

NDS eDirectory Technical White Paper

Introduction

NDS eDirectory is a full-service, platform-independent directory that serves as the foundation for myriad directory-enabled services. The number of directory-based applications is rapidly increasing, many of which provide crucial e-business functionality such as automated business-relationship management, supply-chain management, and electronic store fronts. In this new e-business environment, "one of the biggest impediments...is that there is no way to easily share data across applications from multiple providers. But by making use of eDirectory, multiple application service providers (ASPs) have a common infrastructure for identifying users and storing components" ("Major Vendors Converge on New ASP Model," InfoWorld, Nov. 22, 1999). ASPs are not the only companies leveraging eDirectory: Internet service providers (ISPs), software developers, and other companies that aggressively compete in the Internet economy have made eDirectory their directory of choice, including Alta Vista, BroadVision, Business Layers, CNN, Gadzoox Networks, Lucent Technologies, Oblix, PeopleSoft, Red Hat, Sun Microsystems, and Xircom.

Other services that directory-enabled products can provide include automated provisioning, enhanced security, customer profiling, electronic wallets, automated notification systems, customized Web interfaces, and virtual private networks (VPNs). eDirectory also forms the foundation for several Novell solutions such as Certificate Server, digitalme, eGuide, iChain, MyRealBox, Net Publisher, and Single Sign-on.

A recent report by the Aberdeen Group emphasizes that "today's directory must at least be extensible (able to maintain in-depth, hierarchically linked information about a range of 'objects'—people, devices, applications, resources, and services); portable (able to work with multiple operating systems and applications); and scalable (able to maintain information on thousands of objects in the same directory)" ("Directory-Guided IT: A Planning Manifesto," Feb. 5, 1999). NDS eDirectory meets the first two criteria exactly and it far exceeds the third. Its extensible schema and hierarchical tree structure allow you to include and manage nearly any type of object, its native Lightweight Directory Access Protocol (LDAP) support guarantees compatibility with other LDAP-based applications, and it scales to not only thousands of objects but to more than one billion.

Originally built for NetWare, this latest version of Novell Directory Services (NDS) powers e-businesses running on Windows 2000, Windows NT, and Solaris networks, and support for Linux and Compaq Tru64 Unix is planned for 2000. The advantages of providing your network with robust, scalable directory

services, though already tremendous today, will only increase exponentially as demand for e-business functionality grows and vendors create solutions to fill it.

Benefits

- Enjoy the most fully developed and powerful directory service available
- Lay the foundation for electronic commerce
- Deploy directory-enabled applications
- Access resources with a single login
- Share directory resources with business partners
- Scale to any size directory
- Keep your network resources secure
- Protect your current investment in hardware and software
- Reduce the cost of network computing
- Enjoy superior schema flexibility
- Support open standards
- Easily manage your directory
- Easily customize your directory to reflect your organization
- Use easy and fast application-development tools

Enjoy the Most Fully Developed and Powerful Directory Service Available

NDS has been in development for more than a decade, during more than half of which people have repeatedly proven its value. By far the most widely developed directory service in the world and employed by more than 80 million users to access the services on their networks, NDS eDirectory is flexible, extensible, and powerful enough to be the directory for global networks. Many of the world's most successful companies from every business sector use it as the backbone of their networking operations. Alta Vista recently selected eDirectory as the foundation for its instant messaging services, and National Public Radio, CNN, and British Telecommunications have all chosen to use NDS to directory-enable their networks.

Lay the Foundation for Electronic Commerce

NDS eDirectory is the only directory that eliminates the barrier between Internet, intranet, and extranet resources. You can gain control of critical e-business processes by extending the reach of your existing infrastructure to your employees, customers, and supply-chain partners.

Other Novell technologies are built using eDirectory as the fundamental architecture, including Certificate Server, digitalme, eGuide, iChain, MyRealBox, Net Publisher, and Single Sign-on. With digitalme, for example, customers can compile their personal information—such as user IDs, passwords, and credit card numbers—into one "digital wallet," thereby simplifying Web transactions and

making them more secure. (See the digitalme home page at <http://www.digitalme.com>.) Novell Net Publisher distributes control of Web-page content to ensure changes are made to Web sites quickly and efficiently, even by those who do not know HTML. Certificate Server helps decrease the security hurdles encountered when joining customers, suppliers, and partners into a seamless network. (See the Novell Net Publisher and Novell Certificate Server product descriptions.)

