

Time in the Network



Who am I?

David Venhoek

- Technical lead for statime and ntpd-rs
- Background in physics and mathematics
- Active participant in the IETF ntp working group



Outline

- Why is good time important?
- How can we synchronize our clocks?
- What is NTP and how to use it.
- What is PTP and how to use it.

Why is good time important?

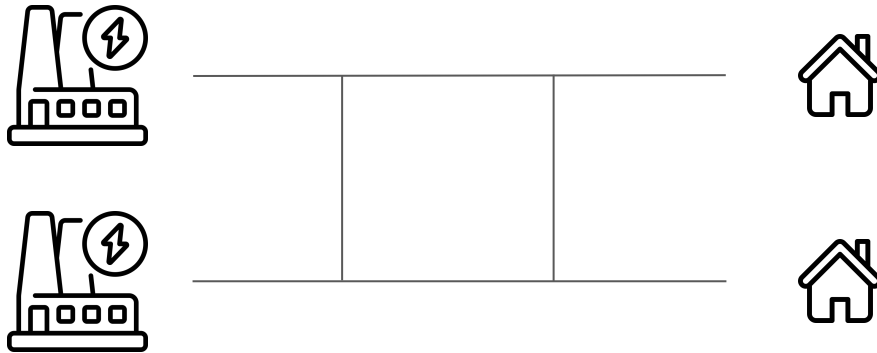
Security:

- When is a certificate valid?
 - Not before time of issuance (shouldn't normally be a problem)
 - Not after expiry date!
- Revocation almost always depends on knowing the time!
- Attack: set the clock back to just before heartbleed.

Why is good time important?

Event logs:

- In what order did failures occur?
 - Important in for example power grids.

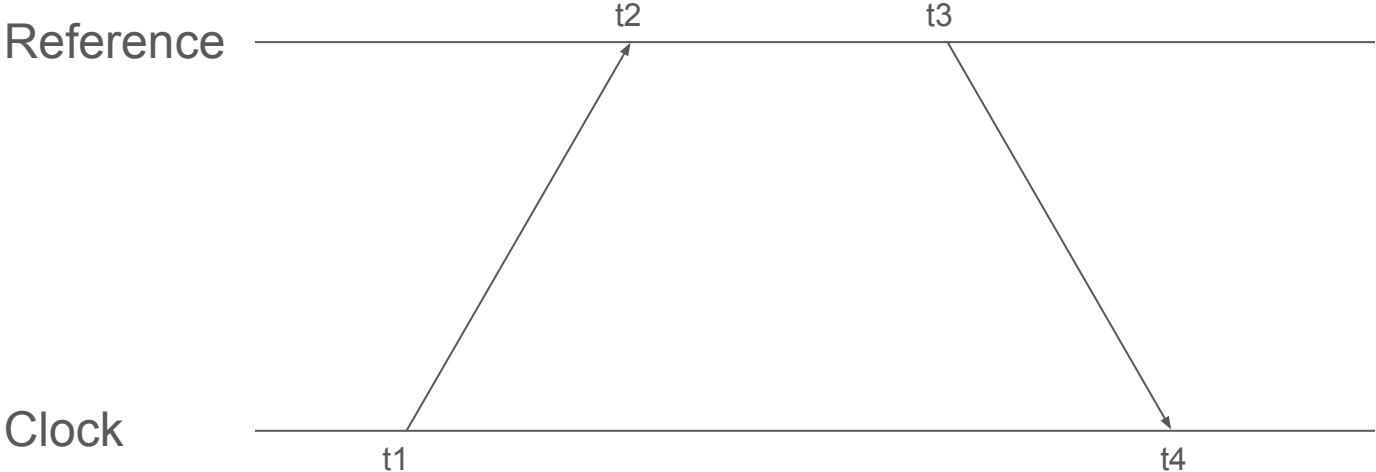


Why is good time important?

Distributed systems:

- Time synchronicity for better performance:
 - Commit-wait for linearization.
 - Multi master setups for databases.

How does time synchronisation work:



How does time synchronisation work:

Over computer networks, two options:

