Quincy Data

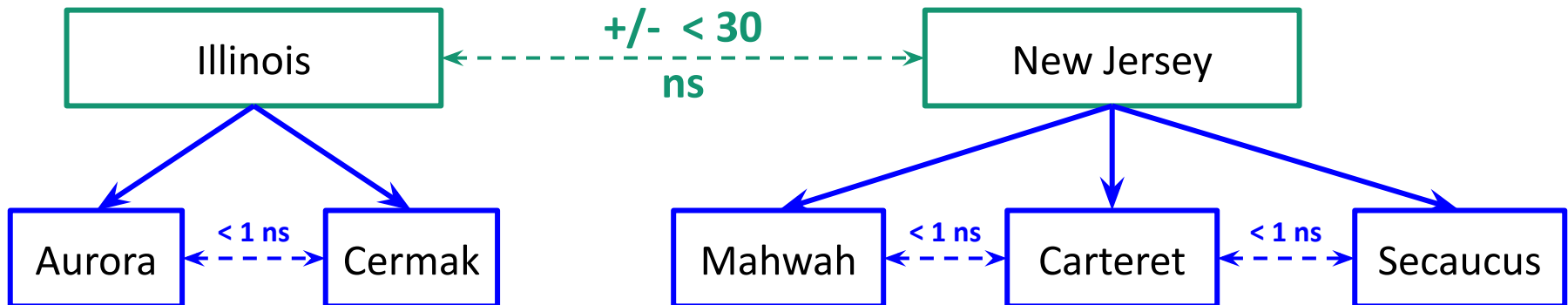# Quincy TSaaS: Toward a Unified Time Synchronization Architecture

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Single Clock Domain

A **single source of time** synchronizing clocks spanning major US Trading Venues

Motivation: high quality **internal timestamps**

- Improving **accuracy** and **precision**
  - Increases utility and value of captures
- Initial requirements
  - Include all **major US trading venues**
  - **Subnanosecond** precision within metro
  - **Better than 30** nanosecond precision between NJ and Chicago
  - No single point of failure

```
                    +/- < 30
   [Illinois] <----------------> [New Jersey]
                       ns
      /    \                    /      |      \
     /      \                  /       |       \
[Aurora] <-> [Cermak]   [Mahwah] <-> [Carteret] <-> [Secaucus]
       < 1 ns                  < 1 ns        < 1 ns
```

Time Transfer Techniques

- Assisted GNSS (GPS) time transfer
  - NIST Time Measurement and Analysis Service (TMAS)
  - Better than **15 ns** accuracy
  - **Traceability** to UTC(NIST)
  - Enables **transcontinental** transfer

