Precise computer clock setting with MS Windows™

Network Time Protocol (NTP)

Verifiable computer clock setting

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Precise computer clock setting – what for?

- If you use a VTI (8 bit video camera) or a camera with a GPS-module, you don‘t need it.

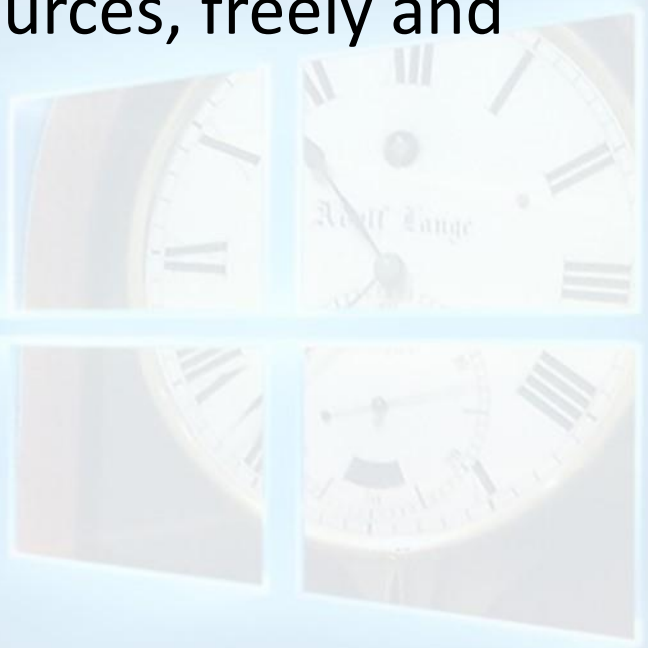
- Is of vital importance, if your computer sets time stamps on video frames;
  i. e. when you‘re using cameras for occultation observations at a USB- or FireWire-port

Precise computer clock setting

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

- 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/)
- By the way: Setting your computer clock by 1pps-signal happens via NTP!

Setting a computer clock using NTP

- 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 (incl. help for troubleshooting)

A brief NTP overview

„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)…”

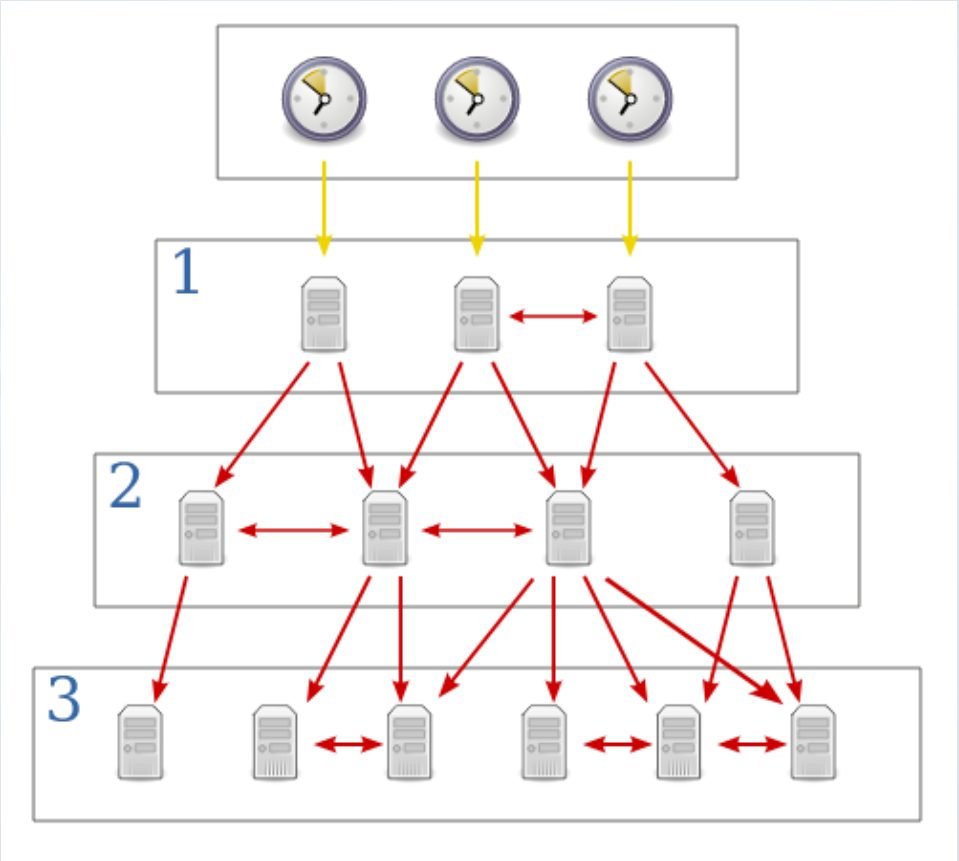
How does NTP work?

- 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 (µs)

  …
  - typical stratum of
    a local PC: 3 (ms)



How does NTP work?

- **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?