Deploy Directory-Enabled Applications

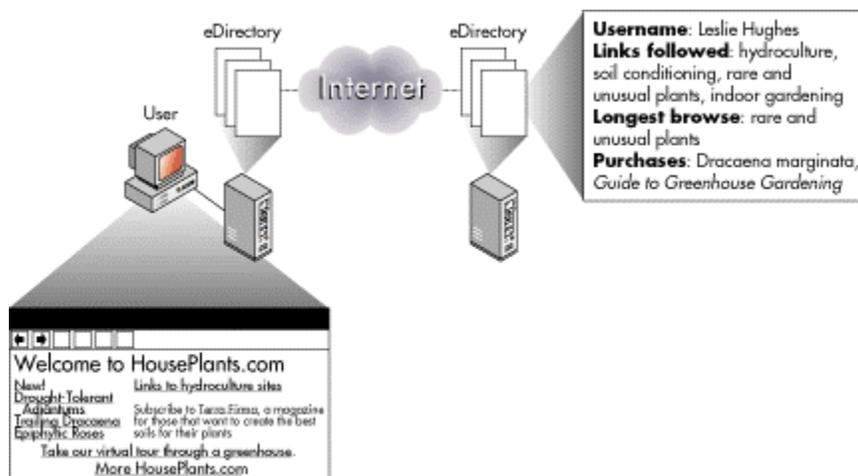
With eDirectory you can take advantage of directory-enabled applications that transform your traditional "brick and mortar" business into a thriving "click and mortar" e-business. The following are a few advantages available to directory-enabled e-businesses:

Customer Profiling

As customers browse through your Web site, directory-enabled applications can collect three important kinds of data: observed information—what users reveal through their patterns of movement through the site; stated information—gathered from on-line surveys and profiles; and transactional information—purchase patterns, etc. With this information stored in eDirectory, you can tailor your offerings and services to each customer and supply-chain partner, thereby improving their business experience with you.

Figure 1 shows how to apply profile information to customize how a customer sees your Web site. If a user named Leslie Hughes enters the Web site HousePlants.com and begins to browse, special applications record where she goes, what she does, and how long she stays on each page. This information is then stored in eDirectory, where an application can retrieve it to create a personalized Web page. Next time Leslie calls up HousePlants.com, your Web page's presentation emphasizes those elements in which she is most interested.

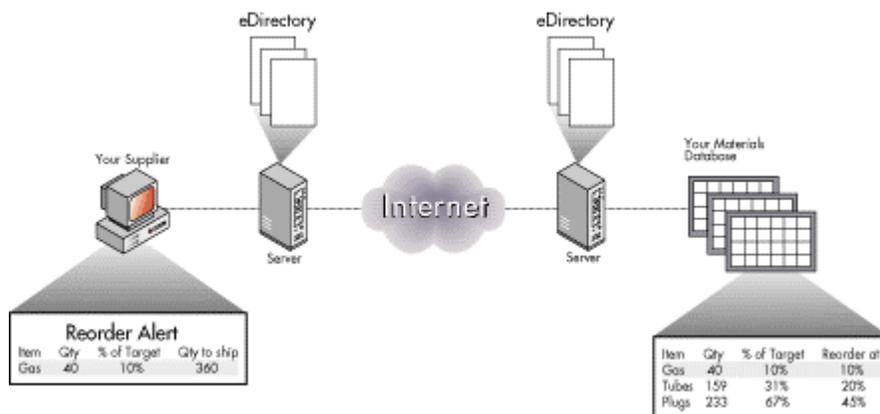
Figure 1: eDirectory can store information used for customer profiling.



Supply-Chain Management

Figure 2 shows how you can improve communication between your business, your customers, and your suppliers. If you manufacture fluorescent lights for construction wholesalers, you need to ship the right number of lights at the right time while at the same time maintain an adequate supply of glass tubing, gas, and electrical components for your own manufacturing processes. With eDirectory-enabled software you can grant your suppliers access to your materials inventory database so that they will know instantaneously when your supplies are low and how much you require. At the same time, you can link to your customers' inventory databases to stay on top of their requirements. Because of eDirectory's superior security protocols, you will not need to worry that your suppliers get access to more information than they need, nor will your customers need to grant you rights to more than what you require.

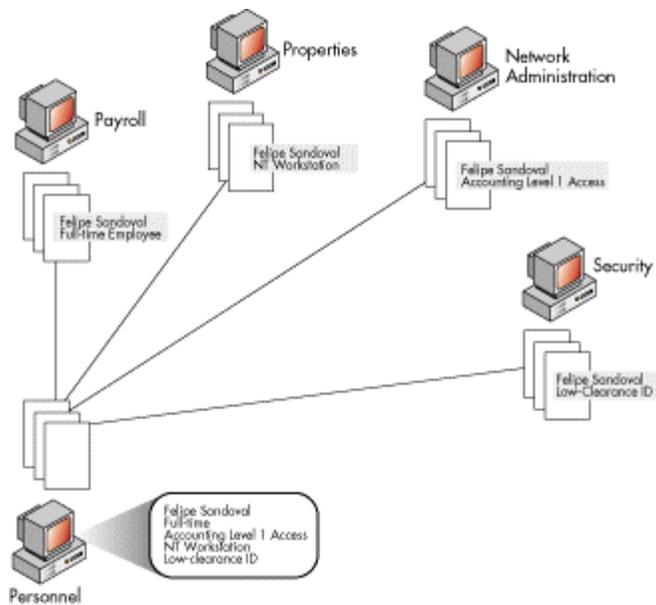
Figure 2: A notification system can automatically alert your supplier when you need another shipment.



