COMPAQ TACKLES CLUSTER MANAGEMENT

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EXECUTIVE SUMMARY

As Microsoft positions Windows NT for entry into the enterprise, clustering solutions have caught the attention of many different global organizations and enterprise-wide business units. Clusters give Windows NT Enterprise Edition the reliability, availability, and scalability it needs to meet the requirements of enterprise-focused applications.

Compaq views the growth in deployment of Windows NT clusters as an opportunity to become a supplier of enterprise IT infrastructures. As a first step towards this goal, Compaq offers two cluster management tools aimed at the enterprise, part of a broad range of enterprise-focused products and services. This pair of initial products begin with support for Windows NT and Microsoft Cluster Server software (MSCS), laying a foundation for extending a solution to Compaq's other supported cluster technology.

- **Cluster Monitor**, a Web-based monitoring subsystem for Windows NT MSCS clusters. An addition to Insight Manager XE, Cluster Monitor aggregates event data and configuration data from agents monitoring the cluster, as well as from individual systems agents within the cluster. These agents provide administrators with a consolidated view of all cluster resources, but also give them the ability to drill down for further analysis.
- **Intelligent Cluster Administrator**, a Web-based administration tool for Windows NT MSCS clusters. Intelligent Cluster Administrator replicates cluster configurations rapidly by importing configurations to other clusters with similar physical setups. Intelligent Cluster Administrator warns administrators of physical exposures when configurations are being imported. It facilitates the logging of all configuration changes and the administrators who made the changes for security and quality control.

The following characteristics make both Cluster Monitor and Intelligent Cluster Administrator enterprise ready:

- a single point of control for all Windows NT clusters;
- a scalable, Web-based architecture that allows managers to control cluster systems from any location;
- open, standards-based data schemas, enabling future extensions to other heterogeneous clustering technology; and
- integration with any management framework in the enterprise environment.

These products deliver a key innovation, setting down an architectural groundwork for a heterogeneous cluster management solution. Compaq is working to develop a solution that allows business and IT managers to investigate the best strategic uses of their clustering capabilities, instead of focusing on how to manage the underlying technology. Compaq's

goal of enabling heterogeneous management does not exist in current cluster management products, even though all enterprise IT departments consider it an issue of major concern. When the product is extended to heterogeneous clustering technologies Compaq will have a distinct advantage over its competition.

SETTING THE STAGE

MARKET PERSPECTIVE

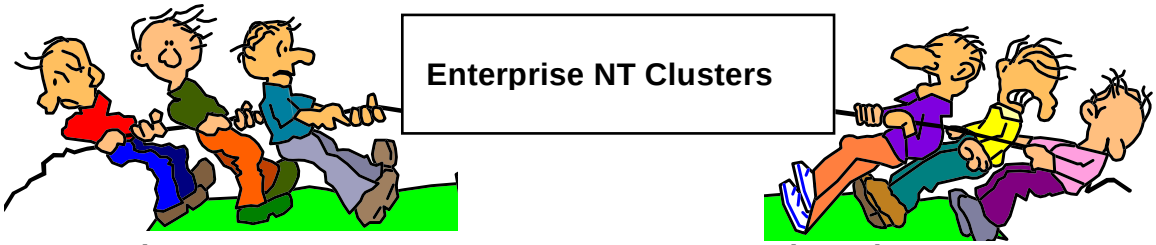
Microsoft is driving Windows NT into the enterprise as a platform for mission-critical applications. The rapid deployment of Windows NT stand-alone servers or MSCS clustered servers for such enterprise systems as e-mail and Web servers represents only the first step in this campaign. Enterprise software vendors such as SAP now offer enterprise-focused solutions on Windows NT platforms and have seen rapid growth in the mid-size business market. The arrival of Windows2000 will only speed this trend, by providing a suite of enterprise-focused features such as Active Directory.

Clustering solutions represent a key technology powering Windows NT's entry into the enterprise space. Clusters increase system availability by transferring resource responsibilities from failed nodes or problematic nodes to other cluster members. NT-based clusters deliver the reliability, availability, and scalability traditionally associated with enterprise systems, enabling Windows NT to meet the requirements of enterprise-focused applications.

Unfortunately, several obstacles offset the acceptance of Windows NT clustering (see Figure 1). Many administrators will find it difficult to install cluster solutions, as it usually involves a lot of network related and shared resources planning. This type of planning falls beyond the experience of most Windows NT administrators.

