



Quincy Data

Quincy TSaaS: Toward a Unified Time Synchronization Architecture

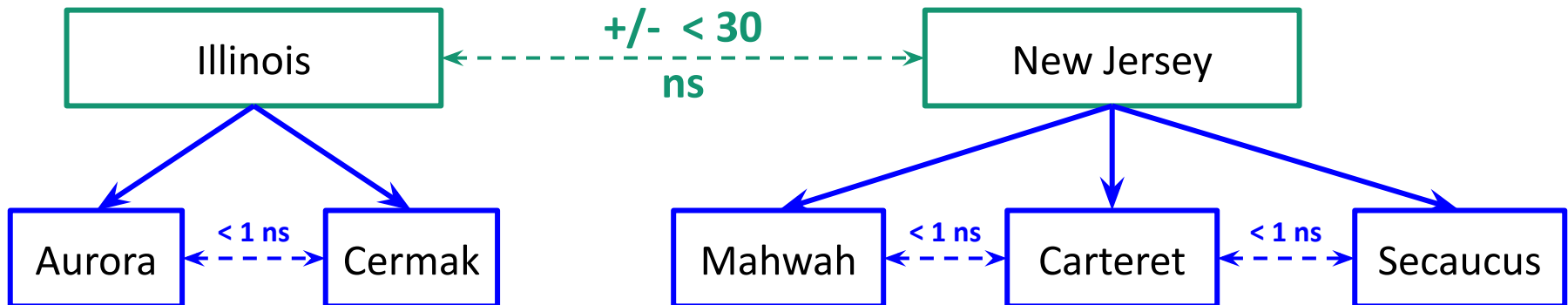
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Single Clock Domain

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

Motivation: high quality **internal timestamps**

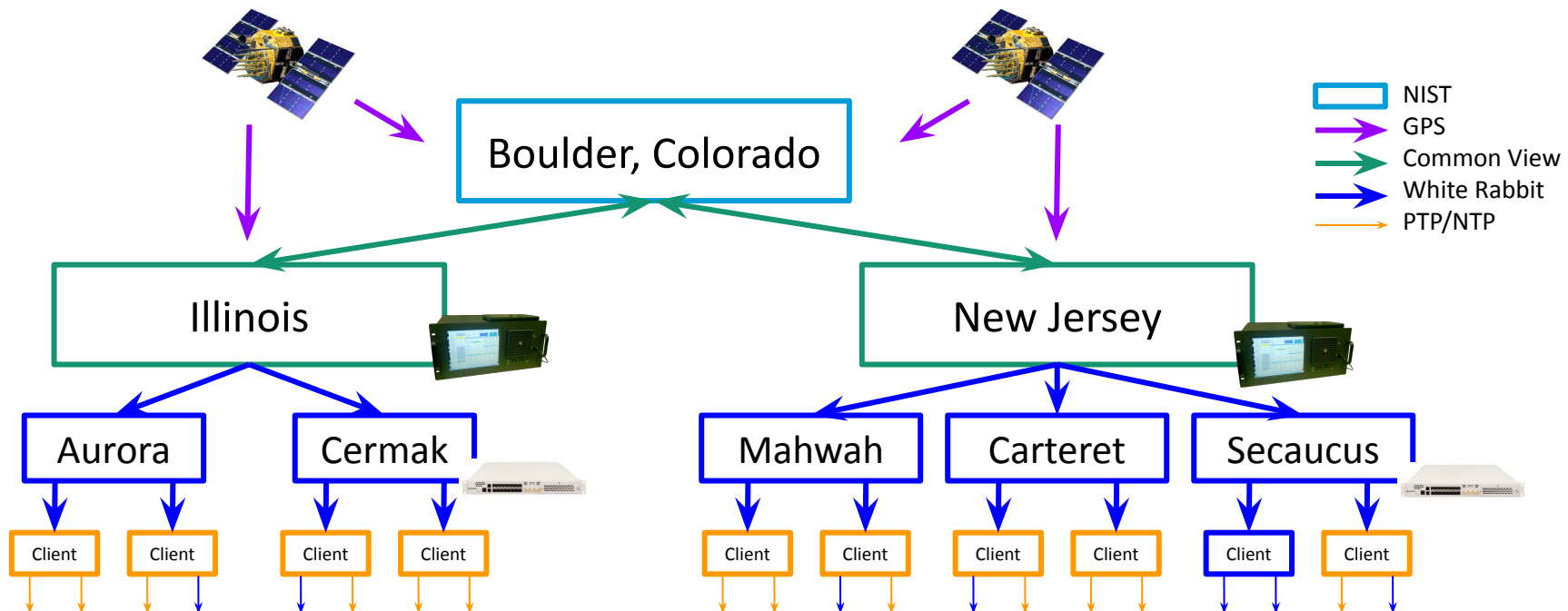
- Improving **accuracy** and **precision**
 - Increases utility and value of captures
- Initial requirements
 - Include all **major US trading venues**
 - **Subnanosecond** precision within metro
 - **Better than 30** nanosecond precision between NJ and Chicago
 - No single point of failure