Automated Provisioning

When a new employee is hired at your company, that employee's first few hours—or days—are occupied primarily with getting things set up: the office or cubicle, hardware and software, ID card, network passwords, network rights assignments, voice and e-mail accounts, payroll, etc. Getting this new employee's provisions together can be complicated and time consuming, and it is not unusual for some of the provisioning to fall through the cracks. Figure 3 shows how you can automate the provisioning process using directory-enabled software: the employee's data is entered in one central location and is then transmitted to the relevant departments. You can therefore have everything ready for that new employee when he or she walks in the door the first day. And when someone leaves the company, you can revoke all accounts, network rights, and passwords as easily as they were created.

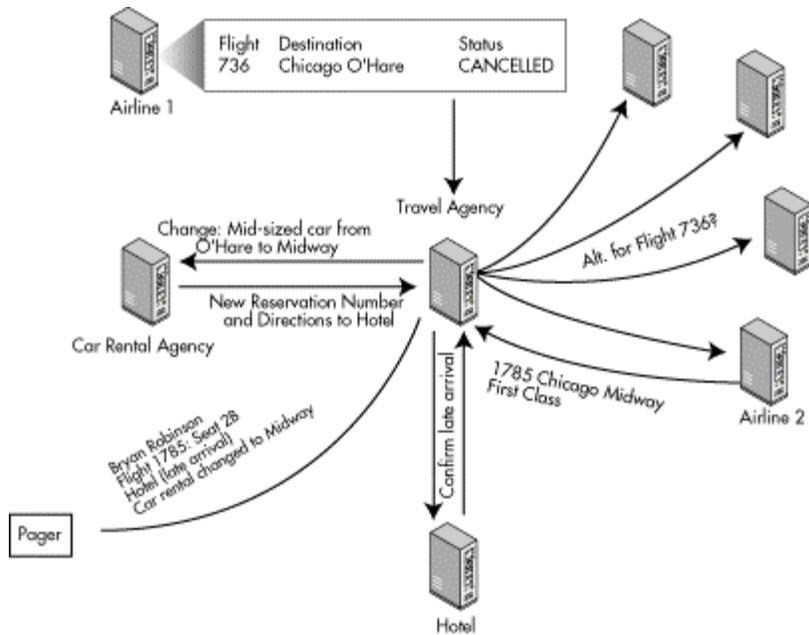
Figure 3: Provisioning software relies on directory technology to send the right information to the right place.



Accelerated Business Processes

One of the most significant properties of eDirectory is that it can automatically update directories on other companies' networks. Figure 4 shows how this feature can accelerate complex business processes. For example, Passenger Bryan Robinson is going to Chicago on business. He is scheduled to depart on Flight 736 out of Salt Lake City. He has a reservation at a Hotel near downtown Chicago, and he will be renting a mid-sized car. Unbeknownst to him, Flight 736 has been cancelled due to foggy conditions at O'Hare—a fact he will not know until he arrives at the airport. A call to his travel agent sets the wheels in motion to change his itinerary, but given that everyone flying into O'Hare also needs a reassignment, his agent is likely to get more busy signals than results. Mr. Robinson resigns himself to a long wait and possibly a missed meeting.

Figure 4: A passenger's cancelled flight can be easily and quickly rescheduled with directory-enabled software.



Now rewind the scenario and play it again, this time with directory-enabled networks in place. When flight status on Flight 736 is updated to "cancelled," the reservation service automatically notifies Mr. Robinson's travel agency's computer, which immediately queries other airline directories for an alternative flight. Another airline reservation system indicates that Flight 1785, which goes to fog-free Midway airport, has seats available. Because the directory at the second airline lists Mr. Robinson as a platinum frequent-flyer passenger, he gets first-class seating. With the flight information updated, the travel agency service contacts the car rental agency's computer, transfers Mr. Robinson's reservation for a mid-sized car from O'Hare to Midway, and draws up new directions to the hotel with a reading from a global positioning satellite. The service at the travel agency simultaneously updates Mr. Robinson's record in the hotel's directory to show late arrival. As soon as Mr. Robinson's new itinerary has been fully updated, the new information is sent to his pager while he is en route to the airport. Instead of frustration and inconvenience from the cancelled flight, there is no waiting, no hassle, and no missed meeting.