- White Rabbit
  - **Subnanosecond** precision
  - Existing infrastructure
  - Data center transfer and, with effort, **metro**
- PPS
- PTP/NTP
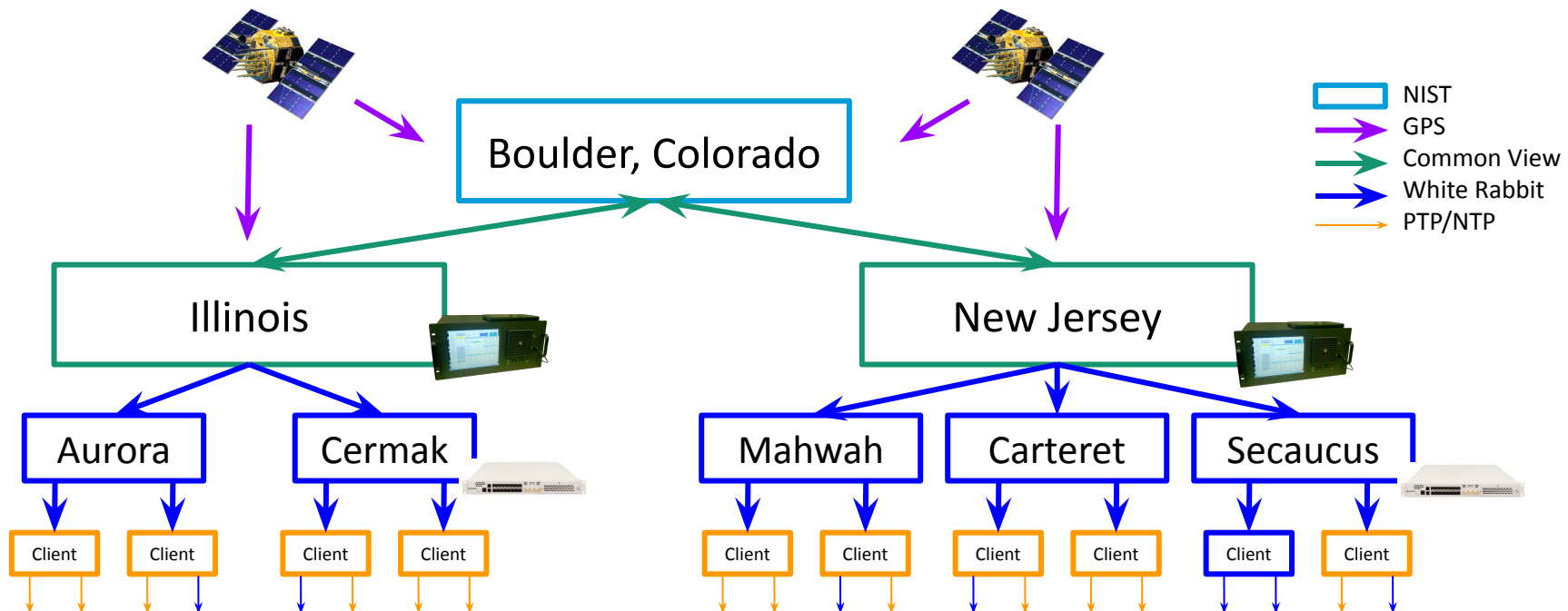
Building a Fault Tolerant Service

- Redundant resources
  - Lots of diverse **dark fibers**
