NIST Network Time Services: Current status and future plans

Judah Levine
Time and Frequency Division
NIST, Boulder
Judah.levine@nist.gov

Current Standard NTP Service

- 25 NTP servers at 4 locations
- Synchronized to local cesium clock ensemble at each site
  - Ensemble realizes UTC(NIST)
- Sites compared with each other
- Approximately 10^6 requests/second
- Accuracy at server about 5 μs
- Accuracy for user depends on network
  - Best 150 μs
  - Typical 5 ms – 10 ms

Authenticated NTP Service

- NTP messages authenticated with symmetric key algorithm
- 4 servers at different locations
- 800 registered users, each one has unique symmetric key
  - Key linked to IP address(es) of client systems
- Authentication prevents spoofing and altering of messages
  - Does not improve accuracy

UT1 time service

- Transmits UT1 time in NTP format
- 2 servers at different locations
- UT1 offset from IERS data of UT1-UTC
- About 1000 user addresses
- Accuracy of received time: 5 – 10 ms
  - Limited by stability of the network delay

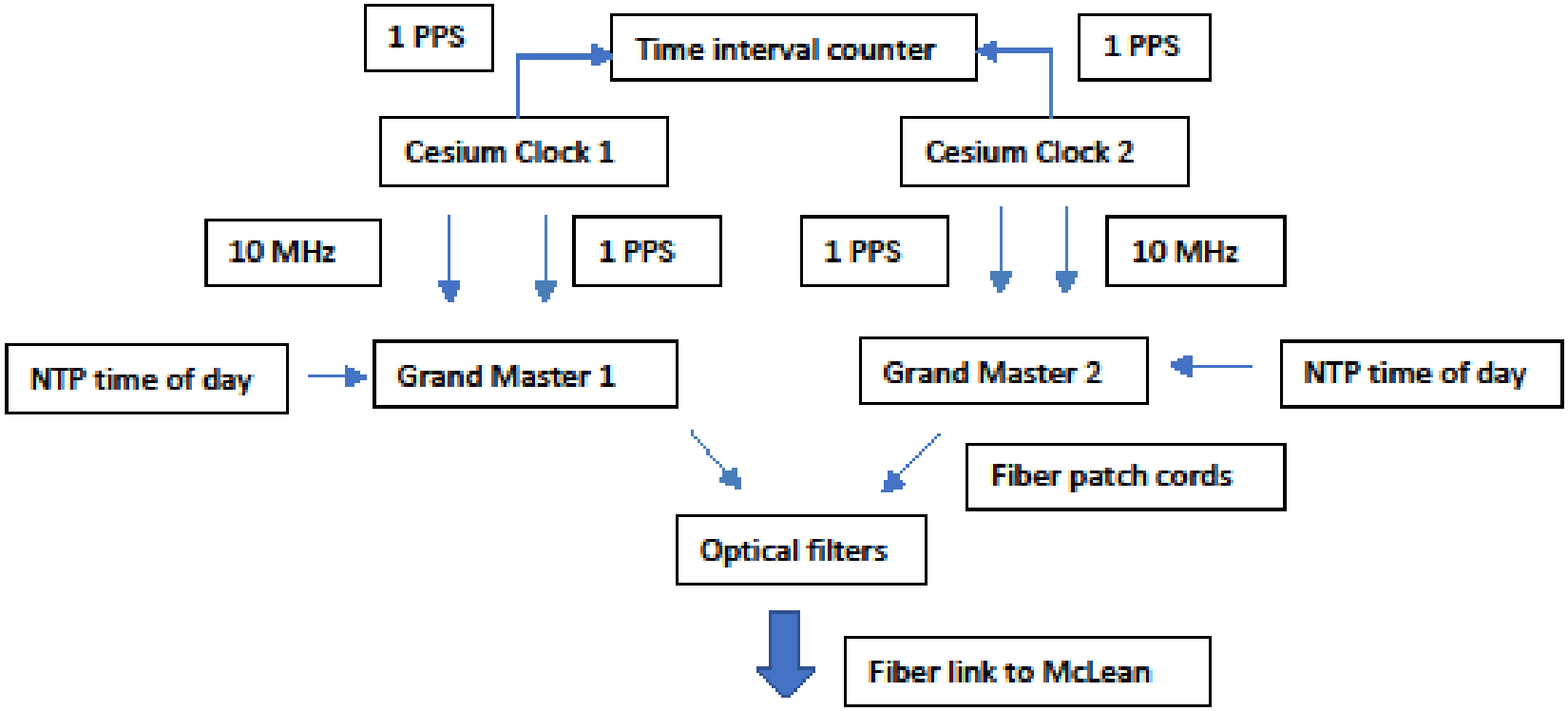
Special Calibration Test - 1

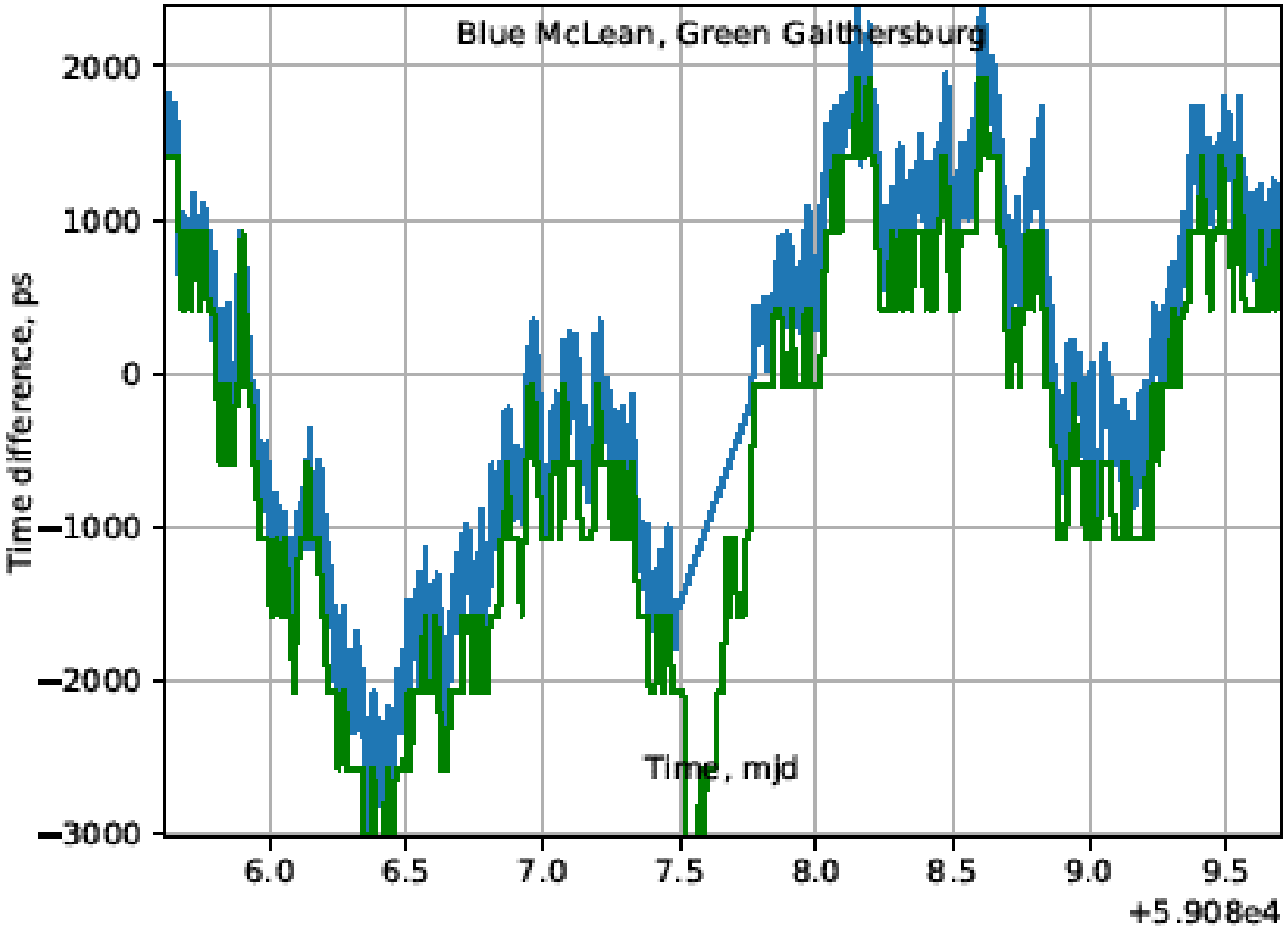
- Provide link to UTC(NIST) by using dedicated fiber circuits
  - Transmission independent of GNSS
- Initial accuracy 1 μs
- Ultimate accuracy < 100 ns after 6 months

Special Calibration Test - 2

- Collaboration with OPNT
- Link from NIST/Gaithersburg to McLean, Virginia
- White Rabbit protocol over single bi-directional fiber strand
- Two cesium clocks provide reference signals to two grand-masters at Gaithersburg
  - Minimize single points of failure

