the cluster.

The IP aliasing feature of AIX® 5L allows more than one service label to be hosted by a single physical adapter. This provides greater flexibility for maintaining availability.

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Concurrent processing

Data can be processed concurrently when using Oracle Parallel Server (OPS), RAC, or Database 10g. The combination of HACMP and OPS offers an additional level of high availability. With HACMP and OPS, all servers in the cluster share the data and system resources; if one or more servers should fail, the remaining servers continue processing with minimal disruption, if any, because no failover is required. An added benefit of HACMP and OPS is a performance improvement, because all database processing is done in a parallel manner.

Breadth of hardware support

High availability is provided across the pSeries, Cluster 1600, and RS/6000® server lines, extending from entry-level desktop servers to the largest enterprise-class servers. Supported disk subsystems include:
- Small Computer System Interface (SCSI)
- Redundant Array of Independent Disks (RAID)
- Fibre Channel-attached disk subsystems
- Serial Storage Architecture (SSA), scalable to terabytes of data storage
- Enterprise Storage Subsystem (ESS)

HACMP also gives you the ability to “mix and match” processor and disk subsystem technologies to meet processing needs. IBM pSeries and RS/6000 servers and symmetric multiprocessors (SMPs), LPARs on applicable servers, and SP™ nodes can have membership in the same HACMP cluster.

Extensive networking support

Extensive configuration flexibility supports a variety of networks, including:
- Ethernet
- EtherChannel
- FDDI
- Token ring
- ATM
- ATM LAN Emulation
- X.25
- SP Switches
- TMSCSI
- TMSSA
- RS232

Comprehensive heartbeat capability

TCP/IP, serial, SSA, SCSI, disk, and IP alias heartbeat transmission paths are available. Multiple heartbeat paths let you reliably differentiate network, node, and adapter failures to eliminate potential false takeovers and their impacts.

HACMP/XD

This optional feature of HACMP V5 offers, in a single package, multiple technologies for achieving long distance data mirror, failover, and resynchronization:
- HACMP/XD supports IBM ESS PPRC. This means HACMP clusters support automatic failover of disks that are PPRC pairs and creates a powerful solution for customers on ESS with PPRC. By automating the management of PPRC, recovery time is minimized after an outage, regardless of whether the clustered environment is local or geographically dispersed. HACMP/XD in combination with PPRC manages your clustered environment to ensure mirroring of critical data is maintained at all times.
- HACMP/XD IP-based mirroring provides the well-known unlimited distance data mirroring of the former IBM HAGEO product. IP-based mirroring allows a cluster of pSeries computers to be placed in two widely separated geographic locations, each maintaining an exact replica of the application and data. Data synchronization during production, failover, recovery, and restoration is provided. HACMP/XD is independent of the disk storage used. RAID or mirroring can be used for local protection. HACMP/XD IP-based mirroring is done at the logical volume layer.

HACMP Smart Assist for WebSphere®

HACMP Smart Assist brings you the best in configuration and setup aids to help complete your WebSphere application environments. The WebSphere Application Server Network Deployment, LDAP, and DB2® components are all inherently highly available, and the addition of the HACMP clustering product can significantly reduce your exposures to downtime or outages.

WebSphere application environments are among the best of breed when it comes to deploying Web-enabled application environments. IBM HACMP is a premier high availability and disaster recovery solution for your pSeries based WebSphere servers. It provides monitoring and recovery mechanisms designed to help ensure that critical servers and infrastructure components are adequately recovered when there is a failure or for when you need to perform maintenance on your production environments. By combining these two powerful and feature-rich products, your IT staff will be better able to keep your critical business applications running 24 x 7.

With HACMP Smart Assist, your IT staff can more easily integrate and configure an optimal environment that will deliver on demand resources to your end users. The WebSphere platform provides your applications with load balancing, dynamic reconfiguration, and system management of the application servers. HACMP brings additional high availability features such as monitoring of the WebSphere internal components and ensuring that all necessary system resources are readily available on backup servers. Fine-tuning this environment is every IT manager’s goal. With HACMP Smart Assist, that job is easier.
**HACMP and RAS**

Reliability, availability, and serviceability (RAS) are implemented on all enterprise-class pSeries, Cluster 1600, and RS/6000 servers:

- Error detection
- Fault tolerance
- Reliable hardware components
- High availability
- Fault-management software
- Concurrent or online diagnostics

HACMP complements these technologies with additional high availability management for your applications and for continuous operation during planned maintenance.

**High Availability Control Workstation**

For cluster customers using PSSP, there is an existing feature called High Availability Control Workstation (HACWS). HACWS is a two-node HACMP application. This application improves the reliability, availability, and serviceability of an SP system by providing a backup control workstation. Automatic failover and reintegration to the backup control workstation are provided should the primary control workstation fail or if there is a need to take the primary control workstation down to perform hardware and software maintenance. HACWS fully supports pSeries servers that are Hardware Management Console (HMC)-controlled in a PSSP-managed cluster.

**Previous release**

Existing customers of HACMP V4 (5765-E54) or V5 (5765-F62) can obtain HACMP V5.2 via the 5771-HMP or 5773-HMP Software Maintenance product offerings and the AIX 5L SPO (5692-A5L).

HACMP 5.1.0 will remain available via current 5765-F62 billing feature numbers and AIX 5L V5 SPO (5692-A5L) supply feature numbers until March 31, 2005. HACMP V5.1 will be withdrawn from marketing on March 31, 2005.

Program warranty service for HACMP 5.1 will end on September 1, 2006.

**Fee service offerings**

IBM Global Services offers a comprehensive selection of locally and remotely delivered services to address your individual support requirements. When you need help with questions or problems with AIX, applications, middleware, performance, and tuning, select from a list of remotely delivered services that include:

- IBM Operational Support Services — Consult Line
- IBM Operational Support Services — pSeries Performance Management
- IBM Operational Support Service RS/6000 — System Alert

When you need help onsite with installation, migration, and service, select from a list of locally delivered services that include:

- IBM High Availability Services — Availability Cluster Implementation Services for RS/6000
- IBM Migration Services for RS/6000 — Workstation/Server and Enterprise Server
- IBM Migration Services for RS/6000 SP

**Discontinued features in HACMP 5.2**

- The cllockd and clclockdES (the Cluster Lock Manager) is no longer supported in HACMP 5.2. During node-by-node migration, it is not installed. Installing HACMP 5.2 removes the Lock Manager binaries and definitions. After a node is upgraded to HACMP 5.2, the Lock Manager state information in SNMP and clinfo shows the Lock Manager as being in the down state on all nodes, regardless of whether the Lock Manager is still running on a back-level node.

