“Let’s do the Time Warp Again…”

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A brief history of time

- Original Datum time servers installed in about 1999/2000
  - Was a “millennium”-type project
  - Preceded by simple Unix stratum 2 box
- Tymserve 2100 and CS Plus GPS
- Product discontinued 2006
- End of support 2010
- I had no photos of it, but a quick Google™ search found a picture of it…

Tymserve 2100

CS Plus GPS steered atomic clock

Tymserve 2100

CS Plus GPS steered atomic clock

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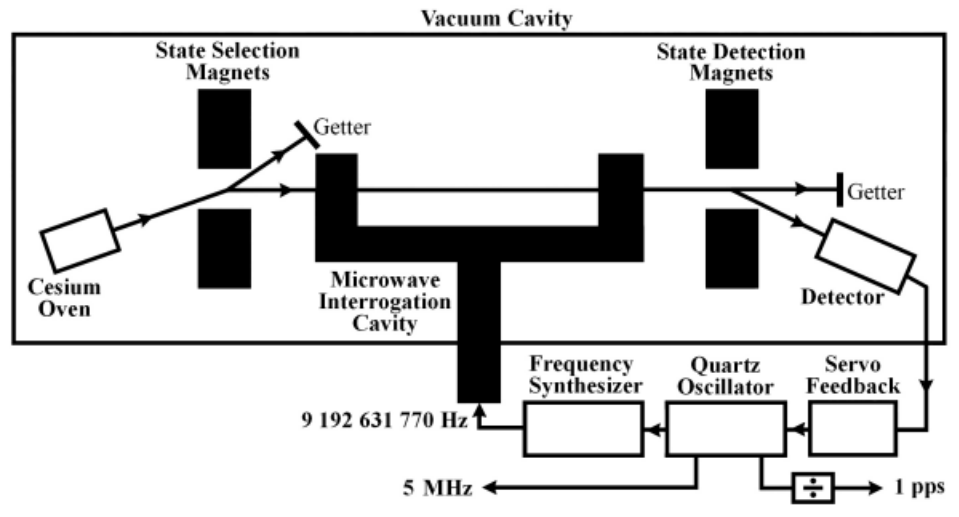
Why Cesium?

- Good question. I'll ask an expert.
- The time anoraks at NIST say:
  - *"Cesium oscillators can be primary frequency standards since the SI second is defined from the resonance frequency of the cesium atom (^{133}Cs), which is 9,192,631,770 Hz."*
- Cesium clocks work by manipulating energy states of gaseous Cesium atoms

Issues and Annoyances

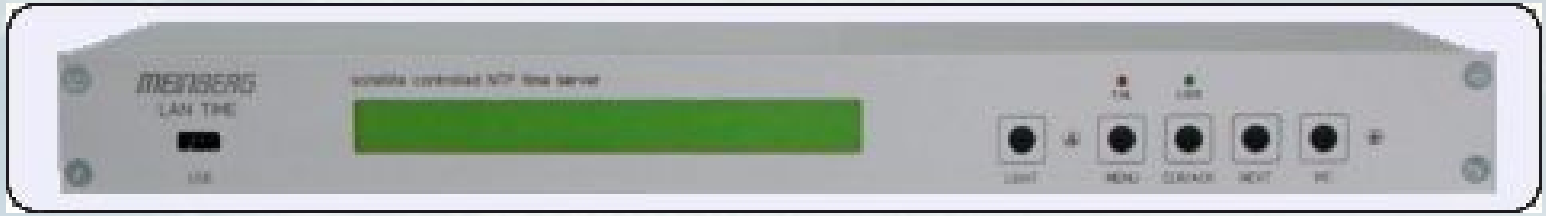


Source: tf.nist.gov

- Cesium Beam Tube life span limited
  - Cs supply exhausts after ~8 years use
- You start becoming a “Time Lord”
- This gear would give out wrong time if hit by power or loss of gps sync event!