Cluster management also proves complex and confusing. Most if not all Windows NT administrators do not have experience managing this type of solution, which combines servers, network, and software into a single system image. And whereas a mature cluster management system should automate much of the deployment, operations, tuning, and monitoring – making a cluster as easy to manage as a single node – current Windows NT cluster management tools remain relatively immature.

The enterprise focus of Windows NT clustering solutions poses additional complications. In the enterprise, administrators must manage a heterogeneous computing environment – not one that consists only of Windows NT. Therefore, enterprise IT managers not only want to improve management of Windows NT clusters, but also need ways to consolidate management of heterogeneous clustering solutions. To date no cross-platform standards exist to simplify management of heterogeneous clusters.



Drivers

Rapid growth of NT-based business-critical applications

E-business solutions demand for high availability

Improve computing services by centralizing systems and management

NT-Cluster Technology developments

Obstacles

Complexity of clustered systems configuration and monitoring

Slow pace of ISV support for clustered systems

Immature cluster system management tools

No cross-platform standards for supporting installed clustered solutions

Source: DHBA research

Figure 1: Enterprise Windows NT Cluster Market Drivers and Obstacles

COMPAQ'S RESPONSE

Compaq views the growth in deployment of Windows NT clusters as an opportunity to grown its presence as a supplier of enterprise IT infrastructures. The company seeks not only to distribute Windows NT systems, but also to offer a broad range of products and services that meet the various computing needs of large enterprise. Over the past three years, Compaq has aggressively acquired technology and services organizations, aiming to become an end-to-end computing supplier for large enterprises. The company's Enterprise 2000 vision details a road map to integrate these disparate technologies and services into a unified set of product offerings that meet enterprise computing needs. As a supplier of heterogeneous operating systems, processor architectures and clustering technologies, Compaq can now better appreciate and address the concerns of the enterprise.

Compaq's Enterprise Systems Management concept represents a key component of the overall E2000 vision. By consolidating management of its heterogeneous systems and clusters, Compaq will help enterprise IT departments solve the enormous, ongoing problem of managing a heterogeneous computing environment. Clusters provide benefits that make them a smart place to start the process of enterprise management consolidation. As a result, clustering solutions have caught the attention of many different global organizations and enterprise-wide business units, because clustering can benefit any computer processing work where downtime is costly and uptime is profitable. Clusters also provide potential cost

savings for maintaining multiple systems by integrating the administration tools across all members of a cluster.

As a step toward its goal of enhancing its position in the enterprise market, Compaq now offers cluster administration and monitoring tools that target enterprise needs. These products begin with supporting Windows NT and Microsoft Cluster Server software (MSCS), laying down a foundation architecture for extending the company's solutions. Compaq aims to link with Novell NetWare and SCO UnixWare, as well as positioning its products to accommodate Tru64Unix, Open VMS, and Tandem Non-Stop Kernel (NSK) systems. The company will deliver its cluster management offerings as both a stand-alone product and as package integrated with its enterprise management offering, Insight Manager XE.

ENTERPRISE CLUSTER MANAGEMENT

The number of enterprise cluster environments will likely increase rapidly as Windows NT moves into the enterprise. Once clustering reaches a critical mass, IT organizations will have to consolidate management in order to control the total cost of ownership for clusters. Forward-looking organizations already have begun looking for management tools that can grow along with the enterprise cluster environment. These leaders want to find a solution that not only provides features for cluster administration, but that also can handle all the clusters in an enterprise.

CLUSTER MANAGEMENT ISSUES

In a cluster, each server can operate independently and use a mutual distrust approach to ensure high availability. In this approach servers, LAN and drive controllers poll each other to ensure that each one is working. If one server node experiences problems, the cluster triggers failover processes that allow a working server node to assume the failed node's workload in addition to the load the node is already doing. This capability creates a single computing resource across multiple servers that proves much more cost-effective than mirroring data onto idle systems. Clusters ensure that IT investments in hardware provide maximum returns. Configuring and maintaining a cluster to achieve these benefits, however, is much more complex than simply networking several servers together and mirroring associated data.

Further, the configuration of many clusters allows all servers to share a common view of the database. A database management system and a Distributed Lock Manager coordinate the database activity of all nodes in the cluster. Usually, these types of scalable systems also involve connecting shared disk arrays directly into each server. Correctly configuring these features proves time consuming and error-prone for even experienced systems administrators. Cluster management solutions should automate and simplify this process

Finally, cluster management must address single-system image. Administrators cannot just monitor each server individually, because they need to know how the cluster behaves as a whole. This means cluster management solutions must aggregate data from individual servers and correlate this data with the cluster configuration, providing a single point of control for the management staff.

