WSTS* Virtual

Clock Sync in the Time of Covid19

**Workshop on Synchronization & Timing Systems May 13 2020*

Time for isolation

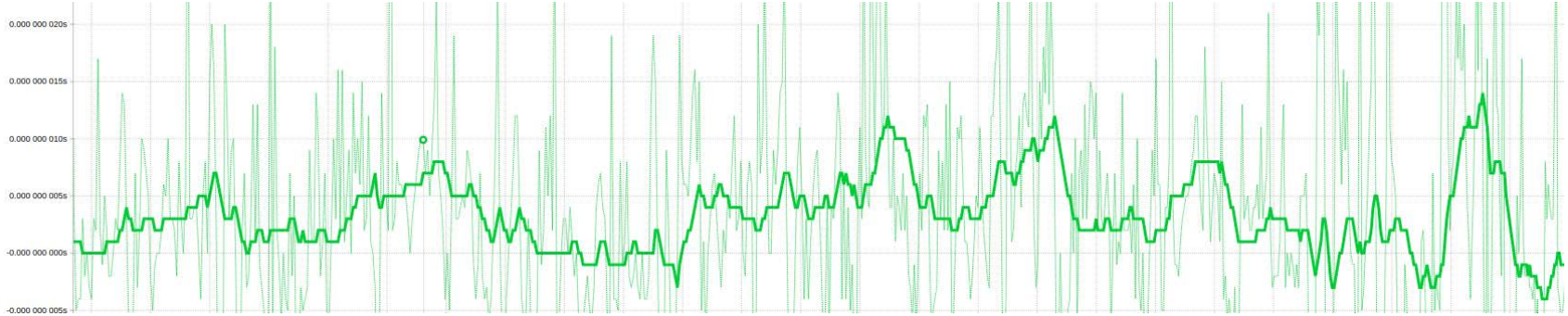
- Clock Sync for a home office reveals a lot about challenges in the data center
- Low skilled workforce (or over-committed)
- Commodity hardware
- Networking issues
- Monitoring and alerts

Issues

- Many of the issues covered here are important in data centers too.
- There is a growing regulatory emphasis on desktop “business clocks”.
- Exposition focuses on tools and analytical graphs that come with TimeKeeper but are general issues.

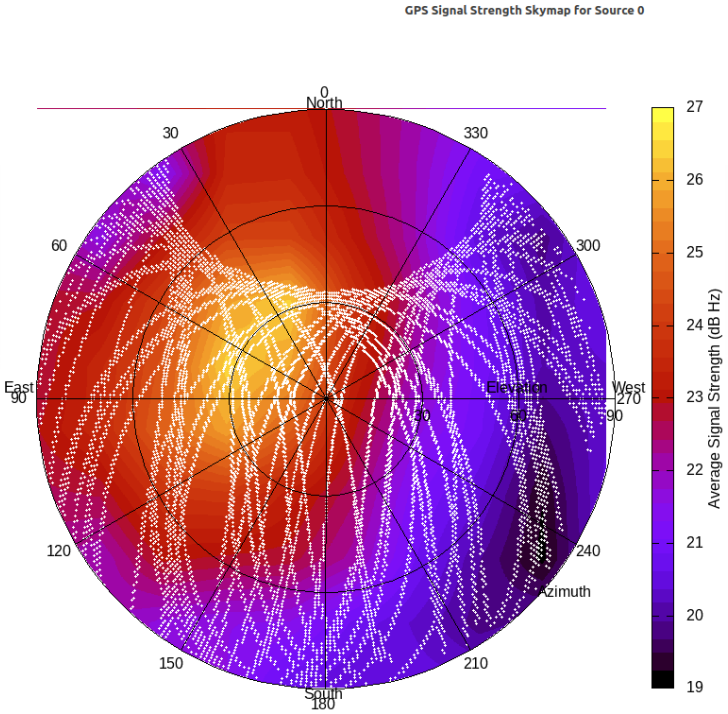
Cobbled together GM in a desktop

Tracking GPS to within a few tens of nanoseconds (Y axis scale 5ns grid)



Commodity GPS/OCXO module and a lot of software control algorithms to make up for device oscillator, intermittent fans, PCI-delays, interpolation, etc.

