

# Precise computer clock setting with MS Windows™

Network Time Protocol (NTP)  
Verifiable computer clock setting

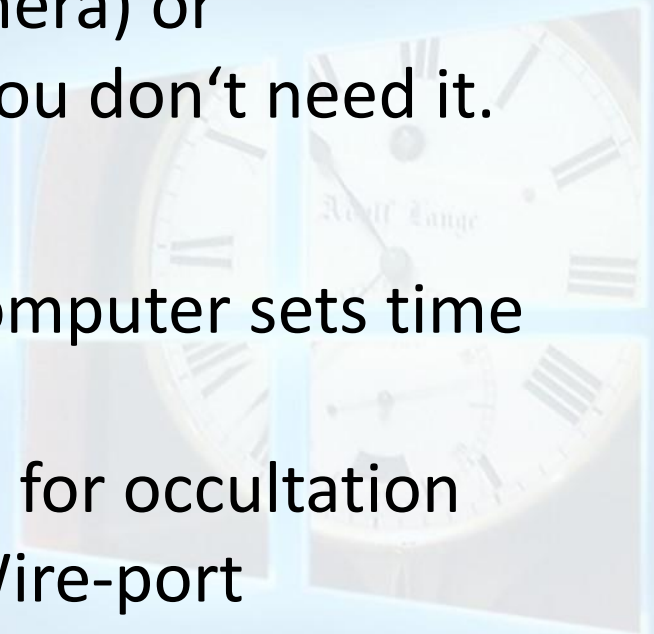


*ESOP 37 · Nikolai Wünsche, IOTA-ES*

# Precise computer clock setting – what for?

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- If you use a VTI (8 bit video camera) or a camera with a GPS-module, you don't need it.
- Is of vital importance, if your computer sets time stamps on video frames;
  - i. e. when you're using cameras for occultation observations at a USB- or FireWire-port

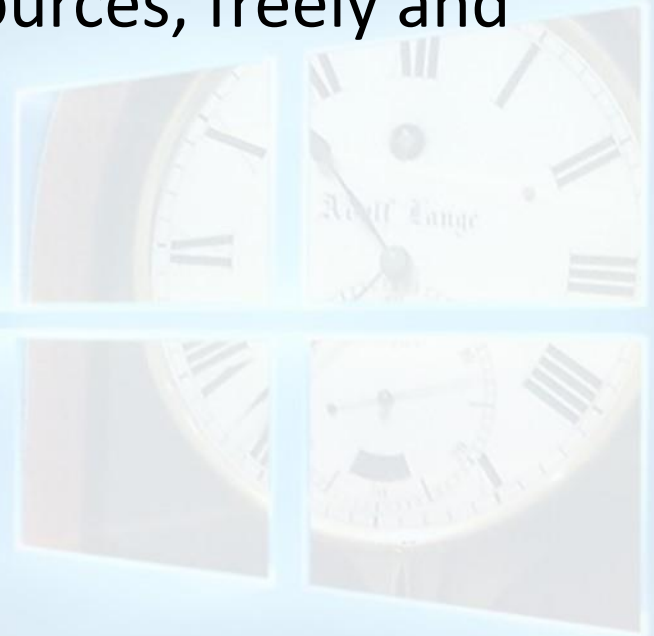


# Precise computer clock setting

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There are only two precise time sources, freely and world-wide available :

- **GPS** / 1pps-signal  
→ for expeditions
- **NTP** via internet  
→ at home station



# Setting a computer clock using GPS

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- 1pps (puls per second) from a GPS-receiver is highly accurate
- A piece of hardware is needed:
  - professional time server *or*
  - DIY-time server, mostly Raspberry Pie *or*
  - DIY-setup via serial port(see [www.satsignal.eu/ntp/](http://www.satsignal.eu/ntp/))
- By the way: Setting your computer clock by 1pps-signal happens via NTP!

# Setting a computer clock using NTP

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- Standard NTP-client of MS Windows™ does **not** fulfil the minimum requirements!
- A widely recommended software comes from Meinberg:
- NTP-client / Monitoring Software, both are cost-free.
- Easy install: comes as installation package.
- good installing guide can be found here:  
[www.satsignal.eu/ntp/setup.html](http://www.satsignal.eu/ntp/setup.html)  
(incl. help for troubleshooting)

# A brief NTP overview

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„NTP“ stands for **N**etwork **T**ime **P**rotocol, used worldwide since 1985.

Wikipedia:

„NTP is a networking protocol for clock synchronization between computer systems over packet-switched, variable-latency data networks...”

“NTP is intended to synchronize all participating computers to within a few milliseconds of Coordinated Universal Time (UTC)...”



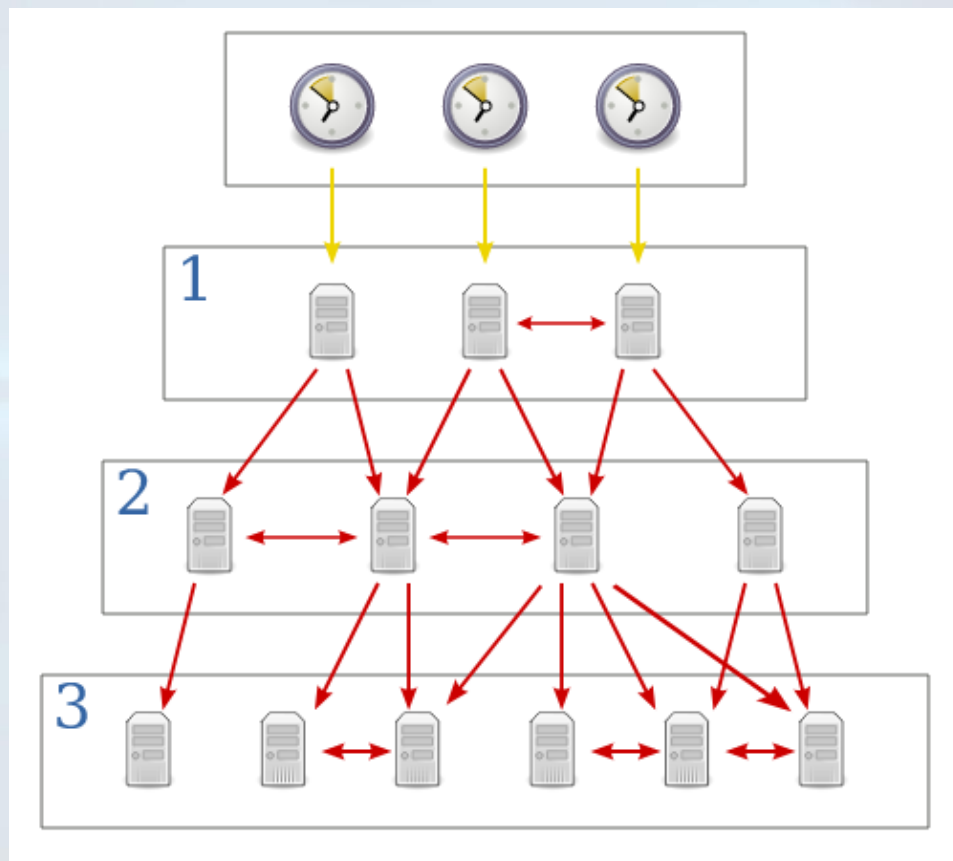
# How does NTP work?

