DCF77

V2.00 Siemens Edition

Time Synchronisation Service for

Windows XP
Windows Vista
Windows 7
Windows Server 2003
Windows Server 2008/2008 R2

Usage Agreement

Trademarks

Version 2.00
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<u>Contents</u>

One second is the fundamental unit of time equal to 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of an atom of cesium-133.

Overview

The Time Synchronization Service evaluates the time signals emitted by the DCF77 transmitter of the Physikalisch-Technische Bundesanstalt PTB (the National Institute of natural and engineering sciences and the highest technical authority for metrology and physical safety engineering of the Federal Republic of Germany) at Mainflingen near Frankfurt, compares them with the system time of the computer and adjusts the system time, if necessary. The time signals can be read in different ways by a receiving module. The enclosed service type expects the time signals via one of the serial ports.

For more than 20 years the long-wave transmitter DCF77 has been emitting coded time information on the frequency 77.5 kHz. Due to its central position in Europe and its long range (up to 2000 km), the DCF77 time signal can be received not only in Germany. The emitted time information derives from the two atomic clocks CS1 and CS2 at the PTB and represents the legal time according to the Law of the Federal Republic of Germany since 1978. It corresponds to the Central European Time (CET) respectively to the Central European Summertime (CEST) and results directly from the internationally defined time scale UTC (*Universal Time Coordinated*):

$$CET = UTC + 1h \qquad and \qquad CEST = UTC + 2h$$

The start and the end of the "summertime" (Daylight Saving Time) are not appointed by law, but established by the Federal Government for a period of three to five years.

The highly precise time by the DCF77 transmitter has a variation of 1 s in 1 million years. In contrast, the comparatively simple clock element of a computer can't be as precise. Especially with servers and other computers which are operated without supervision for days or even for weeks, insignificant inaccuracies soon add up to important variations which are no longer tolerable.

The DCF77 Service keeps the time difference between the system time of the computer and the legal time within predefined limits. Thus, the recorded times can be reliably compared with the logs of other systems and measuring devices (and eventually you can set your digital watch according to the system time of your computer instead of vice versa).

The signals emitted by the DCF77 transmitter are received very reliably within office buildings, and even in production halls. The field strength is hardly attenuated by common walls and roofs. Even with ferro-concrete walls the attenuation of long waves is much lower than of short waves or even ultra-short waves. In most cases it even doesn't make sense to adjust the system time after every minute since the time variation is only a few milliseconds. That means some correctly received time updates per day are sufficient to assure the required precision of the system time.

Installation

System Requirements

Hardware   1 free serial port to connect the receiver module

Software   One of the following operating systems:
Microsoft® Windows XP SP3
Microsoft® Windows Vista
Microsoft® Windows 7 (32-Bit or 64-Bit Version)
Microsoft® Windows Server 2003
Microsoft® Windows Server 2008 or 2008 R2

Installing

To install the DCF77 Synchronization Service you need access to an user account with administrator privileges.

- Connect the receiving module to the assigned serial port.

- Start the *Setup.exe* on your installation device.

- As soon as setup is active, please follow the instructions on the screen.

- Start the "DCF77 Settings" application under Start → All Programs.

- Verify and change the settings if necessary (e.g. the name of the serial port to which the receiving module is connected) and click the *OK* button.

- Close the application.

- Deactivate the FIFO-Buffer for the specified serial port. To do this go to the Windows Device Manager, go to the properties of the COM port you are using, select the "port settings" tab and click on "Advanced". Now disable the check box and the FIFO-Buffer isn't used anymore.

All receiving modules are usually equipped with a light-emitting diode (LED), which is blinking at the clock pulse of the time signal. After having started the service, the LED may emit permanent light for up to a minute und should then start blinking every second.

If the LED is blinking irregularly, too often or not at all, the signal conditions are too bad at this place or in this location. Keep a distance of at least 1 m to any computer, monitor or other metal surfaces. Position the receiving module at a place where the LED is blinking regularly every second.

If the serial port is equipped with a hardware FIFO, you have to turn it off via the control panel. In the control panel double click on *Connections*, select the corresponding port, click on *Settings*... and in the dialog box which opens on *Options*. Deactivate the checkbox *use FIFO*, then close the dialog boxes.

Uninstall

If you want to remove the time synchronization service from your computer, log in as Administrator and use the Windows uninstall routine.

Note: After having removed the time synchronization service, you will get numbers displayed in the *Event Logger* instead of text messages for the corresponding entries.