- Cascading, rotating, and predefined concurrent resource groups are no longer supported. Also, cascading without failback and Inactive Takeover settings are no longer used. In HACMP 5.2 you can continue using the groups migrated from previous releases. You can also configure these types of groups using the combinations of startup, failover, and failback policies available for resource groups in HACMP 5.2.

- Manual reconfiguration of user-defined events is required. HACMP 5.2 interacts with the RSCT Resource Monitoring and Control (RMC) subsystem instead of with the Event Management subsystem. This affects the following utilities: Dynamic Node Priority (DNP), Application Monitoring, and User-Defined Events (UDE).

**Offering information**

Product information is available through the Offering Information Web site at


**Publications**

*License Information* and *Proof of Entitlement* documents will display automatically when HACMP V5 is installed.

The following publications are supplied on CD-ROM with the basic machine-readable material.

<table>
<thead>
<tr>
<th>Title</th>
<th>Order number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concepts and Facilities</td>
<td>SC23-4864</td>
</tr>
<tr>
<td>Planning and Installation Guide</td>
<td>SC23-4861</td>
</tr>
<tr>
<td>Administration and Troubleshooting Guide</td>
<td>SC23-4862</td>
</tr>
<tr>
<td>Programming Client Applications</td>
<td>SC23-4865</td>
</tr>
<tr>
<td>Glossary</td>
<td>SC23-4867</td>
</tr>
</tbody>
</table>

**For HACMP/XD / ESS PPRC customers:**

HACMP/XD: ESS PPRC Planning and Administration Guide | SC23-4863 |
For Desktop systems: Models 370, 380, 390, 397, and 39H
Entry systems: Models 25S, 250, and 25T
Compact server systems: Models C10 and C20
Desktop systems: Models 370, 380, 390, 397, and 39H

For PCI desktop systems: Models 140, 150, 170, 240, 260, and 270

For HACMP Smart Assist customers:
HACMP Smart Assist for WebSphere User Guide
The IBM Publications Center
http://www.ibm.com/shop/publications/order

For HACMP/XD / IP customers:
HACMP/XD for AIX 5L for HAGEO Technology Concepts and Facilities
HACMP/XD for AIX 5L for HAGEO Technology Planning and Installation Guide

For HACMP/XD / IP customers:
HACMP Smart Assist for WebSphere User Guide
The IBM Publications Center
http://www.ibm.com/shop/publications/order

The IBM Publications Notification System
http://service5.boulder.ibm.com/pnsrege.nsf/messages/welcome

Hardware requirements: HACMP V5.2.0 works with pSeries servers in a "no-single-point-of-failure" server configuration.

HACMP V5.2.0 supports the pSeries, Cluster 1600, and RS/6000 models that are designed for server applications and that meet the minimum requirements for internal memory, internal disk, and I/O slots. The following pSeries and RS/6000 models and their corresponding upgrades are supported in HACMP V5.2.0:

- PCI desktop systems: Models 140, 150, 170, 240, 260, and 270
- PCI deskside systems: Models E20, E30, F30, F40, F50, F80, 6F0, and 6F1 (pSeries 620)
- Entry systems: Models 25S, 250, and 25T
- Compact server systems: Models C10 and C20
- Desktop systems: Models 370, 380, 390, 397, and 39H
- Deskside systems: Models 570, 57F, 580, 58F, 58H, 590, 59H, 59I, 59S, 7028-6E1 (pSeries 610), 7029-6E3 (pSeries 615), 7025-6F1 (pSeries 620), and 7028-6E4 (pSeries 630)
- Rack systems: Models 98B, 98E, 98F, 990, 99E, 99F, 99J, 99K, B80, R10, R20, R21, R24, R50, R5U, S70, S7A, H10, H50, H70, H80, M80, 7028-6C1 (pSeries 610), 7029-6C3 (pSeries 615), 7028-6C4 (pSeries 630), 6H0, 6H1, 6M1 (pSeries 660), 7039-651 (pSeries 655), and 7038-6M2 (pSeries 650), including models with PCI-X Expansion Drawer (7311-D10 and 7311-D20)
- High-end servers: Models 7040-6B1 (pSeries 690), 7040-671 (pSeries 670), including models with POWER4+ processors, and PCI-X Planar 10 slot I/O drawer (7040-61D feature 6571)

Any supported pSeries or RS/6000 server can be joined with any other supported pSeries or RS/6000 server in an HACMP V5.2 configuration. Models with less than three slots can be used in the HACMP V5.2 server configuration, but due to slot limitations, a single-point-of-failure is unavoidable in shared-disk or shared-network resources.

HACMP 5.2.0 supports concurrent access configuration with all supported external storage systems.

Certain non-IBM RAID systems can operate in concurrent I/O access environments. IBM will not accept Authorized Program Analysis Reports (APARs) if the non-IBM RAID offerings do not work properly with HACMP 5.1.0.

The minimum configuration of each machine is highly dependent on the user’s database package and other applications.

Actual configuration requirements are highly localized according to the required function and performance needs of individual sites. In configuring a cluster, particular attention must be paid to:

- Fixed-disk capacity and mirroring (Logical Volume Manager [LVM] and database)
- Slot limitations and their effect on creating a single-point-of-failure
- Client access to the cluster
- Other LAN devices (such as routers and bridges) and their effect on the cluster
- Replication of I/O adapters and subsystems
- Replication of power supplies
- Other network software

Whenever a process takes over resources after a failure, consideration must be given to work partitioning. For example, if node A is expected to take over for failed node B and continue to perform its original duties, A must be configured with enough resources to perform the work of both.
HACMP 5.2.0 device support

HACMP supports client users on a LAN using TCP/IP. HACMP monitors and performs IP address switching for the following TCP/IP-based communications adapters on cluster nodes:

- Ethernet
- EtherChannel
- Token ring
- FDDI
- SP Switches
- ATM
- ATM LAN Emulation

At this time, the following adapters are supported in the HACMP 5.1.0 environment. Refer to individual hardware announcements for the levels of AIX supported.