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- A few technical terms to understand NTP...
  - **stratum**: Level of hierarchy of time servers
  - **polling**: getting time information (in intervals)
  - **delay**: travelling time of the incoming time information
  - **offset**: difference ,UTC minus Computer clock‘
  - **jitter**: random fluctuation of delay

# How does NTP work?

- **stratum:**  
Level of hierarchy
  - Stratum 0:  
atomic clock
  - Stratum 1:  
Time servers ( $\mu\text{s}$ )
  - ...
  - typical stratum of  
a local PC: 3 (ms)





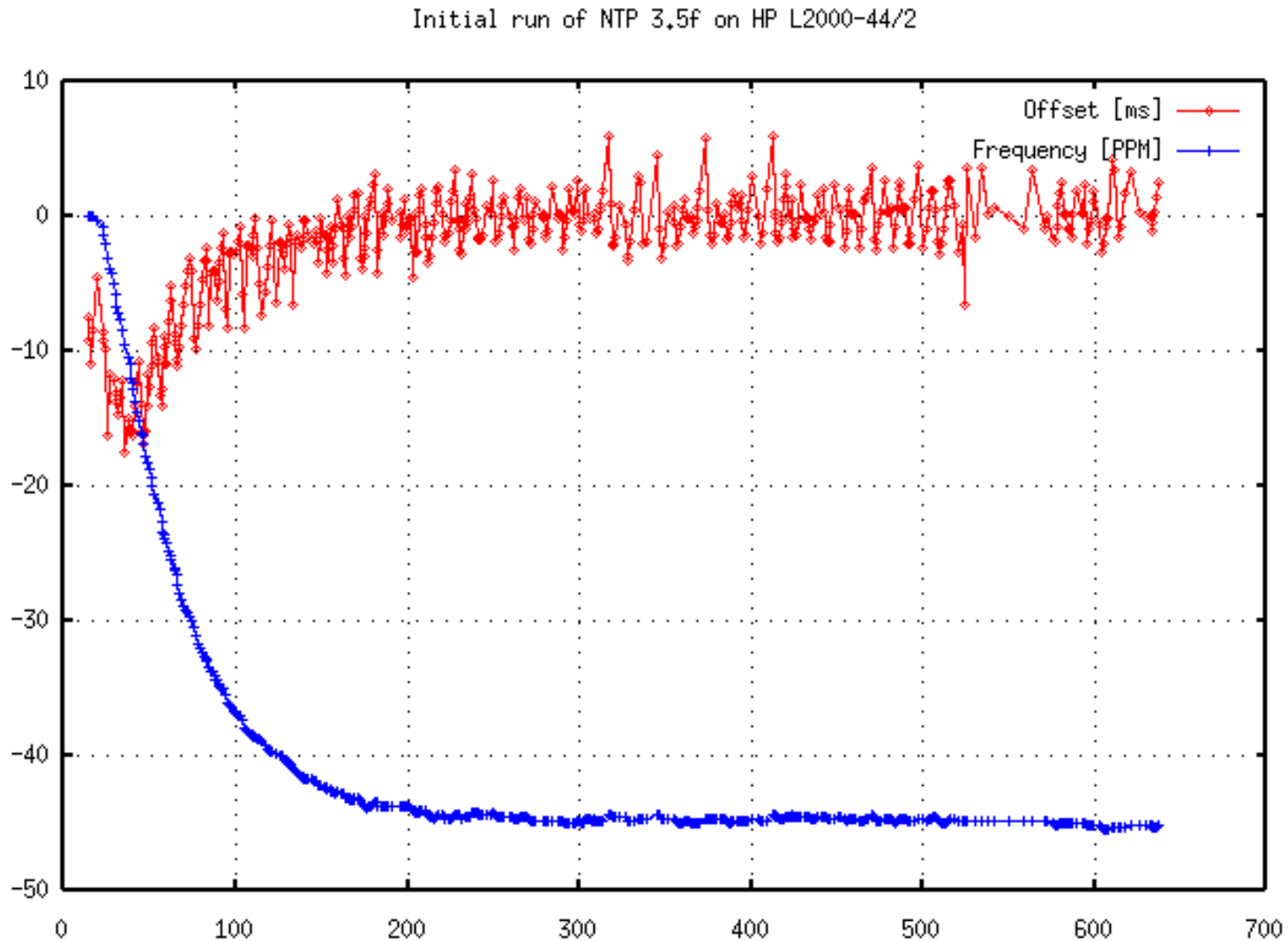
# How does NTP work?

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- **Synchronizing a client** to a network server consists of several packet exchanges where each exchange is a pair of request and reply.
- When receiving the reply, the receiver will once more log its own receipt time to estimate the travelling time of the packet. The travelling time (**delay**) is estimated to be half of "the total delay minus remote processing time", assuming symmetrical delays.

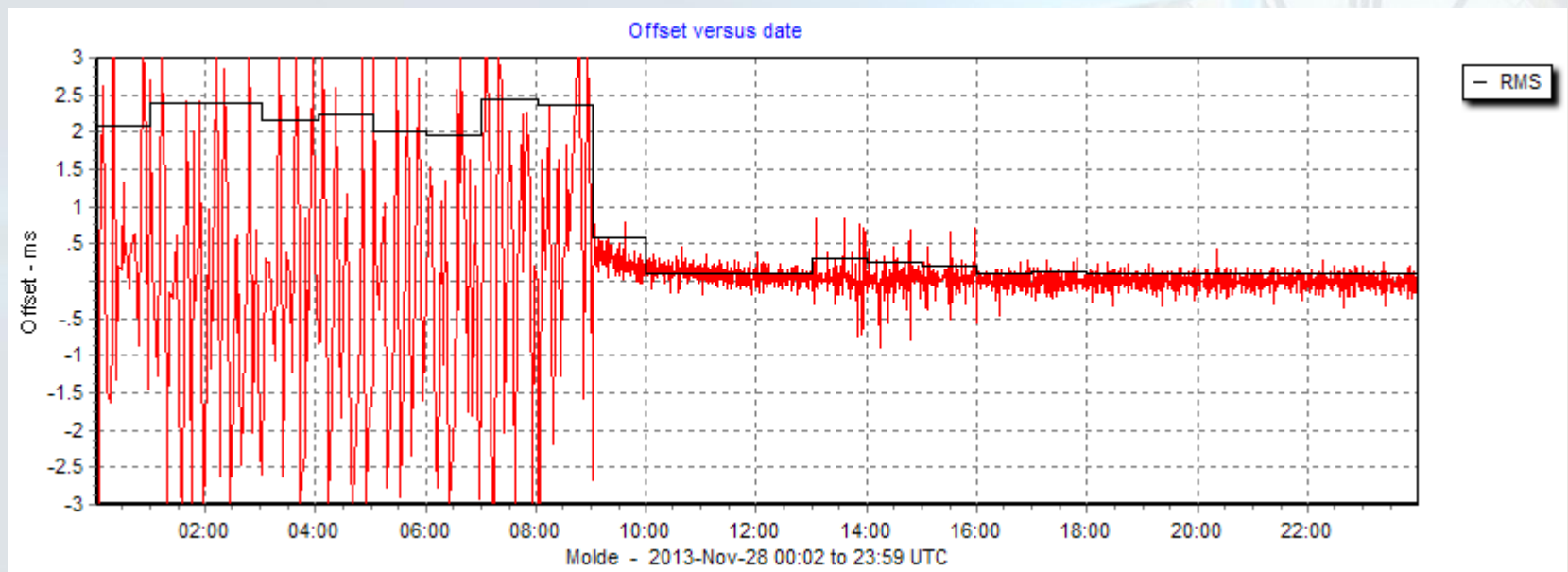
<http://www.ntp.org/ntpfaq/NTP-s-algo.htm>

# How does NTP work?



# How does NTP work?

- **Wi-Fi warning:** Always use cable connection!