  - Multiple **NIST TMAS** reference clocks
  - Rubidium(Rb) **atomic clocks** for holdover
  - Redundant **White Rabbit** hardware
- Configuration and topology
  - No single point of failure
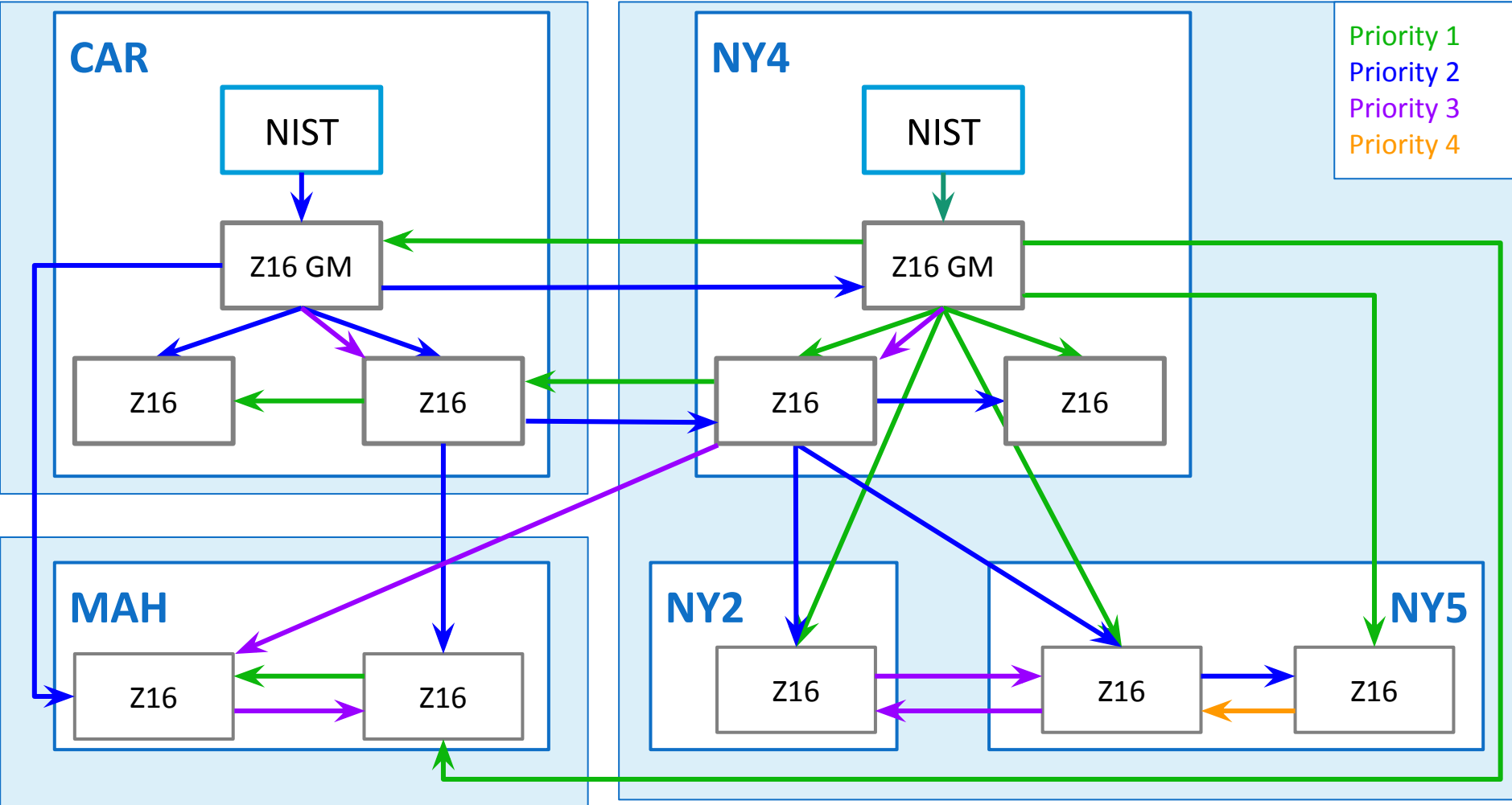 - Never split **clock domains**
  - Maintain **traceability**