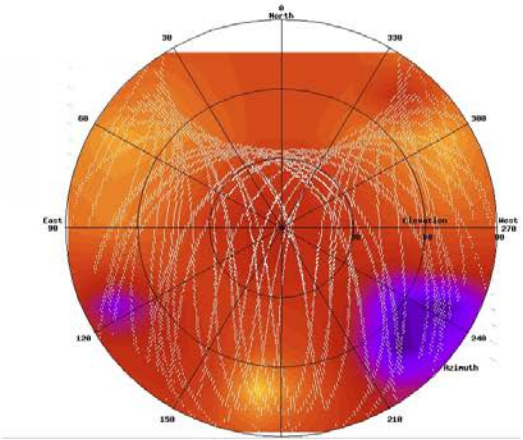
The antenna and the view



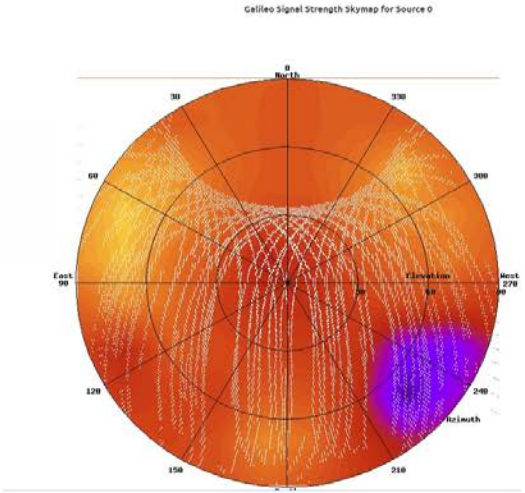
TimeKeeper “skymap” shows roof to the left (dark)

In a data center – there may be multiple constellations

Sky view for different constellations should not differ radically. If one changes and the others don't – problem with that source.

