Novell® Storage Manager for Novell eDirectory™

Bringing the Exponential Growth of Unstructured Data under Control

Novell®

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for Novell eDirectory™

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The amount of data maintained on organizations' network storage systems has grown exponentially over the past few years. This is generally due to regulatory compliance or the demands of today's digital workplace fueling significant increases in users' unstructured file storage. IDC projects that the annual capacity growth rate for unstructured data in traditional enterprises is expected to grow at 62.2 percent.[†] Unfortunately, most organizations lack the tools necessary to control and manage this ever-increasing storage growth.

Bringing unstructured data under control can be extremely difficult and time consuming. While many organizations develop written policies for managing their storage, the execution and enforcement of these policies often fail to occur. This is often due to time constraints, limited IT resources and the inadequacy of the tools organizations employ to manage their unstructured data.

The majority of the tools available for managing unstructured data lack the ability to help organizations automate their storage management policies, manage storage at the file system level or deliver the visibility needed to understand the true state of their storage infrastructure. They also fail to reconcile the relationship between users' identities, roles and storage resources, making them ineffective at managing the lifecycle of user storage management. As a result of these inadequate tools and limited resources, unstructured user storage typically remains unmanaged and proliferates further out of control.

Novell Storage Manager for eDirectory is not like any other storage management solution. Based on an identity- and policy-driven state machine architecture, Storage Manager addresses the challenges created by the out-of-control growth of unstructured data. Through its unique approach of managing storage based on identity, Storage Manager automates the management of file system storage by bridging the gap between users' identities, their roles in the organization and their storage resources.

Novell Storage Manager introduces management to unmanaged network storage systems, and in the process it automates the entire storage management lifecycle, while giving organizations control and visibility of their storage infrastructure. It automates a comprehensive set of storage management tasks that allocate, share, move, resize, groom, clean up, and archive user and collaborative storage based on user identities, policies and events in the directory. Furthermore, Storage Manager is easy to implement and doesn't change the way users work. It seamlessly and transparently works with, not against, an organization's unstructured storage environment, bringing unstructured data under control. Through its identity and policy-based state machine architecture, Novell Storage Manager enables organizations to reduce costs, enhance data security, improve productivity and achieve regulatory compliance. Novell Storage Manager:

- _Automates the consistent enforcement of storage policies_

- *Accelerates storage provisioning and de-provisioning*
- *Eliminates redundant administration tasks*
- *Reduces helpdesk burdens*
- *Simplifies the ability to meet audit and regulatory requirements*
- *Facilitates team collaboration*
- *Reduces storage management complexity*

Storage Management Lifecycle Automation

Novell Storage Manager moves user and collaborative network storage from an unmanaged state to a managed state. From user and group storage provisioning to archiving and disposition, Storage Manager leverages identity, policy and directory events to automate the full lifecycle management of user and group storage.

New and existing users are provisioned storage based on their identity or role in the organization. Such provisioning includes allocating user storage in the proper location with the appropriate quotas, and appropriate rights. When users change roles, Novell Storage Manager can automatically change those storage allocations based on policy. As users change from one department to another, Storage Manager can transparently move their storage to the appropriate location associated with their new role. If a user changes his or her name, and that user object is renamed in the directory, Storage Manager can automatically rename the user's storage folders and make sure the directory attributes are properly preserved.

Novell Storage Manager also provides data scrubbing, grooming and vaulting capabilities.

Policies can be created that automatically move, clean up or archive files based on access, type, age or size. For example, zip files over 25 MB that haven't been accessed for more than a year could be moved to storage vaults located on less expensive hardware.

Additionally, when users leave an organization and are deleted from the directory, the policies in Novell Storage Manager can be configured to do a variety of different things to properly handle the deprovisioning of those users' storage. This might include automatically vaulting storage, deferring the clean up of storage for a set number of days, or queuing the storage to a specified manager or administrator. For organizations that do not immediately delete departing users, Storage Manager allows them to create inactive user policies. With such policies, the solution can automatically move inactive users' storage to another location, as well as remove their access rights to that storage.

State Machine Architecture

Built on a state machine architecture, at the heart of Novell Storage Manager is its policy engine driven by identity and events that happen in the directory. The following key components comprise its identity and policy-driven state machine architecture:

- *Directory services*
- *Storage policies*
- *Novell Storage Manager event monitors*
- *Novell Storage Manager policy engine*
- *Novell Storage Manager agents*
- *Action objects*

As users change from one department to another, Storage Manager can transparently move their storage to the appropriate location associated with their new role.