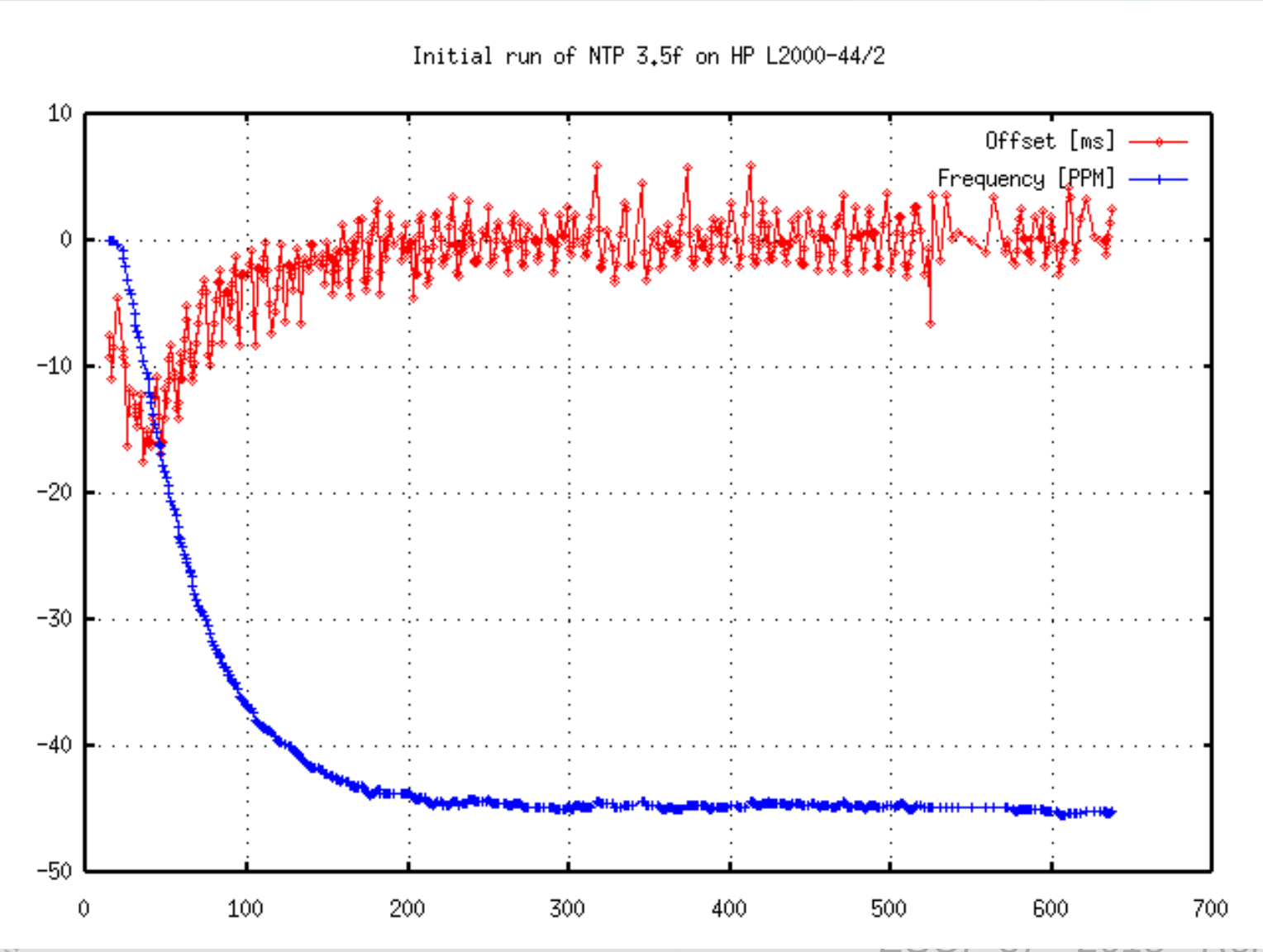
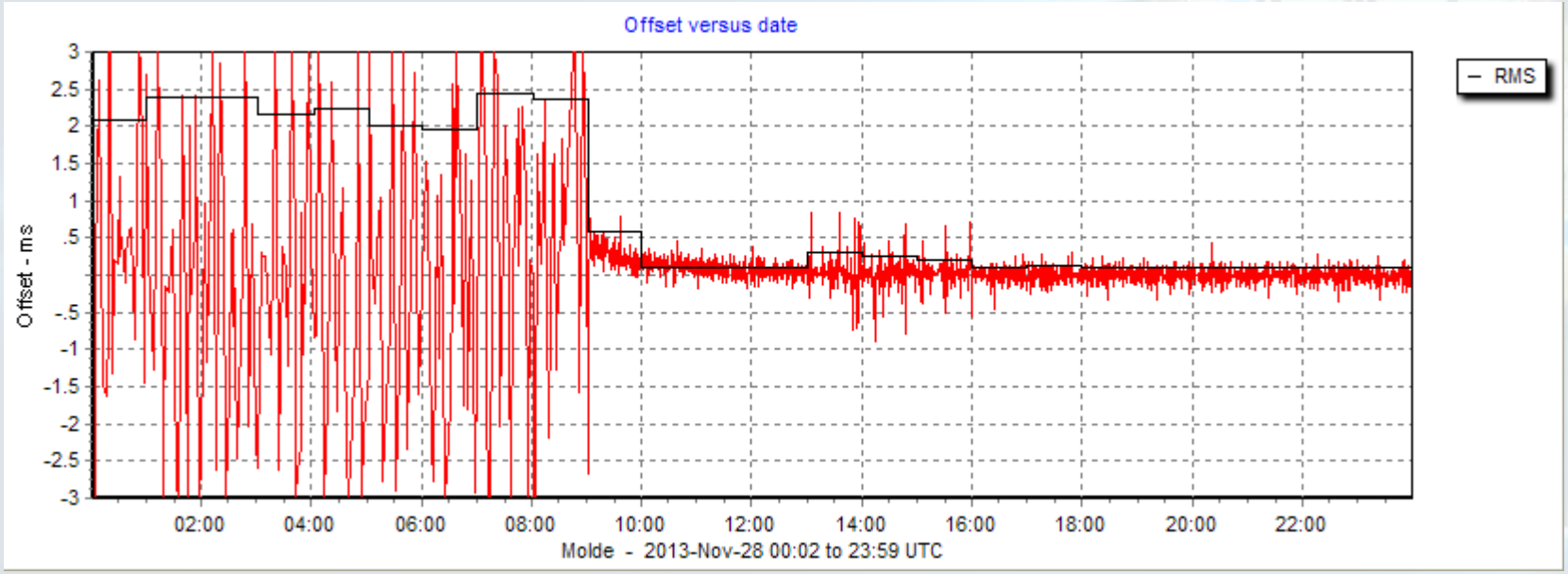


Image: http://www.ntp.org/ntpfaq/NTP-s-algo.htm

How does NTP work?