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DC/Campus TSaaS Fault Tolerance

- Safran Failover Clock Algorithm (FOCA): "Out of the box" support with minor caveats
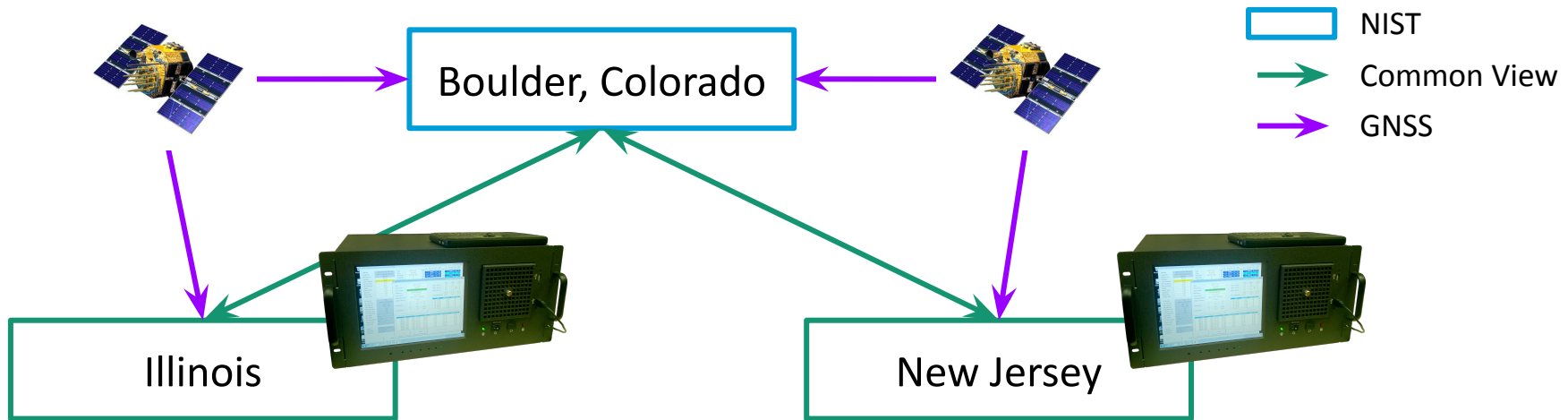- GNSS redundancy at metro level
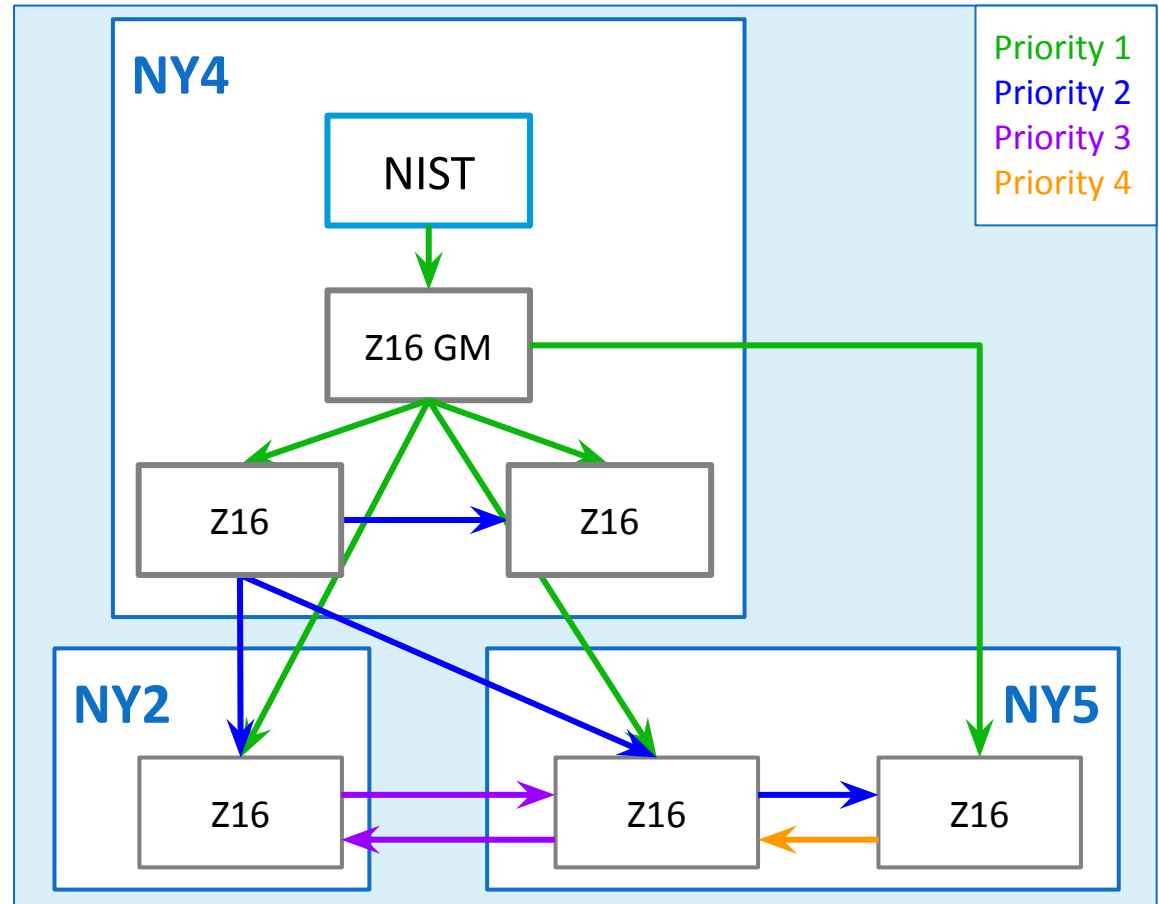
Metro White Rabbit Networks

Common View

- **Dual NIST devices** in each domain with Rubidium atomic clocks for holdover
- **Common view** (CV) time transfer provides traceability to UTC(NIST)

NIST/TMAS Failure and Traceability

- Complex failure modes:
    1. **All good**: GNSS locked and CV working
    2. **No NIST**: CV failed and GNSS working
    3. **Rubidium clock holdover**: GNSS failed
- When CV fails local TMAS loses traceability
- But we maintain **synchronization** and **traceability**:
    - **Monitor the offset** between two NIST devices
    - Using **survey mode** and/or time interval counter

