Enterprise

CHAPTER

11

Optimizing Windows NT Server Directory Services

About Chapter 11

This chapter is all about optimizing Windows NT Server Directory Services, particularly in a WAN environment.

First, Chapter 11 takes a quick look at the benefits of optimizing Directory Services. Then, the first step in the optimization process—which consists of determining the size of the Directory Services database—is explored. Next, you'll learn how to determine the appropriate number of master domains for your organization. After this, the chapter explains how to determine the ideal number of domain controllers.

The remainder of the chapter focuses on two primary techniques an administrator can use to optimize Directory Services in a WAN environment. First, the section outlines how to optimize the location of BDCs to reduce logon and authentication traffic across a WAN link. Second, steps to optimize Directory Services synchronization are presented.

This chapter includes one lab. In this lab, you'll plan the optimization of WAN link performance by determining the appropriate number and placement of BDCs throughout a master domain model.

Chapter 11 is optional if you're preparing for the Workstation or Server exams, but essential if you're preparing for the Enterprise exam. This chapter maps to the "Optimize performance for various results" objective in the Monitoring and Optimization section in the Enterprise exam's objectives.

Why Optimize Windows NT Server Directory Services?

Optimizing Windows NT Server Directory Services refers to an overall network design and administration process that includes: choosing the appropriate domain model and number of master domains, determining the optimum number of domain controllers, optimizing the location of *backup domain controllers* (BDCs), and optimizing synchronization between a domain's *primary domain controller* (PDC) and BDCs.

The larger your network environment, the greater the likelihood that you need to optimize Directory Services. If you have a small network, or all your *Wide Area Network* (WAN) links are high speed (1Mbps or more), then you may not have a need to optimize Directory Services.

The benefits of optimizing Directory Services include:

- Efficient user logon and authentication
- Efficient use of computer resources
- Efficient synchronization across WAN links

User logon and authentication create network traffic. In a WAN environment, it is normally preferable to keep user logon and authentication traffic from crossing the WAN link, so that the link is freed up for other network traffic. Optimizing Directory Services by choosing the appropriate domain model and optimizing the location of BDCs allows users to logon and access resources quickly and efficiently.

Computers are expensive resources. When Directory Services is optimized, you choose the appropriate type of hardware and optimum number of computers to use as domain controllers in your organization. In this way, you spend neither too much nor too little on your network infrastructure to achieve desired performance levels.

Synchronization of a domain's PDC with its BDCs can create a significant amount of network traffic. When synchronization traffic must cross a WAN link, you can optimize the rate and frequency of synchronization, and limit synchronization traffic to specified time periods during the day.

A first step in optimizing Directory Services is determining the size of the Directory Services database.

Determining the Size of the Directory Services Database

The size of the Directory Services database is used to make virtually all decisions for optimization of Directory Services, including: determining which domain model is best suited to your needs; how many master domains and domain controllers are required; determining the optimum location of BDCs; and determining the amount, rate, and timing of synchronization traffic.

The recommended maximum size of the Directory Services database is 40MB (40,000KB). Larger databases have been tested, but are not recommended by Microsoft. The Directory Services database contains user accounts, computer accounts, and group accounts.

Each account contained in the Directory Services database requires a specific amount of space:

- Each user account requires 1,024 bytes (1KB). (40,000 user accounts occupy 40MB of disk space. This is where the 40,000 user account limit per domain comes from. However, the 40,000 user account limit does *not* take into account computer accounts or group accounts.)
- Each computer account requires 512 bytes (.5KB).
- Each local group account requires 512 bytes (.5KB) for the group, *plus* 36 bytes for each member of the group.
- Each global group account requires 512 bytes (.5KB) for the group, *plus* 12 bytes for each member of the group.

The average amount of space required by a group account normally varies between 2KB and 4KB. I recommend that you use a size of 3KB for each group when you calculate the size of the Directory Services database. Using this recommended size is obviously not 100 percent accurate, but it does provide a simple, ball-park estimate to perform the calculation.

To calculate the size of the Directory Services database, use the following formula: Size of Directory Services database, in KB, = Number of user accounts + (.5 × number of computer accounts) + (3 × total number of groups).

For example, assume that a company has 18,000 users, 18,000 computers, and 300 groups. The size of the company's Directory Services database is calculated as follows:

Number of user accounts	18,000
.5 × number of computer accounts	9,000
3 × total number of groups	900
Total size of Directory Services database:	27,900KB

Determining the Appropriate Number of Master Domains

Now that you've determined the size of your Directory Services database, you can determine the appropriate number of master domains for your organization.