Replacement Device

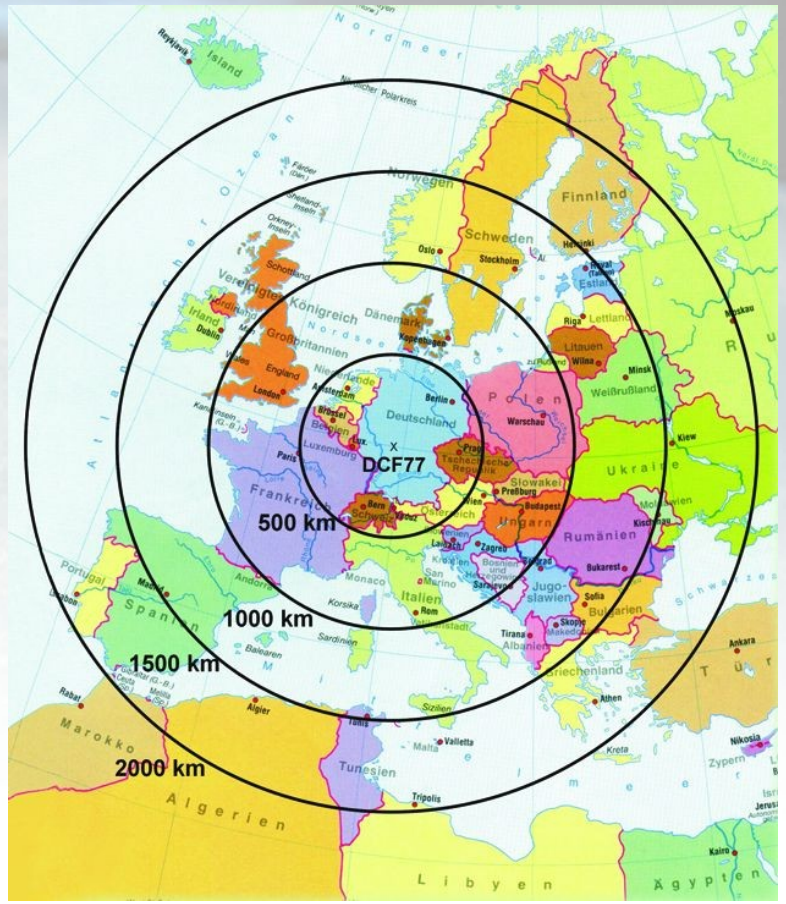
- Meinberg LANTIME SHS (Secure Hybrid System) – **ntp0** and **ntp1** (Telehouse)



- Uses GPS and DCF77 signal from Mainflingen, Germany
- Microsecond accurate timecode served
  - Without Cesium oscillator!

Mainfling-what?

- German standard time signal
- Administered by *Physikalisch-Technische Bundesanstalt*
- US equivalents
  - WWV, WWVB, WWVH



Basis of “Secure Hybrid System”

- The DCF77 signal uses PZF modulation
  - Pseudo-random phase noise (512 bit long)
- Allows receiver to generate a higher degree of accuracy compared to AM-only reception (such as the UK’s MSF)
- Can convey advance warning of things such as leap second data in addition
- Micro-second accuracy allows comparison with GPS time
  - Raises ntp stratum or stops service if clock drifts