Directory-Enabled Applications

The following is a brief list of products that leverage eDirectory:

- Automated Provisioning—Business Layers eProvision Employees, Oblix Service Center
- Customized Web Sites—Bowstreet Web Automation Factory, BroadVision One-to-One Enterprise, enCommerce getAccess, Eprise Participant Server
- Supply-Chain Management—Netfish XDI system, webMethods B2B Product Suite

- E-Commerce—BroadVision One-to-One Commerce, TRADE'x Distributor, Verix eSales
- Dynamic Document Publication—Novell Net Publisher, Eprise Participant Server, JetForm product family, NetObjects Authoring Server Suite, Oblix Publisher
- User Management Systems—SiteMinder by Netegrity
- Network Management Systems—Novell ZENwork, Network Associates Zero Administration Client Suite
- Virtual Private Networks—Indus River Networks RiverWorks Enterprise VPN
- Sharable Address Books—Nexal NexCard
- Enterprise Work Management—Novell GroupWise®, Metastorm e-work
- Network Traffic Prioritization—Lucent Technologies RealNet Rules, Nortel Networks Optivity Policy Services

Access Resources with a Single Login

Because of eDirectory's powerful authentication services, your customers and partners will not need to log in more than once to access resources on your network. For example, when users at your supplier's company log in to their own network via eDirectory, they will not need to log in again when accessing those parts of your directory to which they have rights.

Share Directory Resources with Business Partners

NDS eDirectory uses standard X.500 naming to define the hierarchically located objects within the directory tree. This naming scheme establishes a common “root” where all names can be resolved. It also establishes a management domain where administrators can assign access permissions to objects in the hierarchy to other objects in the hierarchy thereby creating the valuable object relationships.

In addition to supporting the X.500 naming model, NDS eDirectory also supports the Internet namespace, DNS or Domain Name Service. DNS is the mechanism that Internet entities including servers, users, web pages, and others use to uniquely identify themselves. Support for DNS naming within NDS means that NDS objects can share the same namespace with Internet entities which makes them Internet entities too.

Because of support for DNS naming within NDS, the common namespace “root” used to resolve names resides with DNS rather than a specific NDS tree. This means that different NDS trees can use this namespace to resolve the names of NDS objects that reside in different trees. The result of this capability is the ability to assign trustee rights and access control permissions to objects residing in different trees, thereby *federating* NDS trees without having to merge the objects into a single tree.

Granting rights to objects in one tree to entities in a second tree means that directory data can be shared between two different organizations without compromising the management control over the data. Businesses can “federate” their environments to the extent that it makes business sense to accomplish sharing of data. A practical application of this functionality is the use of eDirectory to manage access to business information, like web forms. Since access to the data is controlled by NDS, then a valid NDS identity must be established in order to access the information. NDS performs the authentication, and then using NDS access controls determines which authenticated users get access to the data.

If two companies wanted to share this data then they could use the DNS namespace support in NDS to grant rights to users in one tree to the object (web forms) in the other tree. This eliminates the need to create multiple directory accounts and preserves the integrity of the management domains of each company. The possibilities of leveraging this powerful new feature of NDS for building directory-enabled business-to-business solutions is unlimited...proving once again that NDS eDirectory is the directory platform of choice for deploying e-business solutions.

Scale to Any Size Directory

In March 1999 Novell demonstrated eDirectory with one billion objects in the directory tree—a new bar for directory scalability. Even more impressive, Novell demonstrated eDirectory performing LDAP searches with subsecond speed. Therein lies the power of eDirectory: even at large capacities, it performs with great speed. Organizations that deploy eDirectory can be confident the infrastructure will support growth with consistent performance. With virtually unlimited capacity, eDirectory allows you to extend your directory infrastructure to the Internet, bringing your customers, partners, and suppliers online. In fact, eDirectory can manage more than five times the number of users as there are on the Internet today. This unlimited scalability is invaluable to ISPs and Internet customers who are constantly capturing and managing enormous amounts of data in a central location. eDirectory helps enterprise customers build the infrastructure required for e-business.

Keep Your Network Resources Secure

NDS eDirectory offers superior security features. It protects access to the network by requiring users to authenticate to it when they log in. eDirectory provides flexible user authentication support ranging from passwords encrypted over Secure Sockets Layer (SSL) to X.509v3 certificates and smart cards. The login authentication service is based on the public-key/private-key encryption technology developed by RSA Data Security, Inc., which relies on a private key and digital signature to verify the user's identity. Once the user is authenticated

to the network, further authentication (which is required when a user makes a request to a different server) is handled in the background by eDirectory and thus is transparent to the user.