Special Calibration Test - 3

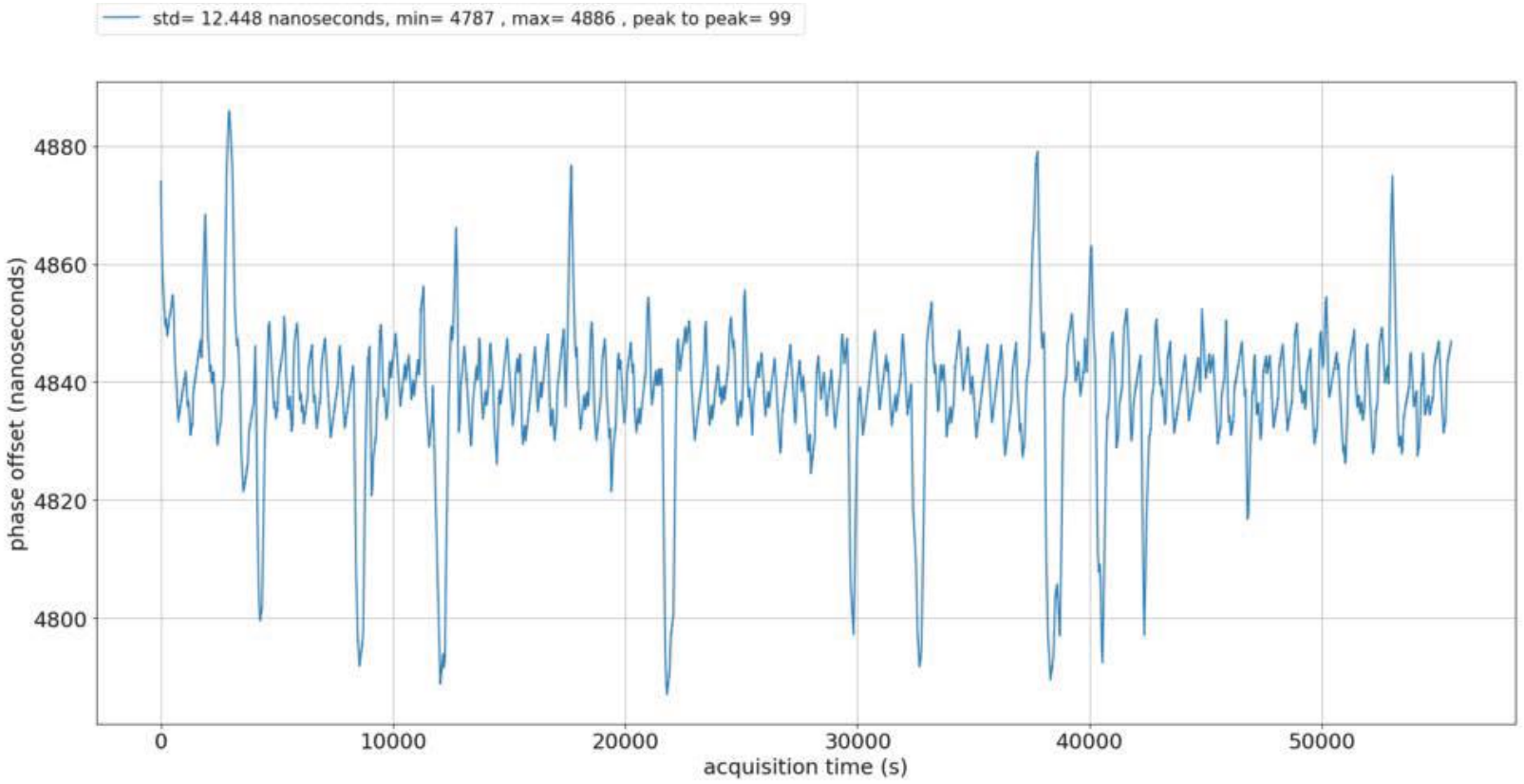



Blue McLean, Green Gaithersburg
2000
1000
0
−1000
−2000
−3000
Time difference, ps
Time, mjd
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
+5.908e4

Special Calibration Test - 4

- Extend link from McLean, Virginia to Atlanta, Georgia
- Preliminary loop-back test
  - 4.8 μs static time offset
  - Stability:
    - 99 ns p-p
    - 13 ns 1σ

Special Calibration Test - 5



Summary

- NIST NTP services:
  - Standard Service
  - Authenticated Service
  - UT1 time service
- Special Calibration Test:
  - Links to UTC(NIST) over dedicated circuits
  - 1 μs initially, 100 ns after 6 months
  - Initial tests confirm performance:
    - Gaithersburg to McLean
    - McLean to Atlanta