Communications adapters

PCI/ISA

- 2920 IBM PCI Token-Ring Adapter
- 2931 ISA 8-Port Asynchronous Adapter
- 2932 ISA 8-Port Asynchronous Adapter
- 2933 ISA 128-Port Asynchronous Controller
- 2741 PCI FDDI-Fiber Single-Ring Upgrade
- 2742 PCI FDDI-Fiber Dual-Ring Upgrade
- 2743 PCI FDDI-Fiber Single-Ring Upgrade
- 2844 128-Port Asynchronous Controller, PCI bus adapter
- 2943 8-Port Asynchronous EIA-232/RS-422, PCI bus adapter
- 2963 TURBOWAYS® 155 PCI UPT Adapter
- 2968 PCI Ethernet 10/100 Adapter
- 2969 PCI Gigabit Ethernet Adapter
- 2979 PCI AutoLANStreamer Token-Ring Adapter
- 2985 PCI Ethernet BNC/RJ-45 Adapter
- 2986 PCI Ethernet 10/100 Adapter
- 2987 PCI Ethernet AUI/RJ-45 Adapter
- 2988 Turboways 155 PCI MMF ATM Adapter
- 2989 PCI Ethernet MMF ATM Adapter
- 4951 IBM 4-Port 10/100 Base-T Ethernet PCI Adapter
- 4953 IBM 64-bit/66 MHz PCI ATM 155 UTP Adapter
- 4957 IBM 64-bit/66 MHz PCI ATM 155 MMF Adapter
- 4961 IBM Universal 4-Port 10/100 Ethernet Adapter
- 4962 IBM 10/100 Mbps Ethernet PCI Adapter II
- 4959 Token-Ring PCI Adapter
- 8396 RS/6000 SP System Attachment Adapter
- 4025 Scalable POWERParallel® Switch2 PCI Attachment Adapter (#8397) for SP-attached servers
- 8398 RS/6000 SP Switch2 PCI-X Attachment Adapter
- 2975 10/100 Mbps Ethernet PCI Adapter — UNI
- 2972 AutoLANStreamer Token-Ring Adapter
- 2980 Ethernet High-Performance LAN Adapter
- 2989 Turboways 155 ATM Adapter
- 2992 Ethernet/FDX 10 Mbps TP/AUI MC Adapter
- 2993 Ethernet BNC MC Adapter
- 2994 10/100 Mbps Ethernet Adapter — EIA-232
- 4018 High-Performance Switch (HPS) Adapter-2
- 4020 Scalable POWERParallel Switch Adapter
- 4025 Scalable POWERParallel Switch2 Adapter
- 4025 Scalable POWERParallel Switch2 MX2 Adapter (#4026) on SP nodes

Storage adapters

PCI

- 6203 PCI Dual Channel Ultra3 SCSI Adapter
- 6204 PCI Universal Differential Ultra SCSI Adapter
- 6205 PCI Dual Channel Ultra2 SCSI Adapter
- 6206 PCI SCSI-2 Single-Ended Ultra SCSI Adapter
- 6207 PCI SCSI-2 Differential Ultra SCSI Adapter
- 6208 PCI SCSI-2 Single-Ended Fast/Wide Adapter
- 6209 PCI SCSI-2 Differential Fast/Wide Adapter
- 6215 PCI SSA Adapter
- 6225 Advanced SerialRAID Adapter
- 6230 Advanced SerialRAID Plus Adapter (including Fast Write Cache (#6235) with two-initiator only)
- 6227 Gigabit Fibre Channel Adapter
- 6228 1- and 2-Gigabit Fibre Channel Adapter for 64-bit PCI Bus
- 6239 2 Gigabit FC PCI-X Adapter
- IBM @server pSeries PCI-X Dual Channel Ultra320 SCSI Adapter (#5710, #5712)

MCA

- 2412 Enhanced SCSI-2 Differential Fast/Wide Adapter/A
- 2415 SCSI-2 Fast/Wide Adapter/A
- 2416 SCSI-2 Differential Fast/Wide Adapter/A
- 2420 SCSI-2 Differential High-Performance External I/O Controller
- 6212 High Performance Subsystem Adapter/A (40/80 Mbps)
- 6214 SSA 4-Port Adapter
- 6216 Enhanced SSA 4-Port Adapter
- 6219 MCA SSA Adapter

For compatibility with subsystems not listed in the following section, refer to the individual hardware announcements.

External storage subsystems

- IBM 7131 SCSI Multi-Storage Tower Model 105 (supports up to four nodes; no CD-ROMs or tapes can be installed)
- IBM 7131 SSA Multi-Storage Tower Model 405 (supports up to eight nodes; no CD-ROMs or tapes can be installed)
- IBM 7133 SSA Disk Subsystem Models 020 and 600 (supports up to eight nodes)
- IBM 7133 SSA Disk Subsystem Models D40 and T40 in up to 72.8 GB Mode (supports up to eight nodes)
- IBM 7137 Disk Array Subsystem Models 413, 414, 415, 513, 514, and 515 (supports up to four nodes)
- IBM 7204 External Disk Drive Models 317, 325, 339, 402, 404, and 418 (supports up to four nodes)
- IBM 2105 Versatile Storage Server™ (VSS) Models B09 and 100 (supports up to four nodes)
- IBM Enterprise Storage Server™ (ESS) Models E10, E20, F10, and F20 (supports up to eight nodes using SCSI and Fibre Channel interfaces via IBM FC/FICON™ features 3021, 3022, and 3023)
- IBM 2105 TotalStorage® Enterprise Storage Server (ESS) Model 800
- IBM TotalStorage FASTt200 Storage Server 3542-2RU
- IBM TotalStorage FASTt500 Storage Server 3552-1RU
IBM TotalStorage FASiT600 Storage Server 1722-60U
IBM TotalStorage FASiT600 with Turbo feature (1722-60U with #2000 or #2010)
IBM TotalStorage FASiT700 Storage Server 1742-1RU
IBM TotalStorage FASiT900 Storage Server 1742-900
IBM 2102-F10 Fibre Channel RAID Storage Server
IBM 2104 Expandable Storage Plus Models DL1, TL1, DU3, and TU3
IBM 2104 TotalStorage Expandable Storage Plus 320 Models DS4 and TS4
IBM 2108 Storage Area Network (SAN) Data Gateway Model G07
IBM 2031-016 McData ES-3016 Fibre Channel Product
IBM 2031-032 McData ES-3032 Fibre Channel Product
IBM 2031-216 McData ES-3216 Fibre Channel Product
IBM 2031-232 McData ES-3232 Fibre Channel Product
IBM 2032-001 McData ED-5000 Fibre Channel Director
IBM 2032-064 McData ED-6064 Fibre Channel Director
IBM 2031-224 McData Sphereon 4500 Fibre Channel Switch
IBM 2034-212 McData Sphereon 4300 Fibre Channel Switch
INRANGE FC/9000 Fibre Channel Director Model 2042-001 and Model 2042-128
IBM 2109 Models S08, S16, F16, F32, and M12 SAN Fibre Channel Switch
IBM 3534 Model F08 SAN Fibre Channel Switch

IBM TotalStorage Enterprise Tape Drive 3590 Model H11
IBM Magstar® 3590 Tape Drive Model E11 and B11
IBM 3581 Ultrium Tape Autoloader Model H17 and L17
IBM 3580 Ultrium Tape Drive Model H11 and L11

IBM 7139-111 Vicom Systems SLIC Router
IBM 7140-160 SAN Controller 160

Rack-mounted storage subsystems
IBM 7027 High Capacity Storage Drawer Model HSC (supports up to two nodes; no CD-ROMs or tapes installed)
IBM 7027 High Capacity Storage Drawer Model HSD (supports up to four nodes; no CD-ROMs or tapes installed)

The following table shows the SCSI-2 Single-Ended, SCSI-2 Differential, and SSA cabling that HACMP 5.1.0 supports.

