

NIST Physics Laboratory

Time & Frequency Division

NIST

Configuring Windows 2000 and Windows XP to use NIST Time Servers

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Section 1: Purpose

- This document provides step-by-step instructions on how to use the NIST Internet Time Service (ITS) for computers running the [Windows 2000](#) or [Windows XP](#) operating systems. These operating systems have a built-in capability to use the NIST time servers to set and maintain the correct time on their computers' time-of-day clock.
- This document also provides background information and pointers that may be helpful for installing and running time synchronization software, in general, on a wider variety of computers.
- Comments and feedback on this document may be sent to timeinfo@boulder.nist.gov.



Section 2: Background Information

- Almost all modern computers contain a time-of-day clock. This clock also keeps track of the day, month, and year. (A separate “clock” governs the speed of the computer and is commonly quoted in megahertz or gigahertz.)
- The time clock in the computer is used to keep track of when documents (files) are created and last changed, when electronic mail messages are sent and received, and when other time-sensitive events and transactions happen. In order to accurately compare files, messages, and other records residing on different computers, their time clocks must be set from a common standard. It is particularly important that computers that are networked together use a common standard of time.
- In [Windows 2000](#) and [Windows XP Professional](#), a common time standard is also a critical element for secure network communication between computers within a “Domain.” Therefore, these versions of Windows include a “service” (a program that runs in the background, that you usually do not have to interact with) to synchronize a computer’s clock to the clocks of the other computers within the Domain. (Computers running [Windows XP Home Edition](#) cannot join Domains.)
- For a detailed description of the Windows Time Service, how it operates on a Windows 2000 network, and how it can be configured, please see the White Paper from Microsoft at: <http://www.microsoft.com/windows2000/techinfo/howitworks/security/wintimeserv.asp>
- In summary, when computers running [Windows 2000](#) (or [Windows XP Professional](#)) are networked together, centrally administered, and organized into a Domain, a hierarchy is established whereby a computer obtains the time from another computer at a ‘higher level.’ Ultimately, one computer (or more) at the ‘highest level’ is considered authoritative for the Domain. Using this method within a “site,” Microsoft expects the computer clocks to be synchronized to within 2 seconds of each other. However, within larger, more distributed enterprises, Microsoft allows the computer clocks to differ by up to 20 seconds.
- The design of this process puts a premium on assuring that all the computer clocks within a Domain have approximately *the same time*. However, an external source of information is required for the clocks to have *the right time*. Ideally, the goal should be for all the clocks to be automatically set from an accurate national standard.
- This document explains methods by which computers running Windows 2000 or Windows XP can get the time from the [National Institute of Standards and Technology \(NIST\)](#), an accurate and [official source of time in the United States](#). It is particularly relevant for three types of users:
 - 1) Administrators of an enterprise network who are responsible for establishing the correct time within an entire Domain
 - 2) Users within an enterprise network who need greater time accuracy or traceability than the enterprise network provides by default
 - 3) Users that are not within an enterprise network at all, such as home-computer users

- [The National Institute of Standards and Technology \(NIST\)](#) is a U. S. Government agency that maintains an [official time scale](#) for commerce in the United States. Certain regulations, for example those that affect the [securities industry](#), require time records to be traceable to NIST. NIST maintains the time scale using [atomic clocks](#), and they coordinate it with the time scales used by [other nations](#) and the [U.S. military](#).
- NIST disseminates the time using several methods. These include the long-standing time broadcasts over [short-wave](#) and [long-wave radio](#). In addition, two services are offered of particular benefit to computer users. They allow you to set your computer's clock from the atomic clocks. For computers with modems attached, NIST provides a [telephone dial-in service \(ACTS\)](#). For computers on the Internet, NIST provides an [Internet Time Service \(ITS\)](#).
- ACTS does not require that you have an Internet Service Provider, but does require a long-distance telephone call through a modem to Boulder, Colorado. ITS does not require long-distance telephone calls, but does require that your computer be connected to the Internet.
- The Windows Time Service (in [Windows 2000](#) and [Windows XP](#))—which implements the hierarchical time-synchronization scheme by default—also can be configured to get the time directly from NIST (via ITS) instead. Indeed, in [Windows XP Home Edition](#), it is the only way that it can be used. The main purpose of this document is to explain how to enable this feature.
- In this document, after choosing a NIST ITS server to use (Section 3), Section 4 is best suited for:
 - Users of Windows 2000
 - Users of Windows XP Professional who are connected to an enterprise network (i.e., Domain)
 and Section 5 is best suited for:
 - Users of Windows XP Home Edition
 - Users of Windows XP Professional who are not part of a Domain
- The Windows Time Service is available also for Windows NT 4.0. For details, please see <http://www.microsoft.com/technet/treeview/default.asp?url=/TechNet/prodtechnol/winntas/downloads/W32TIME.asp>. The principle differences for the Windows NT implementation (unlike the Windows 2000 implementation that is described in this document) are:
 - 1) If an older program named TIMESERV has already been installed, it must first be removed.
 - 2) W32TIME does not come preinstalled; you must download it from Microsoft.
 - 3) W32TIME is configured by editing a file named W32TIME . INI, rather than through the Command Prompt.
 - 4) You must run the command `W32TIME -UPDATE` to update the Registry after editing W32TIME . INI.
- There is other software available for Windows (all versions, not just 2000 and XP) that allows you to use ITS or ACTS. For example, any program that utilizes [Network Time Protocol \(NTP\)](#) servers can use ITS.