With eDirectory you can create a secure environment with the Internet, extranets, and e-commerce by providing the scalability, reliability, and universal access necessary to properly manage digital certificates, cryptography, authentication, and other security concerns. eDirectory has open-standard security services—establishing Novell as the leading provider of directory-based network security. eDirectory security components include:

- Novell International Cryptographic Infrastructure (NICI)—The first international cryptographic infrastructure that developers can leverage to receive the appropriate level of encryption for their application (based on the region of the world where the application will be used) without embedding cryptography in the application.
- Secure Authentication Services (SAS)—A modular authentication framework that provides next-generation authentication services; SAS currently provides SSLv3 support.

Protect Your Current Investment in Hardware and Software

NetWare Independence

NDS eDirectory is a truly cross-platform global directory that will operate on NetWare, Windows 2000, Windows NT, Linux, and Sun Solaris, thus ensuring compatibility with your customers' and partners' current systems. In the year 2000, eDirectory will also run on the Compaq Tru64 Unix.

LDAP Support

NDS eDirectory features a native implementation of LDAPv3, which provides fast searches, auxiliary classes, referrals, and controls. Such native LDAP implementation provides an open structure for applications and developers and simple integration with applications that are written to this Internet standard. To this end, Novell has released an OpenLDAP Software Developer Kit (SDK) that makes developing to LDAP and eDirectory easy and practical.

Reduce the Cost of Network Computing

Significant Return on Investment

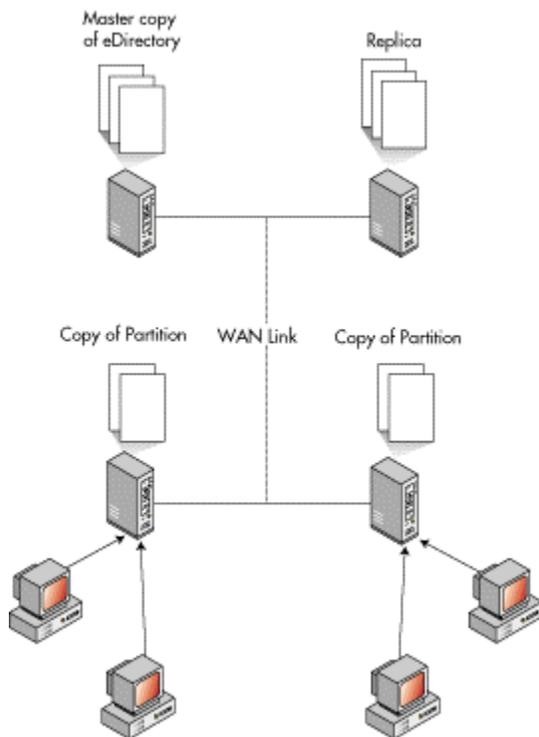
A recent white paper by International Data Corporation found that the three-year return on investment (ROI) for companies that use NDS averages 210 percent. By centralizing management and simplifying tasks such as password administration, adding and deleting users, changing user configuration and access rights, and handling application installation and upgrades, companies both large and small report gains of 20 to 30 percent in IT staff operational

efficiency. Staff needed to administer servers, desktops, and applications was reduced by an average of 33 percent, and the need for system administrators to travel to remote locations was virtually eliminated.

Increased Network Efficiency

With the replication features in eDirectory you can ensure optimum network performance. Figure 5 shows how you can divide the directory into partitions and distribute replicas of these partitions to distant servers, placing resources closer to users who need them. Because users will not have to access a central database each time they log in to the directory, authentication and access to data is almost immediate.

Figure 5: Users can authenticate to their local partition of eDirectory instead of authenticating across an expensive WAN connection.



A replicated directory increases reliability: when a copy of the directory is placed on every server in the partition, directory services will be available when a server goes down or if a link is accidentally severed. eDirectory enables you to construct a system where server failure, maintenance, or temporary loss of a communication link will not affect your users' access to directory services and directory-enabled applications.

New to NDS eDirectory is the ability to create filtered versions of these replicas. NDS has always managed the replicas according to three different replica type definitions: master replica, read-write replica, and read-only. NDS eDirectory

now includes two new replica types: filtered read-write, and filtered read-only. These new replica types allow a filter to be applied to the replication traffic so that only the desired set of data is stored in the replica.

The filters applied to the new filtered replica types are designated according to object class and attribute selections. For example, a filtered replica could be configured to only contain information about users (use the "User" object class in the filter). Additionally, the specific attributes of the "User" could be selected like phone number, full name, email address, etc. allowing for the creation of a filtered replica that only contained the information that was designated by the filter.

This provides a very powerful mechanism for collating and organizing directory data specifically for application consumption. Using filtered replication, NDS eDirectory keeps all the information current. It also allows for the localization of the data to a single server, the application server, where applications can find the data without exhaustive searches across the network and directory connections.