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



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

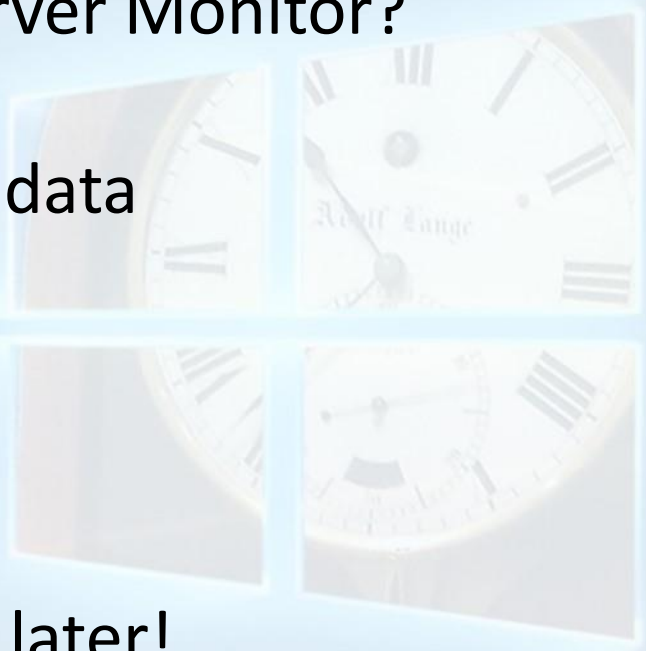
Image: http://satsignal.eu/ntp/Win-7-Wi-Fi-vs-LAN.html

Precise computer clock setting

- Why to use Meinberg‘s Time Server Monitor?

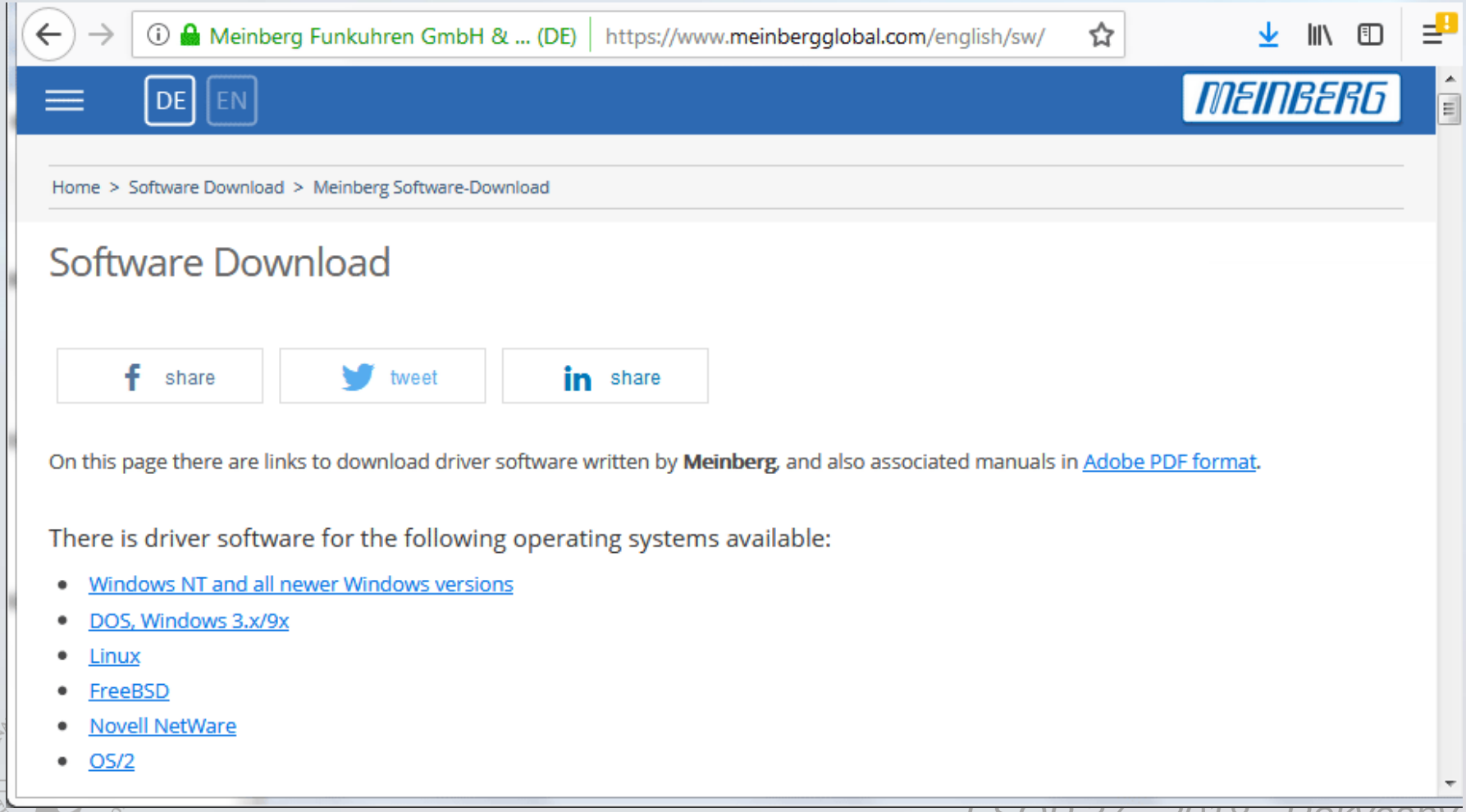
  - (one) easy way to **log** the NTP data