Publishers of Time and Frequency Software that are known to NIST are indexed here:

<http://www.boulder.nist.gov/timefreq/general/softwarelist.htm>.

NIST makes available free-of-charge an ITS client program for Windows. Instructions for it are found here: <http://www.boulder.nist.gov/timefreq/service/pdf/nts.pdf>.

Section 3: Choose a NIST Internet Time Service (ITS) Server

- Select a NIST ITS Server Address from the table below. Any of these servers should work, but the closer you are to the selected server the more accurate the time settings may be. The fluctuation in the time it takes for data to travel over the Internet will lead to slight errors (usually less than one second) in the time setting. The seven servers at the bottom of the table are the ones least used; they may give you the best results.

<u>Server Address</u>	<u>Location</u>	<u>(IP Address)</u>
time-a.nist.gov	NIST, Gaithersburg, Maryland	129.6.15.28
time-b.nist.gov	NIST, Gaithersburg, Maryland	129.6.15.29
time-a.timefreq.bldrdoc.gov	NIST, Boulder, Colorado	132.163.4.101
time-b.timefreq.bldrdoc.gov	NIST, Boulder, Colorado	132.163.4.102
time-c.timefreq.bldrdoc.gov	NIST, Boulder, Colorado	132.163.4.103
utcnist.colorado.edu	University of Colorado, Boulder	128.138.140.44
time.nist.gov	NCAR, Boulder, Colorado	192.43.244.18
time-nw.nist.gov	Microsoft, Redmond, Washington	131.107.1.10
nist1.datum.com	Datum, San Jose, California	63.149.208.50
nist1.dc.glassey.com	Abovenet, Virginia	216.200.93.8
nist1.ny.glassey.com	Abovenet, New York City	208.184.49.9
nist1.sj.glassey.com	Abovenet, San Jose, California	207.126.103.204
nist1.aol-ca.truetime.com	TrueTime, AOL facility, Sunnyvale, CA	207.200.81.113
nist1.aol-va.truetime.com	TrueTime, AOL facility, Virginia	205.188.185.33

Caution: The Server Addresses (and IP Addresses) in this list are subject to change without notice. While operational stability of the Internet Time Service is an important goal, changes cannot be avoided as NIST and the third-party hosts improve their networks. For the most up-to-date information on the NIST Internet Time Service, please see <http://boulder.nist.gov/timefreq/service/its.htm> and <ftp://time-b.nist.gov/pub/nist-srv.lst> .

The [University of Delaware](http://www.eecis.udel.edu/~ntp/) hosts a World Wide Web site (<http://www.eecis.udel.edu/~ntp/>) that provides additional information on the [Network Time Protocol \(NTP\)](#), its variant, the [Simple Network Time Protocol \(SNTP\)](#), and [other NTP servers](#) that are publicly available around the world. In many cases, Internet service providers, universities, and other institutions also provide NTP servers for their own communities. NTP servers other than the NIST ITS servers may or may not be of comparable accuracy, and may or may not satisfy traceability requirements.