There are several factors that should be considered when determining the appropriate number of master domains:

- The size of your organization's Directory Services database (as computed in the previous section)
- The hardware capabilities of computers used as domain controllers
- The organizational structure of your organization—i.e., logical department groupings
- The management structure you want to use on your network—centralized or decentralized
- The geographical distribution of your organization's users and computers

When you consider the size of your Directory Services database to determine the number of master domains required, don't forget to take into account future company growth.

When planning a domain architecture, I recommend that the *maximum* size of computed Directory Services database allocated to each master domain be limited to 20,000KB. Depending on the hardware specifications of your domain controllers, your network management needs, the geographic distribution of your network,

or your company's anticipated future growth, you may want to limit each master domain to an *even smaller size* of computed Directory Services database.

The hardware capabilities and specifications of the computers used as domain controllers will significantly affect your determination of the appropriate number of master domains. Table 11-1 shows recommended minimum hardware configurations of domain controllers to accommodate various Directory Services database sizes.

If you've computed your Directory Services database size and the figure is nearing 40,000KB, I strongly recommend that you don't try to use the single domain or single master domain model.

TABLE 11-1 MINIMUM HARDWARE REQUIRED FOR VARIOUS DIRECTORY SERVICES DATABASE SIZES

DIRECTORY SERVICES DATABASE SIZE	*MINIMUM CPU REQUIRED*	*MINIMUM RAM REQUIRED*
5MB (5,000KB)	486DX/33	32MB
20MB (20,000KB)	Pentium or RISC	64MB
40MB (40,000KB)	Pentium Pro or RISC	128MB
Greater than 40MB	Not recommended	

For example, if your company plans to use Pentium computers with 64MB of RAM for its domain controllers, the maximum Directory Services database size that these computers can accommodate is 20MB per domain. However, this table assumes that domain controllers are used *only* for logon validation and do not perform any other network services (such as WINS, DHCP, hosting shared resources, etc.). If your domain controllers perform multiple functions, you will need more powerful hardware to support the Directory Services database sizes listed in Table 11-1. If more powerful hardware is not available, you must decrease the Directory Services database size that the domain controllers can contain.

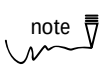
Some companies choose their domain structure based on their organization's departmental structure, or by the geographic location of various offices. These factors often have as much influence in determining the number of master

domains as do Directory Services database size and hardware limitations. When departmental or regional control over user accounts and resources is desired, master domains are often implemented for these departments or locations.

When a company wants centralized network management, the single master or multiple master domain models are often used. When a more decentralized network management scheme is desired, more master domains are used. If your network structure becomes too decentralized, it may approach the complete trust domain model, which is not recommended.

Determining the Ideal Number of Domain Controllers

The minimum recommended number of domain controllers for each domain is one PDC and one BDC. This number of domain controllers accommodates from one to approximately 2,000 users, and is based on a domain controller hardware configuration consisting of a 486/66 CPU with a minimum of 32MB of RAM. (More powerful computers can accommodate more users.)



You can configure a Windows NT Server domain with a single PDC and no BDCs. This configuration will work for a small network, but eliminates all of the fault tolerance features of a Windows NT Server domain.

It is recommended that a BDC be added for every additional 2,000 users, or increment thereof. Using these guidelines, a domain that contains 8,000 users requires one PDC and four BDCs. A domain that contains between 8,001 and 10,000 users requires one PDC and five BDCs.

These guidelines assume that BDCs are used *only* for logon validation, and do not perform any other network services (such as WINS, DHCP, hosting shared resources, etc.). If BDCs perform multiple functions, you need more powerful hardware or additional BDCs to support the number of users recommended in these guidelines.

More BDCs may also be required in a WAN environment to support local user logon validation and authentication at each location. The next section discusses how to optimize Directory Services in a WAN environment.

Optimizing Directory Services in a WAN Environment

Operating a Windows NT network in a WAN environment can present a network administrator with a unique set of challenges.

The WAN environment consists of networks in different locations connected by communications links. WAN links, which consist of dial-up or leased lines, generally vary in speed from 28Kbps to 44Mbps. Because WAN links are typically bottlenecks for network traffic, the administrator needs to ensure that logon and authentication traffic are handled efficiently across the WAN link, and must also ensure that synchronization can occur without tying up the WAN link during peak use times.

There are two primary techniques an administrator can use to optimize Directory Services in a WAN environment: selecting appropriate locations for BDCs to optimize logon and authentication traffic, and optimizing Directory Services database synchronization between the PDC and the BDCs.

Optimizing Location of BDCs

In a non-WAN environment, the placement of domain controllers is not critical. In a WAN environment, however, because logon and authentication create network traffic, the location of domain controllers is of primary importance.

The PDC should normally be placed in the same location as the network administrator. BDCs should usually be placed in the locations where users log on.