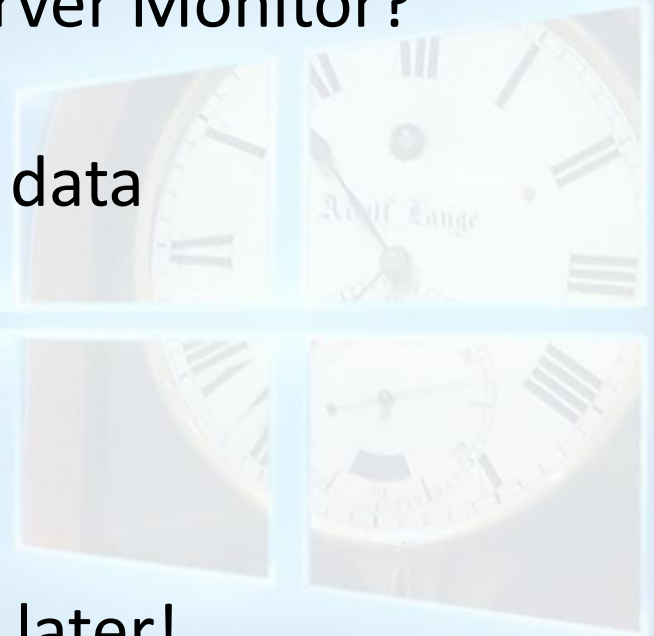
- In the graph: First Wi-Fi, then cable connection

Image: <http://satsignal.eu/ntp/win-7-wi-fi-vs-LAN.html>

# Precise computer clock setting

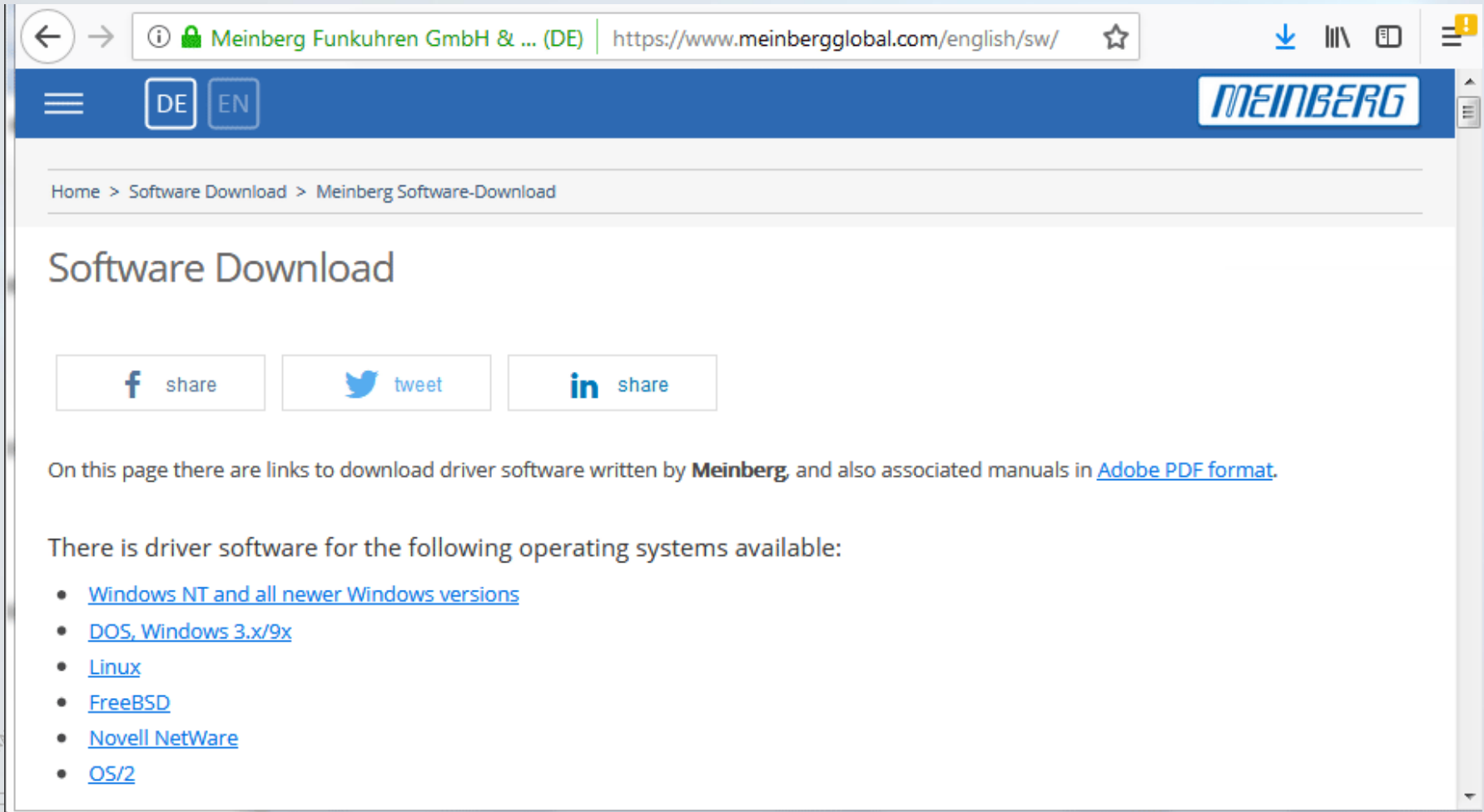
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- Why to use Meinberg's Time Server Monitor?
  - (one) easy way to **log** the NTP data
  - to **know** the difference  
,UTC – computer clock'  
during an observation;  
logged to review even years later!



# Precise computer clock setting

- First step: Install NTP client (on the camera-computer)