Section 4: Configuring Windows 2000 & XP Professional to Use ITS

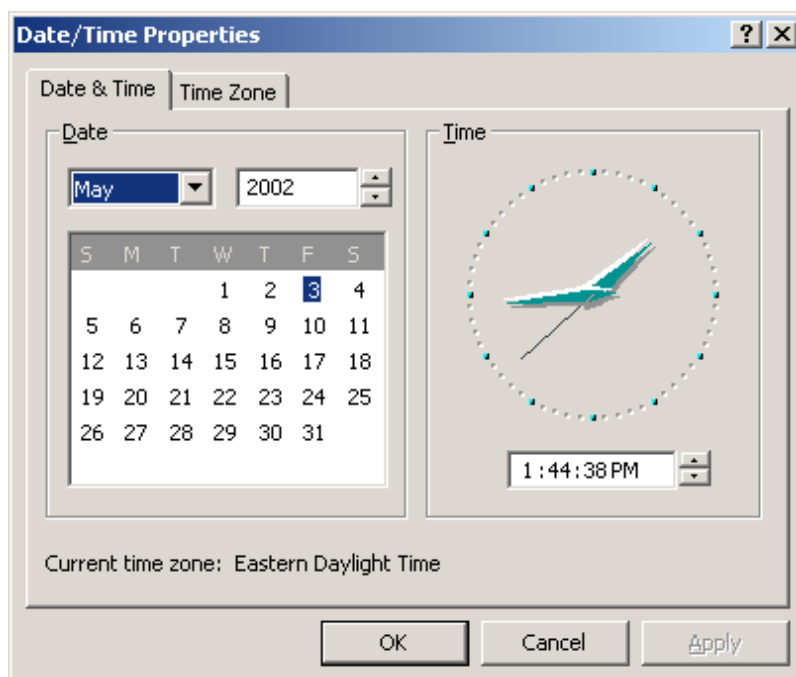
- **Caution:** Before attempting the procedure described in this Section, review the Background explained in [Section 2](#). You may not need to make these changes if your computer operates within a centrally administered Windows “Domain.” You should consider sharing this information (including the [White Paper from Microsoft on the Windows Time Service](#)) with your system administrator, as the better course of action might be changing the configuration of the Domain Controllers, rather than your individual computer. As explained in the [White Paper](#), this procedure—when implemented on individual computers rather than the Primary Domain Controllers—introduces certain security risks that would not otherwise be present on the enterprise network. Further, changes that cause your computer clock to differ by more than a certain amount from the clocks of other computers in your Domain (5 minutes by default, but changeable by Domain administrators) will cause you to lose network connectivity with the other computers within your Domain.
- **Note:** Before you begin, you may wish to check whether or not your computer clock is already close to the correct time—perhaps because your system administrator has already adopted an accurate external reference. Further, it is good to know how to check whether or not configuration changes make any improvement.

A low-tech but effective diagnostic is to listen to the NIST [WWV](#) broadcast over the telephone while watching the Date/Time Control Panel.

To open the Control Panel:

- 1) Click on the “Start” button
- 2) Move the pointer to “Settings”
- 3) Move the pointer to “Control Panel”
- 4) Click on “Control Panel”
- 5) Double-click on “Date/Time” (or click once and use the “Open” command)