Figure 1. *Event Monitors capture directory events, sends them to the Engine where actions are initiated, and then sends them on to the Agents to perform additional actions.*

Directory Services

Novell Storage Manager ties together the directory, identity and file systems to enable organizations to ensure that storage resources allocated t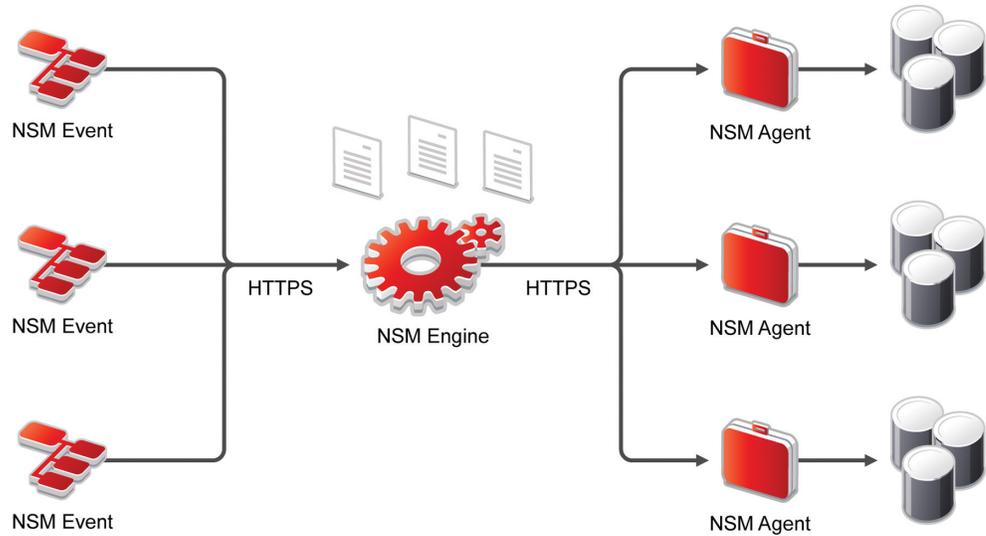o users are always aligned with corporate storage policy. By leveraging the identities stored in directory services, Storage Manager dynamically manages and provisions storage based on user and group events that occur in the directory, including user creations, group assignments, moves, renames and more. In other words, when a change happens in the directory that affects a user's storage needs or user storage policy, Storage Manager automatically makes the necessary changes at the file system level to address those storage needs or policies.

Storage Policies

Novell Storage Manager eliminates the hassle of managing user and collaborative storage on network file systems. Instead, organizations focus on managing and maintaining storage policies for their users and

groups. The solution extends the directory schema to include storage policies that dictate the actions to be taken when certain directory events occur. Policies leverage load-balancing algorithms to determine target file system storage locations for provisioning storage. After a given piece of storage is provisioned, appropriate user and group file system rights for that storage are granted. Policies can also be created for storage cleanup, quotas, grooming, moves, renames and more. Policies can be assigned specifically to users, groups and container objects, with the standard directory services inheritance model governing usage.

Policy Engine

The Novell Storage Manager policy engine manipulates file systems on network storage to set aside both user storage and collaborative storage according to policies defined by an organization. It accomplishes this by acting on directory event notifications that it receives from the Storage Manager event monitors.

When the policy engine receives notification that a directory event has occurred, it refers to the policy associated with the object affected by that event. This will determine what actions need to be executed to carry out that policy and when these actions should be executed. For example, a user creation event might stipulate that a home directory associated with the user's name be created on a specific volume on a specific storage area network, all based on the role of that user within the organization. While the policy engine initiates and governs what actions need to take place, it actually leverages Novell Storage Manager agents to carry out the bulk of the work to be performed.

Event Monitors

Through its global event system, Novell Storage Manager captures specific events that happen in the directory to determine if certain storage-related actions need to be executed. The global event system is typically comprised of a few event monitors deployed throughout the enterprise, monitoring a small set of directory events that effect storage policy, such as user or group creations, moves, renames and deletions. When these directory events occur, the event monitors notify the Storage Manager policy engine so it can initiate the appropriate actions.