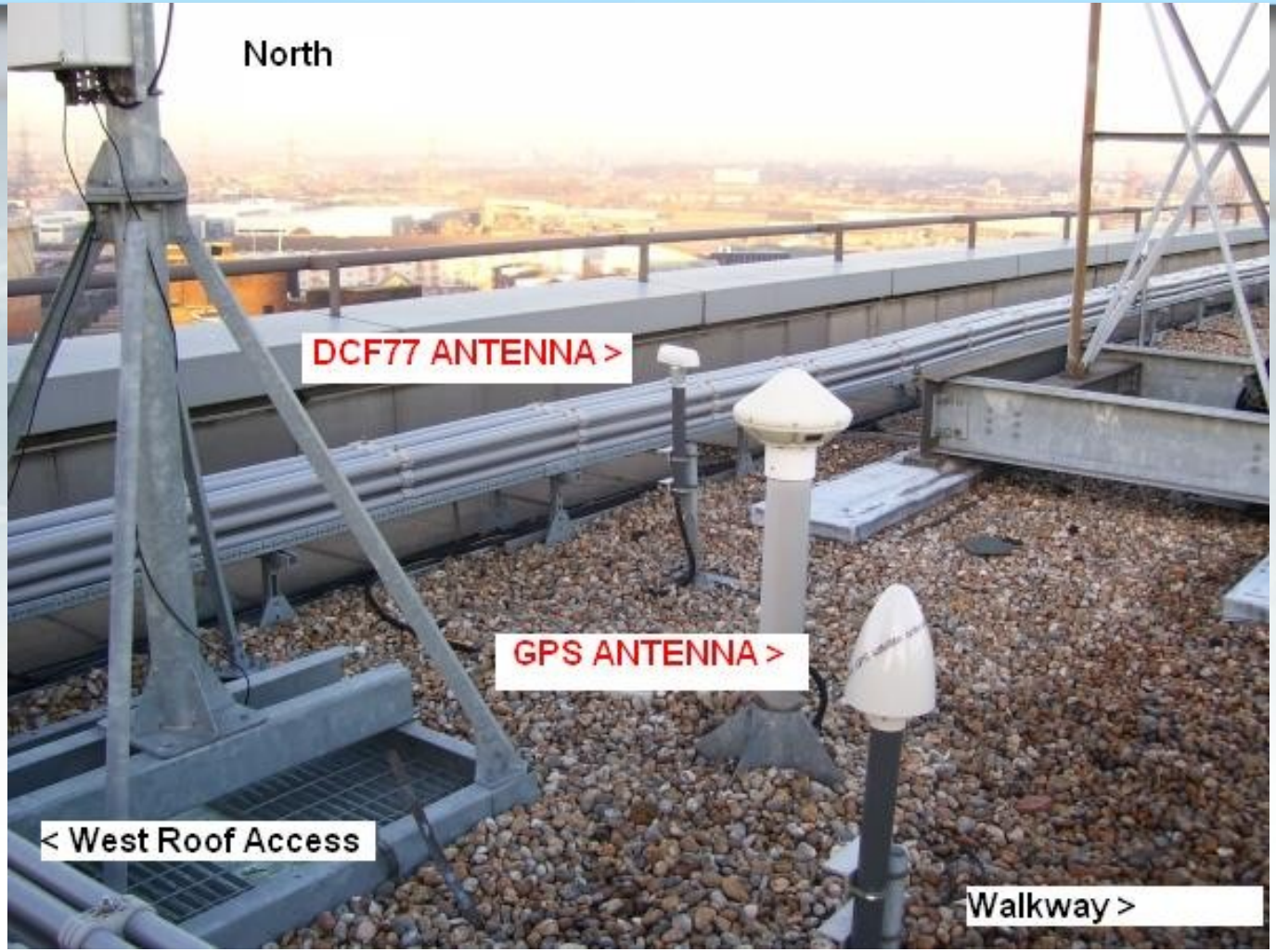
Antennas

- Both GPS and DCF77 need roof-mounted antennas
  - Replacing existing antennas
- Quite a job to find the existing antennas
- Poor documentation meant nobody could remember where they were!
- Quite a few of them up there now
  - Wasn't the case back in 1999