Operation

Due to the implementation of the time synchronization as a system service under Windows, the processing of the received time signals is started immediately after launching the operating system. No user needs to be logged in.
Like other system services, the time synchronization service can be started and terminated via the service control manager of the control panel. All changes of parameter settings are made by using the application "DCF77 Settings".

DCF77 Settings

The time synchronization service installs an application called "DCF77 Settings" under "All Programs", which allows you to change the settings. For that purpose, start this application.

A description of the different parameters can be found in chapter *Registry Database* (page 9).

If you don't have the authorization required to change the settings (you aren't logged in as administrator), the window is displayed, but you are not able to make any changes.

If the program can't store your changes in the registry database, an appropriate warning will be displayed.

Parameter changes will only become effective after restarting the service, as the DCF77 Service reads the current settings from the registry database only during startup.

Timezone

The Earth is divided in different time zones. Every country decides on its own which time zone to join. The central European countries joined the zone called *Mitteleuropäische Zeit* (Central European Time), which is emitted by the DCF77 transmitter. Your computer has to be adjusted to this time zone, then the service should operate correctly. You can change the time zone via the system panel *Menu*, *Settings*, *Date/Time*. If another time zone than MEZ/MESZ has been selected, for security purposes the synchronization service doesn't synchronize the system time at all. However, the time synchronization service can be used in another time zone as well to synchronize the system time, by deactivating the option *Verify Time Zone MEZ/MESZ* in the control panel supplement. There you also can select via *Time Reference* whether the received time signal is referring to MEZ/MESZ – the default setting, which normally shouldn't be changed – or to your *Local Time*, that means the time zone selected in the control panel, or to *UTC (Universal Time Coordinated)*. If you select a different setting than MEZ/MESZ, be sure to deactivate the option *Verify Time Zone MEZ/MESZ*, because if it is activated the system time will not be synchronized by the time synchronization service

Software Activation

To protect your and our investments, since 2011 our products are protected to prevent unknowingly malpractice. Because we are anxious to keep it as less time-consuming for our clients as possible, we're anxious to use the same procedure in all our products.
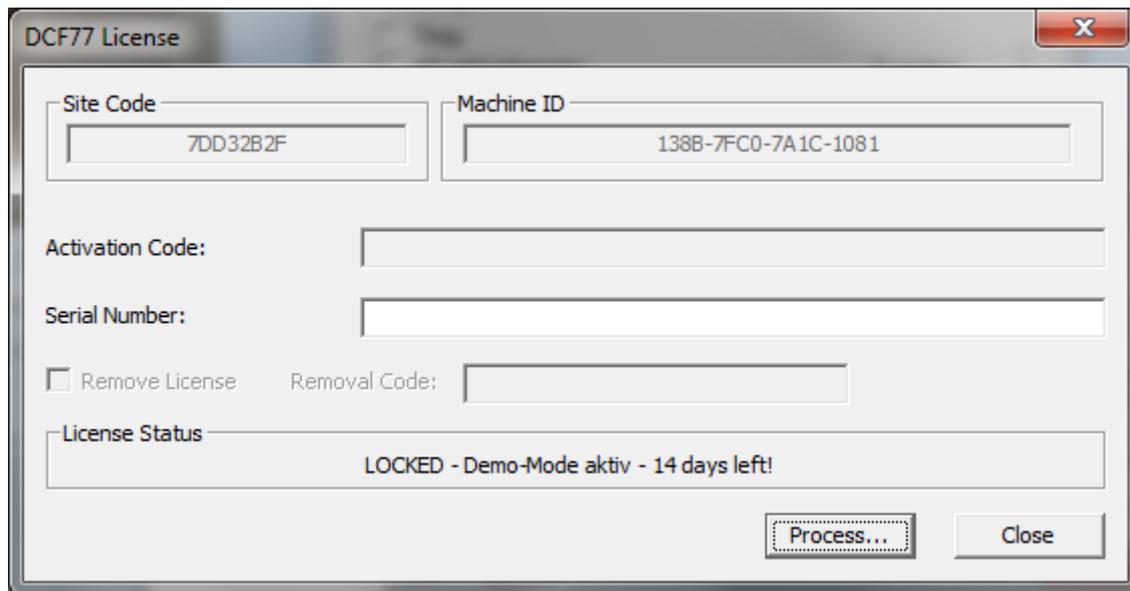
After your purchase you'll get a unique serial number from us or your reseller. Depending on your order, this serial number can have one or several licenses assigned. If you decide later on to increase the number of licenses, this number can be increased without using a new serial number. Please insert this serial number in the desired field.

Of course you have the possibility to evaluate our product for free. This duration is limited to 14 days, in this time you can use the program without any restrictions.