Consider the following example of a company that has two domains: a master domain in San Francisco, which contains all user accounts, and a resource domain in Atlanta. The ATLANTA domain trusts the SAN_FRANCISCO domain, and a 56Kbps WAN link connects the two domains. There are 1,500 users in the San Francisco location, and 1,100 users in the Atlanta location. When users in the Atlanta location log on, a domain controller in the SAN_FRANCISCO domain must validate the logon requests. Because the number of users at the Atlanta location has doubled in size over the past year, users there report that their logon requests take much longer to process than in the past.

Figure 11-1 shows the SAN_FRANCISCO and ATLANTA domains. Notice that all logon requests from users in the ATLANTA domain must flow across the WAN link to the SAN_FRANCISCO domain for validation.

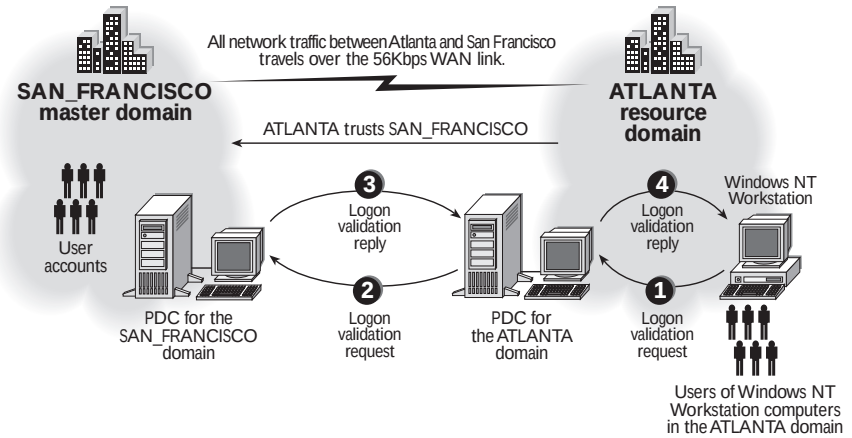


FIGURE 11-1 **Logon authentication across a slow WAN link**

To resolve the slow logon problem, the company's network administrator decides to place a BDC from the SAN_FRANCISCO domain in the Atlanta office. This results in much faster logons for users in the Atlanta office, because logon validation is now performed locally, instead of across the slow WAN link. Placing a BDC for the SAN_FRANCISCO domain in the Atlanta office also frees up the WAN link, allowing it to handle other network traffic more efficiently.

Figure 11-2 shows the SAN_FRANCISCO and ATLANTA domains with a BDC for the SAN_FRANCISCO domain installed in the Atlanta office. Notice that the logon validation for Atlanta users is all performed locally now, and no longer needs to cross the WAN link.

The key point in optimizing BDC placement is the *location of users* that require logon validation, especially when you want to eliminate logon traffic across a WAN link. Also keep in mind that a BDC can serve up to 2,000 users. If more than 2,000 users are logging on from a remote location, additional remote BDCs are required.

Adding remote BDCs to eliminate logon traffic across a WAN link solves one problem—and to an extent, creates another. Logon traffic across the WAN is eliminated, but because the BDC must periodically update its Directory Services database, and this synchronization with the PDC takes place across the WAN link, synchronization traffic across the WAN link is increased. This synchronization traffic is significantly less than logon validation traffic, but can still create a bottleneck across the WAN link if not managed carefully by the administrator.

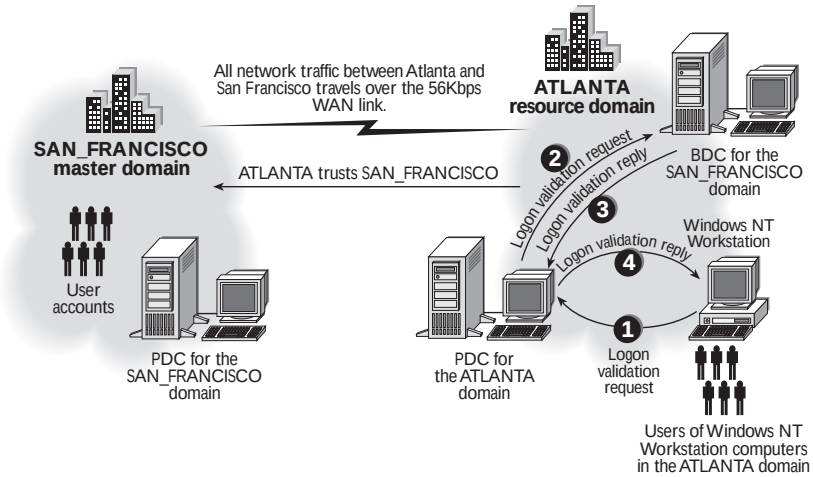


FIGURE 11-2 **Local logon authentication made possible by a remote BDC**

Optimizing Directory Services Synchronization

Optimizing Directory Services synchronization refers to the process of managing the periodic synchronization of Directory Services database changes between the PDC and the BDCs so that other network traffic, particularly traffic across a WAN link, is not hindered.