Event monitors in Novell Storage Manager have a very small footprint. Also, since they only monitor for a very specific set of directory events, they have very little, if any, impact on system resources.

Agents

As mentioned previously, when a directory event occurs that affects storage policy, under the direction of the policy engine, Novell Storage Manager agents (formerly known as Sentinels) carry out the actual work dictated by that policy. Similar to an orchestra conductor, the policy engine directs the work carried out by the agents deployed on an organization's geographically distributed servers.

Agents eliminate the need for the policy engine to do all the file copy work centrally. This allows it to optimize efficiency through workload balancing and reducing system traffic. For example, agents are extremely beneficial in WAN environments. They can be deployed on servers at remote locations, allowing all of the storage copy work to be performed at the remote site server and reducing WAN traffic.

Action Objects

Novell Storage Manager action objects give organizations the ability to go beyond the canned constructs of Storage Manager policies, enabling them to work with events and objects not connected to Storage Manager policies. Action objects offer a set of interfaces that enable organizations to automate specific file system actions in coordination with other eDirectory management activities such as those initiated via Novell iManager, LDAP or Novell Identity Manager. For example, action objects can work as an extension of the approval processes or role-based provisioning into an organization's workflows. Action objects are an ideal way to provide exception-based access or quota management to storage folders in a secure manner.

How Novell Storage Manager Works

At a high level, the inner-workings of Novell Storage Manager can be summed up by simply stating that when a directory event of a user or group object occurs, Storage Manager applies the defined policy for that event, appropriately provisioning and managing the storage for that user or group. The following sections explain some of the details of how the solution works in certain scenarios.

Novell Storage Manager action objects give organizations the ability to go beyond the canned constructs of Storage Manager policies, enabling them to work with events and objects not connected to Storage Manager policies.

User Creation

Suppose the sales department in New York hires a new employee named Brian Smith. A user object for Brian Smith is created in a directory container called SALES.NY. When that user object is created, the Novell Storage Manager event monitors capture that creation event and send it to the policy engine. The Storage Manager policy engine looks to see if an associated storage policy exists for the user object created in the SALES.NY container. When it finds the policy, it determines that a home directory with a 200 MB quota needs to be created for the user on the OESLX-NY-SALES server (based on Novell Open Enterprise Server) located at the New York office. The policy also specifies the rights and file path for that home directory.

The engine provisions the home directory for the user according to the attributes defined in the policy. As a result, a home directory with a 200 MB quota is created for Brian Smith on OESLX-NY-SALES with the file path vol1:\users\BSMITH.

User Role Changes

If the user, Brian Smith, changes roles by transferring from the sales department to the marketing department, Novell Storage Manager handles the necessary changes to his storage resources automatically and transparently. When Brian Smith is reassigned from the SALES.NY container in the directory to the MKTG.NY container, the event monitors see this event and pass it on to the policy engine. Once again, the policy engine checks to see if an associated storage policy exists for the user object being moved to the MKTG.NY container. The policy associated with the MKTG-ATL container will now dictate what operations need to be carried out to successfully handle the transition of the user's role change.

In this instance, the policy might dictate that users in the MKTG.NY container should have a home directory with a 150 MB quota limit on the servers—based on Novell Open Enterprise Server—used by marketing in the Atlanta office. In this instance, the policy engine will orchestrate the actions of the Novell Storage Manager agents, delegating the necessary actions to the agent running on the server in Atlanta.

However, the policy will first determine when the work needs to happen. Policy might dictate that all such operations should only occur between 3 a.m. and 6 a.m. in order to minimize impact on users, as well as to ensure no conflicts with nightly backup operations. When the operation begins, the policy will leverage load-balancing algorithms in Novell Storage Manager to determine which of the marketing servers should host Brian Smith's new home directory. The engine then creates the new home directory on the new server.

Once the engine has verified that no conditions exist that could adversely affect the movement of files from the old home directory to the new home directory (i.e., open files, user logged in, etc.), it will block user access to the old directory and temporarily change the name. Next, the engine will send a command to the agent to copy the data from the old home directory location to the new home directory location.