Event Viewer

All relevant events are appended to the Windows Event-Log within the event viewer. These events are:

- if the service is started or terminated
- if the service is stopped or operation is resumed
- if the time signal is missing (after having started the service)
- if the quality of the time signal is too bad (after having started the service)
- if a leap second is announced
- if changes between MEZ and MESZ are announced
- if changes between MEZ and MESZ are made
- if the system time of the computer is synchronized
- if an error occurs during system calls

The following events can be recorded as well, if required:

- changes of the signal quality
- each correctly received time telegram (normally once a minute!)
- the result of each time comparison (according to the ac*tualization interval*)

For the last two events additional data is entered: For *every correctly received time telegram* the content of the telegram itself (58 Bit) and for the *result of the time comparison* the time (in milliseconds) provided by the system call GetTickCount() since the operating system has been started.

When a system call fails, the entry in the event log will contain an error code returned by the operating system. The following screenshot is an example for one of these entries:
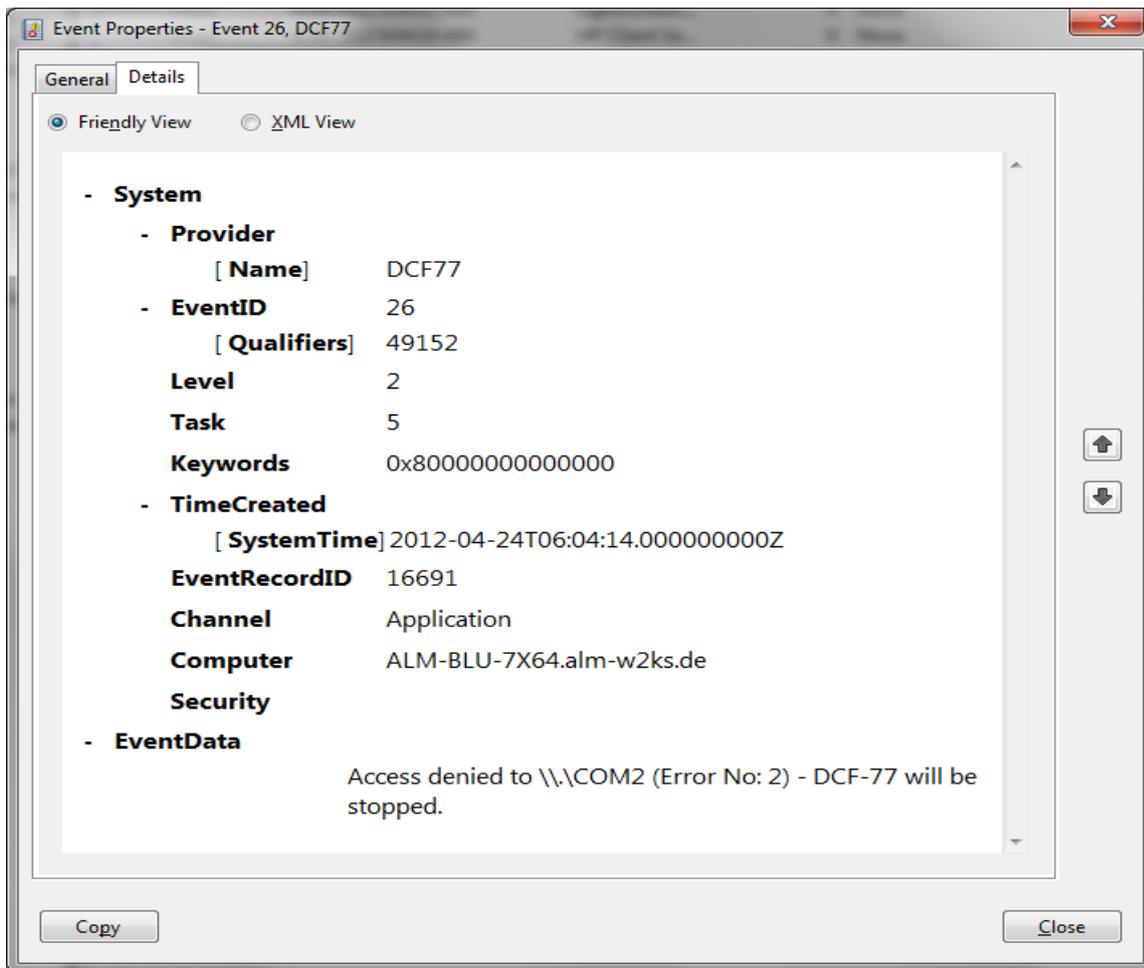
Some of the most common error codes are:

Error code	Description
20002	The specified serial port is NOT known by the operating system.
20005	Access denied (The specified serial port might be used by another program)

Technical Background for software developers

Application programs receive a WM_TIMECHANGE message, every time the service is changing the system time.