  → to **know** the difference
  ‚UTC – computer clock‘
  during an observation;
  logged to review even years later!



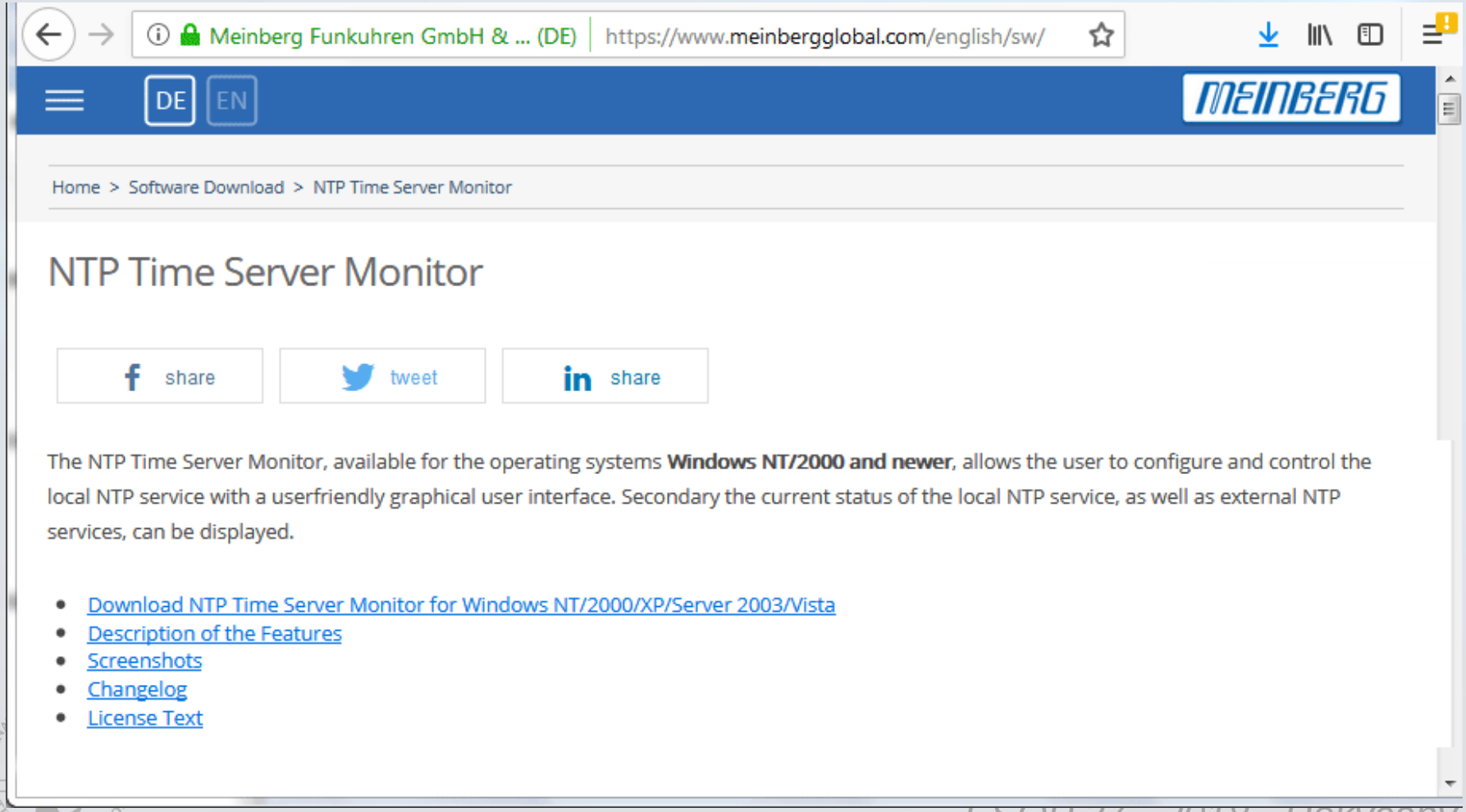
Precise computer clock setting