TO OPTIMIZE DIRECTORY SERVICES SYNCHRONIZATION, FOLLOW THESE STEPS:

1. Determine the amount of time required each month to perform Directory Services synchronization.
2. If the amount of time required for Directory Services synchronization is significant or causes a bottleneck across the WAN link, then one or more of the following measures can be taken:
   - Increase the size of the change log
   - Modify the ReplicationGovernor value
   - Use the Schedule service and the `Regini.exe` program to configure the time of day Directory Services synchronization occurs

These steps are discussed in detail in the following sections.

Determining synchronization time

The first step in optimizing Directory Services synchronization is determining the amount of time it takes, per month, to synchronize data between a PDC and one BDC (in a given domain) that are separated by a WAN link.

Before you can determine the amount of time synchronization takes, you need to gather the following data:

A. Number of user accounts in the domain

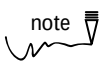
B. The maximum password age, in days

C. Speed of the WAN link, in Kbps

D. Number of BDCs located across the WAN link from the PDC

To estimate the amount of time synchronization takes, you can use the following formula (let A = number of user accounts, etc.):

Synchronization time per month, in hours = $(A \times B/30 + .1A) \times D / (C \times 450)$



The .1A in this formula represents an estimated number of account changes that occur (including the creation of or change in user accounts, computer accounts, and group accounts; but excluding password changes) in a month. I like to use 10 percent of the total number of users (hence .1A) for this estimate.

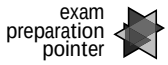
For example, consider the previous example of the SAN_FRANCISCO and ATLANTA domains. The SAN_FRANCISCO domain, which contains all the user accounts, has a total of 2,600 user accounts. The two domains are connected by a 56Kbps WAN link. The SAN_FRANCISCO domain has one remote BDC in the Atlanta location, and, for convenience, assume that the maximum password age is 30 days. The calculation to determine the amount of time it takes each month to synchronize data between the PDC located in San Francisco and its BDC in Atlanta looks like this:

$(A \times B/30 + .1A) \times D / (C \times 450)$ = Synchronization time per month, in hours

$(2{,}600 \times 30/30 + 260) \times 1 / (56 \times 450) =$

$(2{,}860) / (25{,}200) = .11$ hours per month

In this example, Directory Services synchronization does not appear to be an issue, because the estimated time it takes is less than seven minutes per month. However, in a multiple master domain model that has a large number of users *and* multiple BDCs from each master domain at multiple remote locations, Directory Services synchronization can consume a significant amount of WAN link bandwidth.



It might appear as though less than roughly two percent of network administrators ever have to worry about managing Directory Services synchronization. However, *everyone* who wants to pass the Enterprise exam should have a solid grasp of how to optimize Directory Services synchronization.

If Directory Services synchronization is utilizing too much of a WAN link's capacity, an administrator can take various steps to optimize synchronization traffic, including increasing the size of the change log and modifying the ReplicationGovernor value.

Increasing the size of the change log

The *change log* is a file located on the PDC that contains recent changes to the Directory Services database. The size of this file can be adjusted by changing the value of a setting in the Registry. Sometimes it is beneficial to increase the size of the change log when optimizing Directory Services synchronization.

Synchronization between the PDC and a BDC can be either full or partial.

Full synchronization (which is not the norm) involves copying the entire Directory Services database from the PDC to the BDC. Full synchronization only occurs when *all* changes listed in the change log occurred *after* the last synchronization between the PDC and the BDC.

Partial synchronization involves copying only the changes listed in the change log that have occurred since the last synchronization between the PDC and the BDC. Because partial synchronization involves copying significantly less data, it is preferred over full synchronization when a slow WAN link is involved.

The change log can contain up to approximately 2,000 account and password changes. In most network environments, this is an adequate size when synchronization occurs at normal intervals. However, the size of the change log may need to be increased if you decide to limit the amount of synchronization data than can be transferred, or the frequency or hours when synchronization traffic across a WAN link can occur.

If the size of the change log is *not* increased and synchronization intervals are too infrequent, then full synchronization (which is not desired because of the large amount of WAN bandwidth used) will occur. This resulting situation may be worse than the one you were attempting to fix.

The change log entry is stored in the Windows NT Registry in: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Netlogon\Parameters\ChangeLogSize`.

The default size of the change log is 65,536 bytes (64KB), and can be configured as large as 4,194,304 bytes (4MB). The average change log entry uses about 32 bytes of space in the change log.