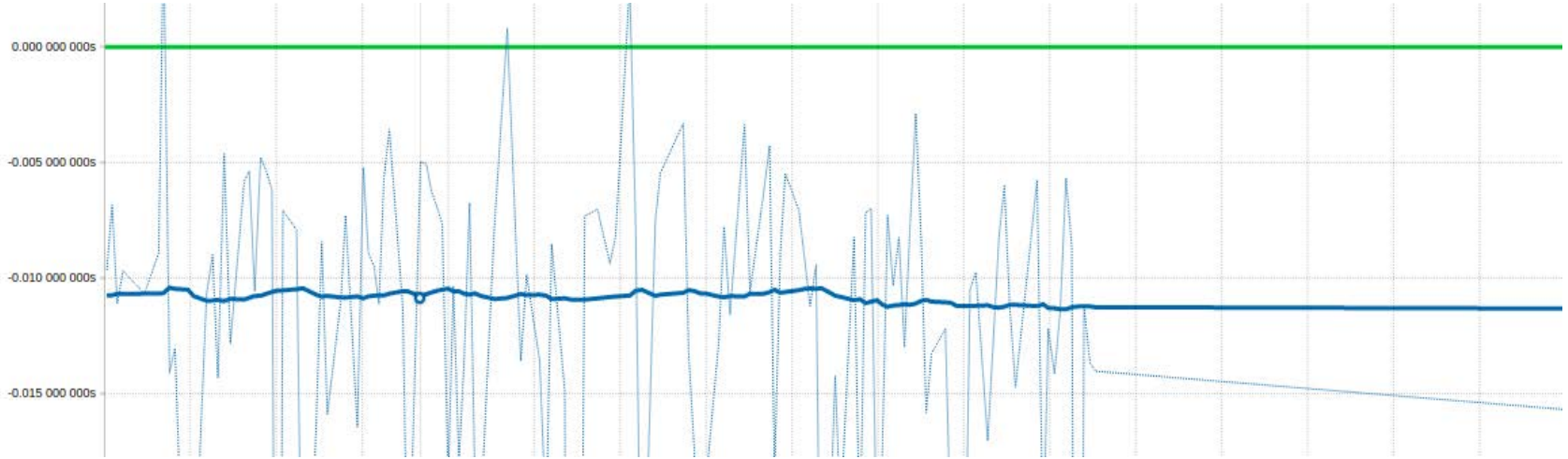


GPS



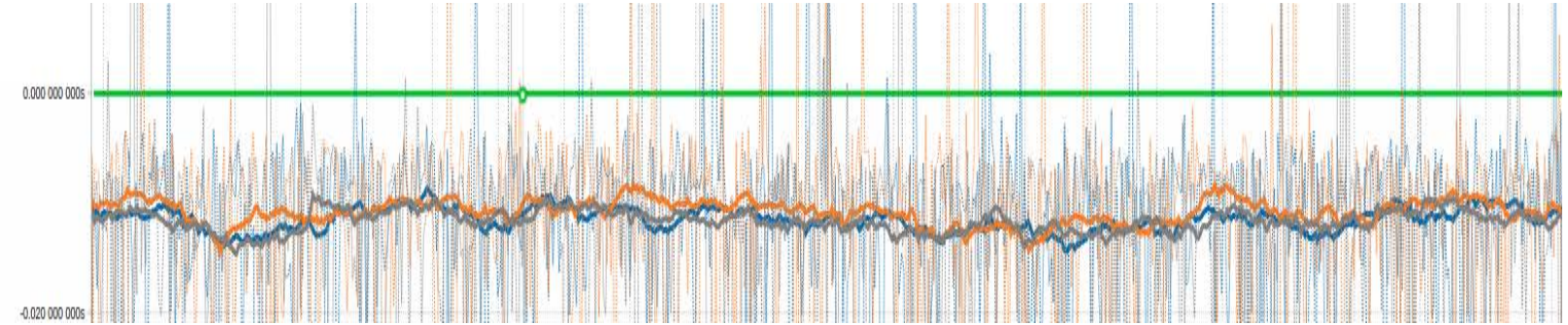
Galileo

GPS versus internet NTP (thanks U. of H)



We can track the Internet NTP source pretty well, but it is 10 milliseconds off. A single clock source is impossible to validate from the client. On the other hand, this is external validation of gross time and frequency.

