

The NIST Special Calibration Test Service

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Goals of the service

- Provide a connection from user equipment to the NIST clock ensembles in Boulder, Colorado and Gaithersburg, Maryland
- Connection is independent of all satellites; End users stability and accuracy better than 100 ns with respect to UTC(NIST)
- Provides time reference for financial transactions and synchronization of electrical power distribution

Ongoing discussions with Equinix Data Centers, Hoptroff (London), and Oak Ridge National Laboratory

Transmission methods and formats

Dedicated dark-fiber pair

- signal goes in only one direction on each fiber
- ns-level accuracy with white rabbit.
- protocol includes calibration of link delay
- highest recurring cost for fiber circuit

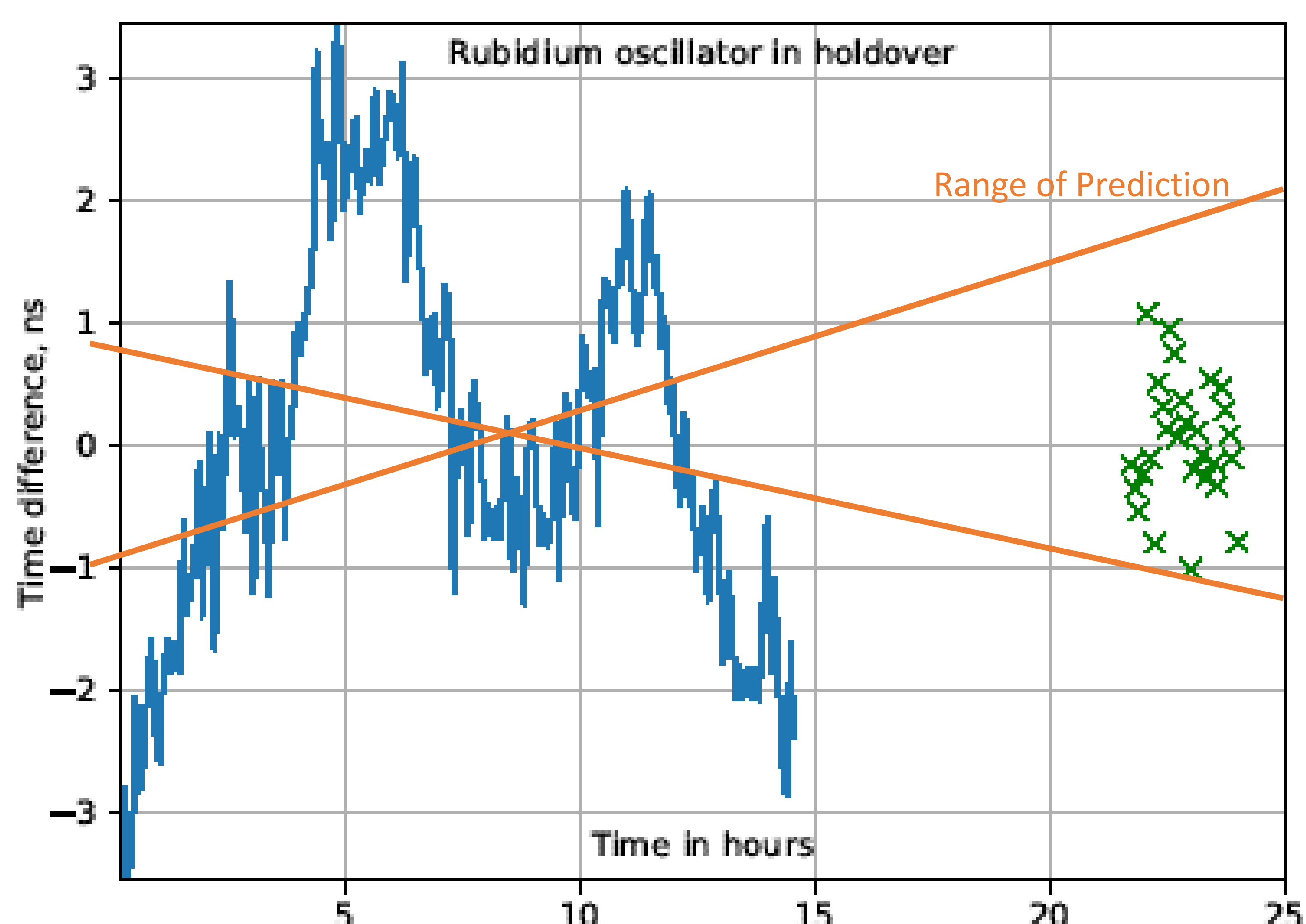
Dedicated single dark fiber

- Two wavelengths on single fiber – lower recurring cost
- ns-level accuracy with white rabbit
- protocol includes calibration of link delay
- fiber may require bi-directional optical amplifiers
- end-point hardware requires passive optical filters