Even if the data in Brian Smith's old home directory exceeds the new 150 MB quota limit, the quota preservation capabilities in Novell Storage Manager will allow all of that data to be copied to the new home directory. However, once all the new data is copied, all the file system attributes for the new policy will be applied, including the 150 MB quota attribute. This means that even though all of Brian Smith's data will be in his new home directory, he won't be able to add more data until he either gets a quota increase or he deletes enough files to bring it in line with marketing's quota limits.

Once all the data is successfully copied from the user's old home directory to the new home directory, the old home directory will be deleted. Finally, when Brian Smith logs in the next morning, he'll be able to access all of his data as before, and will likely not even be aware that it has moved to a new server.

Benefits of State Machine Architecture

The logic built into Novell Storage Manager state machine architecture ensures that policies will be applied successfully and correctly even if steps within the process are interrupted. The internal transactional state machine architecture enables the engine to properly deal with transient waits with directory synchronization issues. It also allows recovery from virtually any failure involving network communications, a target server or a server running a component of Storage Manager—including the policy engine itself. So, if a failure or interruption occurs at any point during operation, Storage Manager will be able to successfully continue the operation from where it was when the interruption occurred.

Each transaction consists of a series of steps or states. The engine contains a process queue that is backed by the file system of the local server. Each transaction on the process queue contains the state or progress of a given transaction. If a situation occurs that holds up completion of a particular transaction, the engine will move on to the next transaction in the list. When it comes back around to the transaction that experienced the delay, its processing will continue. The process queue is rebuilt from the file system each time the engine is restarted.

Additionally, even before initiating a process, the policy engine will perform a variety of checks to make sure it's okay to proceed. For example, when moving a user's home

directory, it will determine if the user is currently logged in or if any of the files in the user's home directory are open. If any of the checks determine that the process needs to be put on hold, the event will be queued up as a pending operation to be initiated at a later time. Once the engine determines that the operation can proceed, it will move through the process to successful completion in a step-by-step manner so that the state of each step can be returned to if needed.

Essentially, the state machine architecture in Novell Storage Manager has been designed so that policies will be successfully applied regardless of unforeseen interruptions to their execution.

Deploying Novell Storage Manager

The wizard-driven and straightforward graphical interface of the Novell Storage Manager installation makes it easy to deploy. A typical installation can usually be performed in ten minutes or less. Still, there are certain aspects of this process that organizations should consider as part of their deployment preparation.

Engine Deployment

The Novell Storage Manager policy engine is very efficient and generally does not require a dedicated server, even in very large environments. The engine can be deployed on a NetWare® 6.5 server or as a NetWare virtual machine on a Linux* server.

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Through validation and consolidation processes, the Novell Storage Manager global directory event system is able to handle these spurious and multiple instance events appropriately

Agent Deployment

Organizations can deploy agents on all of their servers, or they can have a single agent be responsible for the storage management workload of multiple servers. The Novell Storage Manager engine uses agents to sculpt and minimize an organization's file system operation traffic by determining which agents should copy data for which servers.

To prevent unnecessary movement of data over WAN links, organizations should deploy at least one Novell Storage Manager agent at each of their geographically diverse locations. This enables local agents to perform their workload closer to where the actual work takes place, such as within the server where the agent resides or other local servers on the LAN.

Even though a single Novell Storage Manager agent can provision and allocate storage resources for multiple servers (acting as a management proxy for those servers) organizations might want to distribute the workload by deploying agents on all of its servers, since agents utilize no processing power when idle and marginal processing power when active. However, agents can only be deployed on servers running either Novell Open Enterprise Server 2 Linux SP1 (or later) or NetWare 6.5 SP7 (or later). Agents running on supported servers can act as proxies for servers running earlier versions of NetWare or Open Enterprise Server Linux.

It should be noted that an agent running on a Linux server can act as proxy for a NetWare server, and vice versa. Having a Linux agent proxy for a NetWare server can be quite helpful if the NetWare server has any files 4 GB or larger in size. This is because the Linux agent is able to handle moves for such large files, while the 32-bit agent for NetWare would not be able to do so.

Event Monitor Deployment

Due to the nature of directory systems in enterprise environments with multiple directory replicas, both multiple instances and spurious directory events of a single directory event often surface in individual directory replicas. Through validation and consolidation processes, the Novell Storage Manager global directory event system is able to handle these spurious and multiple instance events appropriately.

