MANUAL

Meinberg PTP-Client
Software for Windows and Linux

26th September 2019
Meinberg Funkuhren GmbH & Co. KG
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1 Imprint

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2 Meinberg PTP Client for Windows and Linux - End User License Agreement (EULA)

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3 Introduction

The Meinberg PTP client software enables Microsoft Windows and Linux servers and desktop PCs to synchronize time by implementing an IEEE 1588-2008 PTP stack with software and hardware timestamping support. The PTP client provides a comprehensive PTP feature set that is available for the two major operating systems by using the Oregano Systems PTP stack as its core. Users can configure the software to work with any PTPv2 Grandmaster Clock or PTP-enabled network infrastructure by supporting most PTP configuration options and operating modes listed in the PTP standard.

The software supports Default, Enterprise, Power, Telecom, Broadcast and AVB/TSN profiles. Software timestamping can be used on any of the supported operating systems with any Ethernet adapter supported by the operating system. IEEE 1588 hardware timestamping is currently supported on Windows for Oregano network cards that are PTPv2 enabled. For Linux systems, hardware timestamps can be enabled besides the Oregano PCI card for all PTP-capable network cards that use the standard PTP kernel framework (PHC).

The PTP client software has been tested on a wide range of Linux distributions and is available as an installation package that can be used with the distribution’s package manager to install, update or remove the PTP client from any system. For Microsoft Windows, an installation program is provided that can be used to install the software interactively or in an automatic, unattended setup. Tests with different Linux and Windows systems were conducted on both physical machines and virtualized environments and showed excellent synchronization performance. For example, the system time of a Windows 2016-based server can be maintained with less than 100 microseconds deviation from UTC time.

The license for the Meinberg PTP Client Software is always bound to a MAC address of a network port that is to be used for PTP synchronization. If the PTP Client is running without a valid license file, the demo mode is activated and the system time corrections are deactivated after 72 hours.
4 Technical Details

Operating Systems

Windows-Versions:
Installation software (supports unattended installation) with the PTP client service and a graphical user interface is available for the following Windows versions:

- Windows 7 SP1 | 32 & 64 bit
- Windows 10 | 32 & 64 bit
- Windows Server 2016 | 64 bit

Linux-Versions:

- Centos 6 | 32 & 64 bit
- Centos 7 | 64 bit
- Debian 9 | 32 & 64 bit
- Fedora 25 | 32 & 64 bit
- Fedora 26 | 32 & 64 bit
- Fedora 27 | 32 & 64 bit
- RHEL 6 | 32 & 64 bit
- RHEL 7 | 64 bit
- SLE12 | 64 bit
- SLE12-SP1 | 64 bit
- SLE12-SP2 | 64 bit
- SLE12-SP3 | 64 bit
- openSuse 42.1 | 64 bit
- openSuse 42.2 | 64 bit
- openSuse 42.3 | 64 bit
- Ubuntu 16.10 | 32 & 64 bit
- Ubuntu 17.04 | 32 & 64 bit
- Ubuntu 17.10 | 64 bit

Supported Network Protocols:

- Layer 2 / Ethernet IEEE 802.3
- Layer 3 / IPv4
- Layer 3 / IPv6
Communication Model:

• Unicast
• Multicast
• Hybrid Multicast/Unicast

Delay Mechanism:

• End-to-End (E2E)
• Peer-to-Peer (P2P)

Message Rates:

• From 1/128s to 128/s for sync and delay request/response messages

Supported PTP Profiles:

Default: IEEE 1588v2 PTPv2 Default Profile
Enterprise: Hybrid unicast / multicast mode according to Enterprise Profile Draft RFC
Power: IEEE C37.238-2011
Power: IEEE C37.238-2017
Telecom: ITU-T G.8265.1 Frequency synchronization
Telecom: ITU-T G.8275.1 Phase/Time with Full Timing Support from the Network
Telecom: ITU-T G.8275.2 Phase/Time with Partial Timing Support from the Network
Broadcast: SMPTE ST 2059-2 for IP-based TV Studio Environments
AVB/TSN: IEEE 802.1AS Profile for Audio/Video Bridging and TSN (Time Sensitive Networks)
5 Use under Windows

5.1 Program Installation

To install the PTP Client, execute the installation file and follow the instructions of the setup program:

The installation includes the actual PTP services as well as the "PTP Management Console" interface for configuration and status display. During the installation, Windows services are registered with the display names "Meinberg PTP" and "Meinberg PTP Hardware Timestamping". The "Meinberg PTP" service is automatically started by default at system startup. The "Meinberg PTP Hardware Timestamping" service is started automatically if hardware timestamping is activated by configuration.