Optical Transport network (OTN)

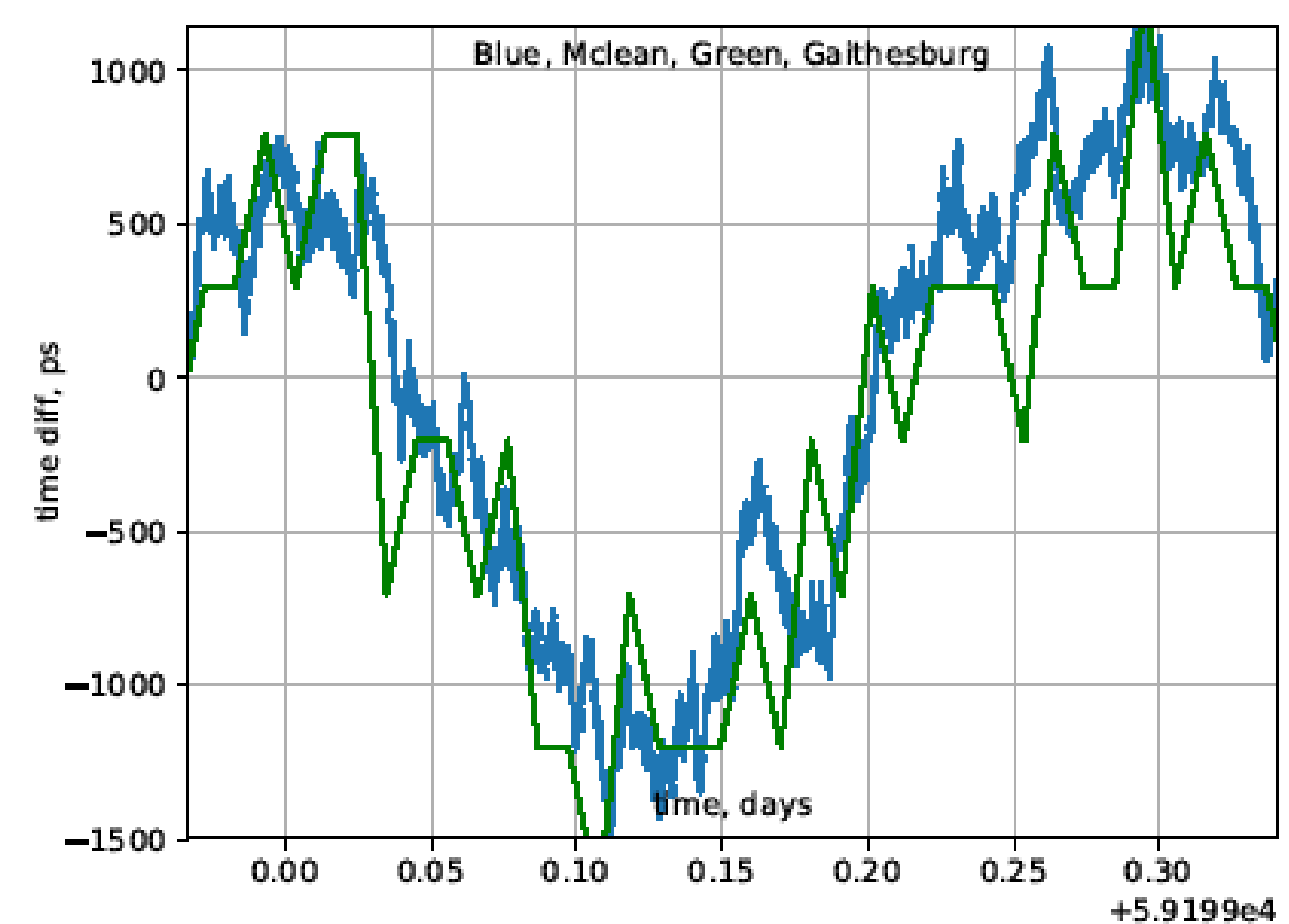
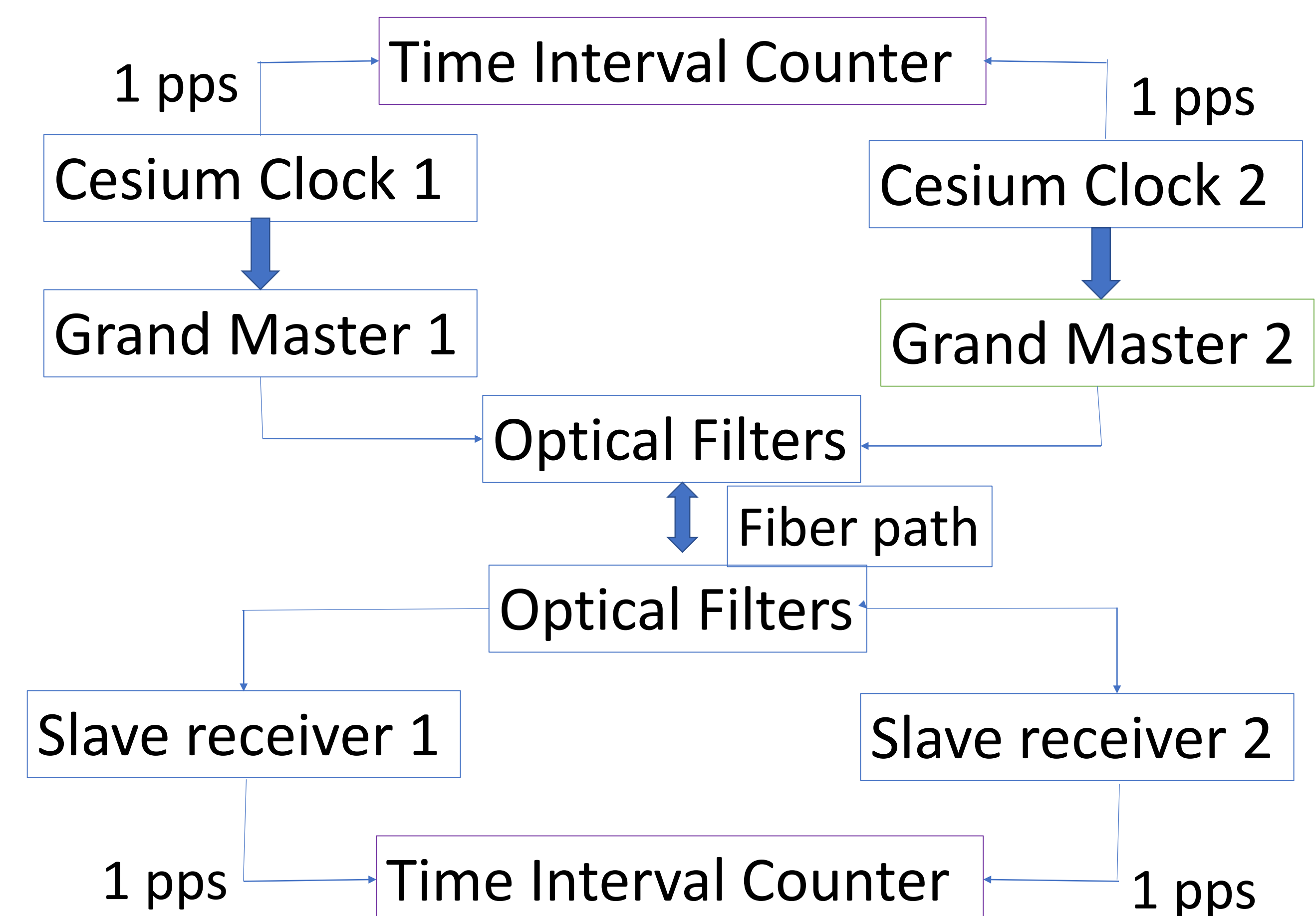
- lowest recurring and non-recurring costs
- PTP/IEEE1588 format, does not support white rabbit
- Network hardware must be compatible with PTP
- Transmission delay not symmetric and may change
- μ s-level short-term stability
- better than 100 ns accuracy with external calibration
- rubidium oscillator at remote end can bridge time step:
- **uncertainty about 3 ns after gap of 7 hrs.**

Uncertainty of rubidium oscillator in holdover



Results: Dedicated single dark fiber

Two white-rabbit circuits from Gaithersburg, Maryland, to McLean, Virginia by using single dark fiber (40 km)
Compare time-difference measurements at both ends



Results: OTN Link, McLean, Va to Atlanta, Ga, 1200 km