Antennas – GPS

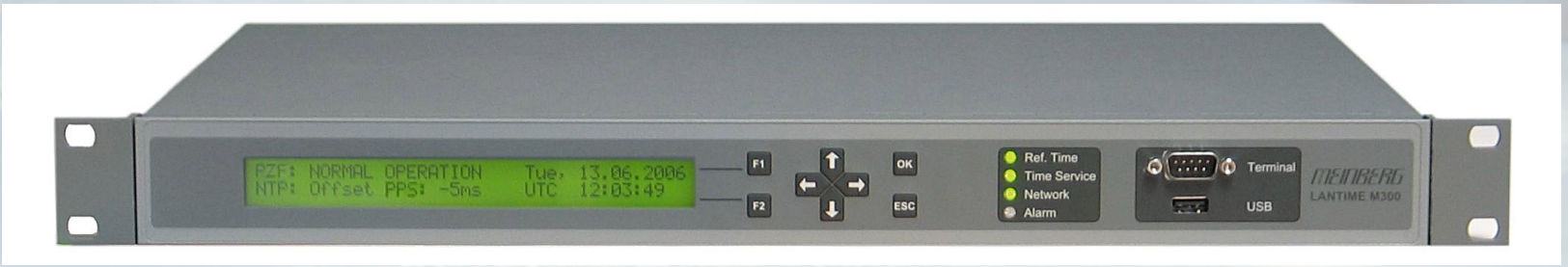
Antennas – DCF77

Antennas in situ



TeleCity Millharbour

- LANTIME M300 / GPS+MSF (**ntp2**)