The global event monitoring system in Novell Storage Manager also knows how to reconcile both spurious events and multiple instances of the same event, ensuring that it only takes action when appropriate. To ensure the proper performance of the global event monitoring system, Storage Manager event monitors should be deployed on at least two servers in each directory replica ring. Event monitors can be deployed on NetWare 6.5 SP7, Novell Open Enterprise Server 2, or SUSE® Linux Enterprise Server 10 SP1 or later.

File Systems

Novell Storage Manager seamlessly manages storage resources on NSS volumes on both Novell Open Enterprise Server and NetWare, as well as Ext3 and Reiser file systems on Open Enterprise Server. Even though different file systems have different advantages and disadvantages, Storage Manager understands how to work with the unique capabilities and limitations of individual file systems. For example, a storage policy may be configured to manage directory quotas, but if the policy's target volume does not support directory quotas (Ext3 and Reiser) Novell Storage Manager will not try to provision quota.

What's New in Novell Storage Manager 2.5

Novell introduced a broad array of enhancements to Novell Storage Manager 2.5 to specifically address exponential storage growth, regulatory compliance and customer requested enhancements. The following represents the major new features added to this version of the solution:

- *Enhanced management interface*
- *Collaborative storage enhancements*
- *Anomaly reports*
- *Quota preservation*
- *Action objects*
- *Auxiliary storage*
- *Graphical analysis and reporting*

Enhanced Management Interface

Novell Storage Manager 2.5 features a fresh new administrative interface that is more intuitive and easier to use. Tasks that previously required administrators to wade several layers deep into the menu system have been raised closer to the surface of the interface for quick and easy access. In a single form, administrators can perform operations that used to take multiple steps. Quick access tabs allow administrators to place and access their most frequently used management options in the new Quick Access toolbar. Additionally, icons and dialogs have all been updated with fresher and more intuitive appearances.

Collaborative Storage Enhancements

While Novell Storage Manager has long enabled the creation of collaborative storage areas for members of an organizational unit (OU), the process required many steps. These steps included creating a group object, adding all users in the OU to the group and then creating the policy for creating the group storage. Novell Storage Manager 2.5 greatly simplifies the provisioning and management of collaborative storage, by allowing administrators to create collaborative storage based on the OU object itself.

Once a policy has been created for the OU, the administrator can perform a backfill operation to provision existing users into the collaborative storage area, where they can collaborate—with policy-defined rights—among all members of the OU.

File vaulting and grooming capabilities have also been extended to collaborative storage in this version of Novell Storage Manager. When administrators set collaborative storage vaulting policies for aged files and file types in violation of the company's network storage policy, these files can be moved from collaborative storage to a vault location or simply deleted—just like with user file vaulting and grooming.

The new migration capabilities for collaborative storage in this release can be leveraged to facilitate server consolidation efforts. By simply changing the collaborative storage policy and location path, the collaborative storage can be automatically migrated to a new hardware device.

Anomaly Reports

Over time, a variety of different anomalies make their way into enterprises' vast network of storage systems. Even though these anomalies often remain hidden from view for long periods of time, they can consume valuable storage space or create administrative nightmares that are difficult to pinpoint and resolve. One of the most common of these anomalies is orphaned home directories, which are home directories of users that no longer exist in the organization, but for some reason still have existing directories and files.

The anomaly reports in Novell Storage Manager make it easy to find and properly deal with these orphaned directories. And the solution includes reports for discovering other anomalies as well, including the following:

- *Name mismatch*
- *Objects not cataloged*

Novell Storage Manager 2.5 features a fresh new administrative interface that is more intuitive and easier to use.

Auxiliary storage in Novell Storage Manager enables organizations to manage multiple pieces of discrete storage for an object throughout the entire lifecycle of that object.

- *Orphan candidates*
- *Missing home directories*
- *Path cross-talk*
- *Missing auxiliary storage*
- *Duplicate storage pointer*

Additionally, Novell Storage Manager includes a janitor process that collects information used in the anomaly reports, as well as its global statistics reports.

Quota Preservation

The new quota preservation capabilities in Novell Storage Manager enable users to retain their previous storage quota allowances according to policy when their storage resources are moved to a new location.

Action Objects

Action objects enable organizations to extend Novell Storage Manager beyond its standard policies, enabling them to automate specific file system actions through a set of interfaces and by working in coordination with Novell iManager, LDAP or Novell Identity Manager.