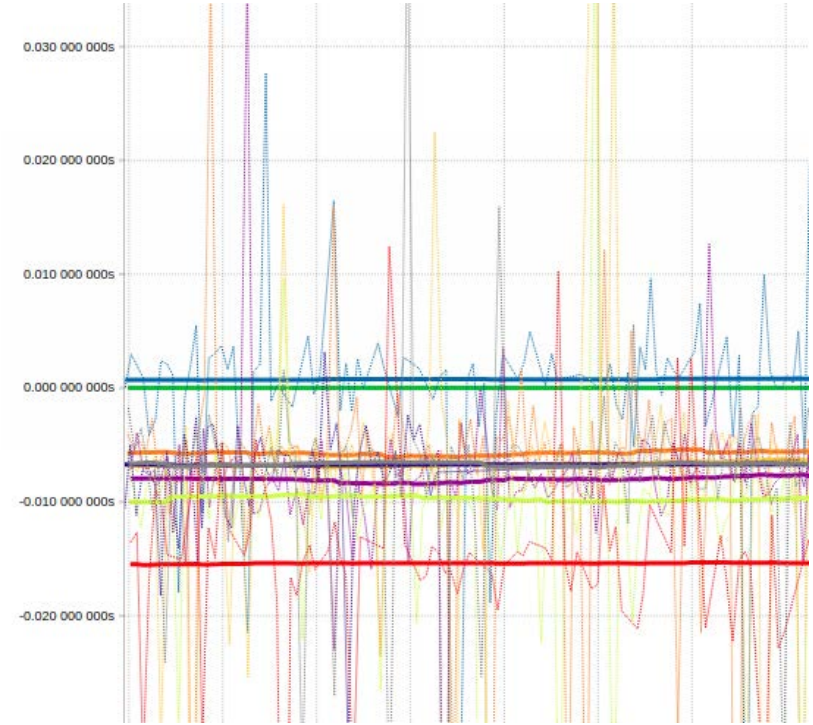
Multi-Source



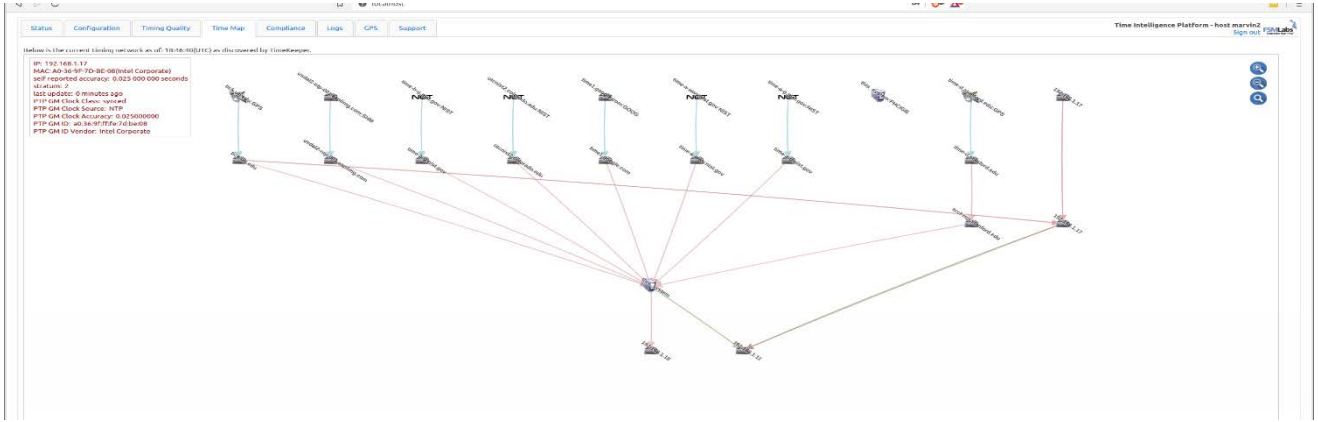
Tracking multiple NTP sources shows they all agree and all have the similar offset. This is probably due to Comcast. But it shows how time provides valuable network connectivity data and limitations of aggregation (you need a smart IT staff, or in this case one with access to smart advice, to distinguish source quality).

Redundancy

Even in this case, once U of. H is shown to be pretty reliable (over long measured intervals), its offset can be corrected to provide some resiliency if GPS fails or is spoofed (I don't trust my neighbors, many of whom are technically sophisticated). See the blue line which has been corrected to align with the GPS green line.