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



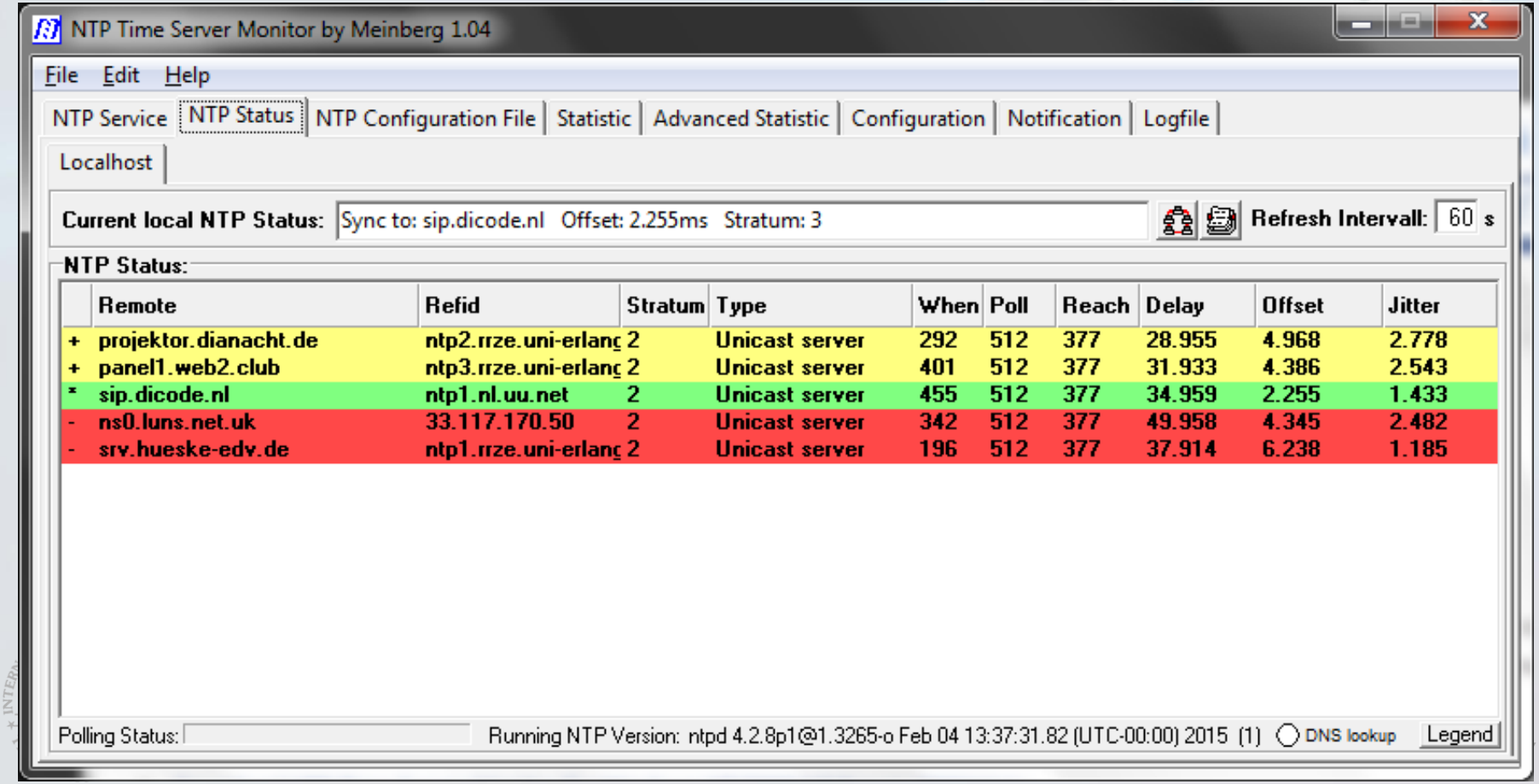
Precise computer clock setting

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



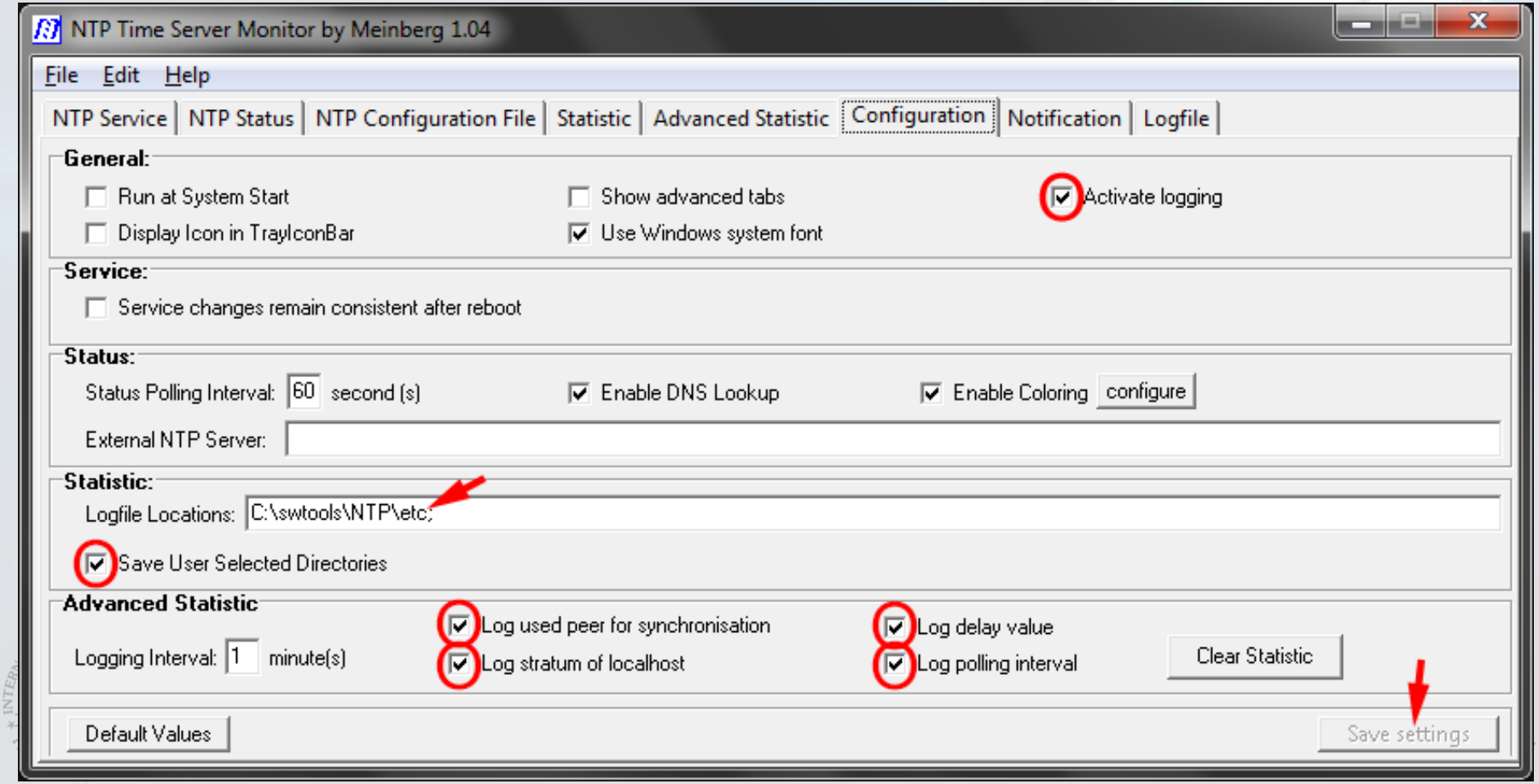