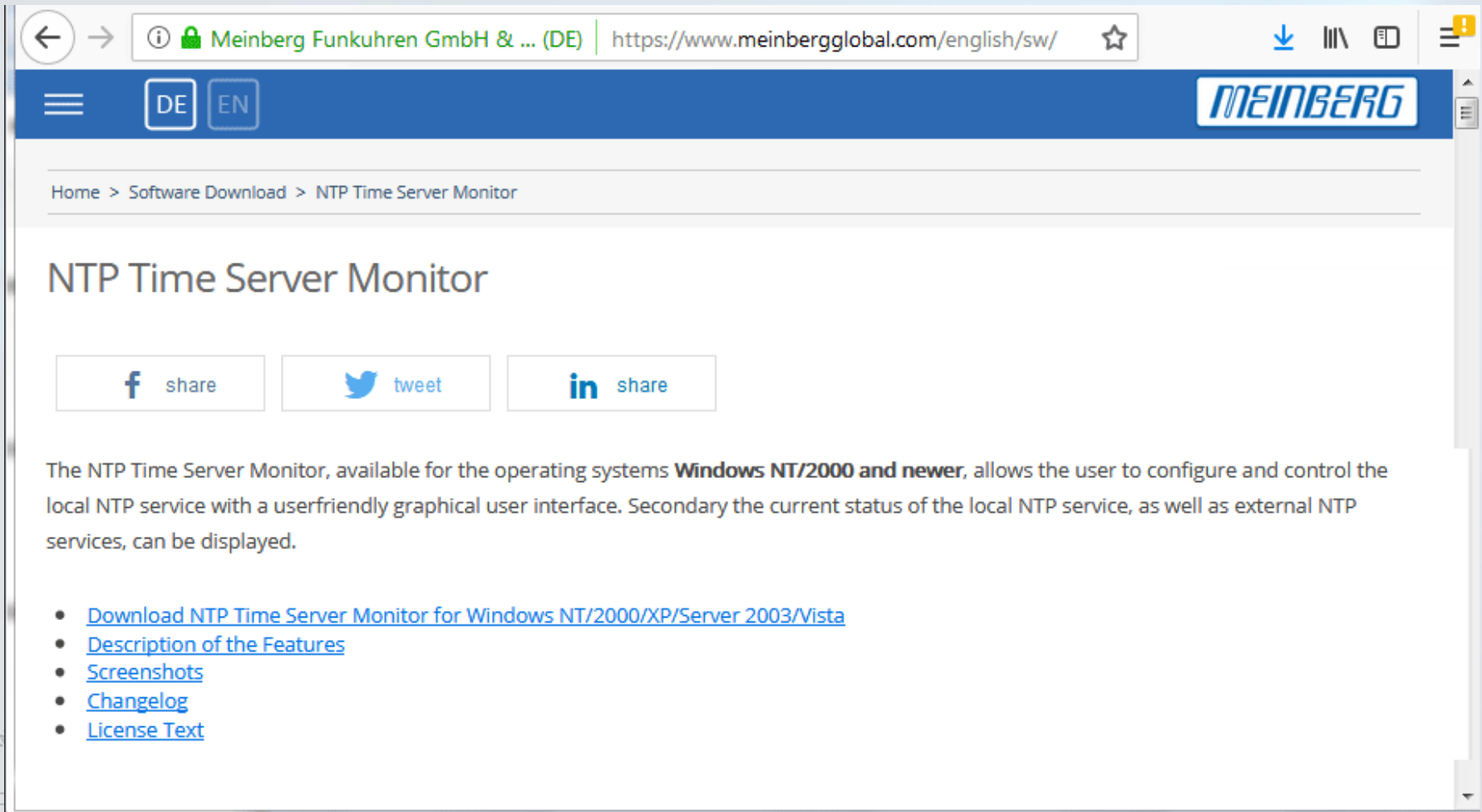


The screenshot shows a web browser window displaying the Meinberg website. The address bar shows the URL <https://www.meinbergglobal.com/english/sw/>. The page title is "Software Download". Below the title, there are three social media sharing buttons: Facebook share, Twitter tweet, and LinkedIn share. The main content area contains the text: "On this page there are links to download driver software written by **Meinberg**, and also associated manuals in [Adobe PDF format](#)." Below this, it states: "There is driver software for the following operating systems available:" followed by a bulleted list of operating systems: 

- [Windows NT and all newer Windows versions](#)
- [DOS, Windows 3.x/9x](#)
- [Linux](#)
- [FreeBSD](#)
- [Novell NetWare](#)
- [OS/2](#)

# Precise computer clock setting

- Second step: Install Time Server Monitor (..)



The screenshot shows a web browser window displaying the Meinberg website. The address bar shows the URL <https://www.meinbergglobal.com/english/sw/>. The page title is "NTP Time Server Monitor". The page content includes a breadcrumb trail: "Home > Software Download > NTP Time Server Monitor". Below the title, there are three social media sharing buttons: Facebook share, Twitter tweet, and LinkedIn share. The main text describes the NTP Time Server Monitor as a user-friendly graphical user interface for configuring and controlling the local NTP service. It also lists several links for further information: "Download NTP Time Server Monitor for Windows NT/2000/XP/Server 2003/Vista", "Description of the Features", "Screenshots", "Changelog", and "License Text".

Home > Software Download > NTP Time Server Monitor

## NTP Time Server Monitor

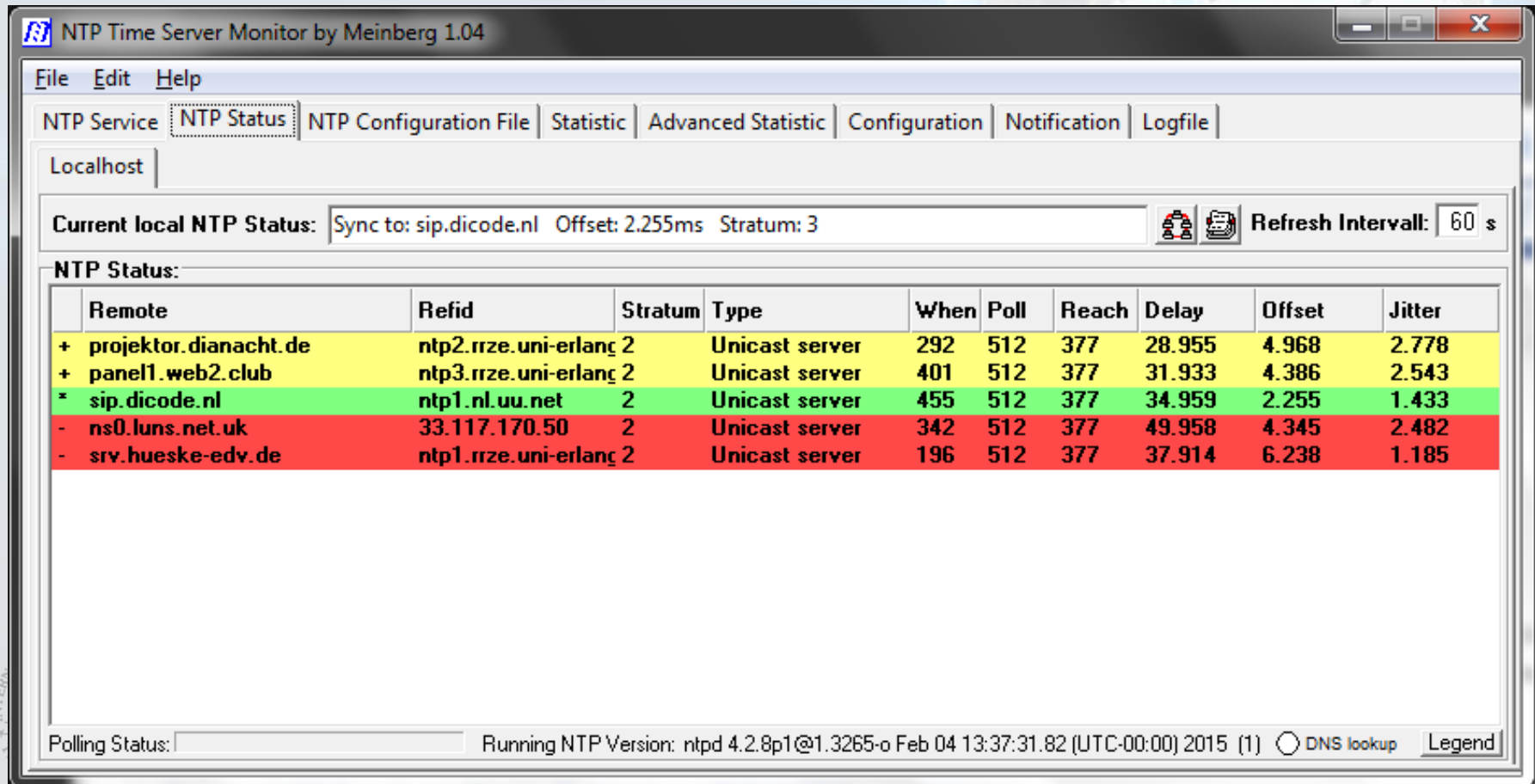
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The NTP Time Server Monitor, available for the operating systems **Windows NT/2000 and newer**, allows the user to configure and control the local NTP service with a userfriendly graphical user interface. Secondary the current status of the local NTP service, as well as external NTP services, can be displayed.