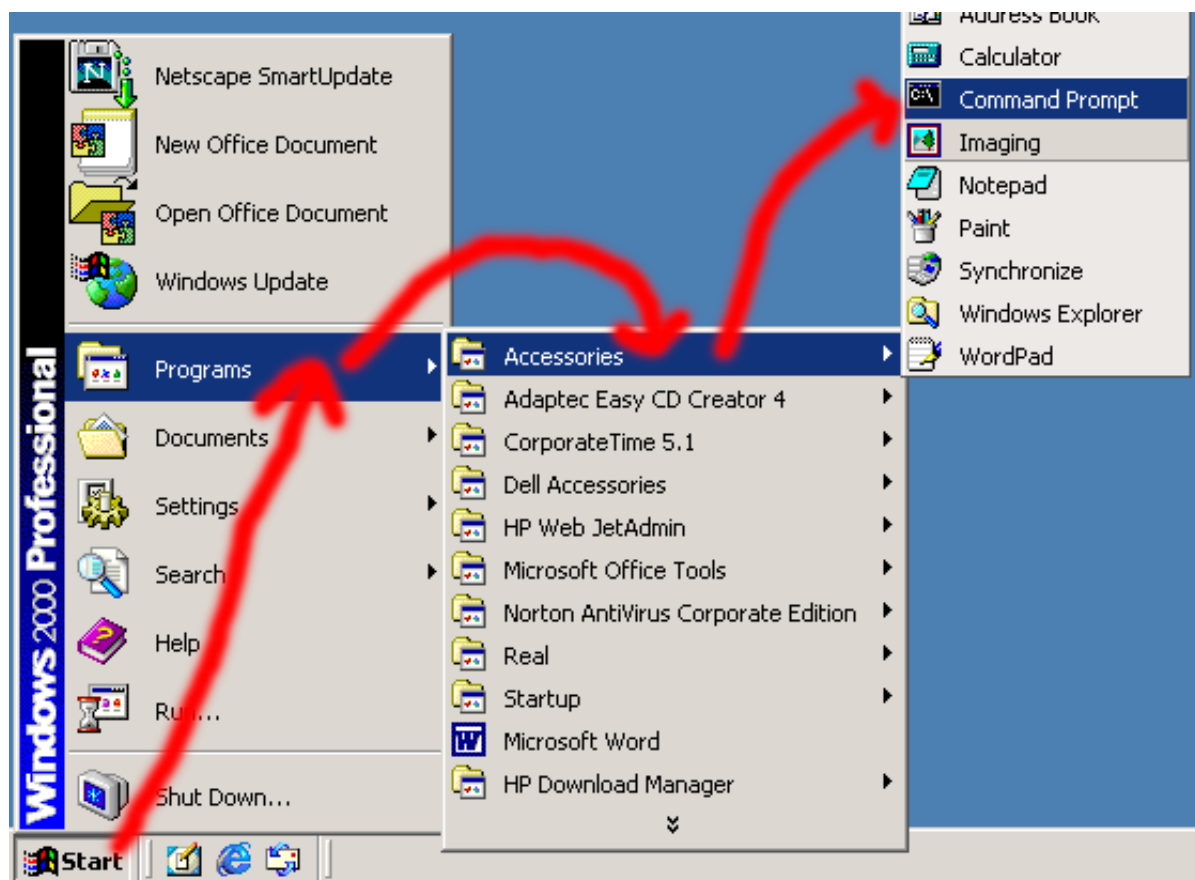
When completed, you will see:



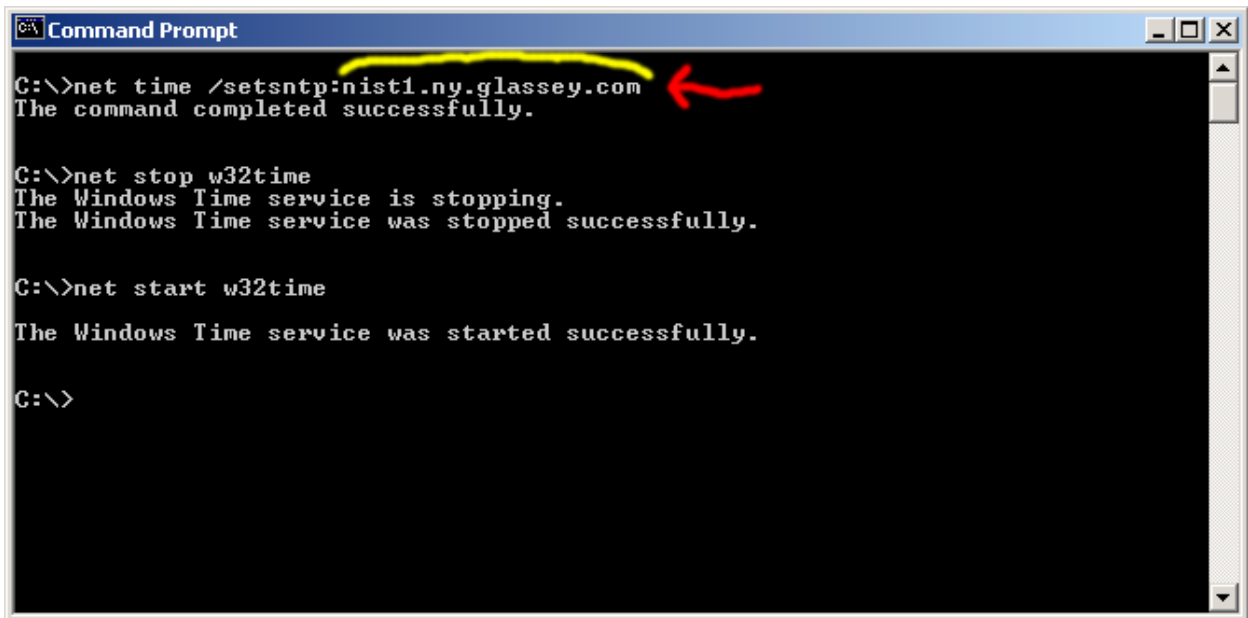
You can listen to [WWV](#) over the telephone by calling 303-499-7111. (Long distance charges to Boulder, Colorado may apply.) [Please note that other time-of-day telephone services are often not accurate. If possible, use an ordinary “land line” telephone—digital cordless and cellular telephones introduce noticeable time delays. Telephone calls from outside the contiguous United States may go by satellite, which also introduces noticeable time delays.]