<table>
<thead>
<tr>
<th>Type</th>
<th>Adapter</th>
<th>Enclosure</th>
<th>Maximum number of enclosures per bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCSI-2 Differential</td>
<td>6209</td>
<td>7131-105</td>
<td>2</td>
</tr>
<tr>
<td>(16-bit)</td>
<td></td>
<td>7137-413</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-414</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-415</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-513</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-514</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-515</td>
<td>2</td>
</tr>
<tr>
<td>SCSI Single-Ended</td>
<td>2415-6208</td>
<td>7027-HSC</td>
<td>1</td>
</tr>
<tr>
<td>SCSI-2 Differential</td>
<td>2420</td>
<td>7137-413</td>
<td>2</td>
</tr>
<tr>
<td>(8-bit)</td>
<td></td>
<td>7137-414</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-415</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-513</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-514</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-515</td>
<td>2</td>
</tr>
<tr>
<td>SCSI-2 Differential</td>
<td>2416 or 2412</td>
<td>7027-HSD</td>
<td>1</td>
</tr>
<tr>
<td>(16-bit)</td>
<td></td>
<td>7131-105</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-413</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-414</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-415</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-513</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-514</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-515</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7204-317</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7204-325</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7204-339</td>
<td>14</td>
</tr>
<tr>
<td>SSA</td>
<td>6214 or 6216</td>
<td>7133-020</td>
<td>96 disks</td>
</tr>
<tr>
<td></td>
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<td>7133-600</td>
<td>96 disks</td>
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<td>7133-040</td>
<td>96 disks</td>
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<tr>
<td></td>
<td></td>
<td>7133-740</td>
<td>96 disks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7131-405</td>
<td>4</td>
</tr>
</tbody>
</table>

SCSI-2 Differential disk cabling for HACMP

The cabling configurations in the following tables assume the processors are at the end of the bus (just before each terminator) and the storage devices are connected to the bus between two of the processors.

The first table lists the available y-cables. Y-cables have three legs that are called base, long leg, and short leg. The first table shows what you can connect to each leg. The cables listed under the long leg and short leg columns can be found in the subsequent table under the cable name column, except for the terminator, which is supplied with the y-cable.
<table>
<thead>
<tr>
<th>Y-cable feature number</th>
<th>Base to adapter</th>
<th>Long leg to device cable</th>
<th>Short leg to Length (m)</th>
<th>Notes</th>
<th>Cable/Device feature number</th>
<th>From</th>
<th>To</th>
<th>Cable name</th>
</tr>
</thead>
<tbody>
<tr>
<td>2114</td>
<td>6209</td>
<td>7131-105</td>
<td>.94</td>
<td>16-bit</td>
<td>Y-cable 7131-105</td>
<td>9158</td>
<td>1.0</td>
<td>7131-105 Cable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-413</td>
<td></td>
<td></td>
<td>Y-cable 7131-105</td>
<td>9132</td>
<td>2.5</td>
<td>7131-105 Cable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-414</td>
<td></td>
<td></td>
<td>Y-cable 7131-105</td>
<td>9161</td>
<td>4.5</td>
<td>7131-105 Cable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7137-415</td>
<td></td>
<td></td>
<td>Y-cable 7131-105</td>
<td>9146</td>
<td>12.0</td>
<td>7131-105 Cable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7204-339</td>
<td></td>
<td></td>
<td>Y-cable 7131-105</td>
<td>9145</td>
<td>14.0</td>
<td>7131-105 Cable</td>
</tr>
</tbody>
</table>

| 2422                   | 2420           | 7137-413                 | .765                   | 8-bit  | Y-cable 7137-413            | 2415 | 3133 | 3.0| 7027-HSC Cable |
|                        |                | 7137-414                 |                        |       | Y-cable 7137-414            | 2415 | 3134 | 6.0| 7027-HSC Cable |
|                        |                | 7137-415                 |                        |       | Y-cable 7137-415            | 6208 | 3133 | 3.0| 7027-HSC Cable |
|                        |                | 7137-415                 |                        |       | Y-cable 7137-415            | 6208 | 3134 | 6.0| 7027-HSC Cable |
|                        |                | 7204-339                 |                        |       | Y-cable 7027-HSD            | 3137 | 12.0| 7027-HSD Cable |
|                        |                |                         |                        |       | Y-cable 7027-HSD            | 3138 | 18.0| 7027-HSD Cable |

| 2426                   | 2416           | 7027-HSC                 | .94                    | 16-bit | Y-cable 7027-HSD            | 3137 | 2002 | 4.0| 7137 Cable |
|                        |                | 7131-105                 |                        |       | Y-cable 7137-413            | 7137-414 | 3001 | 2.0| 7137 System-to-System Cable |
|                        |                | 7131-105                 |                        |       | Y-cable 7137-413            | 7137-414 | 3001 | 2.0| 7137 System-to-System Cable |
|                        |                | 7131-105                 |                        |       | Y-cable 7137-413            | 7137-415 | 3001 | 2.0| 7137 System-to-System Cable |
|                        |                | 7131-105                 |                        |       | Y-cable 7137-413            | 7137-416 | 3001 | 2.0| 7137 System-to-System Cable |
|                        |                | 7131-105                 |                        |       | Y-cable 7137-415            | 7137-417 | 3001 | 2.0| 7137 System-to-System Cable |
|                        |                | 7131-105                 |                        |       | Y-cable 7137-415            | 7137-418 | 3001 | 2.0| 7137 System-to-System Cable |
|                        |                | 7131-105                 |                        |       | Y-cable 7137-415            | 7137-419 | 3001 | 2.0| 7137 System-to-System Cable |
|                        |                | 7131-105                 |                        |       | Y-cable 7137-415            | 7137-420 | 3001 | 2.0| 7137 System-to-System Cable |
|                        |                | 7131-105                 |                        |       | Y-cable 7137-415            | 7137-421 | 3001 | 2.0| 7137 System-to-System Cable |
|                        |                | 7131-105                 |                        |       | Y-cable 7137-415            | 7137-422 | 3001 | 2.0| 7137 System-to-System Cable |
|                        |                | 7131-105                 |                        |       | Y-cable 7137-415            | 7137-423 | 3001 | 2.0| 7137 System-to-System Cable |

SSA Disk Cabling for HACMP 5.2.0: HACMP 5.2.0 supports all of the announced SSA cables and Fiber Optics Channel Extenders. Refer to the appropriate system manuals for cabling information.