The desired installation path can be set during installation.

5.2 License Installation

When starting the service, a valid license is automatically searched for in the installation directory. The license file contains an encrypted list of licensed MAC addresses. The installation of the license can be done manually or with the included program.
5.2.1 Installation via the graphical user interface

To install a license via the program, you can use the "Import" function of the supplied program. To do this, open the "Diagnostics & Licensing" tab in the program (step 1 in the picture).

There you use the "Import" function of the program mentioned above. The successful procedure will be acknowledged with a corresponding message.

5.2.2 Manual Installation

You can simply copy the license file to the installation directory via Explorer or command line.

Please note:
The file name of the license file must be 'license.dat' for the service to recognize the license.
5.3 Configuration and Status

The following chapters describe the individual submenus of the PTP Management console, which can be reached via the navigation (see figure).

The current status of the PTP port is always displayed in the left half of the screen.

The following information is visualized:

1) Current PTP service status
2) Currently selected PTP port
3) PTP Port Status
4) Hardware timestamp indicator

If more than one PTP port is active on the system, you can select the port whose status you want to have visualized using the blue arrows (no. 2 in the figure). The currently displayed PTP status (no. 3 in the figure) includes the current port status (e.g. slave), the offset to the grandmaster and the determined path delay. The “Hardware Timestamping” indicator (No. 4 in the figure) gives a quick indication of the current state of the hardware timestamp function, which is as follows:

- Gray: The port does not use hardware timestamps.
- Yellow: state is unknown or is determined
- Green: Hardware timestamp is active and is applied correctly to the selected port
- Red: There is an error. Further information can be found in the log of the service.
5.3.1 Main Window

The main page provides control of the installed PTP service in the category “PTP Service Control” (No.1 in the figure). The service can be started, stopped or restarted using the appropriate buttons. The path to the application directory is also displayed.

The category “PTP Port State Information” gives detailed information about the PTP port. The determined information always refers to the currently selected PTP port (see Configuration and Status). Depending on the selection made, extended information about the current Grandmaster or the PTP domain can be determined. A PTP packet counter is also available. The desired information is displayed in area no.3 of the figure. The Packet Counter can be seen as an example in the figure.

To display information about the current Grandmaster, the PTP port must be located in the ‘Port State: Slave’ must be located.
5.3.2 Program Settings

The program settings can be used to configure whether the program should be started automatically at system startup and minimized to the system tray. The following figure shows the corresponding icon.

![Program Settings Icon](image)

With the button "Add PTP Port" another PTP port can be added, which can also be configured with this program.

⚠️ There are global restrictions on the maximum number of possible PTP ports. This is visualized by the program with a corresponding message.

![Warning Message](image)
5.3.3 Diagnostics & Licensing

To assist the user in troubleshooting, the program provides a set of diagnostic checkpoints that provide a rough overview of the state of time synchronization on the system.

The "Diagnostics" section has a tabular structure. Each ID indexes a single checkpoint. The status of the individual checkpoints is indicated by the signal colors green (→ OK!) and red (→ Error). In the "Details" column you get a short description about the status. The description varies depending on the state of the checkpoints.

Example using the Windows Time Services W32Time:

**Status OK**

Windows Time Service is not running.

**Error State**

Windows Time Service is running. Please consider that only one service should adjust the system time!

A review of the checkpoints is done every 60 seconds.
5.4 PTP Configuration

The menu ‘PTP Configuration’ allows you to configure the created PTP ports and to save the configuration. Each port can be configured separately. The PTP port to be configured must be selected in the corresponding drop-down field (number 1 in the figure).

The PTP configuration is divided into 4 different chapters, which can be accessed via the navigation and the corresponding tabs (number 2 in the figure).

- General Settings
- Network Settings
- PTP Settings
- Manual Configuration

Help on the available configuration parameters for ‘General Settings’, ‘Network Settings’ and ‘PTP Settings’ can be found directly in the program.

Please note: If you make a change under ‘Manual Configuration’, changes that were previously made on other tabs without saving will not be taken into account during the saving process.