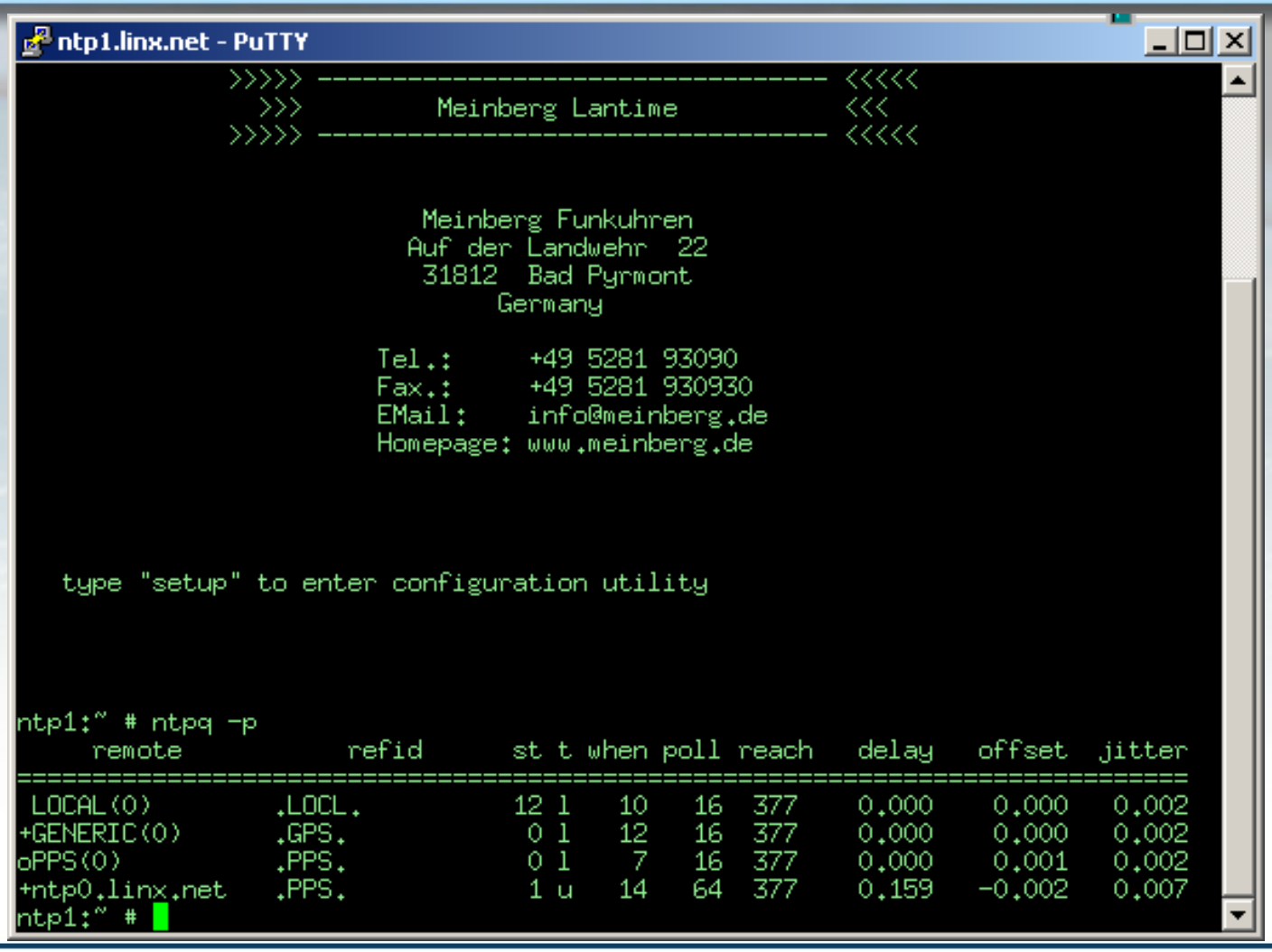


- GPS as primary time source with MSF as backup
- Couldn’t receive DCF77 in this location
- Live in February 2008