Precise computer clock setting

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



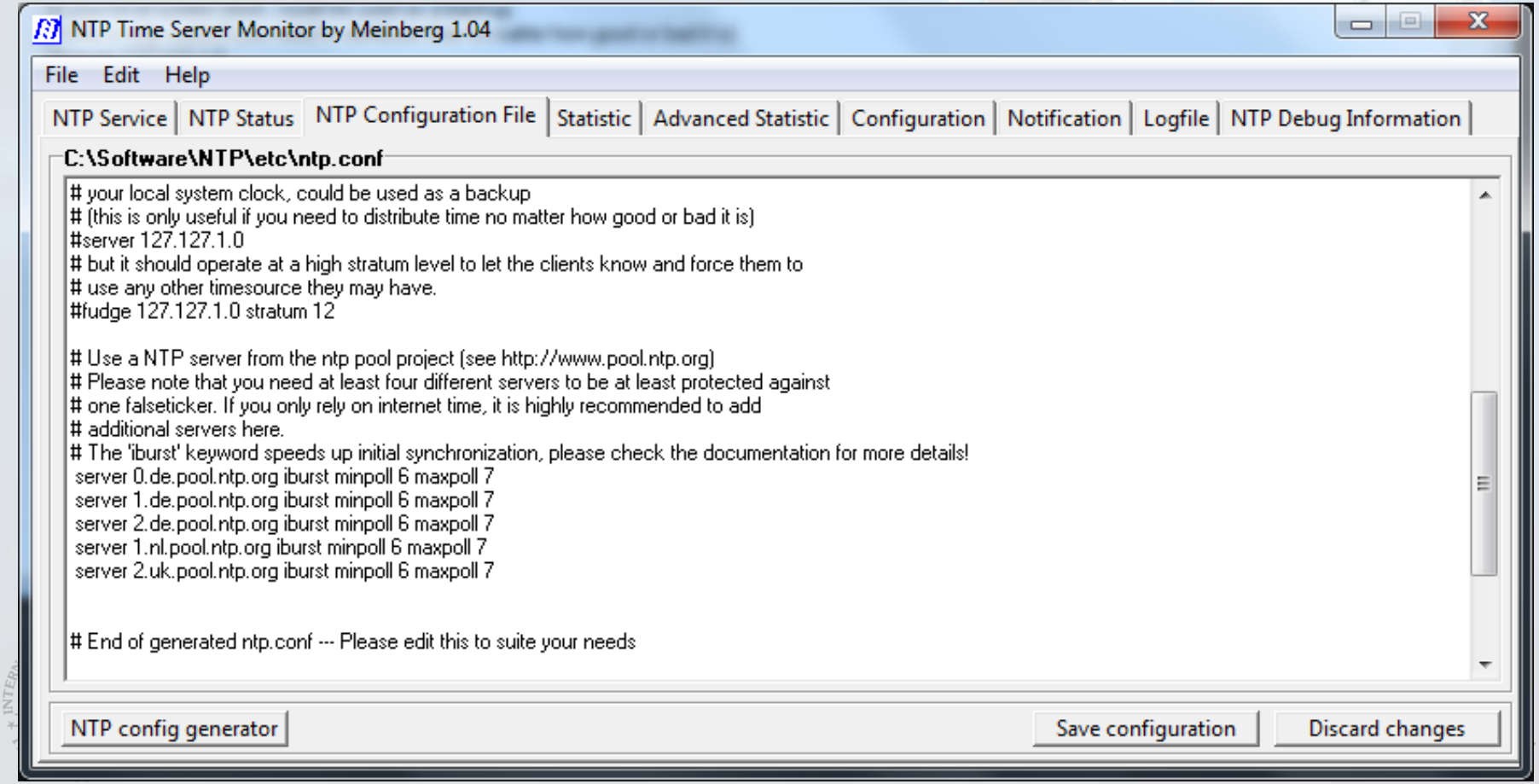
Configuration

- Check and adjust configuration:



Configuration

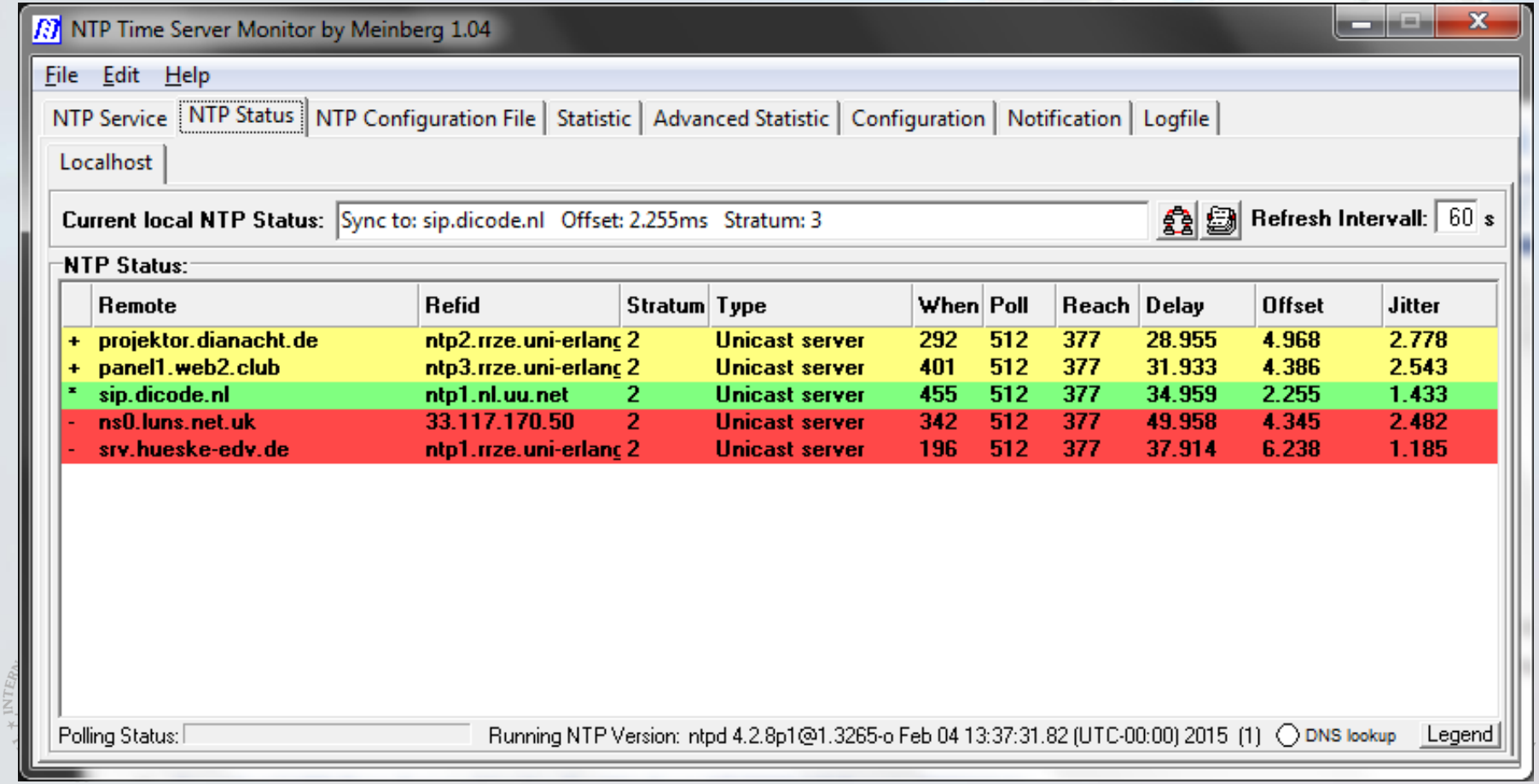
- Preselect local ntp-servers from pool.ntp.org