- [Download NTP Time Server Monitor for Windows NT/2000/XP/Server 2003/Vista](#)
- [Description of the Features](#)
- [Screenshots](#)
- [Changelog](#)
- [License Text](#)

# Precise computer clock setting

- Check after installation of Time Server Monitor:  
→ Is local NTP synchronized?



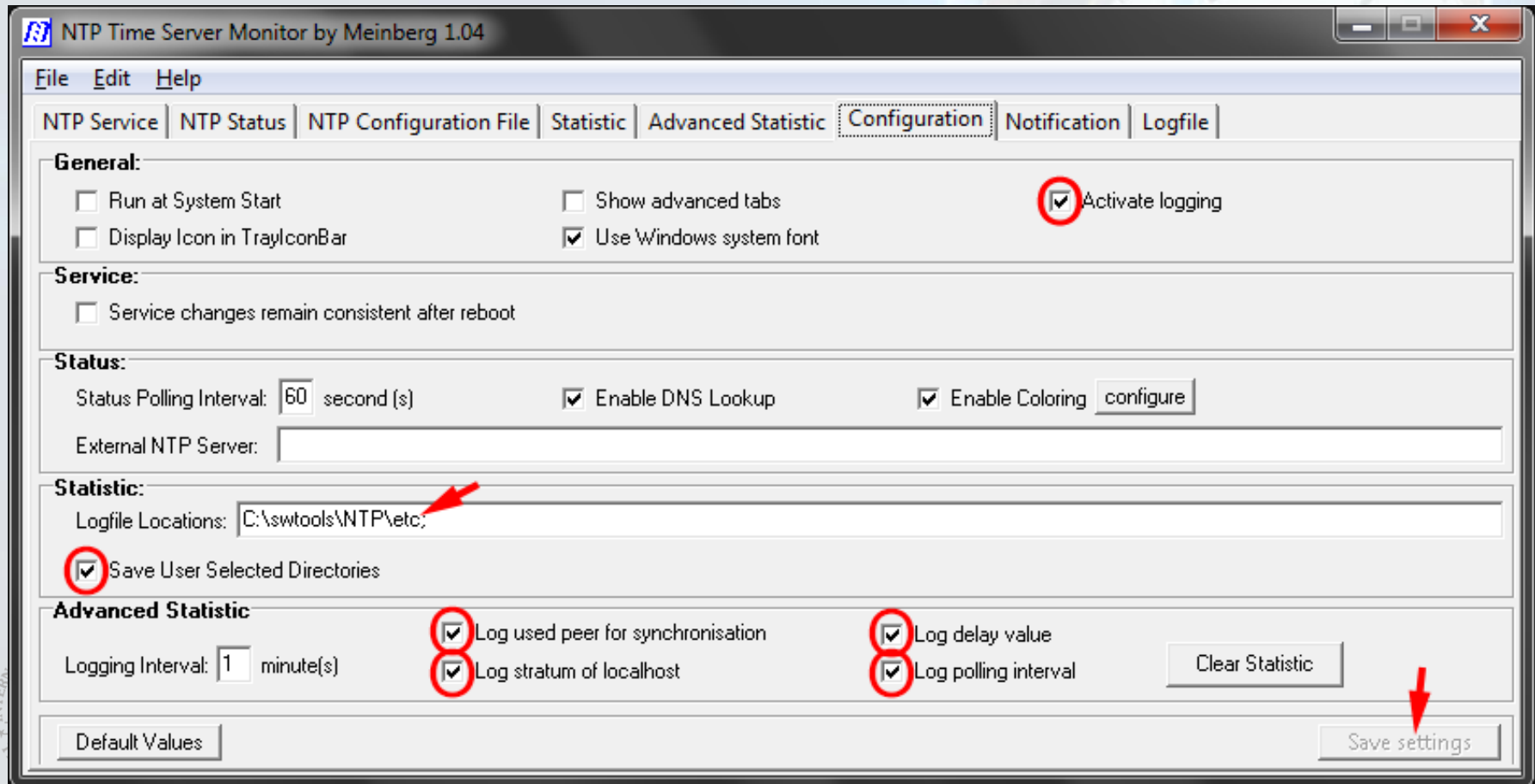
The screenshot shows the 'NTP Time Server Monitor by Meinberg 1.04' application window. The interface includes a menu bar (File, Edit, Help) and a tabbed menu (NTP Service, NTP Status, NTP Configuration File, Statistic, Advanced Statistic, Configuration, Notification, Logfile). The 'NTP Status' tab is active, displaying the 'Localhost' section. The 'Current local NTP Status' is shown as 'Sync to: sip.dicode.nl Offset: 2.255ms Stratum: 3'. A 'Refresh Interval' of 60 seconds is set. Below this, the 'NTP Status' section contains a table of remote servers with columns for Remote, Refid, Stratum, Type, When, Poll, Reach, Delay, Offset, and Jitter. The table lists five servers, with 'sip.dicode.nl' highlighted in green, indicating it is the current time source.

	Remote	Refid	Stratum	Type	When	Poll	Reach	Delay	Offset	Jitter
+	projektor.dianacht.de	ntp2.rrze.uni-erlanç	2	Unicast server	292	512	377	28.955	4.968	2.778
+	panel1.web2.club	ntp3.rrze.uni-erlanç	2	Unicast server	401	512	377	31.933	4.386	2.543
*	sip.dicode.nl	ntp1.nl.uu.net	2	Unicast server	455	512	377	34.959	2.255	1.433
-	ns0.luns.net.uk	33.117.170.50	2	Unicast server	342	512	377	49.958	4.345	2.482
-	srv.hueske-edv.de	ntp1.rrze.uni-erlanç	2	Unicast server	196	512	377	37.914	6.238	1.185

At the bottom of the window, the 'Polling Status' is shown as 'Running NTP Version: ntpd 4.2.8p1@1.3265-o Feb 04 13:37:31.82 (UTC-00:00) 2015 (1)'. There are also checkboxes for 'DNS lookup' and a 'Legend' button.