Reduced Hardware Costs

It is not necessary to purchase a new server to store a backup copy of each partition; instead, you may store copies of several partitions on one server. NDS eDirectory takes up little disk space and is equally conservative with regard to bandwidth usage across the network. Partitioning across wide area network (WAN) links and sending only directory changes to replicas are only a few of eDirectory's features that help you economize on hardware resources.

Enjoy Superior Schema Flexibility

eDirectory includes a robust default schema; nevertheless, you can extend the default schema to customize the database to fit your needs. For example, you can extend a user object by adding new attributes such as a Social Security Number or an emergency contact name and telephone number. Independent software vendors (ISVs) can also integrate new services into the network by extending the NDS schema and creating new objects. For example, ISVs have added fax server functionality to the network by adding a fax server object to the directory tree.

Support Open Standards

Novell is committed to the open standards movement, which seeks to achieve compatibility between vendors' products through common, public-domain standards. The opposite paradigm, proprietary standards, would limit companies to one vendor's offerings, thereby achieving compatibility within an organization's network while jeopardizing compatibility with their customers, suppliers, and partners.

NDS eDirectory, based on the X.500 international standard for directory hierarchy, supports more Internet protocols and de facto standards than any other directory: ActiveX, Bindery, DHCP/BOOTP, DNS, HTTP, IETF dial-in, Java, LDAPv3, NCP, NDAP, NT Domains, ODBC, PKI, PKCS10, RADIUS, SMB, SSLv3, X.509, XML, and others.

Easily Manage Your Directory

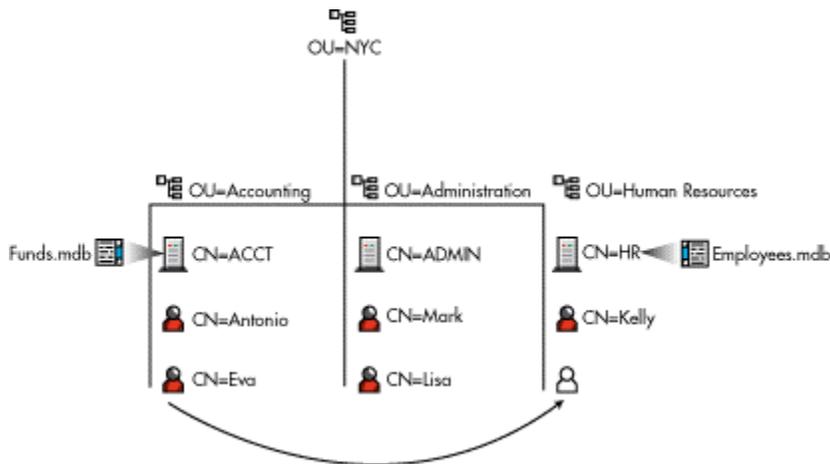
NDS eDirectory is the industry's most easily managed directory. To enjoy this same ease in managing mixed-platform networks, use NDS Corporate Edition. (See the NDS Corporate Edition product description.)

Easy Object Management

When Eva is transferred from Accounting to Human Resources, you can move her object from one organizational unit (OU) to another in one quick, drag-and-drop operation. No need to delete her object from one OU and recreate it in another, and no worry that her information will become lost in the transfer. Her e-mail account and password will remain intact and she will still be able to access her personal network folder. Her object will also automatically acquire all the rights assigned to the new OU: whereas in the Accounting OU she had rights to the Funds database, upon moving her object to the Human Resources OU she will immediately acquire rights to the Employees database. Figure 6 shows how this is accomplished.

With eDirectory you can easily and quickly accommodate changes to the organization and to personnel assignments without having to delete and recreate objects from scratch. This leaves you with time to attend to network improvement. time that is usually taken up by repetitive housekeeping tasks.

Figure 6: The system administrator can grant Eva all the default rights of her new OU in