CLUSTER MANAGEMENT REQUIREMENTS

- **Simplification of Initial Configuration:** A cluster management solution should simplify and automate cluster configuration with resource dependency rules and configuration verification processes. Once administrators create a workable configuration, they can then replicate it for other installations. Windows NT cluster technology is still relatively new, meaning there is little expert knowledge in the field. Experience with Windows NT does not prepare administrators for the complexity of cluster configuration, customization, and operations. Installing MSCS software may be relatively straightforward, but combining the servers, network interfaces, and shared storage resources into a single system is not.
- **Simplification of Rapid Cluster Deployment:** A cluster management solution should provide an efficient and uniform mechanism for configuring and deploying clusters. Administrators should be able to leverage the effort they expend to correctly configure a single cluster. A solution that enables replication of that configuration in a consistent way ensures rapid deployment of working systems. A solution should be able to import configurations from existing clusters and to export configurations to newly installed clusters. The system should then dynamically load the new configuration without requiring a system reboot.
- **Display of Cluster Resource Dependencies:** A solution should provide a hierarchical view of cluster components, revealing component dependencies in a manner that is easy to understand. This capability allows administrators to immediately understand the relationships among resources when they troubleshoot problems.
- **Tracking of All Configuration Changes:** A solution should track all changes associated with clustered components in an audit log. Tracking allows administrators to troubleshoot configuration related problems faster and to catch problematic changes to the system. In addition, the solution should provide comparative capabilities and display the differences between the existing cluster configuration and its log record at different points in time.
- **Simplification of Recovery Situations:** The solution should provide configuration archiving capabilities. This allows administrators to import archived configurations to rebuild systems.
- **Management of Cluster Services:** The solution should provide capabilities specifically for cluster administration and tuning: add, modify, and delete cluster services; assign a cluster service to a particular node; and establish service dependencies.
- **Event Monitoring and Notification:** The solution should monitor for both cluster and

individual node health and notify administrator of critical events by a variety of means – event log, e-mail, paging, etc. The solution should also prioritize events based on their criticality to cluster health and based on requirements defined by the administrator. Event-based monitoring allows administrators to use time more effectively because they only have to interact with the system when a problem occurs. This frees their time for more strategic IT projects.

- **Performance Thresholds:** The solution should enable administrators to set performance monitoring thresholds. Threshold monitoring allows administrators to manage more proactively. When abnormal behavior occurs in a node or cluster, administrators will become aware of the situation before it becomes a problem visible to users.
- **Aggregation of Problems and Events:** The solution must provide a comprehensive view of all cluster resources and dependencies. It should relate all component events to their particular application or service so the administrator can immediately see which cluster services are affected.
- **Display Status for Troubleshooting:** In addition to the configuration view, the solution must display the current state of cluster resources. This view will allow administrators to immediately identify problem components and exact points of failure. They can then take appropriate action and provide good information to the hardware supplier when they need assistance.
- **Collection of Cluster Statistics:** The solution should collect and aggregate information about cluster resource usage, availability, and performance. These statistics allow administrators to enforce performance and availability agreements, change the service agreements as workloads change, and optimize system resources to specific workloads.
- **Creation of Comprehensive Reports:** The solution's reporting capabilities should include several pre-defined reports and should enable creation of custom reports.

ENTERPRISE MANAGEMENT ISSUES

Delivering a cluster management solution represents only the first step for Compaq. The company ultimately aims to deliver a management solution capable of supporting clusters in an enterprise-wide manner. Large-scale computing solutions have additional management requirements that go beyond the ability to monitor and control a single technology. For example, administrative staff works remotely and does not have physical access to the system components. A localized solution thus proves ineffective; a solution must be able to handle diverse network topologies and organizational geographies.

In addition, many members of IT organizations are generalists who handle a wide range of management tasks and responsibilities, with only a few specialists for key technologies. The management solution therefore must provide a way to differentiate among administrator capabilities, for example, preventing generalists from performing tasks that should be

performed only by a specialist The system must also provide significant internal intelligence, such as event correlation, and enable automation of tasks for less experienced users.