# Configuration

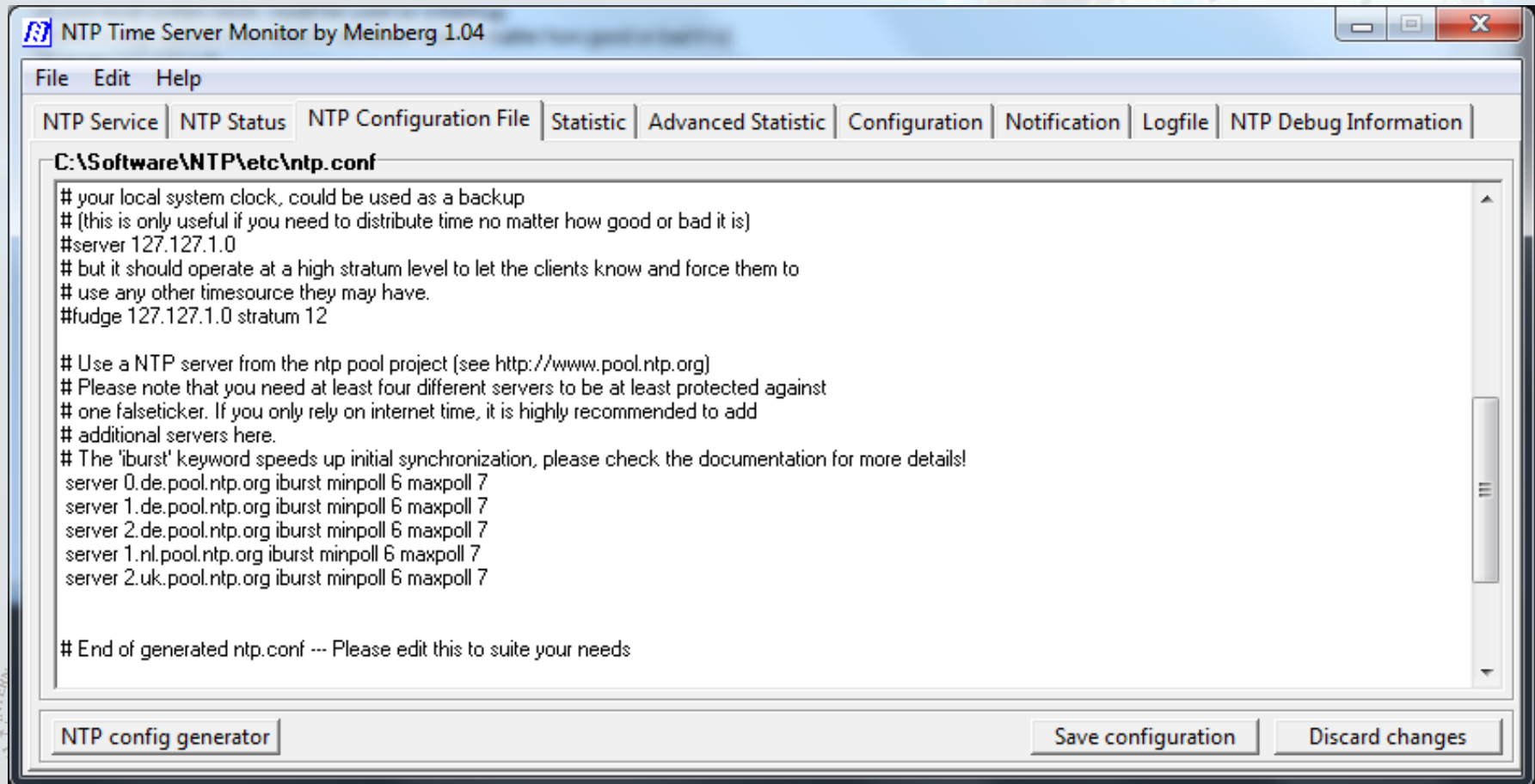
- Check and adjust configuration:





# Configuration

- Preselect local ntp-servers from pool.ntp.org



# Configuration

← → ↻ ⓘ Nicht sicher | www.pool.ntp.org/zone/cz

  JOIN THE POOL  USE THE POOL  MANAGE SERVERS

## Czech Republic — cz.pool.ntp.org

We need more servers in this country. If you have a server with a static IP, please consider [joining the pool!](#)

To use this specific pool zone, add the following to your ntp.conf file:

```
server 0.cz.pool.ntp.org
server 1.cz.pool.ntp.org
server 2.cz.pool.ntp.org
server 3.cz.pool.ntp.org
```

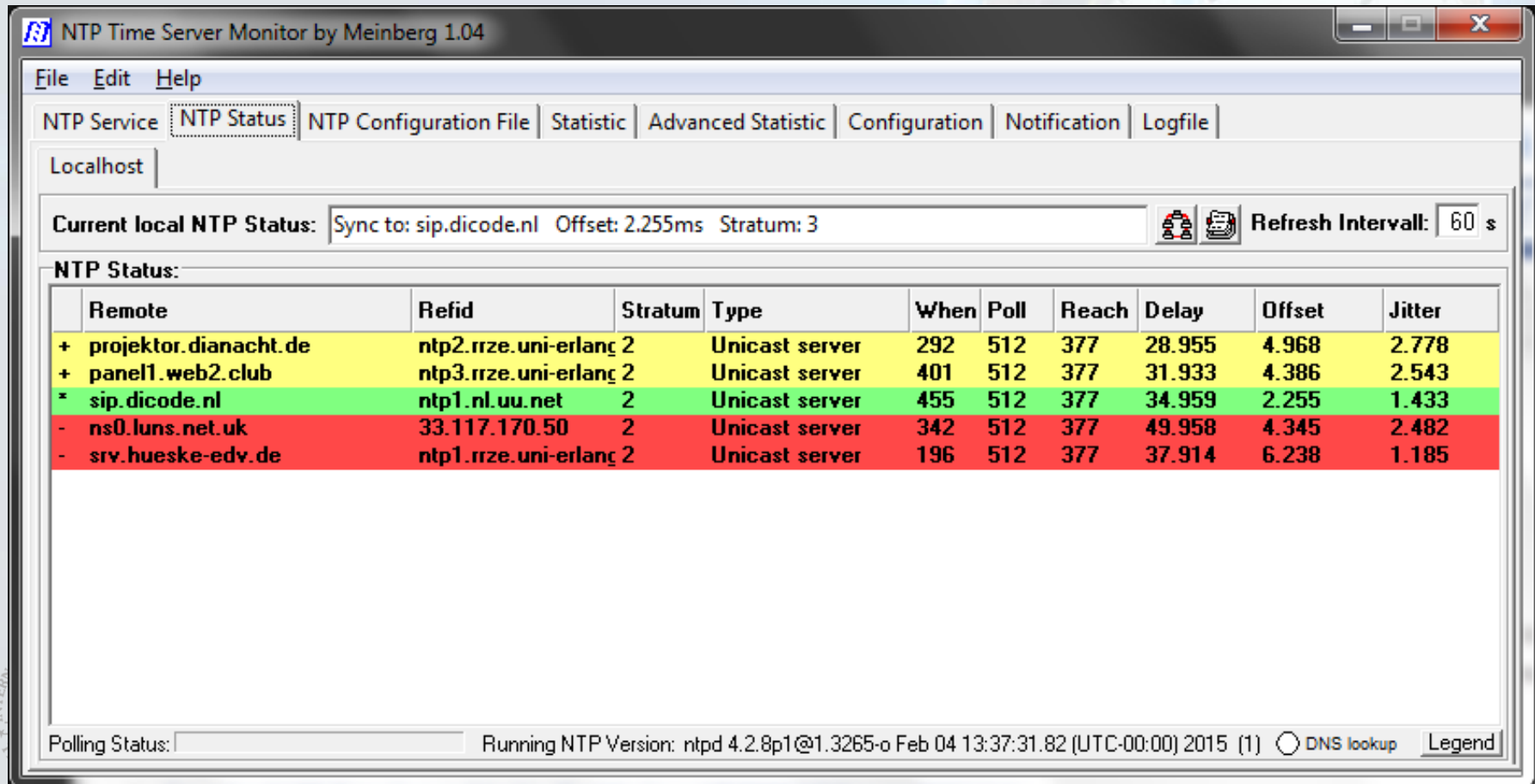
In most cases it's best to use **pool.ntp.org** to find an NTP server (or 0.pool.ntp.org, 1.pool.ntp.org, etc if you need multiple server names). The system will try finding the closest available servers for you. If you distribute software or equipment that uses NTP, please see our [information for vendors](#).