TO INCREASE THE SIZE OF THE CHANGE LOG, FOLLOW THESE STEPS:

1. Select Start ≥ Run.
2. In the Run dialog box, type **Regedt32.exe** in the Open text box. Click OK.
3. The Registry Editor dialog box appears. Select Window ≥ HKEY_LOCAL_MACHINE on Local Machine.
4. In the Registry Editor dialog box, double-click the `SYSTEM` folder. Double-click the `CurrentControlSet` folder. Double-click the Services folder. Double-click the `Netlogon` folder. Click the `Parameters` folder. Select Edit ≥ Add Value.
5. In the Add Value dialog box, type **ChangeLogSize** in the Value Name text box. In the Data Type drop-down list box, select REG_DWORD. Figure 11-3 shows the Registry Editor and Add Value dialog boxes. Click OK.

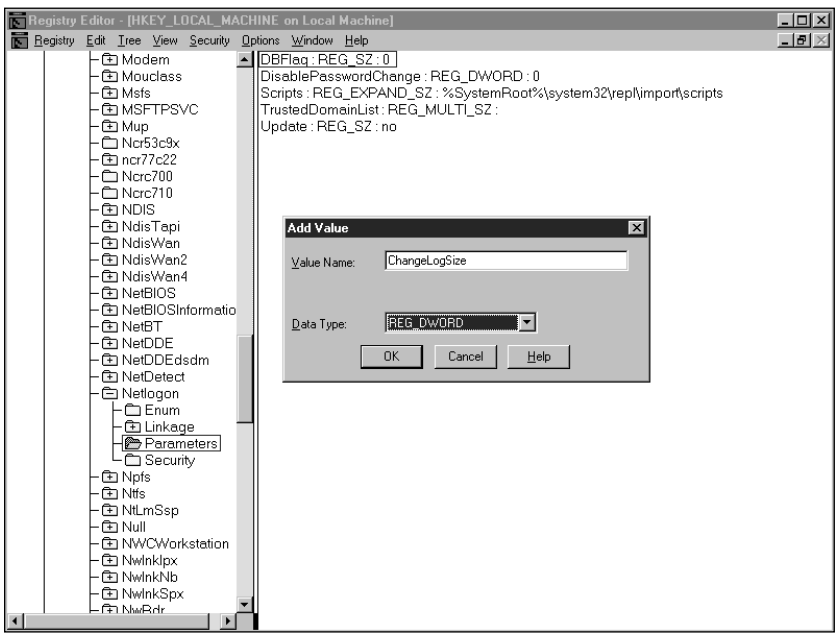


FIGURE 11-3 **Adding the ChangeLogSize value**

6. The DWORD Editor dialog box appears. First, select the radio button next to Decimal. Then, in the Data text box, type in a new value for the ChangeLogSize, in bytes. Figure 11-4 shows the DWORD Editor dialog box. Notice that the number entered is twice the default size of the change log (2 × 65,536 = 131,072). Click OK.

FIGURE 11-4 **Configuring the ChangeLogSize**

7. The Registry Editor dialog box reappears, as shown in Figure 11-5. Notice that the ChangeLogSize value appears on the top right-hand side of the dialog box, and that the new value assigned has been converted to hexadecimal. (20,000 is the hexadecimal equivalent of 131,072.) Exit Registry Editor.

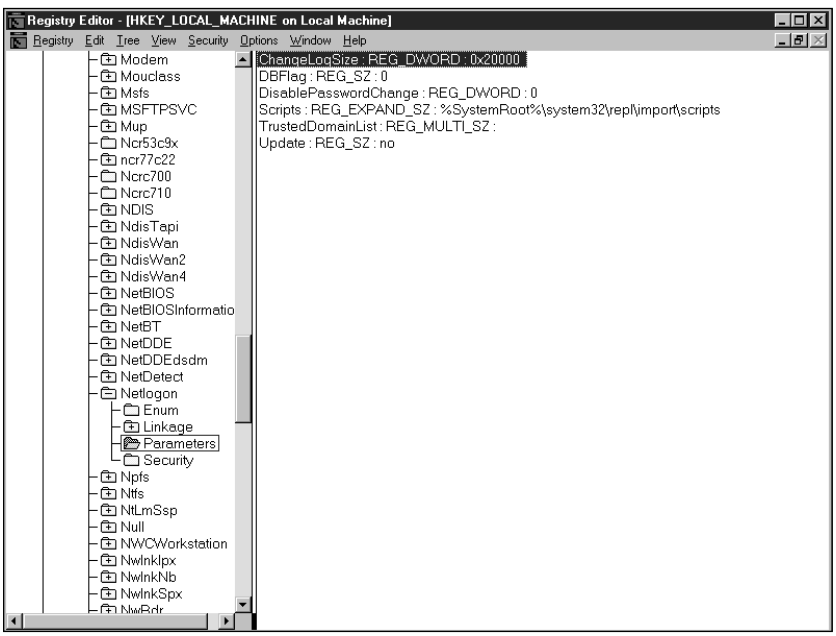


FIGURE 11-5 **ChangeLogSize entry successfully added to the Registry**

You will need to stop and restart the NetLogon service in order for the new ChangeLogSize value to take effect. (You can do this by using the Services application in Control Panel, or by using the `Net.exe` command-line utility.)