Changes under "Manual Configuration" should only be made by skilled personnel or on the instructions of a Meinberg employee. Faulty parameterization can lead to incorrect behavior of the PTP service.
5.5 Statistics

As long as the program is active, statistics are logged continuously. The statistics are written daily in files, which can be found in the installation directory of the program. The file name has the following format:

`ptp_client_stats_YYYY_DDD`

**YYYY** describes the year.
**DDD** describes the day of the year, beginning with 1.

<table>
<thead>
<tr>
<th>Time stamp</th>
<th>Offset to the Grandmaster</th>
<th>Determined path delay</th>
<th>PTP port status</th>
</tr>
</thead>
<tbody>
<tr>
<td>06:30:25</td>
<td>0.0000000000</td>
<td>0.0000000000</td>
<td>Listening</td>
</tr>
<tr>
<td>06:30:42</td>
<td>-0.000006698</td>
<td>-0.001300566</td>
<td>Slave</td>
</tr>
<tr>
<td>06:30:58</td>
<td>-0.001638914</td>
<td>0.002401017</td>
<td>Slave</td>
</tr>
<tr>
<td>06:34:42</td>
<td>-0.001716686</td>
<td>0.002235555</td>
<td>Slave</td>
</tr>
</tbody>
</table>

The columns describe the following values:

1. Time stamp
2. Offset to the Grandmaster
3. Determined path delay
4. PTP port status
The data in the file can be visualized via the program.

To do this, select the desired day from the calendar (number 1 in the figure). If available, you can use the "Create Chart" function (number 2 in the figure) to create a graph that visualizes the values from the log file for the respective day. Number 4 in the figure shows an example of a graph. The X-axis shows the time, the Y-axis the offset in nanoseconds. If desired, you can save the currently displayed graph as an image file in the file system of your PC (section 3 in the figure). If no statistics are available for the selected day, this will be reported by the program.
5.6 Events

The PTP Management Console provides its own logging, which writes detailed information to the Windows Event Viewer.

The events can be viewed via the program or alternatively via the Windows Event Viewer. Events are written to the log file "Windows logs/application".

The following event IDs are written:

- 0 - General Information
- 10 - PTP service was started
- 11 - PTP service was stopped
- 98 - Warning
- 99 - Critical error
- 110 - service for hardware time stamping was started
- 111 - Hardware time stamping service stopped
- 510 - PTP port status change
- 510 - Status change at the PTP Grandmaster
- 199 - Debug

The events in the program are displayed in two steps. After a click on the button "Load Events" (number 3 in the figure) an overview of all service related events is generated in tabular order (number 1 in the figure). If a single event is now selected, the details are loaded in the corresponding text box at the bottom of the graphical user interface (number 2 in the figure).

The service writes additional logs, independent of the graphical program, which are not recorded in the Windows Event Viewer. This log file can be read and visualized by clicking on "Show Service Log" (number 4 in the figure).
6 Use under Linux

6.1 Installation and Configuration

Extract the appropriate installation package for your Linux distribution from the provided archive and install it with the package manager of your Linux distribution. For rpm based distributions like openSuse, Suse Linux Enterprise (SLE), Red Hat Enterprise Linux (RHEL), CentOS, Fedora or Oracle Linux you can use the low level tool rpm, or one of the appropriate package managers like yum, dnf or zypper. For Linux distributions based on Debian, the low level tool dpkg or package manager such as apt, apt-get or aptitude can be used.

The Meinberg PTP service is installed in the `/etc/mbgptp/` directory. To start the service you need a configuration file named `service.cfg`. This file is not available after the installation to prevent starting the service with a default configuration. Copy the default configuration file `/etc/mbgptp/default.cfg` and save it under the name `service.cfg` in the same directory. Then open the file with an editor. The file contains all available configuration parameters including explanations. It is important to first specify the name of the network interface to be used for PTP synchronization in the interface parameter.