	<b>IPv4</b>	<b>IPv6</b>
	There are 32 active servers in this zone.	There are 17 active servers in this zone.
	31 (+1) active 1 day ago	17 active 1 day ago
	29 (+3) active 7 days ago	17 active 7 days ago
	30 (+2) active 14 days ago	15 (+2) active 14 days ago
	28 (+4) active 60 days ago	14 (+3) active 60 days ago
	30 (+2) active 180 days ago	15 (+2) active 180 days ago
	28 (+4) active 1 year ago	12 (+5) active 1 year ago
	32 active 3 years ago	14 (+3) active 3 years ago
	37 (-5) active 6 years ago	8 (+9) active 6 years ago

Neuigkeiten  
Wie kann man pool.ntp.org benutzen?  
Wie kann man sich an pool.ntp.org beteiligen?  
Informationen für Hersteller  
E-Mail-Verteiler  
Zusätzliche Links  
Übersetzungen  
Deutsch

# Configuration

- NTP-client choses best time server.s independently.  
(Europe: 2681 active time servers [26.8.2018])



NTP Time Server Monitor by Meinberg 1.04

File Edit Help

NTP Service **NTP Status** NTP Configuration File Statistic Advanced Statistic Configuration Notification Logfile

Localhost

Current local NTP Status: Sync to: sip.dicode.nl Offset: 2.255ms Stratum: 3 Refresh Interval: 60 s

NTP Status:

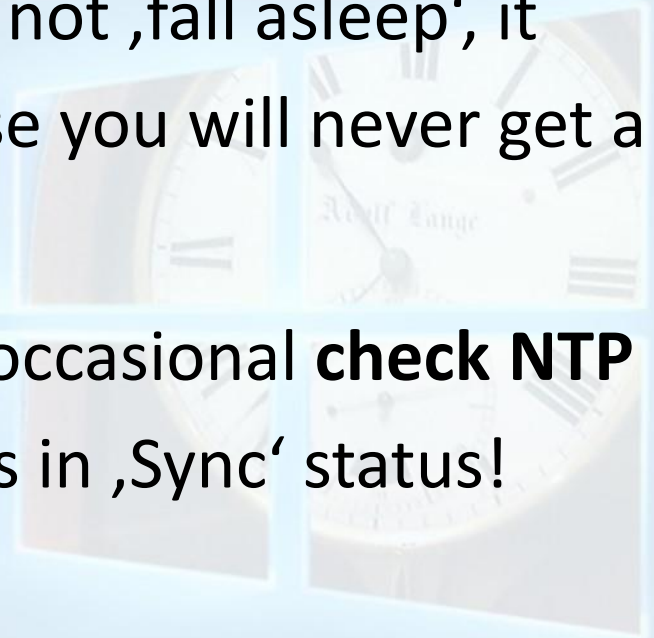
	Remote	Refid	Stratum	Type	When	Poll	Reach	Delay	Offset	Jitter
+	projektor.dianacht.de	ntp2.rrze.uni-erlanç	2	Unicast server	292	512	377	28.955	4.968	2.778
+	panel1.web2.club	ntp3.rrze.uni-erlanç	2	Unicast server	401	512	377	31.933	4.386	2.543
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Polling Status: Running NTP Version: ntpd 4.2.8p1@1.3265-o Feb 04 13:37:31.82 (UTC-00:00) 2015 (1)  DNS lookup Legend

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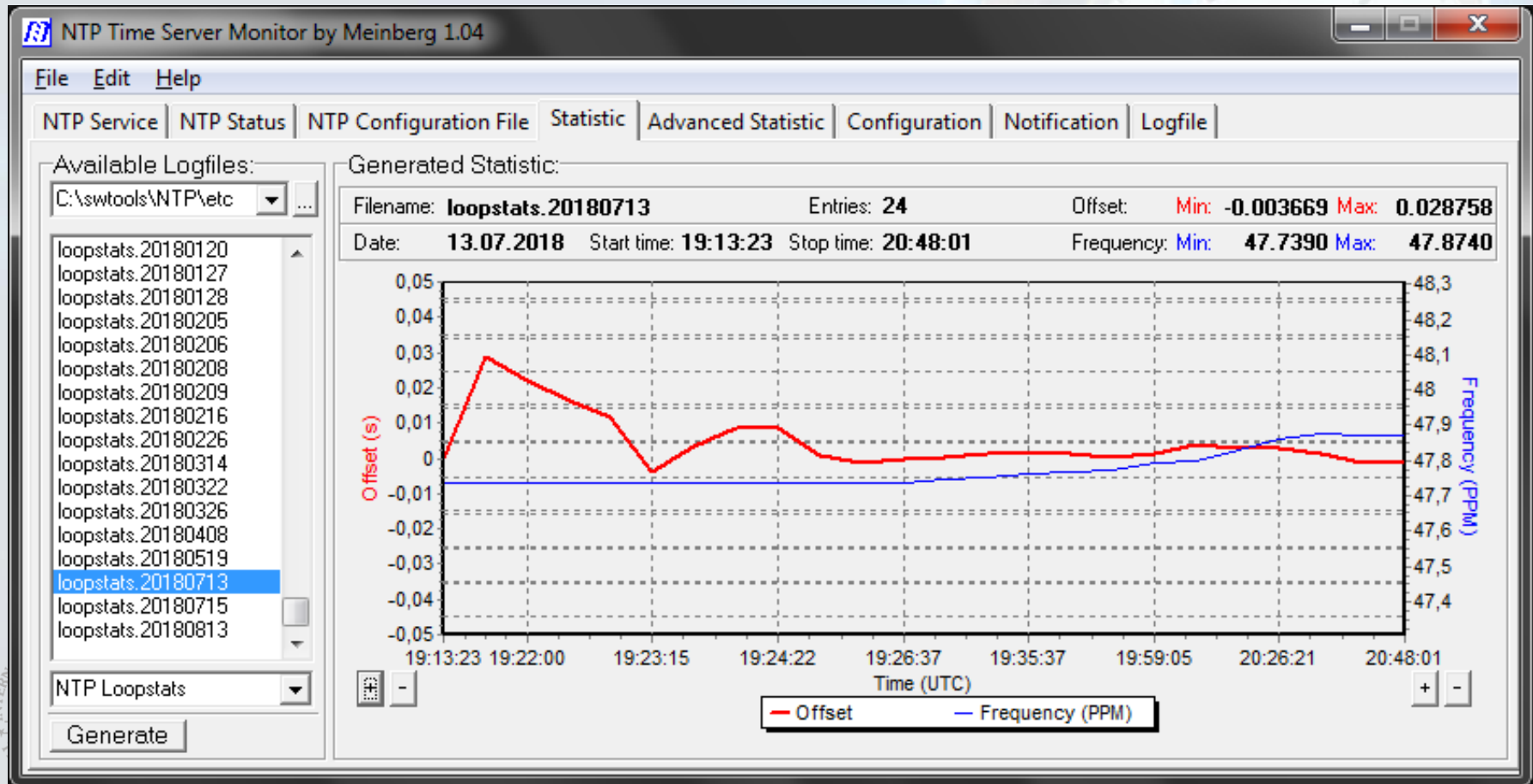
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- Check **energy settings**: PC must not ,fall asleep‘, it has to stay ,always on‘, otherwise you will never get a reliable offset value.
- During an observation session: occasional **check NTP status** to make sure your clock is in ,Sync‘ status!