ENTERPRISE MANAGEMENT REQUIREMENTS

- **Enterprise-Wide View of Clustered Environments:** As multiple departments in the enterprise implement clustered solutions, IT managers need a single view of all cluster solutions. This single view simplifies management tasks and saves time by delivering the information administrators require so they do not have to waste time searching for it.
- **Scalable Architecture:** A management solution should be able to physically scale to cover all clusters on the enterprise network. Such scalability proves a key requirement because IT organizations must usually support increasing numbers of systems and services without increasing their staff levels. The solution also should be operationally scalable – i.e., it should not require additional incremental work for each new cluster added to the environment.
- **Customizable Administrator Roles:** Solutions should be able to customize administrator access and views according to an individual staff member's assigned tasks and responsibilities. Enterprise IT organizations have staff with varying levels of experience and must be able to leverage the most experienced staff effectively.
- **Extensible Architecture:** An enterprise cluster management solution must have a flexible architecture that allows it to expand its support for heterogeneous clusters (see Figure 2). Clustering technology has existed for some time and is available on various operating systems. No enterprise can escape the problems introduced by heterogeneous solutions, but they can simplify management by providing a single toolset that can manage many types of clustering solutions.
- **Integration with Existing Management Schemes:** An enterprise cluster management solution should integrate with frameworks such as HP OpenView, CA's Unicenter TNG, and Tivoli's TME (see Figure 2). Many IT organizations now use management frameworks to implement their enterprise strategy and require tool integration to provide an overview picture of their entire IT infrastructure. Integration with such frameworks enhances the manageability functions of IT's existing infrastructure rather than isolating the new technology from the overall management scheme.

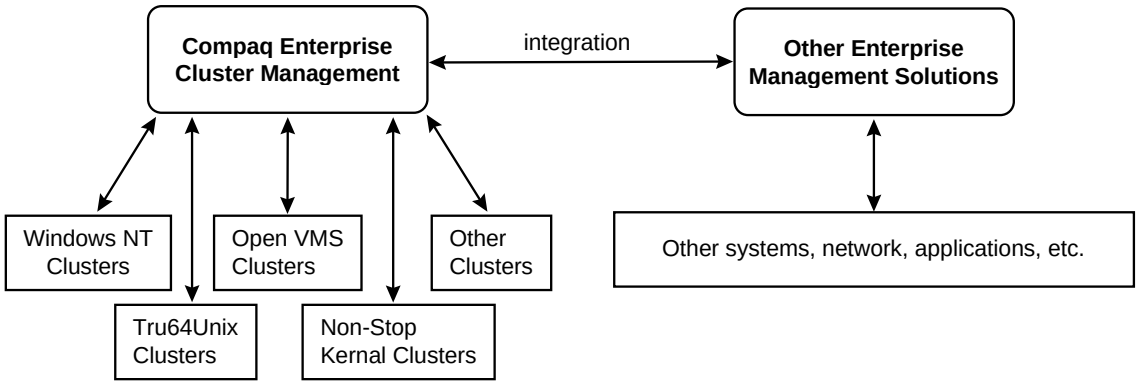


Figure 2: Managing Clusters in the Enterprise

EXISTING SOLUTIONS

Most available enterprise cluster management products fall into two basic categories: point products and framework-based solutions. Neither category provides a complete solution that addresses both cluster management and enterprise issues.

Cluster management point products such as HP's Cluster View, NET IQ's Windows NT Application Manager and NuView's ClusterX address the cluster management requirements discussed earlier. While these products address the single-system image cluster issues and provide performance monitoring, event handling, and configuration management for Windows NT clusters, they tend to be local in scope. Their architectures may allow remote administration and monitoring, but they provide only limited capabilities for enterprise view, extensibility, and flexibility for use with multiple administrators with varying skills.

Management framework solutions from Tivoli, CA, and HP have been designed specifically with the enterprise in mind. They support heterogeneous environments and provide a broad range of management capabilities. However, because of the breadth of their feature sets, these solutions have been slow to provide support specifically for clusters. Most often the enterprise views will list individual servers without displaying the cluster connection, unless the administrator has specifically customized the solution. This means that administrators do not know how the cluster behaves as a whole.

HOW COMPAQ ADDRESSES THE REQUIREMENTS

Compaq is developing a sophisticated cluster management environment for its heterogeneous clustering technologies as part of its Enterprise Systems Management solution. Compaq's Enterprise Systems Management solution represents a key component of the company's overall E2000 vision. This vision calls for a unified set of product offerings that meet enterprise computing needs. To deliver, Compaq must provide comprehensive management capabilities for enterprise-focused technologies that are both easy to use and easy to extend.