Other hardware: Other hardware supported in the previous release of HACMP V5 and still covered under IBM warranty service, remains supported in this release of HACMP, unless otherwise noted.

Software requirements: HACMP 5.2.0 requires AIX 5L on pSeries, Cluster 1600, or RS/6000 servers with at least four slots.

The specific requirements for AIX 5.1 or AIX 5.2 are:

- AIX 5L V5.1 with the 5100-06 Recommended Maintenance package (or later modification levels)
- AIX 5L V5.2 with the 5200-03 Recommended Maintenance package (or later modification levels) and APAR IY56554

PSSP V3.5 is also required on RS/6000 SP (9076) systems.
The RSCT file sets delivered with AIX 5L must be installed. They are:

- AIX 5L 5.1: rsct.compat.basic.hacmp 2.2.1.30, rsct.compat.clients.hacmp 2.2.1.30 and rsct.core.sec 2.2.1.34
- AIX 5L 5.2: rsct.compat.basic.hacmp 2.3.3.0, rsct.compat.clients.hacmp 2.3.3.0, and rsct.core.sec 2.3.3.1

In addition, specific requirements for RSCT include:

- AIX 5L 5.1: APARs IY54018, IY53707, IY54140, IY55017
- AIX 5L 5.2: APARs IY56213

Each node within a high availability server complex requires the licensed program HACMP 5.2.0 to be installed. Except during the upgrade process from earlier releases of HACMP V4, it is recommended that all nodes in the HACMP server complex be at the same AIX 5L operating system level, including PTFs and maintenance upgrades.

Some of the devices supported in HACMP 5.2.0 may require a later release level of the AIX 5L operating system; refer to the specific hardware announcement for releases of HACMP V4, it is recommended that all nodes in the HACMP server complex be at the same AIX 5L operating system level, including PTFs and maintenance upgrades.

The HAView facility requires the installation of Tivoli NetView for AIX (5697-NVW).

To use C-SPOC with VPATH disks, SDD 1.3.1.3, or later, is required.

To use HACMP Online Planning Worksheets, AIX 5L Java™ Runtime Environment is required.

HACMP V5.2 supports use of AIX V5.2 MPIO for multipath access to disk subsystems.

**HACMP/XD requires:**

- HACMP V5.2.0 (cluster.es.server.rte 5.2.0.0)
- For ESS/PPRC mirroring:
  - AIX 5L Java Runtime Environment 1.3.0.15, or later
  - IBM ESS microcode level 2.1.1, or later
  - IBM 2105 Command Line Interface (ibm2105cli.rte 32.6.100.13) or the IBM 2105 Command Line Interface (ibm21056esscli.rte 2.1.0.15)

  **Note:** It is assumed that the command line interface is installed in its default location, /usr/opt/ibm2105cli.

- IBM 2105 Subsystem Device Driver (SDD) ibmSdd_510nchacmp.rte 1.3.3.6, or later
- HACMP/XD for eRCMF requires ESS eRCMF V2.0
- For XD IP-based mirroring: no additional prerequisites

**HACMP Smart Assist for WebSphere requires:**

- HACMP V5.2 (5765-F62) base feature, or later modification levels
- AIX 5L V5.2 (5765-E62) with the 5200-01 Recommended Maintenance package, or later modification levels

HACMP Smart Assist for WebSphere supports the following (or later) modification levels of these applications.

- WebSphere Application Server V5.0 (in a Network Deployment [ND] environment only)
- Tivoli Directory Server V5.1
- Deployment Manager V5.0
- DB2 Server V8.1

**Compatibility:** HACMP V5.2 supports dynamic upgrade from 4.5 and 5.1, and static upgrades from all prior versions.

- An upgrade from HACMP V4.5 or 5.1 involves installing HACMP 5.2 on all nodes in the cluster; however, the Version Compatibility function allows you to upgrade the cluster one node at a time, without taking the entire cluster offline. Configuration is retained.
- An upgrade from HACMP/6000™ V1.2, 2.1, 3.1, 4.1, 4.2, 4.3, 4.4.0, or 4.4.1 to HACMP 5.2.0 involves reinstalling HACMP on all nodes in the cluster at the same time. This means that at some point, the cluster must be brought down; however, with proper planning the downtime can be minimized. Configuration is not retained for HACMP releases prior to 4.5.

**Note:** Although HACMP V4 and V5 can coexist in a cluster temporarily, the Version Compatibility function is intended to ease migration from prior releases of HACMP V4 and is not intended to provide long-term compatibility between versions of the product in a cluster.

**Limitations:** HACMP does not by itself execute a high availability function beyond the nodes in an HACMP cluster.

HACMP clusters containing multiple LPAR partitions within a single pSeries server frame may contain only a single power frame, which would represent a potential single-point-of-failure.

**Specific limitations of HACMP**

- HACMP supports clusters of up to 64 resource groups and 256 interfaces across up to 32 AIX/HACMP images (pSeries servers, SP nodes, RS/6000 systems, or LPARs).
- The following networks are not supported:
  - Serial Optical Channel Converter (SOCC)
  - SLIP
  - Fibre Channel Switch (FCS)
  - 802_ether
  - Virtual IP Address (VIPA) facility of AIX
  - IP V6
- HACMP Support for Capacity Upgrade on Demand (CUoD), Capacity Back Up (CBU), and Dynamic LPAR (DLPAR).

HACMP can be run in LPARs to which processors or memory are added through CUoD or DLPAR (refer to Hardware announcement 102-260) or CBU (refer to Hardware announcement 103-286). Care must be taken to ensure that sufficient capacity and appropriate procedures are in place to support these features.

HACMP can provide application high availability through failover of a production server to a preassigned and operational backup server. The backup server could have processors and memory added through dynamic LPAR operations, using facilities that are already part of the configuration. Alternatively, the backup server could have processors and memory temporarily activated under the CBU offering.
In this second case, the application must be returned to the primary server when that server becomes available.