Especially for programs that produce time controlled actions an exact evaluation of this message is important. Basically the system time is synchronized at the beginning of every minute. As the deviation of the system time of the computer normally increases very slowly after a synchronization (only some milliseconds per minute), the next synchronization follows approximately at the "*maximum deviation*" value set. In case the synchronization takes place just at that moment when the application program should release an action, it is possible, that the release time is never recognized (if the system time is "set forward") or even twice (if the system time is "set back"). Therefore, such programs need to consider any variations of the system time and evaluate this message.

Every time the computer is shut down (or rather, the operating system), the system time is synchronized. In this way, despite of "Use Drift Compensation", the hardware clock component of the computer is adjusted as well to the correct time in order to reduce the time deviation to a minimum when the computer is restarted. As the clock component of a computer can be adjusted only with a precision of one second, you should expect deviations in system time of +/- 1 s after restarting the computer. You can observe this (and thus register within the event viewer, too) by activating the *time comparison* events via the control panel.

Registry Database

Entries within the registry database of Windows are made during the installation at three places below the key „**\Registry\Machine**" (the program REGEDIT displays this key as HKEY_LOCALMACHINE).

Standard operation usually doesn't require any changes of these entries.
ATTENTION: Changes within the registry database should be made only by competent users!

1. Under **SYSTEM\CurrentControlSet\Services\DCF77** those entries are made which are required by *Service Control Manager* for each service. These entries are made during the installation of the Service.

2. Under **SOFTWARE\IB Alm\DCF77** and accordingly on a 64-Bit operating system **SOFTWARE\Wow6432Node\IB Alm\DCF77** those parameters are registered which the service itself uses. These entries are made during the installation using standard values which can be changed later by the user via the control panel.

3. Under **SYSTEM\CurrentControlSet\Eventlog\Applications\DCF77** those entries are made which are required by the Event Logger service. These entries are made by the DCF77 Service itself when it is started for the first time.

The meaning of the parameters for the Service under \Registry\Machine\SOFTWARE\IB Alm\DCF77 and accordingly on a 64-Bit operating system SOFTWARE\Wow6432Node\IB Alm\DCF77 is the following:

- **Aktualisierungsintervall (Interval):**
  Specifies how many time telegrams (=minutes) after the initial actualization, the next comparison and possibly a correction of the system time will be made.
  Default: 1

- **ErstAktualisierung (First update after):**
  Specifies after how many correct time telegrams (=minutes) the first comparison with the system time is made. If the comparison shows a to high deviation (see parameter *tolerance*), the system time of the computer will be corrected. In order to avoid as many reception errors as possible, you should enter here at least value 2.
  Default: 3

- **Optionen (Options):**
  They enable advanced users to adapt the features of the DCF77 Service.
  The following options are currently available:
     0x0008 Inhibit Synchronization
     0x0010 Use Drift Compensation
     0x0080 Increase thread priority

  If *"inhibit synchronization"* is selected, the system time will not be adjusted. This option serves e.g. for recording variations.
  "*Use Drift Synchronisation"* adapts the system time smoothly to the current time, provided that variations remain below the maximum value allowed (*tolerance*). For that purpose, the internal passage of time will be either slowed down or accelerated by 1 ms per 1 second resp. 60 ms per 1 minute maximum.
  Default: 0x0090

- **Protokollieren (EventLog):**
  Releases the recording of certain events in the event viewer. The following values can be combined:
     0x0010 comparison with the system time
     0x0020 each valid time telegram
     0x0080 changes of signal quality
  Default: 0x0080

- **Seriell (Port):**
  Name of serial port, e.g. *COM2*
  Default: COM2

- **Signalquelle (Source):**
  Must have value 1 (=reception via serial port).

- **Toleranz (Maximum deviation):**
  Represents the maximum deviation allowed (in ms). If it is exceeded, the system time will be adjusted (no smooth alignment).
  Default: 0x1d4c (7500)

The following checks are executed for every received telegram:

- The system time of the computer is not adjusted if the time variation is more than 5000 sec.

- The reference time transmitted in two consecutive telegrams must differ by 1 minute exactly, otherwise the reception is being interfered.

LAN

Of course there is a possibility to synchronize the time between Windows based computers, too. In this scenario there is one time reference server, which uses the time synchronization service via a serial module and several clients. For this use case we developed the software "DCF77 Client". If you like more information about that, don't hesitate to contact us.