Secaucus TMAS Performance
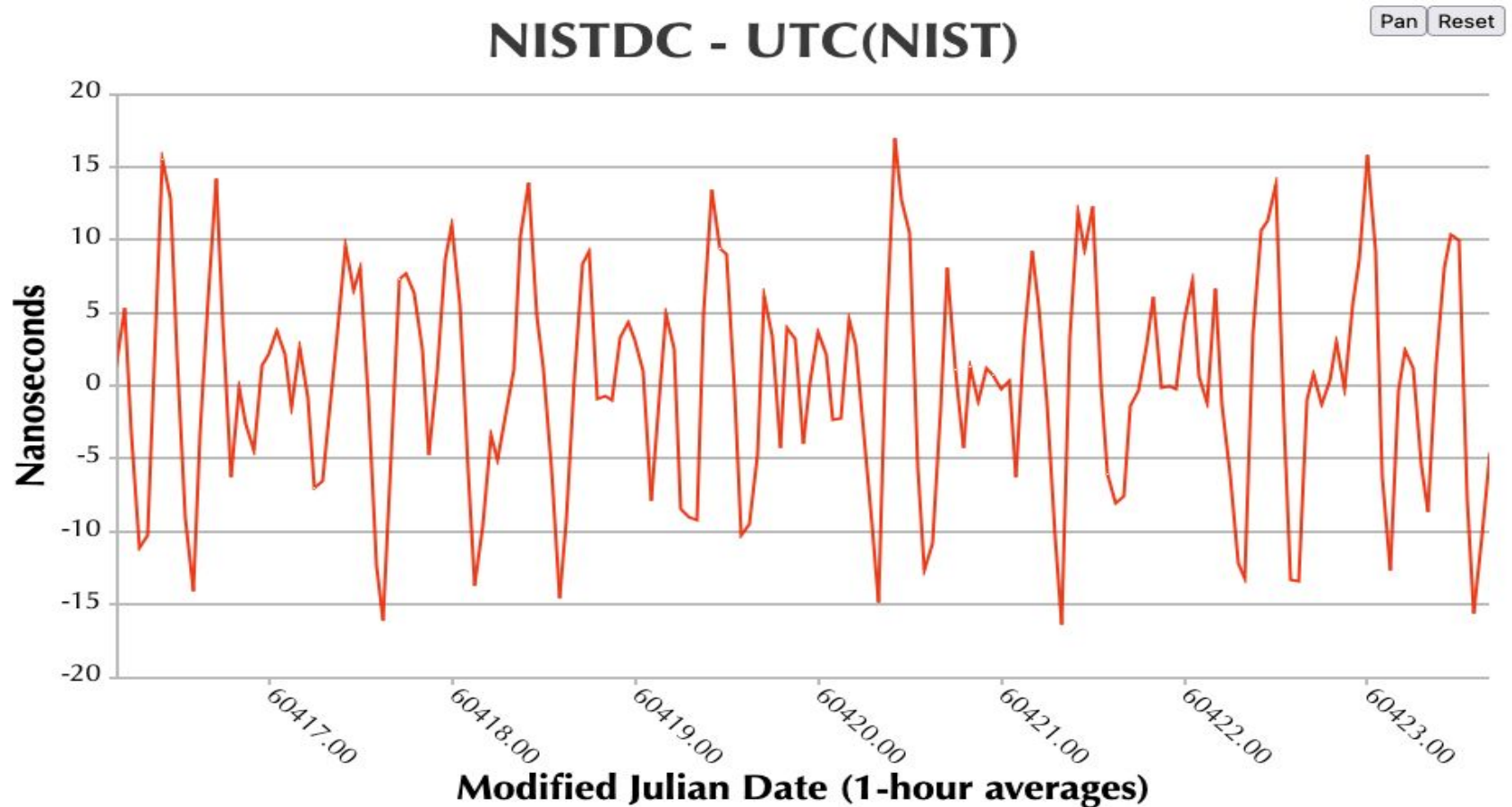
Quincy TSaaS: Future Directions

Time **S**ynchronization **as a S**ervice

- Today many firms have White Rabbit for NJ Triangle but:
  - **Difficult to build** and **maintain** a robust solution
  - Everyone has picosecond precision but **no one agrees on the time**

- Quincy TSaaS is **Unified Time**: picosecond precision with traceability UTC(NIST): we all agree on the time

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Full Picture Conclusion

- Current status
  - **New Jersey** hardware installed and **under test**
  - Redundant fiber nearly complete in New Jersey
  - Full solution available: **later this summer**
    - Subnanosecond in New Jersey and Chicago metro
    - Expect 15 nanoseconds between NJ and Chicago

- **Future directions**
  - Expand beyond North America
  - Redundant White Rabbit domains

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