Another view of the network



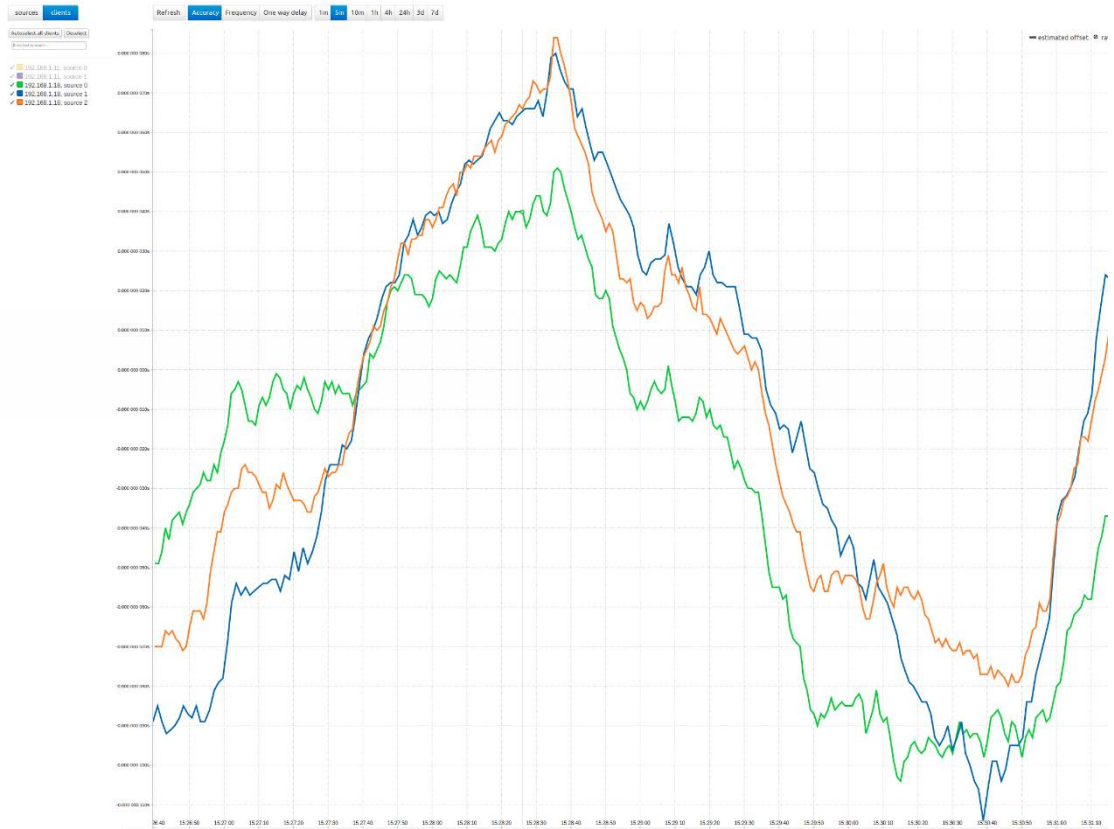
This shows my selection of clock sources and their sources – when GPS fails and we're falling back on NTP.

A desktop client

Current Local Source Snapshot Details	
Source	**Estimated offset**
(1) PTP: Domain 0 (unicast)	0.000000824
(2) PTP: Domain 0 (unicast)	0.000000802
(0) NTP: 192.168.1.17	0.000000611

Both PTP and NTP (the incorrect folklore theory NTP is limited to milliseconds is not consistent with the data.)