Adjusting the hardware configuration (adding or removing processors or memory) of an HACMP node will, under many circumstances, put a significant additional temporary load on that system. This can cause HACMP to interpret that system as having failed. HACMP does not currently have a supported mechanism that will automatically deal with this in all cases. Customers who want to take advantage of these features should run tests and perform adequate benchmarking of their environments to determine the timing implications under varying workload conditions.

The HACMP heartbeat interval should then be extended sufficiently to prevent HACMP from perceiving a system failure for the duration of that change. Additional system tuning may be required. The customer should understand that these tuning changes imply that HACMP could respond more slowly to monitored cluster events. IBM is not responsible for failures due to incorrect settings of these values, as these tuning parameters are unique for every customer environment.

- When installing HACMP on a system with Trusted Computing Base (TCB) security in place, special considerations are required. HACMP will modify some system files that are modified by TCB. This will cause errors to be reported by TCB. The error messages may not identify HACMP as the origin of the changes to the monitored files. While this does not affect the operation of HACMP, TCB, or the AIX system, customers should verify that the messages are indeed caused only by the installation of HACMP. If that verification is successful, then no further action is required (the tcbck command should not be used to undo the HACMP changes). Otherwise, normal security procedures should be followed.

Specific limitations of HACMP/XD

- PPRC support includes the ESS 2105-F20 and 2105-800 models, in either mixed-model or like-model pairs. Only one supported Enterprise Storage Server is supported at each site.
- PPRC ERCMF supports up to eight Enterprise Storage Servers, with a maximum of four at each site.
- Concurrent disk access is supported only within sites, not between sites.
- A single HACMP/XD cluster supports only two sites. A single pSeries or RS/6000 system can be part of only one HACMP/XD cluster.
- A single HACMP/XD cluster supports up to eight nodes.

For additional information regarding IP-based mirroring, refer to the IBM HAGEO/GeoRM Software announcement 202-266, dated October 8, 2002.

Specific limitations of HACMP Smart Assist for WebSphere

- When protecting WebSphere Application Servers, only environments using Network Deployment (that is, using Deployment Manager) will be configured into HACMP by Smart Assist.
- HACMP resource groups created by Smart Assist for any of the WebSphere components are limited to two nodes with cascading behavior. This assumes an unloaded standby system is available, with enough resources to assume the workload of the active system.
- Given the previous statement, a single standby system may be configured to protect multiple workloads, but is assumed to only effectively execute one workload at a time.
- For WebSphere configurations using an IBM HTTP Server (IHS) with application servers, Smart Assist will automatically configure the IHS to failover with the application server. This will require the administrator to place the IHS data on a shareable volume group that may be passed between nodes.

Environmental conditions that affect the use of HACMP

- HACMP supports LAN-attached clients with TCP/IP protocol.
- HACMP’s time to recover from a failure depends, in part, on the amount of time it takes for AIX to detect the failure. Some token-ring failures cannot be detected in less than 60 seconds.
- HACMP does not support attached terminals using Local Area Transport-B (LAT-B) protocols.
- Clients most appropriate to an HACMP environment are ASCII terminals attached via LAN-based terminal servers, Xstations, or TCP/IP-based client systems such as an X-server TCP/IP interface on a PC, UNIX® workstation, or a UNIX server.
- Cluster nodes must be within the cable-length limitations of the shared disks, so the physical distance between nodes is limited by the total cable length of the shared disk cables.
- Transparency of a failure and the subsequent recovery to external users or clients is dependent on the HACMP configuration, the client system, and application protocol design.
- The AIX Journaled File System (JFS and JFS2) does not support concurrent access from multiple nodes; therefore, storage accessed in a concurrent configuration must be in raw logical volumes or through GPFS.
- Some HACMP command operands should not be used on systems also running NetView or other programs that catch SNMP traps. Refer to HACMP documentation for details on the use of the clinto daemon with such programs.
- Although the Version Compatibility function will allow HACMP V5.2 to coexist in a cluster with earlier releases of HACMP, this function is intended as a migration aid only. When the migration is completed, each node in the server cluster should be at the same AIX 5L and HACMP release levels, including all PTFs.
- The Version Compatibility function in HACMP assumes the customer is using hardware and software components supported in AIX 5L.
- National Language Support is fully enabled in HACMP for AIX 5L; message translation is provided for Japanese, but some RSCT messages are provided in English only.
- HACMP 5.2 supports the AIX 5L 64-bit kernel; however, when used with PSSP V3.5, PSSP supports only the 32-bit kernel.
**Performance considerations:** HACMP 5.2.0 cluster performance can be measured and reported in many ways. In a mutual takeover/partitioned workload cluster environment, the user’s applications and data are spread across two to 32 nodes in a cluster. Data management and application management can be placed under the control of a single node for efficiency or on each node for performance. In this partitioned environment, minimal interaction between nodes in a cluster derives high efficiency in each node. When a failover occurs and the backup node takes over for a failed node, performance is degraded for that period of time when the node is down.

In data sharing, LAN and file system overhead and data contention can reduce processor efficiency. Where data must be shared, the concurrent access configuration can be utilized, but less efficiently than a single system because distributed locks must be maintained between cluster nodes and processors.

**Planning information**

**Customer responsibilities:** Customers who purchase two or more HACMP licenses may replicate the contents of the following file sets throughout their enterprise:

- cluster.haview
- cluster.hativoli
- cluster.es.client
- cluster.es.plugins
- cluster.adt.es
- cluster.msg.en_US.es
- cluster.msg.En_US.es
- cluster.msg.ja_JP.es
- cluster.msg.Ja_JP.es
- cluster.man.en_US.es
- cluster.doc.en_US.es
- cluster.es.worksheets
- cluster.es.client.wsm

**Installability**

**Conversion utilities:** HACMP 5.2.0 includes conversion utilities to help you convert your configuration from earlier releases of HACMP without installing each intervening version. All of these conversions can be done while your cluster is not operational; for information regarding node conversion while maintaining cluster operation, refer to the Compatibility section.

The following conversions are provided for converting existing configurations of HACMP V4 (HAS, ES, CRM, or ESCRM) or HACMP V5.1 to HACMP V5.2:

- HACMP for AIX, V4.5.0
- HACMP for AIX, V5.1

HACMP 5.2.0 includes conversion utilities to help you migrate your configuration between products in the HACMP family.

You can convert from the High Availability Network File System (HANFS) feature of older versions of HACMP to HACMP V5.2; however, this requires an intermediate conversion to HAS V4.5, then a conversion to HACMP V5.2:

- HACMP for NFS (HANFS), V4.3.1

**Packaging**

- This program is shipped on CD-ROM; media and publications are shipped under the 5692-A5L SPO.
- Proof of Entitlement (PoE) information to support this licensed program is provided in the License Information document, which will be displayed automatically when HACMP 5.2 is installed.
- Unlicensed documentation is included.