Compaq's first steps toward this goal consist of providing cluster administration and monitoring tools focused on the enterprise. The products begin with supporting Windows NT and MSCS and lay down a foundation architecture that can extend the solution to Novell NetWare, SCO UnixWare, Tru64Unix, Open VMS, and Tandem Non-Stop Kernel (NSK) systems. The first steps of this plan are:

- a Web-based monitoring subsystem, which adds on to Insight Manager XE for Windows NT MSCS clusters, and
- a Web-based administration tool for Windows NT MSCS clusters.

These cluster administration capabilities should improve administrator efficiency in integrating Windows NT clusters to the enterprise IT environment. The monitoring capabilities provide early warning and rapid response workarounds, minimizing the impact of cluster node problems on the application service the cluster provides.

INSIGHT MANAGER XE – CLUSTER MONITOR

Cluster Monitor allows administrators from a single, browser-ready interface to:

- monitor all Windows NT clusters in their environment,
- configure monitoring parameters for individual nodes and for the cluster as a whole,
- set operational performance thresholds on most critical systems components, and
- receive prioritized alerts when thresholds have been met or exceeded.

ARCHITECTURE

Cluster Monitor is a subsystem of Insight Manager XE (see Figure 3), Compaq's Web-based enterprise management extension (an outgrowth of its successful console-based Insight Manager product). The company offers Insight Manager XE in limited availability today. The cluster monitor subsystem is a newly added function suite. This integrated architecture provides a familiar management environment for Windows NT administrators, a key feature. Compaq's solution eliminates the difference between the way an administrator would monitor a single Windows NT server and the way he or she would monitor a Windows NT MSCS cluster.

Cluster Monitor integrates fully with Insight Manager XE. It relies on Compaq Insight Manager agents to gather basic system configuration, availability, and performance information from each cluster node. Cluster Monitor also collects data from agents designed specifically for such cluster health parameters as cluster processing and storage capacity and utilization, as well as checking cluster health from the Windows NT MSCS event logs. The system stores this operational data in Insight Manager XE's common repository and delivers it to the administrator on demand.

The Insight Manager XE's event-handling engine polls the agents for various system and cluster parameters and compares them to thresholds defined by the user with Cluster Monitor. Once these thresholds are exceeded, the system sends an alert to the administrator along with relevant event information. Cluster Monitor aggregates the event and configuration data from both sets of agents to present the administrator with a consolidated view of the cluster.