Differences of less than half a second are typical; differences up to one second are common.

- The commands described in this Section are entered at the command prompt. To open the window with the command prompt: Click on the Start button, move the pointer to Programs; move the pointer to Accessories; move the pointer to Command Prompt, and click again. (If Command Prompt has not been used recently, move the pointer to the chevron symbol until Command Prompt appears.)



- At the command prompt, enter the command: `net time /setsntp:{Server Address}`, where {Server Address} is your selection, as shown:



```
Command Prompt
C:\>net time /setsntp:nist1.ny.glassey.com
The command completed successfully.

C:\>net stop w32time
The Windows Time service is stopping.
The Windows Time service was stopped successfully.

C:\>net start w32time
The Windows Time service was started successfully.

C:\>
```

- This configuration change is not effective until the Windows Time Service next restarts. If you have administrator privileges, you can manually stop and (re)start the `w32time` service by using the commands:

```
net stop w32time
net start w32time
```

Otherwise, you have to restart the computer.

- It is possible that the `w32time` service is not configured to start automatically when the computer is turned on, particularly for computers that are not joined to a Domain (e.g., home computers). To check, open the Administrative Tools folder within the Control Panel folder. Open the application named Services. Either select “Windows Time” and then use Properties command under the Action menu, or just double-click on the “Windows Time” line.

Before changing anything, make note of its initial state so that you can return to these settings later, if you wish. Clicking on the Start or Stop buttons has the same effect as the `stop` and `start` commands described above. You may also change the Startup Type to Automatic if appropriate.

- You may not see effects of this configuration change immediately. If the local computer clock is determined to be set too far ahead (into the future), but by less than three minutes, Windows will bring the clock into gradual (rather than sudden) adjustment. [Of course, you can force a rapid adjustment by ensuring that the local time is off by more than three minutes before (re)starting `w32time`.]
- To disable the use of any external NTP server (to return to the original configuration), enter this command (i.e., without any colon or named server):
`net time /setsntp`

- To query which external NTP server, if any, w32time will use when it next (re)starts:
`net time /querysnTP`
- Consult the [White Paper from Microsoft on the Windows Time Service](#) for complete information on w32time commands.

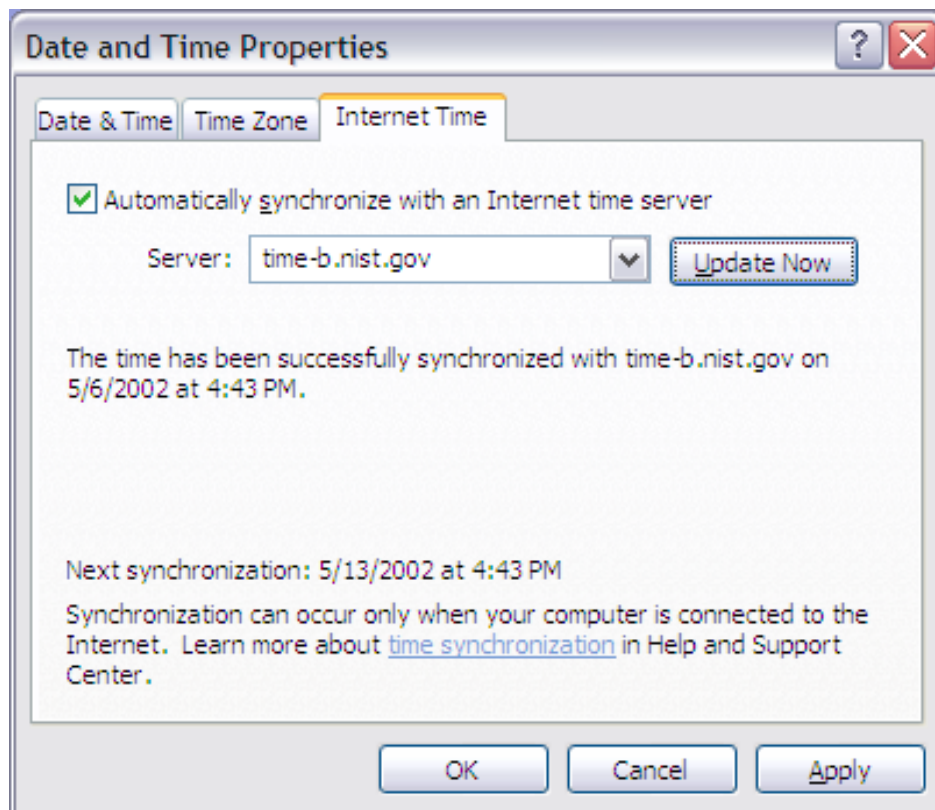
Section 5: Configuring Windows XP Home Edition to Use ITS