**Security, auditability, and control**

The announced program uses the security and auditability features of AIX 5L V5.1 and V5.2 for servers.

The customer is responsible for evaluation, selection, and implementation of security features, administrative procedures, and appropriate controls in application systems and communication facilities.

**Ordering information**

The following applies to both HACMP V5.1 and HACMP V5.2:

HACMP V5 is a server product that has one charge unit: Number of processors. The number of processors is the sum of the number of processors on which HACMP V5 will be installed or run. A license is required for each machine on which HACMP will be installed and run.

HACMP/XD V5 is a server product that has one charge unit: Number of processors. The number of processors is the sum of the number of processors on which HACMP/XD V5 will be installed or run. A license for HACMP V5 and a license for HACMP/XD V5 is required for each machine on which HACMP/XD will be installed and run.

HACMP V5 Smart Assist is a server product that has one charge unit: Number of processors. The number of processors is the sum of the number of processors on which HACMP V5 Smart Assist will be installed or run. A license for HACMP V5 and a license for HACMP V5 Smart Assist is required for each machine on which HACMP Smart Assist will be installed and run.

Software Maintenance for HACMP V5 (5771-HMP or 5773-HMP), HACMP/XD V5 (5771-HMP or 5773-HMP) or HACMP V5 Smart Assist (5771-HMP or 5773-HMP) should be ordered individually in a quantity equal to the sum of the number of processors on which HACMP V5, HACMP/XD, or HACMP Smart Assist, respectively will be installed and run.

**Important license information**

This program is eligible for sub-capacity pricing, usage, and billing. The following terms apply to its use:

1. You must acquire authorization from IBM for use of the program on each processor for each partitioned environment.
2. IBM does not provide credits or refunds for charges already due or paid if a program’s use falls below the authorized entitlement.
3. If in the future IBM makes a license management program, an IBM program that records and reports program use information (“information”) to IBM, available to you for measuring program use, you agree to install and appropriately configure such license management program within 30 days of the date it is made available to you by IBM.

4. If IBM makes such license management program available to you with the machine on which you are authorized to execute the program, you agree to install and appropriately configure such license management program within 30 days of the date on which you begin using the program on such authorized machine.

5. IBM will provide the license management program to you, together with reporting requirements and an e-mail address for transmitting license management reports to IBM. You agree to transmit this information to IBM for the purpose of monitoring your usage of the program and for billing you for usage of the program which exceeds your authorized entitlement. You agree that IBM may store and use your information within IBM for any purpose. IBM may also share your information with third parties such as IBM Business Partners, subcontractors, and consultants under contract to IBM for purposes of usage monitoring, problem determination, assisting you with performance and capacity planning, assisting IBM to enhance IBM products and services and notifying you of your system status and solutions available to you.

6. You agree that upon reasonable written notice IBM has the right to verify your compliance on your premises during normal business hours. IBM may use an independent auditor for this purpose with your prior approval, which you agree not to unreasonably withhold or delay.

**Program withdrawal information**

HACMP V5.1 will remain orderable under the current 5765-F62 billing feature numbers and AIX SPO 5692-A5L supply feature numbers until March 31, 2005. The HACMP V5.1 media supply features of the AIX SPO 5692-A5L (0973, 0974, and 0977) will be withdrawn from marketing on March 31, 2005.

**Program name:** IBM High Availability Cluster Multi-Processing for AIX 5L

**New licenses**

To order the programs described in this announcement, specify the type model number, order type description, media feature number, and desired one-time charge (OTC) feature (maximum of 250 per feature number) from 5765-F62.

There are no new billing feature numbers in this announcement. Existing 5765-F62 billing feature numbers are now used for both HACMP V5.1 and V5.2.

**HACMP V5.1:** HACMP 5.1.0 will remain available via current 5765-F62 billing feature numbers and AIX 5L V5 SPO (5692-A5L) supply feature numbers until March 31, 2005. The SPO supply feature numbers to order are:

<table>
<thead>
<tr>
<th>Description</th>
<th>Feature number</th>
</tr>
</thead>
<tbody>
<tr>
<td>HACMP 5.1 Base</td>
<td>0973</td>
</tr>
<tr>
<td>HACMP 5.1 XD</td>
<td>0974</td>
</tr>
<tr>
<td>HACMP 5.1 Smart Assist</td>
<td>0977</td>
</tr>
</tbody>
</table>

The preceding AIX SPO media supply features for HACMP V5.1 will be withdrawn from marketing on March 31, 2005.

**Current licensees**

Current Licensees of HACMP V4.5 or V5.1 should refer to the Software Maintenance or Software Subscription for AIX sections for information on how to receive HACMP V5.2.

**Software Maintenance**

This software license includes Software Maintenance, previously referred to as Software Subscription and Technical Support.

All distributed software licenses include Software Maintenance (software subscription and technical support) for a period of 12 months from the date of acquisition. Extending coverage for a total of three years from the date of acquisition may be elected. Order the program number, feature number, and quantity to extend coverage for your software licenses. If maintenance has expired, specify the after license feature number.

Software Maintenance replaces Software Subscription for AIX (5692-SSO) for new and expired contracts. Refer to Software Announcement 202-003, dated January 8, 2002.

**Customers who already have Software Maintenance (5771-HMP or 5773-HMP):** Customers who purchased Software Maintenance for HACMP V4.5 (5765-E54) or V5.1 (5765-F62) under 5771-HMP or 5773-HMP are entitled to receive HACMP V5.2 (5765-F62) at no charge. Eligible customers should add the applicable media supply feature number under their existing 5692-A5L AIX SPO record.

Customers who purchased Software Maintenance for HAGEO V2 (5765-E82) under 5771-HGO or 5773-HGO are entitled to receive the HACMP V5.1 or V5.2 XD feature (5765-F62) at no charge. Eligible customers should add the applicable media supply feature number under their existing 5692-A5L AIX SPO record.

**Customers who want to add Software Maintenance:** To register for future upgrades of products from Software Maintenance programs described in this announcement, specify 5771-HMP for one-year registration or 5773-HMP for three-year registration, and the applicable HACMP, HACMP/XD, or HACMP Smart Assist After License billing feature with quantity equal to:

- For HACMP V4, the number of licenses in the base 5765-E54 license contract
- For HACMP V5, the number of processors on which HACMP V5 (base, XD, or Smart Assist) will be installed or run.