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

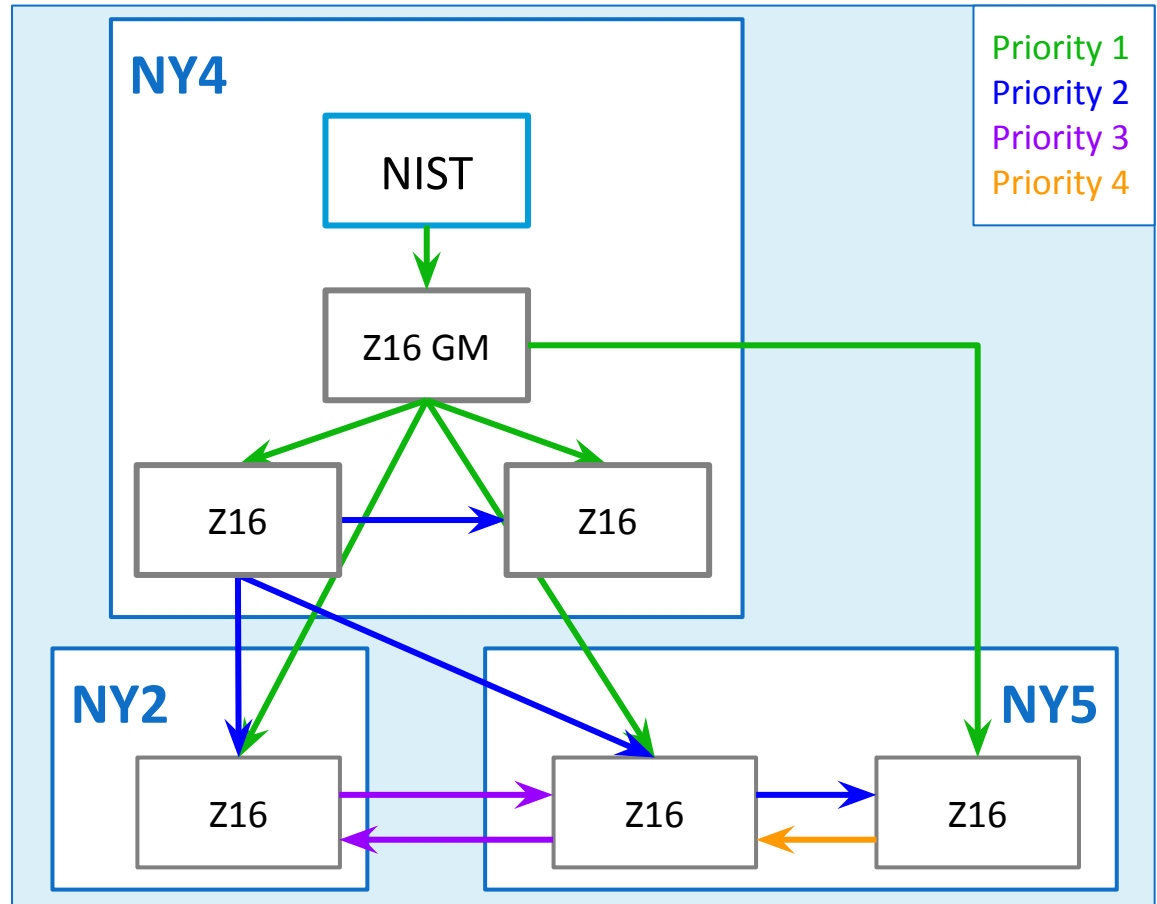


Building a Fault Tolerant Service

- 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**