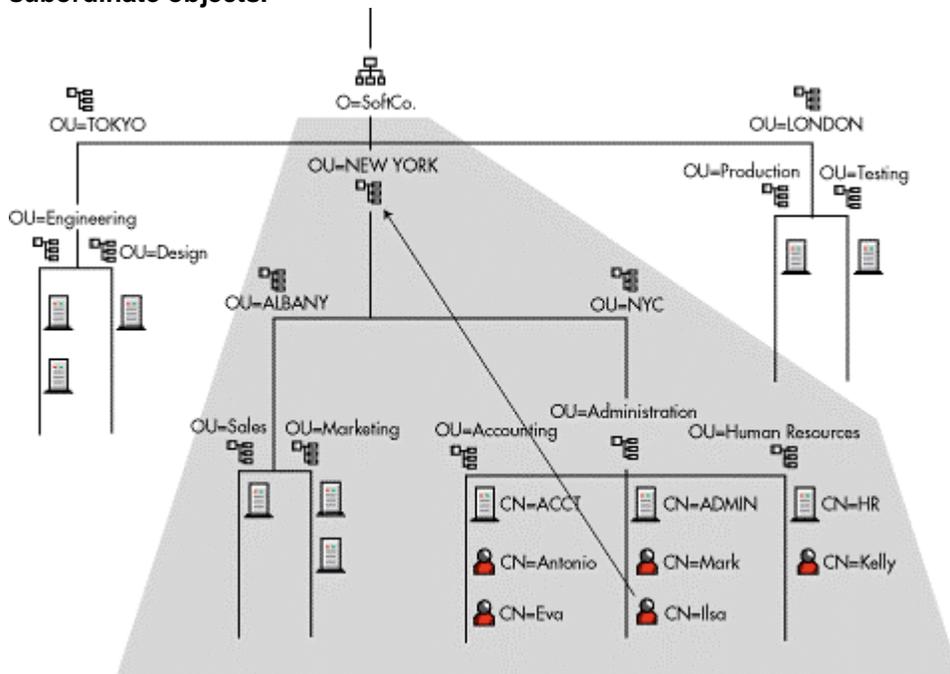
one drag-and-drop operation.

Dynamic Inheritance

With eDirectory, organizations can choose to centralize management and administration services across departmental boundaries or to delegate administration to the department or workgroup level. For example, one department may have more strict security requirements than the rest, so rights can be given to one user who would have exclusive administrative control over that department's directory branch. Once those rights were granted at the highest level of the department's directory, the rights would automatically "flow down" to the subordinate objects. This feature eliminates the need to add redundant information to the access control list (ACL) of each object in that container, which saves valuable disk space and bandwidth.

Figure 7 shows how Ilsa is given administrative control over the entire New York OU: once her user icon has been dragged and dropped to the New York OU level, her rights extend downward to include the Albany and NYC OUs and all the servers and users in them.

Figure 7: Administrative rights granted at the OU level automatically "flow down" to all subordinate objects.



Flexible Scope of Administration

The scope of administration in eDirectory can be as broad as an entire enterprise or as specific as an object's individual attributes. You can grant administrative rights down to the user level, such as the ability for a user to manage objects—users, printers, and servers—or attributes—e-mail addresses and phone numbers.

Partitioning with Fine Degree of Granularity

Creating partitions not only provides increased fault tolerance, it also reduces traffic across unreliable or expensive WAN links, eases workload on servers, and maximizes server disk space. With eDirectory you can partition down to a single OU, which can be any size you choose. This feature gives you the flexibility to partition according to what will best optimize network resources. And no matter how many partitions you create, the directory tree will appear as a unified whole so that you can manage it from a single point.

Flexible Directory Indexing

An indexing system in a directory is necessary to provide optimal search performance of the directory. With eDirectory you can build an index from any object or attribute in the directory.

Directory-Management Tools

With NDS management tools you have the flexibility to design and manage a directory infrastructure that suits your organization's needs. eDirectory includes the following tools:

- NDS Server—places replicas of eDirectory locally on primary domain controllers and backup domain controllers (PDCs and BDCs)
- NetWare Administrator and ConsoleOne—manage all your network users and resources
- NDS Manager—manages partitions, replicas, servers, and the eDirectory schema
- Novell Client—provides users with access to all eDirectory features
- LDAP—provides an open structure for integration with applications written to the Internet standard
- An Import/Export utility—adds millions of objects to the directory in one move using the LDIF data format. This is accomplished using bulk load technologies to add and export directory data
- A repair utility—repairs and corrects problems with the eDirectory database, such as records, schema, bindery objects, and external references
- A backup utility—backs up and restores eDirectory objects and schema

ICE – Import Configuration Export

ICE is a utility design to ensure that directory data is easily accessible whether accessing single entities or the entire directory content. ICE allows users to perform bulk load operations against NDS using different data formats for the source and destination files. Supported formats for bulk load operations include LDIF, DNS Zone Export, and LDAP Server. These formats are implemented using *Format Handlers* which are separate modules meaning that ICE can be extended over time to support other data formats.

In addition to the ICE utility itself, there is a command line interface that allows administrators to use ICE for creating automated bulk loading and exporting of data.

NDS iMonitor

As part of Novell's continuing effort to simplify management of NDS, Novell will be delivering NDS iMonitor, an interactive, web-based tool for examining all aspects of your NDS environment. NDS iMonitor allows administrators to view detailed information about partitions, servers, objects, and activities through a standard web browser. The tool allows you to navigate the NDS tree and view the state of all elements of the tree.

NDS Access Controls are applied to ensure that the security of the tree is never compromised.

When an error is discovered in the tree, the error messages can be quickly decoded, with suggested remedies offered making NDS much easier to maintain than ever before.

