NIST Network Time Services: 
Current status and future plans

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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

Diagram:

- 1 PPS
- Time interval counter
- Cesium Clock 1
  - 10 MHz
  - 1 PPS
- Grand Master 1
  - NTP time of day
- Optical filters
  - Fiber patch cords
  - Fiber link to McLean
- Grand Master 2
  - 1 PPS
  - 10 MHz
- Cesium Clock 2
  - 1 PPS
  - 10 MHz
  - NTP time of day
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

std = 12.448 nanoseconds, min = 4787, max = 4836, peak to peak = 99
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