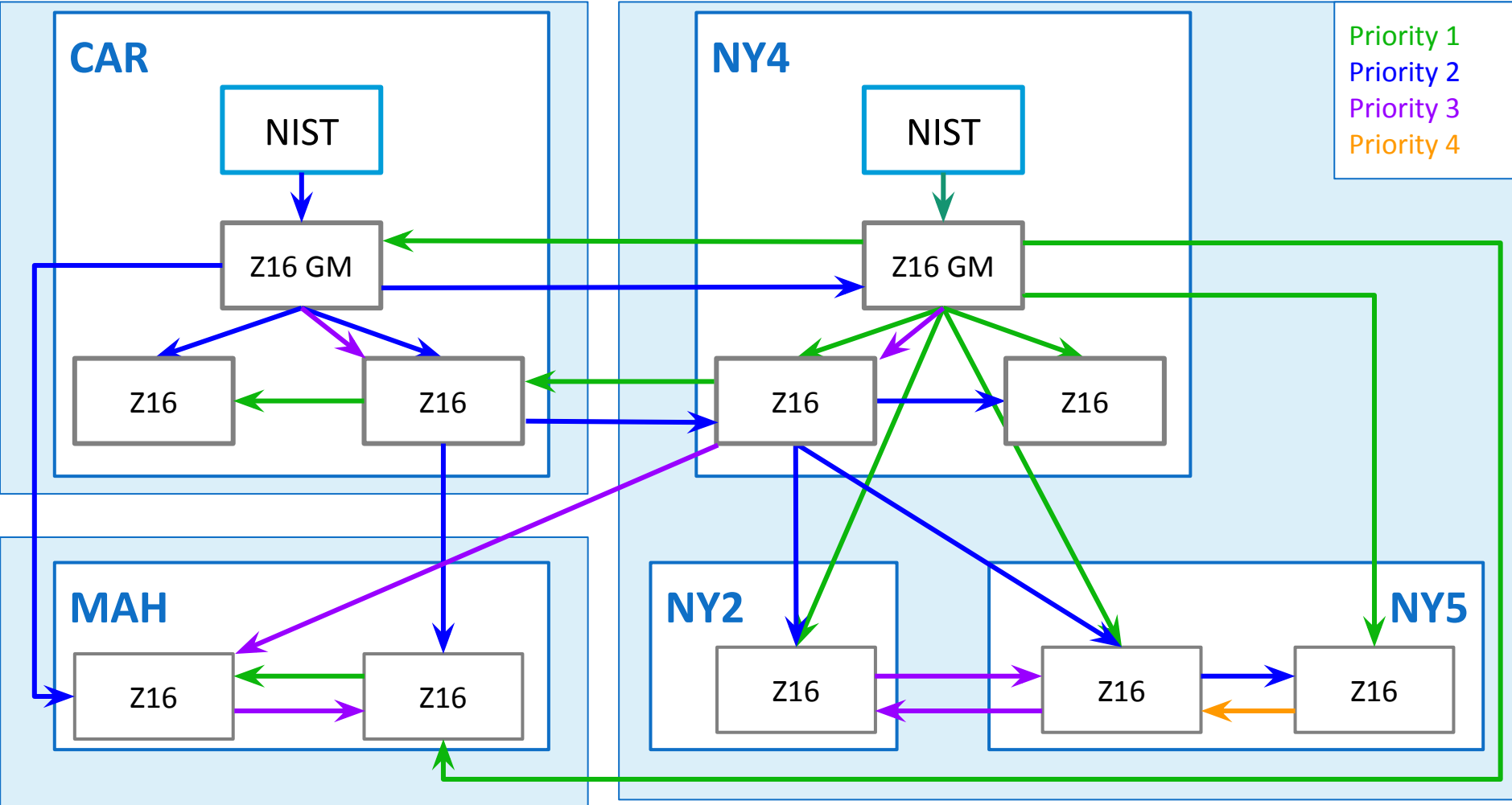
DC/Campus TSaaS Fault Tolerance

- Safran Failover Clock Algorithm (FOCA): “Out of the box” support with minor caveats
- GNSS redundancy at metro level