Modifying the ReplicationGovernor value

The *ReplicationGovernor* is a setting in the Windows NT Registry that controls the size of the synchronization buffer and how frequently the BDC requests Directory Services database updates from the PDC. The value of the ReplicationGovernor can be decreased in order to reduce the frequency and amount of synchronization traffic over a WAN link.

The ReplicationGovernor is configured individually on each BDC, *not* on the PDC.

The acceptable values for the ReplicationGovernor setting are from 0 to 100. The default value for the ReplicationGovernor is one hundred. This means that a maximum buffer size of 128KB is used, and that the BDC requests updates from the PDC (without pausing between requests) until all changes in the change log have been transferred from the PDC to the BDC. After the BDC has received all changes from the PDC, it waits until the PDC notifies it that additional changes to the Directory Services database have occurred. Then the synchronization process begins again.

If a setting of 50 is used, the maximum buffer size is reduced to 64KB. Additionally, during synchronization, the BDC pauses between each request to the PDC so that updates take up only about 50 percent of the WAN link's bandwidth during the synchronization process.

If you decide to decrease the ReplicationGovernor value, you should consider increasing the size of the change log to avoid full synchronization.

If the ReplicationGovernor is set at too low a value, synchronization may never be completed, because changes to the Directory Services database may occur more frequently than the ReplicationGovernor value allows them to be transferred to the BDC. Values lower than 25 percent are not generally recommended.

The ReplicationGovernor entry is stored in the Windows NT Registry in: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Netlogon\Parameters\ReplicationGovernor`.

The steps required to decrease the ReplicationGovernor value are virtually identical to the steps required to increase the size of the change log (listed in the previous section)—just replace all references to ChangeLogSize with ReplicationGovernor, and, when requested, insert the appropriate ReplicationGovernor value.

After changing the ReplicationGovernor value, you will need to stop and restart the NetLogon service in order for the new ReplicationGovernor value to take effect.

Controlling when synchronization occurs

In addition to limiting the size and frequency of synchronization data transfers from the PDC to the BDCs, you can also limit the hours when synchronization can occur.

For example, you might want to limit synchronization traffic over a WAN link to non-business hours, when network traffic on the link is at a minimum.

To accomplish this, you can use the Windows NT Schedule service and the `Regini.exe` program (from the *Microsoft Windows NT Server Resource Kit for version 4.0*) to set the ReplicationGovernor value to 0 during business hours (so that no synchronization occurs), and to 100 during non-business hours. Every time you change the value of the ReplicationGovernor in the Registry, you need to stop and restart the NetLogon service so that the new ReplicationGovernor value will take effect.

You may also need to increase the size of the change log so that it is large enough to hold all of the changes that occur during the work day.

Key Point Summary

This chapter described optimizing Windows NT Server Directory Services through a comprehensive network design and administration process.

- A first step in optimizing Directory Services is *determining the size of the Directory Services database*. The recommended maximum size of the Directory Services database is 40MB (40,000KB). The Directory Services database contains user accounts, computer accounts, and group accounts. Each component requires a specific amount of space in the database. Each user account requires 1KB, each computer account requires .5KB, each local group requires .5KB *plus* 36 bytes for each member, and each global group requires .5KB *plus* 12 bytes for each member of the group.

- You can calculate the approximate size of the Directory Services database by using the formula: Size of Directory Services database, in KB, = Number of user accounts + (.5 × number of computer accounts) + (3 × total number of groups).

- Several factors should be considered when *determining the appropriate number of master domains*:
  - The size of your organization's Directory Services database
  - The hardware capabilities of computers used as domain controllers
  - The structure of your organization, including organizational/departmental groupings, the centralized or decentralized management structure you want to use for your network, and the geographical distribution of your organization's users and computers
  - Future anticipated growth of the organization
  - The hardware specifications of the computers used as domain controllers significantly impact the determination of the appropriate number of master domains. For example, if your company plans to use Pentium computers with 64MB of RAM for its domain controllers, the maximum Directory Services database size that these computers can accommodate is 20MB per domain. This recommended Directory Services database size assumes that domain controllers are used *only* for logon validation and do not perform any other network services. If your domain controllers perform multiple functions, you will need more powerful hardware to support a given Directory Services database size.
- *The minimum recommended number of domain controllers for each domain is one PDC and one BDC.* This number of domain controllers accommodates from 1 to 2,000 users, and is based on a domain controller hardware configuration consisting of a 486/66 CPU, with a minimum of 32MB of RAM.