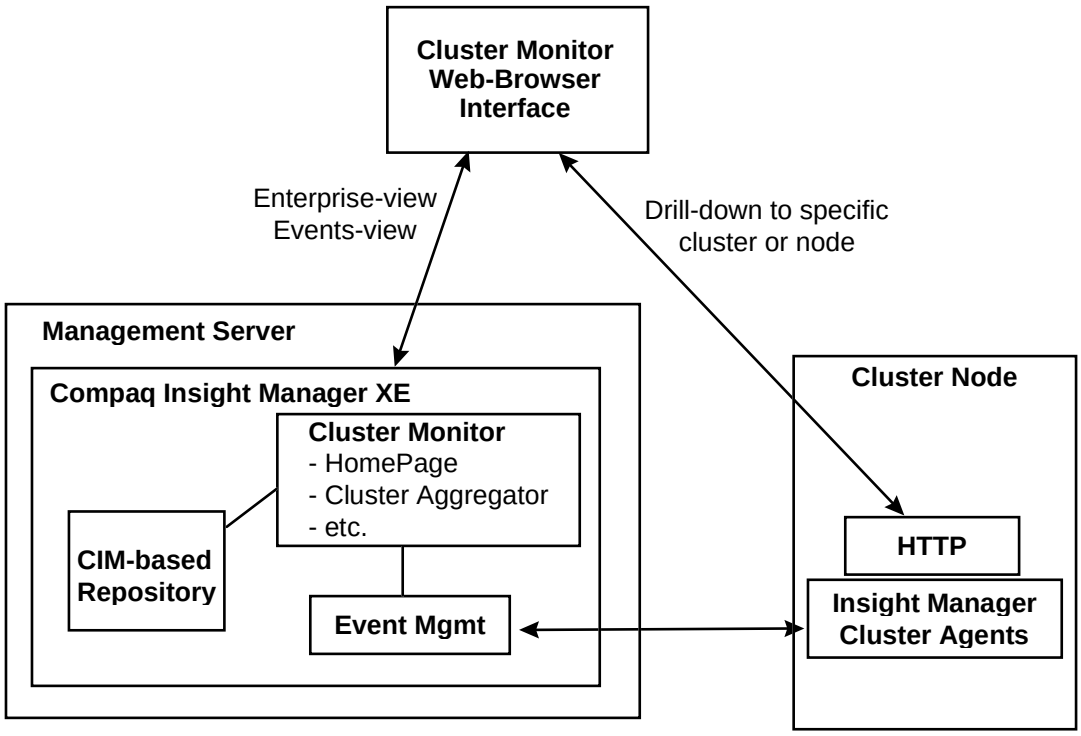


Figure 3: Cluster Monitor Architecture

MEETING CLUSTER MANAGEMENT REQUIREMENTS

- **Event Monitoring and Notification:** Cluster Monitor has agents for both cluster and individual node health, notifies administrators of events, and recommends resolutions or remedies for events. It also prioritizes events based on severity to cluster stability as well as administrator requirements. Cluster Monitor removes the event from the error stack once the event error condition is satisfied.
- **Setting Performance Thresholds:** Using Cluster Monitor's browser interface, administrators can set performance-monitoring thresholds based on cluster health or cluster capacities. They can also set individual cluster nodes with specific notification points for disk, CPU utilization, OS conditions, or other custom-defined metrics. Cluster Monitor is extremely flexible, allowing administrators to specify different monitoring metrics for different clusters and/or individual nodes in a clusters.
- **Aggregation of Problems and Events:** Cluster Monitor aggregates event data and configuration data from agents monitoring the cluster, as well as individual systems agents within the cluster. This provides the administrator with a consolidated view of the cluster.

- **Display Status for Troubleshooting:** Cluster Monitor can drill down into the specific cluster node for further analysis and resolution. It also identifies and displays cluster resources, cluster hardware and software configuration, emergency and support contact information, and an inventory of installed application software.
- **Collection and Reporting of Cluster Statistics:** The current release of Cluster Monitor does not address these requirements. Compaq plans to include these features in future product releases.

MEETING ENTERPRISE MANAGEMENT REQUIREMENTS

- **Enterprise-Wide View of Clustered Environments:** Cluster Monitor's browser-based interface provides a single point of event monitoring for all cluster solutions in the environment. An additional benefit of Compaq's browser interface is the mobility and flexibility it offers. Administrators can use any platform at any location in their organizations to view status and event information about remote cluster solutions.
- **Scalable Architecture:** Insight Manager XE and the Cluster Monitor's architecture does put a practical limit on the number of devices and clusters it can administer because of the network traffic generated by polling. Compaq estimates this limit is in the hundreds of clusters, well above current enterprise cluster deployments. Cluster Monitor is also operational scaleable. It does not add incremental work for each additional cluster managed, allowing a single administrator to effectively manage larger portions of the enterprise cluster environment.
- **Customizable Administrator Roles:** Managers can customize Cluster Monitor's views and access capabilities based on individual administrator roles, assigned tasks and responsibilities, or cluster location and type. The administrator can view all clusters and select sets of clusters based on location, application utilization, and responsible administrator, enabling great flexibility for span of control.
- **Extensible Architecture:** Cluster Monitor currently only supports Windows NT MSCS, but it has extensibility built in. Cluster Monitor agents have an extensible data format with APIs to add extra monitoring metrics. Compaq is currently writing a developer guide that will allow third-party vendors to directly access cluster monitoring capabilities through the APIs. Compaq also is developing a consolidated cluster management information base (MIB) that will provide common monitoring and control capabilities across heterogeneous technologies such as NetWare, UnixWare, OpenVMS or Tru64Unix clusters.
- **Integration with Existing Management Schemes:** As a subsystem of Insight Manager XE, Cluster Monitor automatically integrates with enterprise management frameworks such as HP OpenView, CA's Unicenter TNG, and Tivoli's TME10.

INTELLIGENT CLUSTER ADMINISTRATOR

Intelligent Cluster Administrator provides sophisticated tools for cluster configuration administration, management, and deployment of Compaq ProLiant MSCS Clusters. These functions allow the administrator to copy, modify, and dynamically install a cluster configuration on another cluster anywhere in the enterprise and to use a browser to perform the basic cluster administration tasks available today via console-based systems.