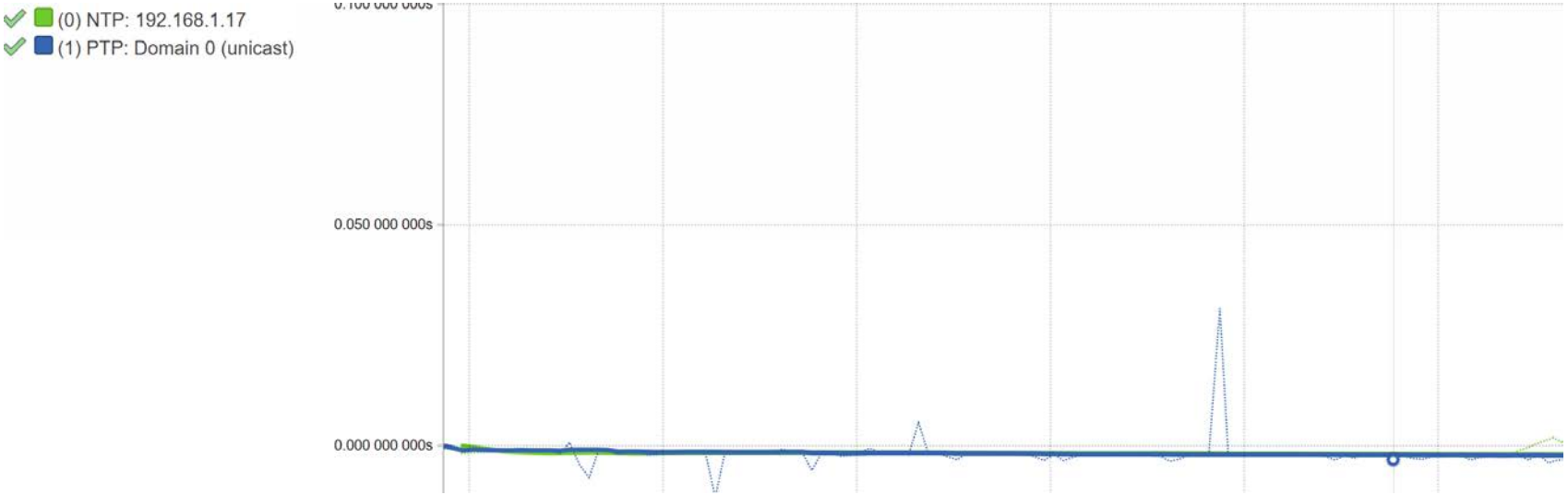
Same desktop client tracked by the GM



Both PTP and NTP. The graph looks terrible but the distance from peak to valley is under 200 nanoseconds.

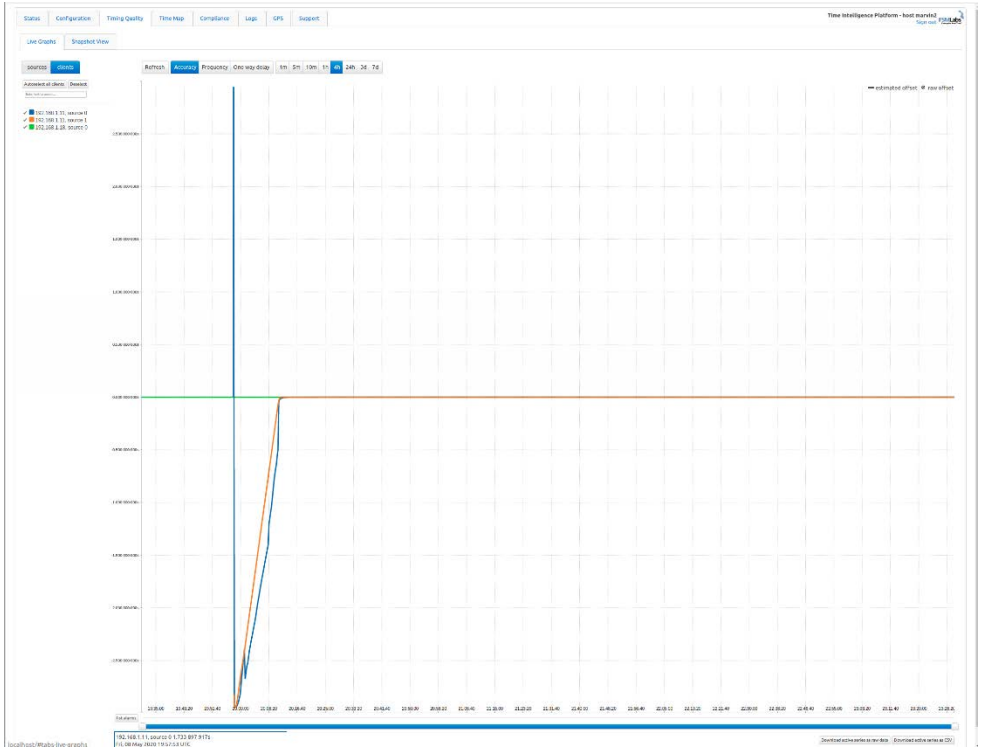
The numbers were improved from previous slide by changing the network configuration.

On the back porch



Timekeeper on a notebook computer over wireless (well within the 50 millisecond level regulations are starting to require for "business clocks" on the edge (PTP and NTP feeds validate each other).

Notebook has some of same issues as VM



Closing the lid on the notebook suspends the clock. The rapid slewing preserves time ordering but returns the system to correct time (the green line is the primary clock on the client)

Microsoft has a tentative (not released) new API that will allow hardware timestamping and TimeKeeper can get nanosecond accuracy with that API on a Windows desktop.

Contact FSMLabs/FSMTime

sales@fsmtime.com