- It is recommended that a BDC be added for every additional 2,000 users, or increment thereof. Using these guidelines, a domain that contains between 8,001 and 10,000 users requires one PDC and five BDCs. These guidelines assume that BDCs are used *only* for logon validation, and do not perform any other network services. If BDCs perform multiple functions, you need more powerful hardware or additional BDCs to support the number of users recommended in these guidelines. More BDCs may also be required in a WAN environment to support local logon validation and authentication at each location.
- There are two primary techniques an administrator can use to optimize Directory Services in a WAN environment: selecting appropriate locations for BDCs to optimize logon and authentication traffic, and optimizing Directory Services database synchronization between the PDC and the BDCs.
  - The key point in optimizing BDC placement is the *location of users that require logon validation*, especially when you want to eliminate logon traffic across a WAN link. Also keep in mind that a BDC can serve up to 2,000 users, so if more than 2,000 users are logging on from a remote location, additional remote BDCs are required.
  - *Optimizing Directory Services synchronization* refers to the process of managing the periodic synchronization of Directory Services database changes between the PDC and the BDCs so that other network traffic, particularly traffic across a WAN link, is not hindered.
    - The first step in optimizing Directory Services synchronization is determining the amount of time it takes, per month, to synchronize data between a PDC and the BDCs. If Directory Services synchronization is utilizing too much of a WAN link's capacity, an administrator can take various steps to optimize synchronization traffic.
    - Sometimes it is beneficial to increase the size of the *change log* when optimizing Directory Services synchronization. By default, the change log is 64KB in size, and can contain up to approximately 2,000 account and password changes. This may not be enough if you decide to limit the amount of synchronization data than can be transferred, or the frequency or hours when synchronization traffic across a WAN

link can occur. The change log entry is stored in the Windows NT Registry in: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Netlogon\Parameters\ChangeLogSize`. The size of the change log can be increased by using Registry Editor.

- The *ReplicationGovernor* is a setting in the Windows NT Registry that controls the size of the synchronization buffer and how frequently the BDC requests Directory Services database updates from the PDC. The value of the ReplicationGovernor can be decreased in order to reduce the frequency and amount of synchronization traffic over a WAN link. The default value for the ReplicationGovernor is one hundred. The ReplicationGovernor is configured individually on each BDC, *not* on the PDC. The ReplicationGovernor entry is stored in the Windows NT Registry in: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Netlogon\Parameters\ReplicationGovernor`.
- In addition to limiting the size and frequency of synchronization data transfers to the BDCs, you can also limit the hours when synchronization can occur. For example, you might want to limit synchronization traffic over a WAN link to non-business hours, when network traffic is at a minimum. To accomplish this, you could use the Schedule service and the `Regini.exe` program to set the ReplicationGovernor value to 0 during business hours, and to 100 during non-business hours. Whenever the change log or ReplicationGovernor values are changed, you need to stop and restart the NetLogon service in order for the new value to take effect.

Applying What You've Learned

Now it's time to regroup, review, and apply what you've learned in this chapter.

The following Instant Assessment questions bring to mind key facts and concepts.

The hands-on lab tests your ability to apply the knowledge you've acquired in this chapter on optimizing Windows NT Services.

Instant Assessment

1. What is the recommended *maximum* size of the Directory Services database?
2. What are the space requirements for each of the components of the Directory Services database?
3. What formula can you use to calculate the size of the Directory Services database?
4. Calculate the approximate size of the Directory Services database for a company that has 21,000 users, 24,000 computers, and 400 groups.
5. Your company has decided to use Pentium computers with 64MB of RAM for its domain controllers. Assuming that the domain controllers are used *only* for logon validation, what is the maximum size of the Directory Services database that can be accommodated by these computers?
6. Your company has decided to use Pentium Pro computers with 128MB of RAM for its domain controllers. Assuming that the domain controllers are used *only* for logon validation, what is the maximum size of the Directory Services database that can be accommodated by these computers?
7. What is the *minimum* recommended number of domain controllers for each domain?
8. Based on a hardware configuration consisting of a 486/66 CPU with 32MB of RAM, up to how many users can each BDC accommodate, assuming that BDCs are used *only* for logon validation and are not used to perform authentication across WAN links?
9. What is the key point in optimizing placement of BDCs, particularly when trying to eliminate logon traffic across a WAN link?
10. By default, what is the size of the change log?
11. Up to how many account and password changes can the change log, by default, contain?
12. Where is the change log entry stored in the Registry?
13. Which Windows NT utility can you use to increase the size of the change log or modify the ReplicationGovernor value?
14. Where is the ReplicationGovernor entry stored in the Registry?