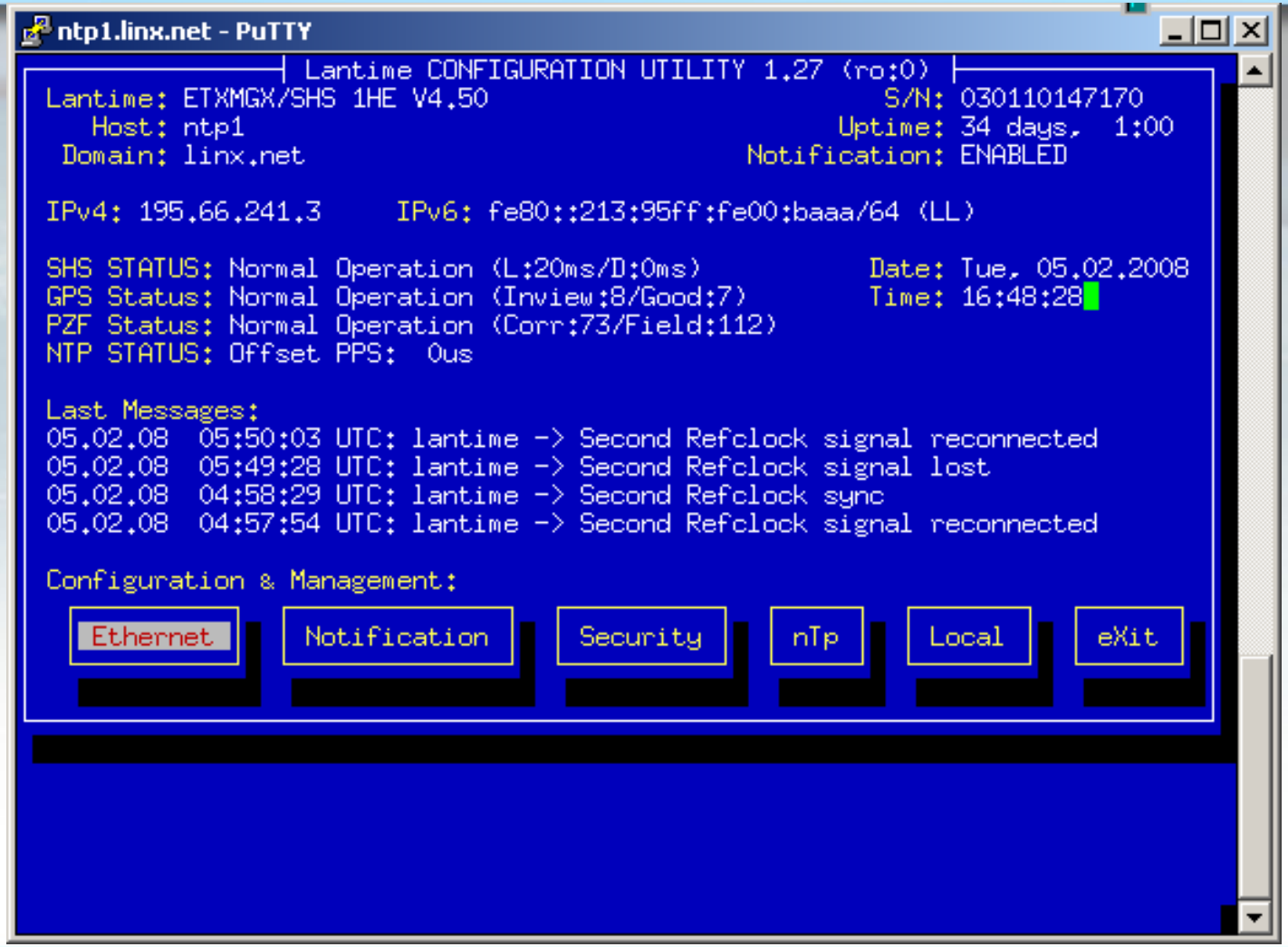
MSF Signal

- “MSF” is the callsign of the UK NPL managed time service
- Commonly referred to as “Rugby”, but moved to Anthorn, Cumbria in 2007
- Simple On-Off keyed 60kHz signal
  - No PZF correlation
- NTP clock is “either/or” derived rather than hybrid

Meinberg LANTIME runs Linux ☺

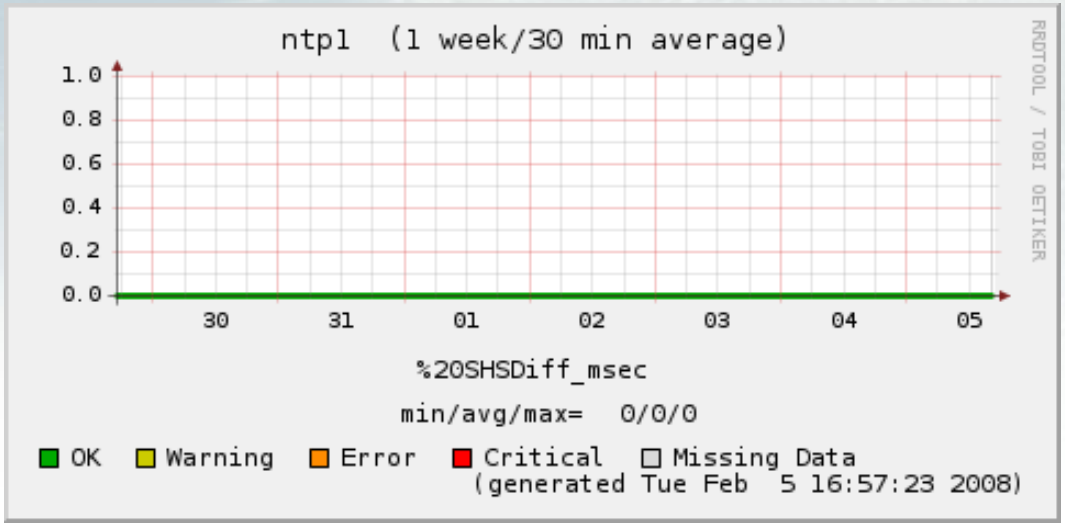


Configuration Utility



Accurate or no time!

- Stops serving NTP if the time drifts or time sources not in sync
  - Or increases NTP stratum



SHS Diff (Difference between two time sources): *Should be zero!*

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Learning Experiences

- Running your own Cesium standards can be expensive, and really benefits from having local “time expertise”
- For NTP, equally good results can be gained from a simpler system
- Roof access in some buildings is a pain
- We used a specialist supplier even with the Meinberg gear

Questions?