Auxiliary Storage

Auxiliary storage in Novell Storage Manager enables organizations to manage multiple pieces of discrete storage for an object throughout the entire lifecycle of that object. In previous versions of Storage Manager, only one-to-one relationships existed between users and their storage. In other words, a user would essentially have a single home directory and a primary policy associated with that user and home directory. Auxiliary storage enables organizations to provision and manage multiple pieces of storage for individual users, creating one-to-many relationships.

For example, the sales department in an organization might have a primary policy

that dictates how to provision and manage changes for the home directories of all the salespeople. Separate auxiliary storage policies can be attached to that primary policy that governs the provisioning and management of multiple additional pieces of storage associated with its users.

Auxiliary storage is governed by different policies than the primary policy for user storage. Administrators have significant flexibility in how auxiliary storage can be provisioned and managed. For example, the attribute settings for target paths, grooming, clean up and rights can be unique to each auxiliary storage policy. Depending on policy settings, some auxiliary storage might be read-only, inaccessible or even invisible to users, or the storage maybe used by applications. Auxiliary storage opens up a whole new range of possibilities on how to use network storage and have these resources fully managed by identity-driven policies.

Here are just a few examples of how auxiliary storage folders might be used:

- **HR folder created for each employee.** *Only the HR department has access; individual employees have no access to the folder, and the folder can be archived when employees leave the organization.*
- **Application folder.** *The application has full access rights, but the user has read-only access rights, and the application folder must move whenever the user relocates or be deleted when the employee is deprovisioned.*
- **Student record folder maintained for each student.** *The student has limited access rights, and the folder needs to be maintained throughout the student's lifecycle, including being moved to an archive location when the student graduates.*

Storage Management Analysis and Reporting

In addition to the anomaly reports that have already been discussed, Novell Storage Manager has an array of reports that enhance organizations' abilities to analyze and manage their storage resources. These reports include the following:

- **Consistency check reports.** *Facilitate the discovery and remediation of existing problems with user storage.*
- **Action reports.** *Provides the results of any action operation.*
- **Runtime config.** *Used to build reports on the current configuration and processing taking place in the policy engine.*
- **Event statistics.** *Provides a daily view of the event statistics tracked on the engine console, including user and group add, delete, deferred delete, rename, user move and user set policy.*
- **Volume statistics.** *Lists all the paths in use by Novell Storage Manager policies, and reports on volume space, space in use and space available with a graphical indication of where space is getting low.*
- **Global statistics.** *Provides a graphical view of the current state of an organization's storage, configurable to report on specific servers, volumes, paths, user storage, collaborative storage or auxiliary storage.*
- **Object properties.** *Performs an analysis and displays details about the selected object. The properties will only display if the object is in the Novell Storage Manager database.*
- **Path analysis.** *The path analysis feature allows administrators to browse down a file path from any server and volume to a particular folder and perform an analysis such as quota, file types and rights analysis.*
- **Quota.** *This option shows the quota set for the folder.*

One of the most powerful aspects of Novell Storage Manager is its ability to help organizations quickly bring their unstructured data storage under control and into compliance with corporate, industry and government regulations.

- **File types.** *This option shows file types that are being stored in a folder and all subfolders based on file extension. For example, by selecting a home folder, an administrator can easily see how many .MP3, .MOV, .JPG or other file types the user has stored in the directory.*
- **Trustee security analysis.** *Performs a rights analysis on any file or directory on the network. The tool enumerates all users and objects that have any type of rights to the given file or directory and tells you how the user got those rights. This includes file system trustee assignments or eDirectory object trustee assignments, including so-called "backdoor" rights assignments that filter through eDirectory into the file system.*

Use Case Scenarios

Bringing Storage under Control and into Compliance

One of the most powerful aspects of Novell Storage Manager is its ability to help organizations quickly bring their unstructured data storage under control and into compliance with corporate, industry and government regulations. One of the first steps to accomplishing this is to run its consistency check report. The consistency check enables organizations to get a better understanding of the current state of their storage.

Novell Storage Manager has an array of reports that enhance organizations' abilities to analyze and manage their storage resources.

Novell Storage Manager has built-in safeguards to ensure the fault tolerance of all of its storage management operations, including data moves.

Novell Storage Manager also provides scheduling capabilities to ensure user productivity is not negatively impacted during a migration.