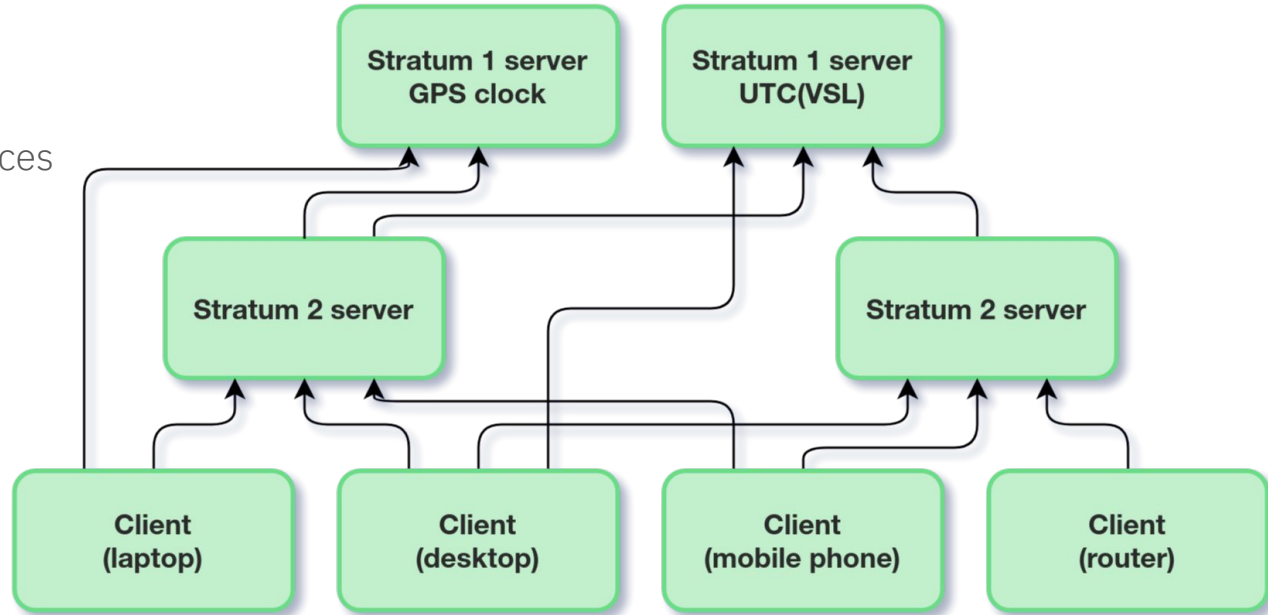
- NTP
- PTP

Other channels

- GNSS (GPS, Galileo, BeiDou, GLONASS)
- AM Radio (DCF77, WWVB)

NTP

- Client-Server
- Works over the internet
- Multiple upstream sources
- Authenticity with NTS
- Accuracy:
 - ~5ms (internet)
 - 1-100 μ s (local)



NTP

When to use

- Default for time synchronization on all operating systems
 - Note: usually without authentication!
- Useful for time for things like:
 - Time for verifying certificates
 - Server logs of most servers
- Simple to set up (mostly)
 - NTS support is not universal yet

NTP

Challenge: NTS bootstrapping

- NTS uses TLS to verify server identity
- Needs to check validity of server certificate
 - But needs current time to do that.

NTP

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Solution

- Require system time to be reasonable before first synchronization (within a day usually works).
- Implement special handling of the certificate validity checks.

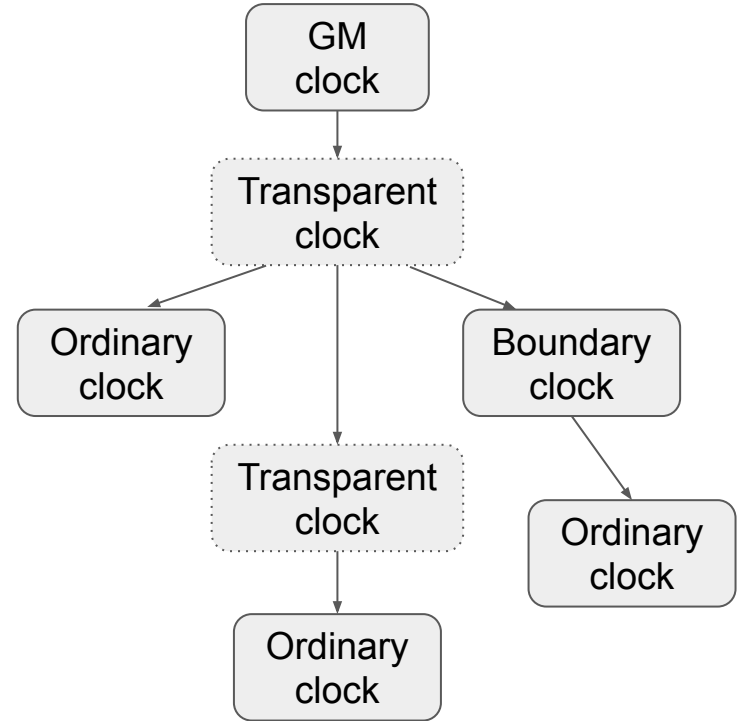
NTP

Disadvantages

- No correction for random delays in routers
- No guarantee of symmetric paths

PTP

- Broadcast
- Single source of time
- Accuracy:
 - ~10ns with hardware support
 - ~100ps with high precision hardware



PTP

Where is it used:

- Large scale distributed systems
 - Facebook
 - High frequency traders
- Synchronization of measurement systems

PTP

Disadvantages:

- More complex to set up
- Needs support in:
 - routers
 - switches
- Needs special network cards
- Limited security

Call to action

- Go think about how you use time in your own systems!
 - Which properties do you need from your clocks?
 - Does your current solution actually guarantee you that?
- Go checkout ntpd-rs and statime.
- If you want to contribute: we need feedback
 - Both in the standards process
 - Also for our software

Interesting URIs

- ntpd-rs: <https://github.com/pendulum-project/ntpd-rs>
- statime: <https://github.com/pendulum-project/statime>
- NTPv5 requirements: <https://datatracker.ietf.org/doc/draft-ietf-ntp-ntp5-requirements/>

Thanks

Getting in touch

Contact someone or checkout Tweede golf on <https://tweedegolf.nl> or [LinkedIn](#)

David Venhoek

Security software engineer
david@tweedegolf.nl