Configuration

Configuration

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

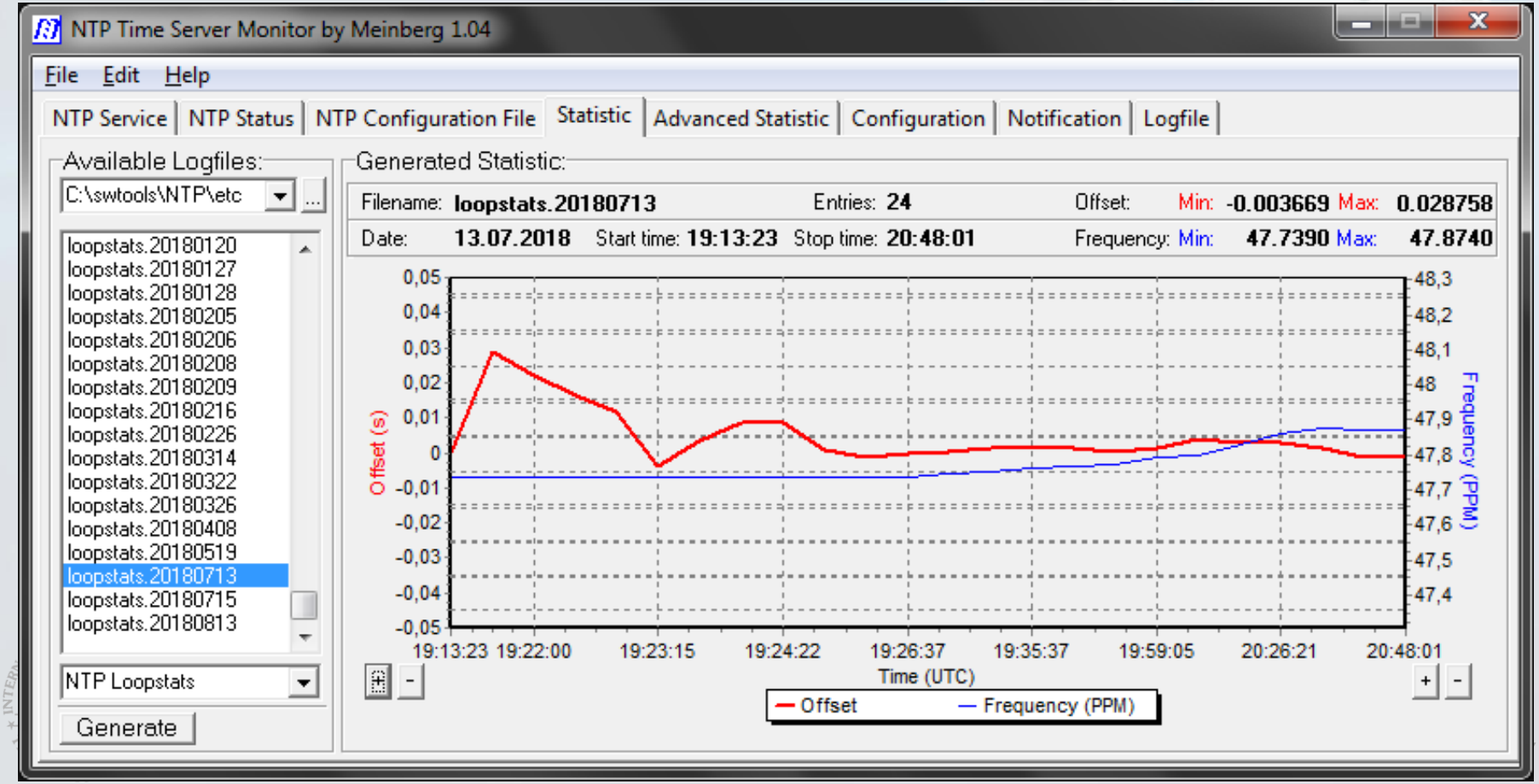


Precise computer clock setting

- 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!

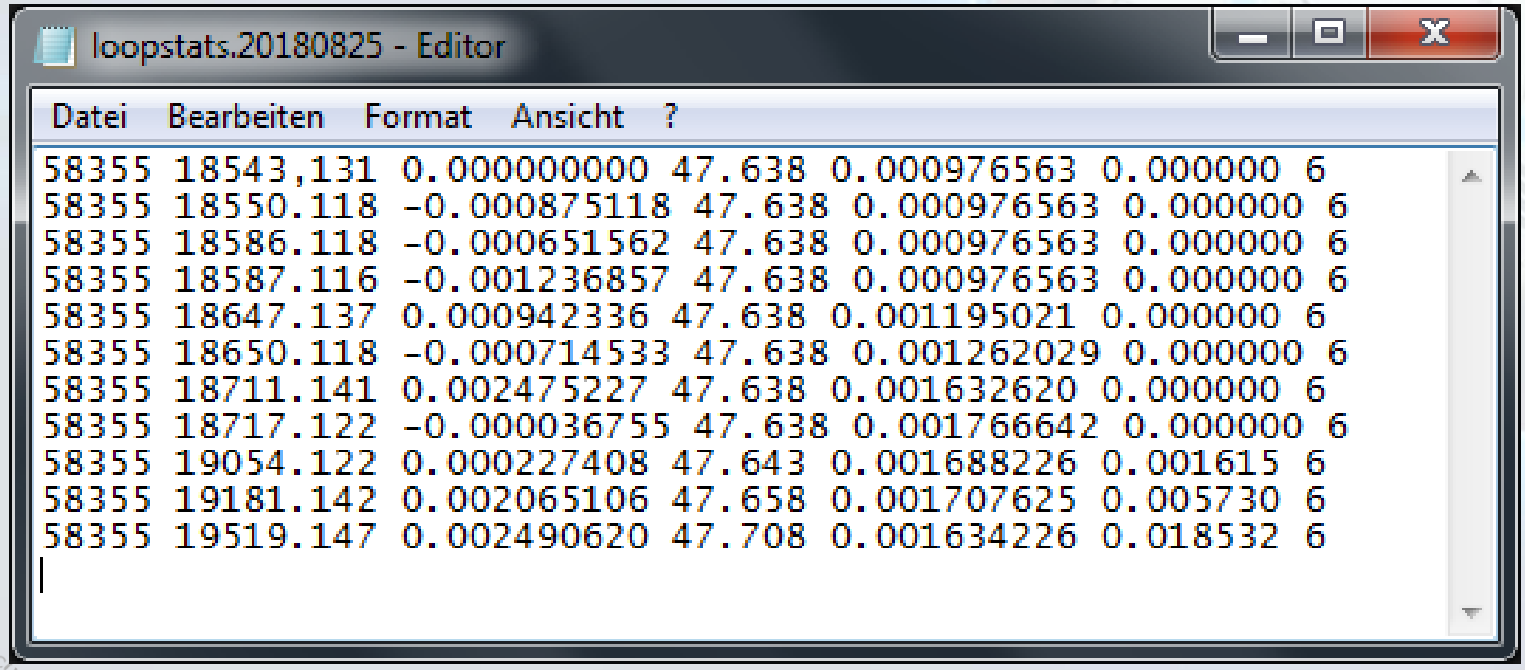
time offset at observation time

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



Review clock status afterwards

- Loopstats-files logging the polls..:



Review clock status afterwards

- 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

UTC — time stamp — offset

- 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

- MS Windows™ improved the implemention 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!