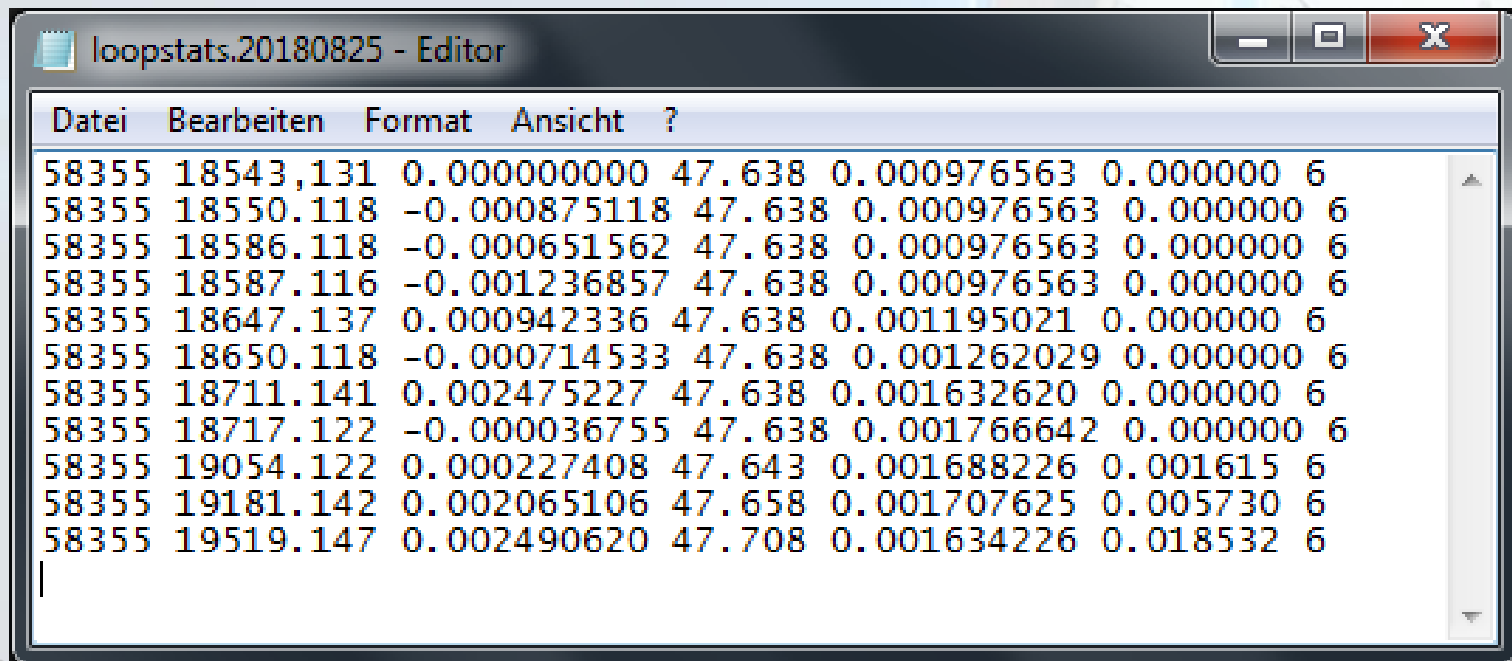
# time offset at observation time

- ‚Statistic‘ > select and double click on a date
- adjust scale by ‚+‘ and ‚-‘ -keys



# Review clock status afterwards

- Loopstats-files logging the polls..:



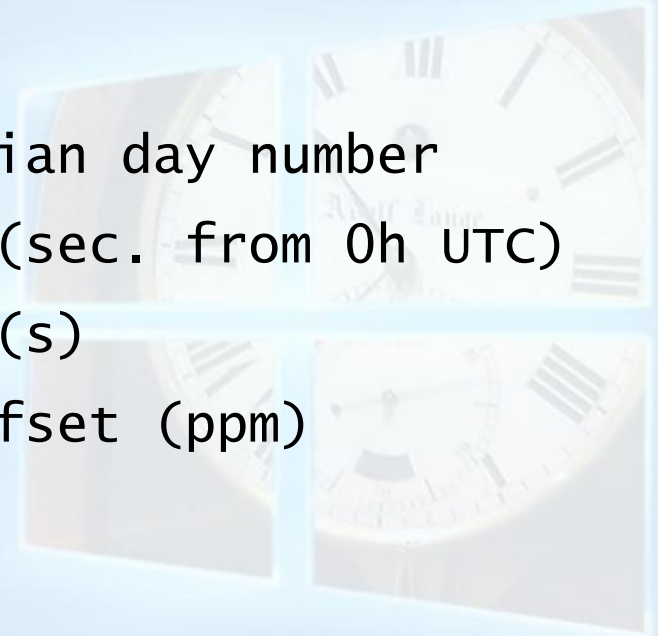
Datei	Bearbeiten	Format	Ansicht	?			
58355	18543,131	0.000000000	47.638	0.000976563	0.000000	6	
58355	18550.118	-0.000875118	47.638	0.000976563	0.000000	6	
58355	18586.118	-0.000651562	47.638	0.000976563	0.000000	6	
58355	18587.116	-0.001236857	47.638	0.000976563	0.000000	6	
58355	18647.137	0.000942336	47.638	0.001195021	0.000000	6	
58355	18650.118	-0.000714533	47.638	0.001262029	0.000000	6	
58355	18711.141	0.002475227	47.638	0.001632620	0.000000	6	
58355	18717.122	-0.000036755	47.638	0.001766642	0.000000	6	
58355	19054.122	0.000227408	47.643	0.001688226	0.001615	6	
58355	19181.142	0.002065106	47.658	0.001707625	0.005730	6	
58355	19519.147	0.002490620	47.708	0.001634226	0.018532	6	

# Review clock status afterwards

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- 58355 18647.137 0.000942336 47.638 0.001195021  
0.000000 6

58355	modified Julian day number
18647.137	time of day (sec. from 0h UTC)
0.000942336	time offset (s)
47.638	frequency offset (ppm)
0.001195021	jitter (s)
0.000000	wander (ppm)
6	phase-lock loop time constant



→ [https://www.meinberg.de/download/ntp/docs/ntp\\_cheat\\_sheet.pdf](https://www.meinberg.de/download/ntp/docs/ntp_cheat_sheet.pdf)

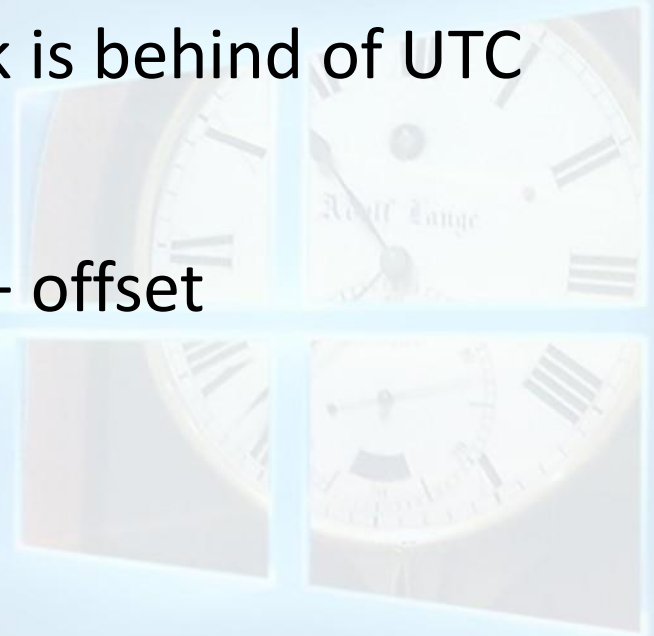
# UTC — time stamp — offset

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- Offset negative = computer clock is ahead of UTC
- Offset positive = computer clock is behind of UTC
- Event time (UTC) = time stamp + offset

## Example

- time stamp: 23h 12m 11.453s
- offset: -8.2ms
- UTC of event: 23h 12m 11.445s





# Remarks

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- MS Windows™ improved the implementation of NTP step by step;  
prefer Win 8 instead of Win 7 (and forget XP).
- Start the computer for time-sync at least one hour ahead of observation.
- Using Wi-Fi is just an emergency solution.
- Using mobile WAN? Doubtful!
- USB 2 is too slow for reliable time stamps  
→ use USB 3 or FireWire!