ARCHITECTURE

Intelligent Cluster Administrator is a value-added product and can be used in a stand-alone fashion for managing a single cluster or integrated with Compaq's Insight Manager XE through the Cluster Monitor subsystem. This integration allows management of all clusters in the environment (see Figure 4). Intelligent Cluster Administrator agents that reside on each node of the cluster provide the control capability. Administrators access these capabilities through the browser interface.

If Intelligent Cluster Administrator is in stand-alone mode, the browser directly accesses the cluster's URL, which displays the cluster resource topology and configuration. When it is integrated with Insight Manager XE – Cluster Monitor, Intelligent Cluster Administrator is provided a view of all clusters in the environment, and administrators can then drill down to manage individual systems.

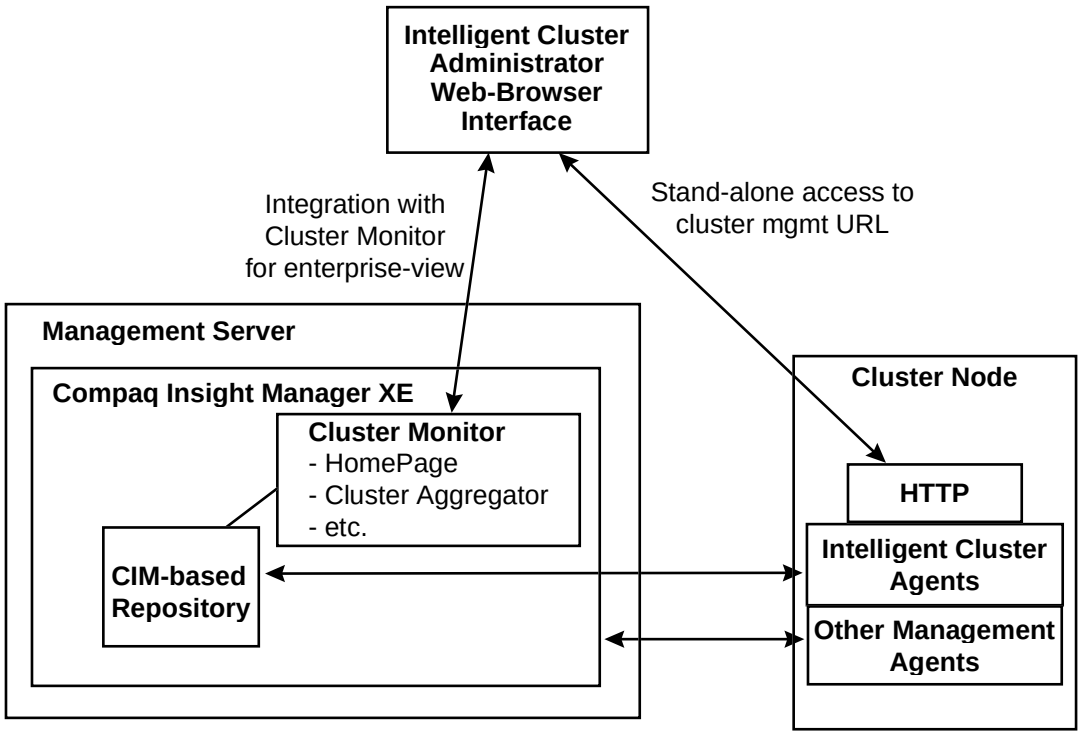


Figure 4: Intelligent Cluster Administrator Architecture

MEETING CLUSTER MANAGEMENT REQUIREMENTS

- **Simplification of Initial Configuration:** Organizations can deploy Intelligent Cluster Administrator on a large scale when clusters are loaded and shipped from a central site to remote locations. Once the remote sites become active, administration and reconfiguration can be performed across the Web.
- **Simplification of Rapid Cluster Deployment:** Intelligent Cluster Administrator can replicate cluster configurations rapidly by importing any current or logged cluster configuration to another cluster with the same physical setup. It warns administrators of physical exposures while it is importing configurations. Administrators can also update and restore configurations as needed.
- **Display of Cluster Resource Dependencies:** Intelligent Cluster Administrator provides a hierarchical view of cluster components, revealing component dependencies in a manner that is easy to understand. This allows administrators to immediately discern the relationships between the resources in troubleshooting situations. It also shows the order in which administrators must restart the resources in recovery situations.
- **Tracking of All Configuration Changes:** Intelligent Cluster Administrator enables the administrator to log each configuration change with the administrator name for security as well as quality control. It can also compare any existing cluster configuration to a logged configuration for differences.
- **Simplification of Recovery Situations:** Intelligent Cluster Administrator can designate a logged cluster configuration as the ideal one for optimal cluster state. Administrators can then import the archived configurations to rebuild systems.
- **Management of Cluster Services:** Intelligent Cluster Administrator does more than simply display service status. Administrators can add, modify, and delete cluster services; modify service properties; assign services to a particular node; establish service dependencies; and failover a service.