With this understanding, organizations then have a reference point that can help them determine the types of storage policies they should create to govern what happens when new users come onboard, move to another location or leave the organization. Policies can address a wide range of compliance concerns, including appropriate access rights, protection of sensitive data, cleaning up inappropriate file types, vaulting or archival of aging data and more. With the policies in place, the organization can run action operations that will leverage these policies to bring existing users and their associated storage into compliance with policy. Finally, the organization can run consistency check reports that can demonstrate that they are compliant.

With existing user, group and collaborative storage in compliance, and policies in place to govern an organization's storage management lifecycle, Novell Storage Manager can help ensure that an organization stays in compliance and their unstructured data stays under control. And, since Storage Manager ties storage policy to user and group-based identity and roles, organizations have greater power and ability to consistently and automatically address their compliance requirements for their storage resources.

Data Migration

Even though many organizations want to take advantage of the benefits of migrating data to higher performing storage hardware, including SANs, many hesitate due to the challenges involved with such efforts. Great measures must be taken to ensure during a move that files are not open, that files cannot be accessed and that users are not logged in at the time. Disaster recovery safeguards must also be in place in case a server crashes or a network fault occurs during the migration process. Additionally, such migrations should have minimal impact on user productivity.

In addition to bringing unstructured data to a managed state, Novell Storage Manager can also be leveraged to address all these data migration concerns, while streamlining, automating and simplifying the overall data migration process. Moving data from older storage to higher performing storage is nearly as simple as changing the target path properties of a policy in Storage Manager and executing an action operation to carry out the move.

Novell Storage Manager has built-in safeguards to ensure the fault tolerance of all of its storage management operations, including data moves. Its state machine architecture keeps track of the progress of all storage operations, providing complete protection during a data migration, enabling interrupted operations to be restored to their last known good state once the system is restarted.

Novell Storage Manager also provides scheduling capabilities to ensure user productivity is not negatively impacted during a migration. In fact, it allows data migration efforts to be carried out in a manner completely unobtrusive and transparent to users.

Server Consolidation and Data Migration to Higher Performing Hardware

An example of a typical data migration scenario might be to move all of an organization's user home directories from eight older NetWare 6.5 servers to four new Linux servers running Novell Open Enterprise Server on the latest 64-bit hardware. To do this, the administrator first creates a Novell Storage Manager policy that points to the four Linux servers. That policy would then be assigned to the containers holding the user objects. Finally, an action operation would be performed against the containers using an "enforce path" option. This option analyzes the location of each user's home directory. If it finds that the directory is not in a location pointed to by the applicable policy, the data is automatically moved to the location specified by the policy.

As a result, all users' home directories will be moved from the NetWare servers and load balanced across the four Linux servers. All trustee assignments and file system attributes will be moved seamlessly. The administrator can even define a schedule for the migration so that network and server performance will not be affected during normal business hours.

Migration of Student Data

Another data migration scenario, which can apply to public education school districts, is providing network disk storage for all students in a district. This storage is always available to the students as they move from elementary school to middle school and finally to high school. While Novell Storage Manager can facilitate this type of data migration in a number of ways, one method involves creating a hierarchy in the directory so each school is represented by its own container. The district would then have a storage policy assigned to each school container.

User objects for each student would then be created in the appropriate container based on the school. When students move from elementary school to middle school, their user objects are reassigned from the elementary school container to the middle school container, and their home directories and data automatically move to the middle school server according to policy. The same process occurs with moves from middle school to high school.

This implementation would even provide seamless data migration for students moving within the district to another school of the same grade level. Once again, the students' user objects would simply need to be assigned to the appropriate school container, and the students' home directory and data would automatically move to that school's server.

Bringing Unstructured Data under Control

With the exponential growth of unstructured data projected to increase at an even faster rate, organizations need to bring structure and management to their network storage more than ever before. Novell Storage Manager delivers on this need by bridging the gap between user identities, user roles and user storage resources. As the only solution on the market today that provides automated user and collaborative storage management through directory-based identity and policy, Storage Manager automates the entire storage management lifecycle from folder creation, to data migration, to folder archiving or deletion.

Novell Storage Manager provides management and structure to previously unmanaged and unstructured network storage systems. Through its identity- and policy-based state machine architecture, Novell Storage Manager enables organizations to reduce costs, enhance data security, improve productivity and achieve regulatory compliance in relation to their storage management efforts.

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