ConsoleOne

ConsoleOne is a Java utility that provides a cross-platform solution for easy extensibility to the Web. With management capabilities for billions of objects ConsoleOne easily "snaps in" to the Web. ConsoleOne is a client-side tool that has base parity with NWAdmin, improved performance, and added value. ConsoleOne is designed to be a central console with capabilities and features that are snapped in as needed to manage and administer the diverse hardware, software, and data that compose modern computer networks. The particular set of features you see in ConsoleOne depends on the composition of your network. For example, if eDirectory is installed on your network, you see features for browsing eDirectory trees and administering eDirectory objects. If NetWare is installed, you see features for accessing NetWare server consoles and managing server resources. With ConsoleOne you can perform the following tasks:

- Browse large eDirectory containers that contain thousands of objects

ConsoleOne retrieves and displays the contents one page at a time.

- Search or filter the contents based on object name and type
- Configure LDAPv3 services on individual NetWare servers and control how LDAP-based access to eDirectory works for different groups of users
- Create, move, rename, delete, and modify any type of eDirectory object defined in the schema of your eDirectory tree

Custom property pages are available on most object types, and a generic Other page lists any leftover properties. You can modify multiple objects of the same type simultaneously.

- Extend the eDirectory schema to allow the addition of new types of objects and properties to your eDirectory tree, including the ability to create auxiliary classes
- Create templates for setting up new user accounts

A template supplies initial values for most properties of the user object.

- Control whether eDirectory rights assignments are inheritable to lower levels in the tree, even for specific properties such as login passwords
- Manage the file system on individual NetWare volumes

You can create, move, copy, and delete individual files and folders. You can modify file and folder attributes, including rights assignments and owners, or view and change volume statistics and control disk space allocations by user or by folder.

Easily Customize Your Directory to Reflect Your Organization

Merges and Divisions

When departments split or consolidate, you can reflect these changes in eDirectory's tree structure. A single drag-and-drop operation painlessly rearranges the structure of the tree and enables new administrative rights to be assigned if needed. eDirectory also places few limitations on the degree of granularity you can use in merging or dividing, nor does it require that the entire network be reconstructed or rebooted every time you need to make major changes.

Strategically Placed Resources

The hierarchical structure of eDirectory enables network supervisors to arrange network resources in the directory tree according to the way they are used. With resources placed near the users who access them, network traffic across WAN links decreases.

Reduce Network Downtime

Unparalleled Fault Tolerance

With eDirectory you can secure your directory against data loss and downtime by replicating partitions to strategic locations on the network. This protects your directory from problems caused by a single point of failure, such as a master server going down or the temporary loss of a communication link. If a primary partition is lost, the directory automatically reconfigures itself to use another copy, or replica, of the partition. In addition, you can restore a partition that has been lost from one server by using a replica on a different server.

When changes are made to any partition, eDirectory automatically updates every replica of the partition, using time synchronization, thereby ensuring the reliability

of the information within each partition. Furthermore, to ensure optimum performance, only the changes are sent across the network.

Dynamic Changes While Server Is Running

eDirectory provides dynamic partitioning and replication "on-the-fly," which means that the directory can be partitioned and replicated without rebooting servers or interrupting directory or user access. This allows network supervisors to change the structure of the directory whenever needed, thus maintaining a fluid network composition that can readily and easily change with the company.

Use Easy and Fast Application Development Tools

To encourage and enable developers to write applications to open directory standards, Novell provides the OpenLDAP SDK. With this SDK, you can develop applications that are compatible with eDirectory or any other LDAP directory. In addition, you can eliminate or greatly simplify the task of creating a directory for your network-enabled applications. With eDirectory as the directory for your applications, you can save a great deal of time—years, in some cases. Third parties have developed more than 400 applications that leverage eDirectory. In fact, the number of developers in Novell's DeveloperNet® program exceeds 50,000; more than 70 percent of them are developing applications that use eDirectory. There are more development tools for eDirectory than for all other directory services combined. Some of the most popular development interfaces used to develop these applications include ActiveX controls, ADSI, C/C++, Java, JavaBeans, JavaScript, JNDI, LDAP, NDS SDK, NetBasic, OCX, ODBC, OpenLDAP SDK, Oracle NCA, Perl, REXX, Visual Café, and VisualBasic. By using eDirectory, developers can be confident that they are adding tried-and-true directory functionality to their applications. They can use their choice of familiar developer tools without having to design and build access and management services of their own. Not only that, they can design, build, market, and support their applications while Novell supports (and markets) the directory services end.

For a listing of Novell partners, applications they have developed that leverage eDirectory, eDirectory development tools and application programming interfaces (APIs), and developer-related documentation, visit <http://developer.novell.com/nds>.