After License support is available via the configurators for HACMP V4.2, 4.3, 4.4, and 4.5, and HAGEO V2.4. If After License support is desired for earlier versions, the order will have to be generated outside of the configurator.
Notes

The following billing features either:
- Must have been previously purchased and must currently be on a customer’s record as proof of eligibility to receive this upgrade and future upgrades at no charge.

or

- May be purchased to receive future releases of this product for no charge; order the program number, feature number, and quantity to obtain coverage for your software licenses.

The appropriate one-year registration feature (no additional charge feature) will transfer automatically to the customer order record when 1-year 5771-HMP is selected.

Customers should select the Renewal Billing Feature for one- or three-year contract renewal.

Customers should select the Maintenance After License to re-enter one of the programs after a contract has lapsed.

Software Subscription for AIX (5692-SSO)

Note: Software Subscription for AIX has been replaced by Software Maintenance. Refer to the Software Maintenance section.

Note: All SSO renewal privileges expired on July 31, 2003. Entry into any Software Maintenance product is via the After License feature. After License support is available via the configurators for HACMP V4.2, 4.3, 4.4, and 4.5, and HAGEO V2.4. If After License support is desired for earlier versions, the order will have to be generated outside of the configurator.

Withdrawal of Software Subscription for AIX features:

Customization options

Select the appropriate feature numbers to customize your order with the desired delivery options. These features can be specified on the initial or MES orders.

<table>
<thead>
<tr>
<th>Feature number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3445</td>
<td>Local IBM Office Expedite (for IBM use only)</td>
</tr>
</tbody>
</table>

Expediting shipments will be processed to receive 72-hour delivery from the time IBM Software Delivery and Fulfillment (SDF) receives the order. SDF will then ship the order via overnight air transportation.

System Program Order (SPO) (5692-A5L): A 5692-A5L SPO is mandatory for shipments of program distribution and publications. The individual licensed program orders (for example, 5765-F62) are for registration and billing purposes only. No shipment occurs under these orders.

To receive shipment of machine-readable materials stacked on CD-ROM requires an SPO (5692-A5L). Billing for the media type selected is generated under the SPO. To prevent additional billing expenses, place only one SPO order per machine.

Select one of the following (5692-A5L) feature numbers for the licensed program hardcopy entitled publications to be shipped on a given date.

AIX SPO

A 5692-A5L SPO order is also mandatory for shipments of program distribution media, which includes publications. The appropriate SPO feature should be selected from the following table:

HACMP 5.2 5692-A5L SPO feature numbers

<table>
<thead>
<tr>
<th>Program name</th>
<th>Feature number</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM High Availability Cluster Multi-Processing for AIX 5L, Version 5.2.0</td>
<td>0996</td>
</tr>
<tr>
<td>IBM High Availability Cluster Multi-Processing for AIX 5L, Version 5.2.0</td>
<td>0997</td>
</tr>
<tr>
<td>Extended Distance (XD) Feature</td>
<td>0998</td>
</tr>
<tr>
<td>IBM High Availability Cluster Multi-Processing for AIX 5L, Version 5.2.0</td>
<td></td>
</tr>
<tr>
<td>Smart Assist Feature</td>
<td></td>
</tr>
</tbody>
</table>

Under SPO 5692-A5L, feature number 3470 can be used to suppress hardcopy documentation. To order entitled hardcopy documentation only, order feature number 3430.

Terms and conditions

Agreement: IBM International Program License Agreement. Proofs of Entitlement are required for all authorized use.

This software license includes Software Maintenance, previously referred to as Software Subscription and Technical Support.

The following agreements apply for maintenance and do not require customer signatures:

- IBM Agreement for Acquisition of Support (Z125-6011)
- Addendum for Support (Software Maintenance) for Select iSeries™ and pSeries Programs (Z125-6495)

Limited warranty: Yes

Program services

Warranty: This program has warranty for a minimum of one year from acquisition from IBM or authorized IBM Business Partner. The warranty provided to the customer, for at least one year from acquisition, is access to data bases (read Web sites) for program information, FAQs, including any known fixes to defects, which the customer can download or obtain otherwise and install at leisure.

Money-back guarantee: If for any reason you are dissatisfied with the program, return it within 30 days from the invoice date to the party (either IBM or its reseller) from whom you acquired it for a refund. This applies only to your first acquisition of the program.
Copy and use on home/portable computer: No

Volume orders (IVO): Yes, contact your IBM representative.

Passport Advantage® applies: No

Software Maintenance applies: Yes

All distributed software licenses include Software Maintenance (Software Subscription and Technical Support) for a period of 12 months from the date of acquisition, providing a streamlined way to acquire IBM software and assure technical support coverage for all licenses. Extending coverage for a total of three years from date of acquisition may be elected.

While your Software Maintenance is in effect, IBM provides you assistance for your routine, short duration installation and usage (how-to) questions and code-related questions. IBM provides assistance via telephone and, if available, electronic access, only to your information systems (IS) technical support personnel during the normal business hours (published prime shift hours) of your IBM support center. (This assistance is not available to your end users.) IBM provides Severity 1 assistance 24 hours a day, every day of the year. For additional details, consult your IBM Software Support Guide at

http://techsupport.services.ibm.com/
guides/handbook.html

Software Maintenance does not include assistance for the design and development of applications, your use of programs in other than their specified operating environment, or failures caused by products for which IBM is not responsible under this agreement.

Program services: Program warranty service for HACMP V5.1 will end on September 1, 2006.

IBM operational support services — SoftwareXcel: No

Other support: AIX (when available)

AIX/UNIX upgrade protection applies: Yes

Entitled upgrade for current AIX/UNIX upgrade protection licensees: Yes

iSeries Software Subscription applies: No

Variable charges apply: No

Educational allowance available: Yes, 15% education allowance applies to qualified education institution customers.

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**Prices**

There are no new price features in this announcement. HACMP 5.1 and 5.2 are both ordered via 5765-F62.

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**Order now**

To order, contact the Americas Call Centers, your local IBM representative, or your IBM Business Partner.

To identify your local IBM representative or IBM Business Partner, call 800-IBM-4YOU (426-4968).

- **Phone:** 800-IBM-CALL (426-2255)
- **Fax:** 800-2IBM-FAX (242-6329)
- **Internet:** ibm—direct@vnet.ibm.com
- **Mail:** IBM Americas Call Centers
  Dept: IBM CALL, 11th Floor
  105 Moatfield Drive
  North York, Ontario
  Canada M3B 3R1

Reference: RE001

The Americas Call Centers, our national direct marketing organization, can add your name to the mailing list for catalogs of IBM products.

**Note:** Shipments will begin after the planned availability date.

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