MEETING ENTERPRISE MANAGEMENT REQUIREMENTS

- **Enterprise-Wide View of Clustered Environments:** Intelligent Cluster Administrator's integration with Insight Manager XE and its browser-based interface provides a single point of administration for all cluster solutions in the enterprise environment. An administrator can use any platform at any location in the organization to view status and event information about remote cluster solutions.
- **Scalable Architecture:** Intelligent Cluster Administrator's Web-based architecture allows managers to control cluster systems from anywhere. Its configuration-replication and change-tracking capabilities also simplify the installation, deployment, and configuration of multiple cluster systems, increasing the efficiency of single administrator.

- **Extensible Architecture:** Intelligent Cluster Administrator agents store configuration data in Common Information Model schemas, which will allow the solution to readily expand coverage to other cluster technologies and operating systems.
- **Integration with Existing Management Schemes:** When the Intelligent Cluster Administrator is used with Insight Manager XE the necessary linkages between Intelligent Cluster Administrator and enterprise management frameworks such as HP OpenView, CA's Unicenter TNG, and Tivoli's TME10 are provided.

WHY COMPAQ'S APPROACH MAKES SENSE

Compaq's approach to delivering administration and monitoring capabilities for clusters demonstrates the company's understanding of the current state of the cluster management market. IT managers are still trying to understand how to implement and deploy this new technology. For enterprise-wide customers, however, delivering reliable, high-performance computing services depends on ensuring that good management practices get consistently applied. In addition, enterprises must reduce the time they spend troubleshooting a problem. Although clusters can increase Windows NT availability for mission-critical applications, the individual nodes remain exposed to problems or failures. To provide peak service to users, it is important get these nodes back online.

Compaq meets these requirements by:

- facilitating management consistency (provided with Intelligent Cluster Administrator's focus on creating a replicable cluster deployment); and
- providing comprehensive cluster monitoring and troubleshooting capabilities (with Cluster Monitor).

These initial products from Compaq deliver innovations that set the stage for expansion to the company's other clustered systems solutions. Anyone can make a point product that manages Windows NT clusters. Compaq aims to provide a common, intuitive, and consistent management interface targeted at business process management. With this vision, Compaq will create a flexible and extensible management solution that can incorporate different clustering technologies under a single management interface.

Flexibility and extensibility will allow administrators to choose clustering technologies based on features and performance and to manage them in a consistent, task-driven manner that supports business processes. Compaq's current solutions will can be extended to support Compaq's other clustering technologies, allowing companies to manage heterogeneous clustering solutions without the complexity of customizing an enterprise management framework.

Integrating cluster management capabilities into Compaq's Insight Manager XE solution also makes sense because it provides a consolidated management solution for a range of computing technologies, from stand-alone desktops to sophisticated Windows NT clusters.

Using the same tool to manage a variety of solutions reduces management costs in terms of licensing software. Consolidating the solution also shortens the return on investment timeline by reducing learning curves for managing Windows NT clusters. The consistent interfaces allow Windows NT administrators to leverage their existing knowledge of Compaq's management environment.

BOTTOM LINE

Cluster Monitor and Intelligent Cluster Administrator represent solid first steps toward a unified management solution for the enterprise clustering environment. These products do a good job in meeting most of the cluster administration requirements, as well as satisfying enterprise solution needs. They also lay the foundation for future development, which will allow Compaq to deliver on its ultimate goal: a heterogeneous cluster management solution that allows business and IT managers to focus on strategic business use of clustering instead of on how they manage the underlying technology. DHBA expects Compaq to deliver these capabilities over time, as the company works to complete its strategic plan, transforming from a vendor of PC servers to a provider of enterprise-ready IT infrastructures.