- There is a much simpler method to configure computers running Windows XP than that described in Section 4. However, it is only available if the computer is not part of a Domain.
- Open the Date & Time Control Panel. The Windows XP user interface varies slightly from computer to computer, so it is difficult to give detailed directions for this step. In general, when you click on the Start button, either “Control Panel” will be visible immediately, or you will find it under “Settings.”

However, there is usually a useful shortcut. If you double-click on the time shown on the bottom right of the screen, the Date & Time Control Panel will open.



- Click on the “Internet Time” tab, as shown below:



- Check the box labeled “Automatically synchronize with an Internet time server.”
- Type your chosen server name into the box to the right of “Server:”.
- Click on the “Update Now” button to ensure it is working properly.
- Click on the “OK” button to confirm the configuration change.
- You may have noticed that the time server is only polled once per week. (Windows 2000 polls it every 8 hours.) At this time, we are unable to report a confirmed method of changing the interval for Windows XP. However, a clue may be found here:
<http://support.microsoft.com/default.aspx?scid=kb;EN-US;q223184>
(Note: This link goes through the NIST “exit” page. Click on the link on the exit page.)

Experiment at your own risk!

Section 6: Troubleshooting Hints

- The overall accuracy of the NTP protocol is affected by many things, including the distance between you and the NTP server, the load on the network, and any firewalls or proxy servers that your site or Internet provider might have.
- The accuracy of NTP may be significantly degraded as a result of asymmetric delays between the incoming and outgoing traffic in a proxy system.
- If you have difficulty using a time server, your first course of action should be to try another server. However, if the problem is the same for all servers, the source of the problem might be a firewall or proxy server.

Windows Time Service uses NTP symmetric mode, which sends the request out on UDP port 123 and also receives the response on UDP port 123. If there is a firewall or proxy server on your network, outgoing and/or incoming traffic on port 123 may be blocked.

You will need to contact your network administrator to determine if this is what is happening on your network. There are two solutions to the problem, either of which needs to be done by the network administrator:

- 1) Reconfigure the firewall to allow both incoming and outgoing traffic on UDP port 123.
- 2) Set up a local network time server inside of the firewall.

Special arrangements might also need to be made if you are using a Microsoft Proxy Server. See the technical note at <http://support.microsoft.com/default.aspx?scid=kb;EN-US;q305135> for details. (Note: This link goes through the NIST “exit” page. Click on the link on the exit page.)

- Windows Time Service and ITS require connection to the Internet. Computers that connect to the Internet intermittently (e.g., using modems and telephone lines, or ISDN) may be configured to automatically place a call when a program needs Internet access. This means that, potentially, your computer might call your Internet service provider without your affirmation when it becomes time for Windows Time Service to query the time server. Furthermore, even though the time-synchronization transaction would be over very quickly, such a dial-up connection might linger for an extended period of time. It would be difficult for us to give specific advice on this subject because of the great variety of computer systems and user needs. Nevertheless, users should consider this issue when enabling Windows Time Service, and, if necessary, test the behavior of their system before leaving it unattended. One might, for example, manually advance the system clock to a point just before a scheduled update in order to witness the system’s behavior when the update becomes due.