15. Whenever you change the size of the change log or modify the ReplicationGovernor value, what must you do before the newly assigned value becomes effective?
16. What is the default value for the ReplicationGovernor?
17. What does the ReplicationGovernor control?
18. On which type of domain controller is the ReplicationGovernor configured?

For answers to the Instant Assessment questions see Appendix D.

Hands-on Lab Exercise

The following hands-on lab exercise provides you with an opportunity to use the techniques you've learned in this chapter to optimize Windows NT Directory Services in a WAN environment.

Lab 11.17 *Optimizing WAN link performance by the appropriate placement of BDCs*

Enterprise

The purpose of this lab is to provide you with hands-on experience in planning the optimization of WAN link performance by determining the appropriate number and placement of BDCs throughout a master domain model.

Your goal, in optimizing WAN link performance, is to optimize for efficient local user logon and authentication.

Scenario: You are planning to implement a master domain model for your company's multilocation Windows NT network. You have chosen to implement the master domain model that is shown in Figure 11-6. Notice that the LAS_VEGAS, SALT_LAKE_CITY, and ALBUQUERQUE domains trust the DENVER domain. Also note that the DENVER domain contains all of the user accounts.

Your company's three remote locations (Las Vegas, Salt Lake City, and Albuquerque) are connected to the Denver office by various-speed WAN links, as shown in Figure 11-7.

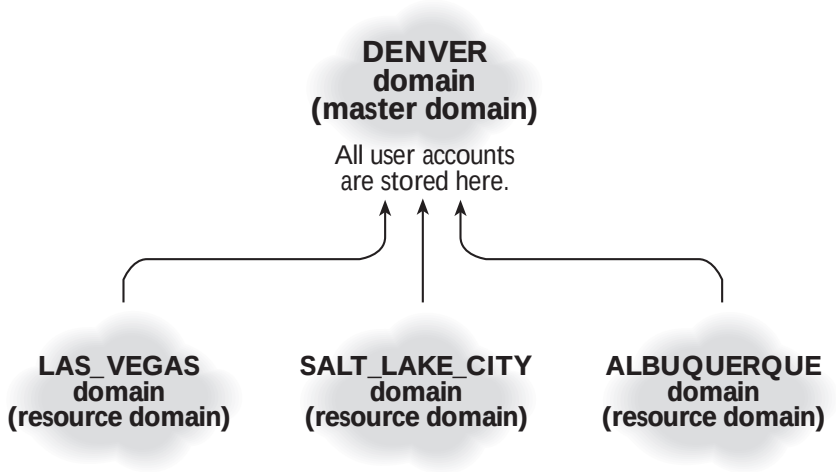


FIGURE 11-6 **Your company's domain model**

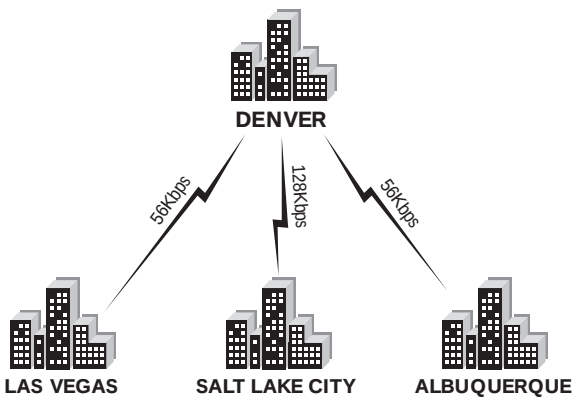


FIGURE 11-7 **WAN connections between your company's four locations.**

Your company has a different number of users at each of its four locations. Table 11-2 shows the number of users at each location.

TABLE 11-2 NUMBER OF USERS, BY LOCATION

LOCATION	*NUMBER OF USERS*
Denver	4,500
Las Vegas	2,700
Salt Lake City	3,800
Albuquerque	1,200

Your company's minimum hardware standard for BDCs is a 486/66 CPU with 32MB of RAM. The BDCs will be used *only* for user logon and authentication purposes.

The PDC will be located in the Denver office.

How many BDCs for the DENVER domain are required in each location to optimize your company's network for efficient local user logon and authentication? (Record your answers below).

Location	**# of BDCs**
Denver	_____
Las Vegas	_____
Salt Lake City	_____
Albuquerque	_____

For answers to the hands-on lab exercise see Appendix D.