Error Messages

In case of an error during startup or operation, which doesn't allow the service to proceed, an explanatory message is entered in the event logger and the service will be terminated. If the error occurs during startup, the service control manager displays a code number referring to the error cause:

The meaning of the code numbers displayed in these messages is as follows:

Code No.	Description	Recommendation
1	Cannot access the signal source.	Check the settings for the time synchronization service in the DCF77 Settings application
2	The serial port couldn't be adjusted as required	Check the settings for the time synchronization service in the DCF77 Settings application
3	The serial port couldn't be adjusted as required	Check the settings for the time synchronization service in the DCF77 Settings application
4	The service cannot access required resources.	
5	The service cannot access required resources.	
6	The service cannot access required resources.	
7	The program file is damaged.	Reinstall the service. If the error still occurs, the setup disk may be damaged
8	The function „RegisterEventSource" was unsuccessful	
9	The entries for the service in the registry database are not correct	Check the settings for the time synchronization service in the DCF77 Settings application
10	An internal test was not successful	Reinstall the service. Check the settings for the time synchronization service in the DCF77 Settings application
11	An error occurred during signal reception from the serial port	
12	An error occurred during signal reception from the serial port	
13	An error occurred during signal reception from the serial port	
42	Time signal could not be received because the FIFO-Buffer of the selected COM-Port was not disabled	Check the settings of the selected COM-Port and disable FIFO-buffer

Troubleshooting

Problem: During startup the service displays the service specific error code 1 and terminates automatically.
Solution: Make sure that the serial port selected in the control panel for the DCF77 time synchronization service is not yet used by another application.

Problem: The time is not being adjusted and the message 'The time signal reception is too bad' has been entered in the event logger. The light-emitting diode (LED) of the module is not blinking.
Solution: Check the settings for the DCF77 time synchronization service in the control panel regarding the correct selection of the serial port, as well as the proper connection of the receiving module to the desired port.

Problem: Although the light-emitting diode (LED) of the receiving module is blinking regularly every second, the time is not synchronized. The message 'The time signal reception is too bad' has been entered in the event viewer.
Solution: Make sure that in the control panel the FIFO option has been deactivated within the properties of the used port.
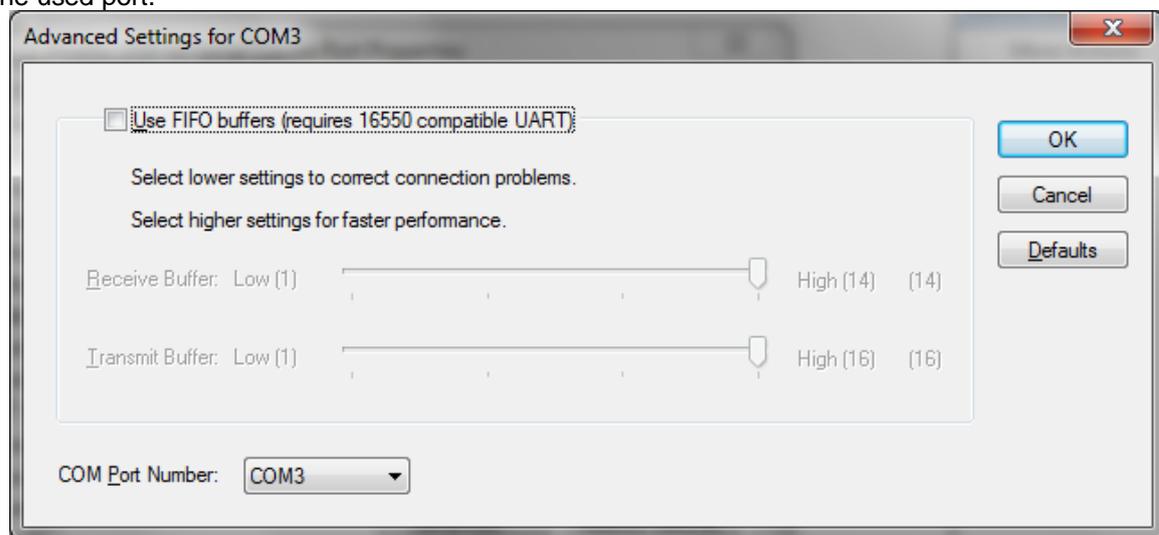
Problem: The DCF77 time synchronization service is running correctly, but the system time hasn't been changed from summertime (Daylight Saving Time) to standard time or vice versa.
Solution: Even when using the DCF77 time synchronization service, the option 'Change clock automatically to summertime (DST) resp. standard time' must be activated in the control panel for *Date/Time*.

Questions?

Your feedback is important to us. Please call or send comments, questions, or suggestions to:

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