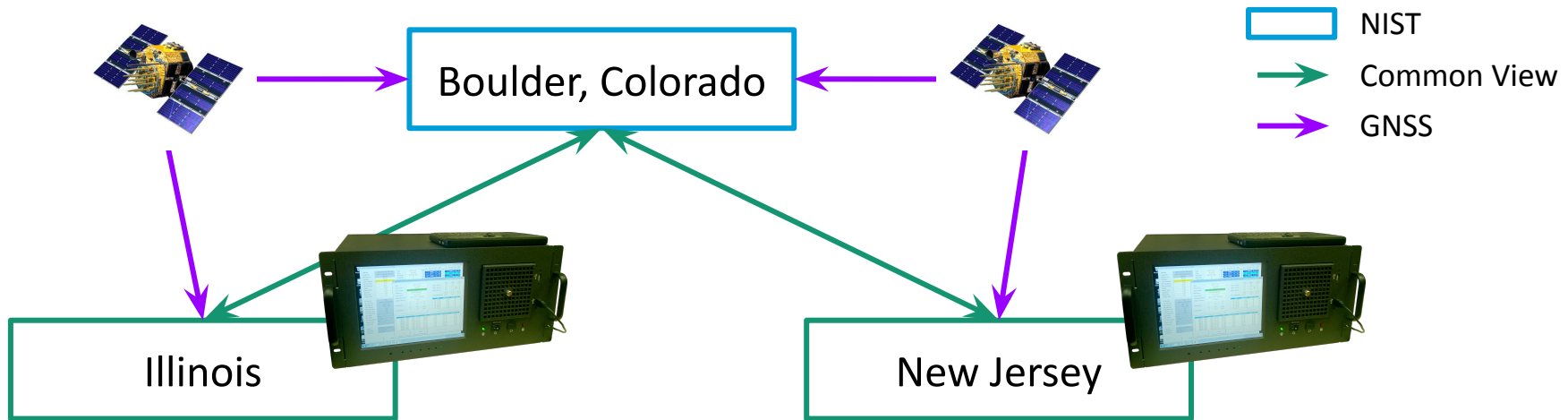


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Metro White Rabbit Networks



Common View



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

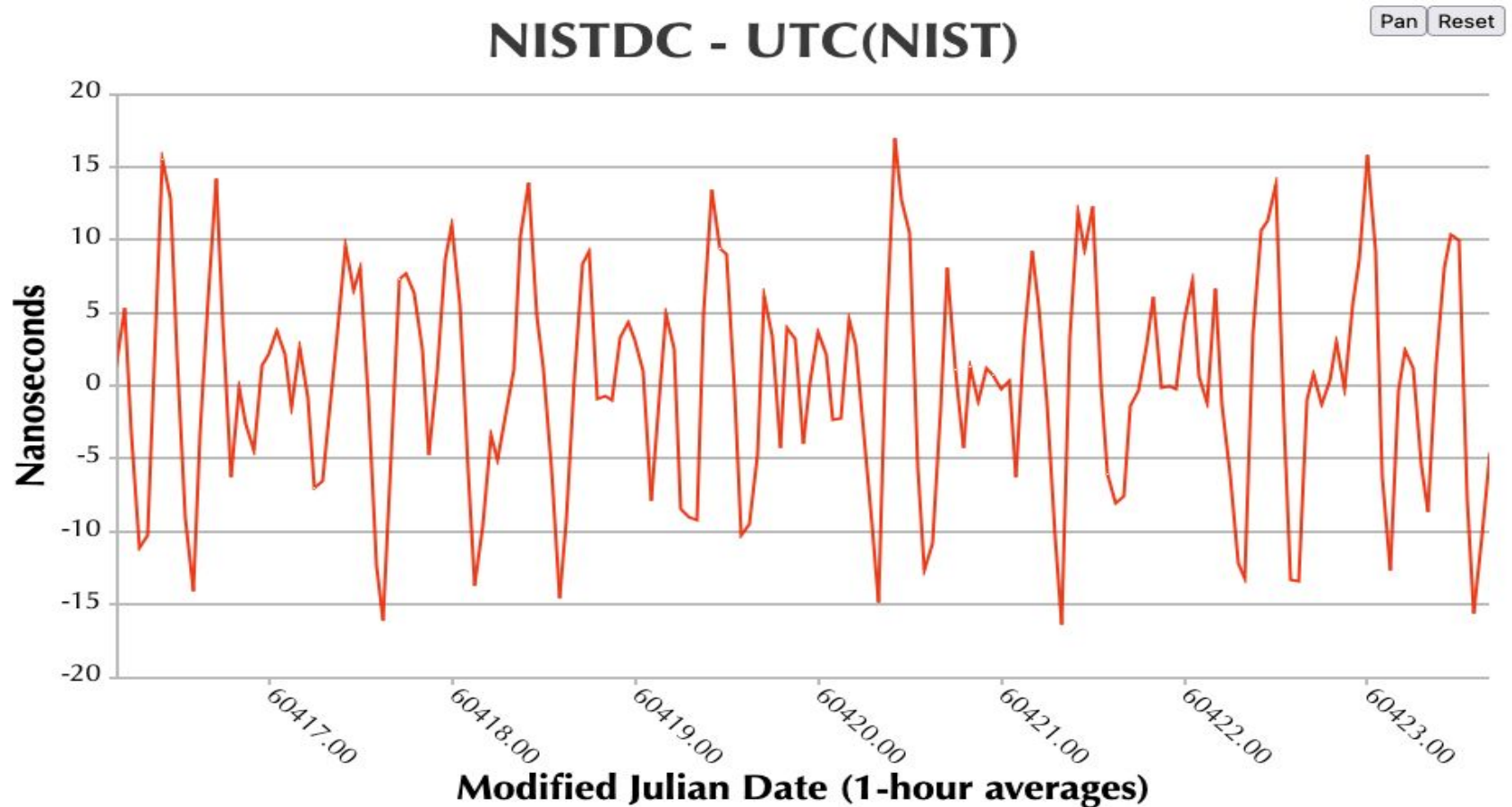
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NIST/TMAS Failure and Traceability

- 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

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Secaucus TMAS Performance



Quincy TSaaS: Future Directions

Time Synchronization as a Service

- 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



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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