Example:

```
# interface:
# The IP-Address (IPv4 or IPv6; windows and linux) or interface name
# (IPv4 or Layer2; linux only) of the desired
# of the Port you want to configure.
interface eth5
```

By default the service is configured as Multicast Slave, Layer 3, End to End Delay mechanism and PTP Domain 0. The default settings can be changed via the corresponding configuration parameters, for example:

```
# domain: (uint8_t) [0]
# Sets the PTP domain number.
# domain 0
...

# delay_mechanism: (E2E,P2P,None) [E2E]
# Selects the used delay mechanism:
# E2E...End to End delay measurement
# P2P...Peer to Peer delay measurement
# None..No delay measurement (syntonization)
# delay_mechanism E2E
```

On Linux systems with `SysVinit` as the init system, the service is stopped after installation. The following commands can be used to start/stop and check the status:

```
service mbgptp status
service mbgptp start
service mbgptp stop
```
For Linux systems with **systemd** as the init system, please note that the **mbgptp** service must first be enabled after installation, since according to the systemd policy, services installed subsequently may not be started by default. Execute the following command with root rights:

```
systemctl enable mbgptp
```

The command creates the appropriate link so that the service can be started via **systemd**. The following commands can be used to start/stop and check the status:

```
systemctl status mbgptp
systemctl start mbgptp
systemctl stop mbgptp
```

On both Init systems a status file is written under `/var/run/mbgptp.status` after successful start of the service, which is updated every second. The following example shows the status file of a system running as multicast slave in PTP domain 84:
[root@vm-centos-6-64 mbgptp]# cat /var/run/mbgptp.status
mbgptp Status
--------

Host name : vm-centos-6-64
Status Created : 2018-02-28 13:56:54.291529 (UTC)
Domain number : 84
Network Protocol : L3 (UDP/IPv4)
Delay Mechanism : E2E
Port State : Slave
Local ClockIdentity : 00:0C:29:FF:FE:68:5B:01

Parent ClockIdentity : EC:46:70:FF:FE:00:69:4A/1
GM ClockIdentity : EC:46:70:FF:FE:00:69:4A
GM Priority1 : 128
GM Clock Class : 6
GM Clock Accuracy : $\pm 250$ ns (0x22)
GM Clock Variance : 13056
GM Priority2 : 128
Announce ival : 0
Sync ival : -2
DelayReq ival : -2
PDlyReq ival : 0
Announce Rec Tout : 3

Offset from GM : -0.000005661 s
Mean Path Delay : 0.000151881 s
Steps removed : 1

UTC offset : 37 s
Flags : UTC valid: Y, Time traceable: Y,
Freq traceable: Y, leap61: N,
leap59: N (hex: 0x3C)

Time Src : GPS (0x20)

Packet Counter:
Announce Msg RX : 108 (1.00/s)
Announce Msg TX : 0 (0.00/s)
Sync Msg RX : 420 (4.00/s)
Sync Msg TX : 0 (0.00/s)
FollowUp Msg RX : 0 (0.00/s)
FollowUp Msg TX : 0 (0.00/s)
DelayReq Msg RX : 0 (0.00/s)
DelayReq Msg TX : 409 (4.00/s)
DelayResp Msg RX : 409 (4.00/s)
DelayResp Msg TX : 0 (0.00/s)
PDelayReq Msg RX : 0 (0.00/s)
PDelayReq Msg TX : 0 (0.00/s)
PDelayResp Msg RX : 0 (0.00/s)
PDelayResp Msg TX : 0 (0.00/s)
Signalling Msg RX : 0 (0.00/s)
Signalling Msg TX : 0 (0.00/s)
RX total : 949 (9.00/s)
TX total : 409 (4.00/s)
If the packet counter in the status file will not display any PTP packets, although a PTP Grandmaster is active in the network, please check the firewall settings of your Linux system.

6.2 License Installation

A license for the Meinberg PTP Client Software is always bound to a MAC address of a network port. When starting the software, a valid license file named `license.dat` must be available in the `/etc/mbgpptp/service.cfg` directory for the interface configured in the `/etc/mbgpptp/service.cfg` configuration file. If the PTP client is executed without a valid license file, the demo mode is activated. After the demo mode has expired, the port state changes to DISABLED and no more system time corrections are performed.

After starting the service, you can check in the log file whether a valid license for the configured interface is available or whether the service is running in demo mode. If a valid license exists, the following line is written to the log file:

```
(1) mbgptp syn1588(R) PTP Stack full licensed version
```

If no valid license is available and the service is running in demo mode, the following line appears in the log file:

```
(1) mbgptp syn1588(R) PTP Stack protected evaluation version
```

The service does not write a log file by default configuration. However, this can be configured via the parameters `filelog` and `loglevel` (1, 2, 3, 4, where 4 provides the most detailed output) in the configuration file `/etc/mbgpptp/service.cfg`. 