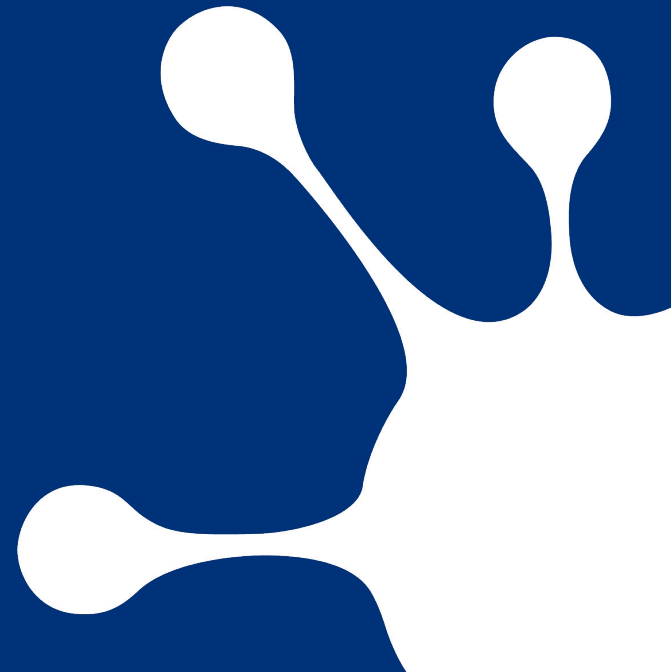


# NETWORK TIME PROTOCOL FROM A DISTRIBUTED TIMESCALE TRACEABLE TO UTC

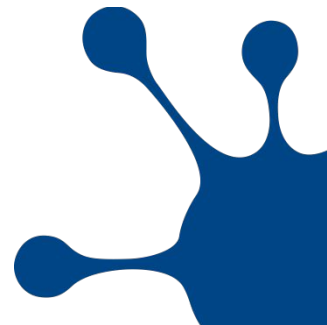
Netnod spring meeting 2016

Ragnar Sundblad



# Agenda

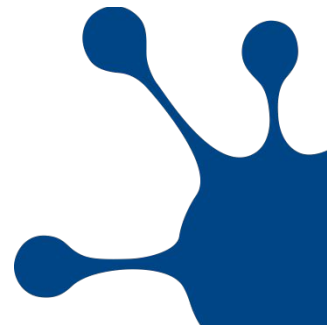
- Background & overview
- Services delivered
- Node overview, node structure
- Hardware (FPGA) NTP server
- Time transfer
- Network
- Future work
- Conclusion
- Questions



# Background & overview



- Funded by the Swedish Post and Telecom Authority - PTS
- Distributed timescale in 5 locations
- Placed at Netnod IX
- Each node autonomous
- Traceable to UTC(SP)



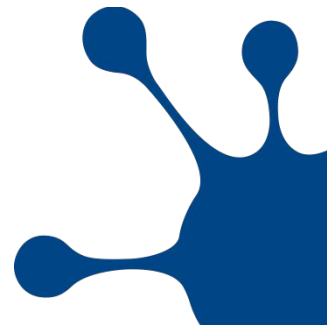
# Services delivered

## Live data available:

- NTP, unicast and anycast, IPv6 and IPv4, authenticated
- Comparisons to UTC(SP) and other labs
- Time transfer data (GNSS)
- Local clock measurements
- Steering data, operational data

## Physical signals:

- 1 PPS, 5 MHz & 10 MHz
- PTP / IEEE 1588v2 over 1GE, SyncE
- E1 clock at 2048 kHz



# Node overview



Two node halves

Distribution (1PPS, 5MHz & 10MHz)

Measurement and control

NTP IPv4 & IPv6

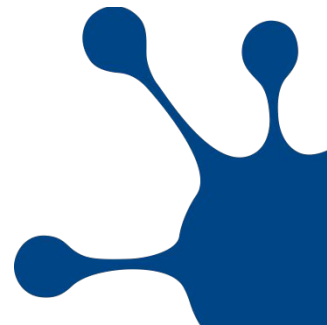
PTP/IEEE 1588v2 and SyncE,  
E1/2048 kHz

GNSS time transfer

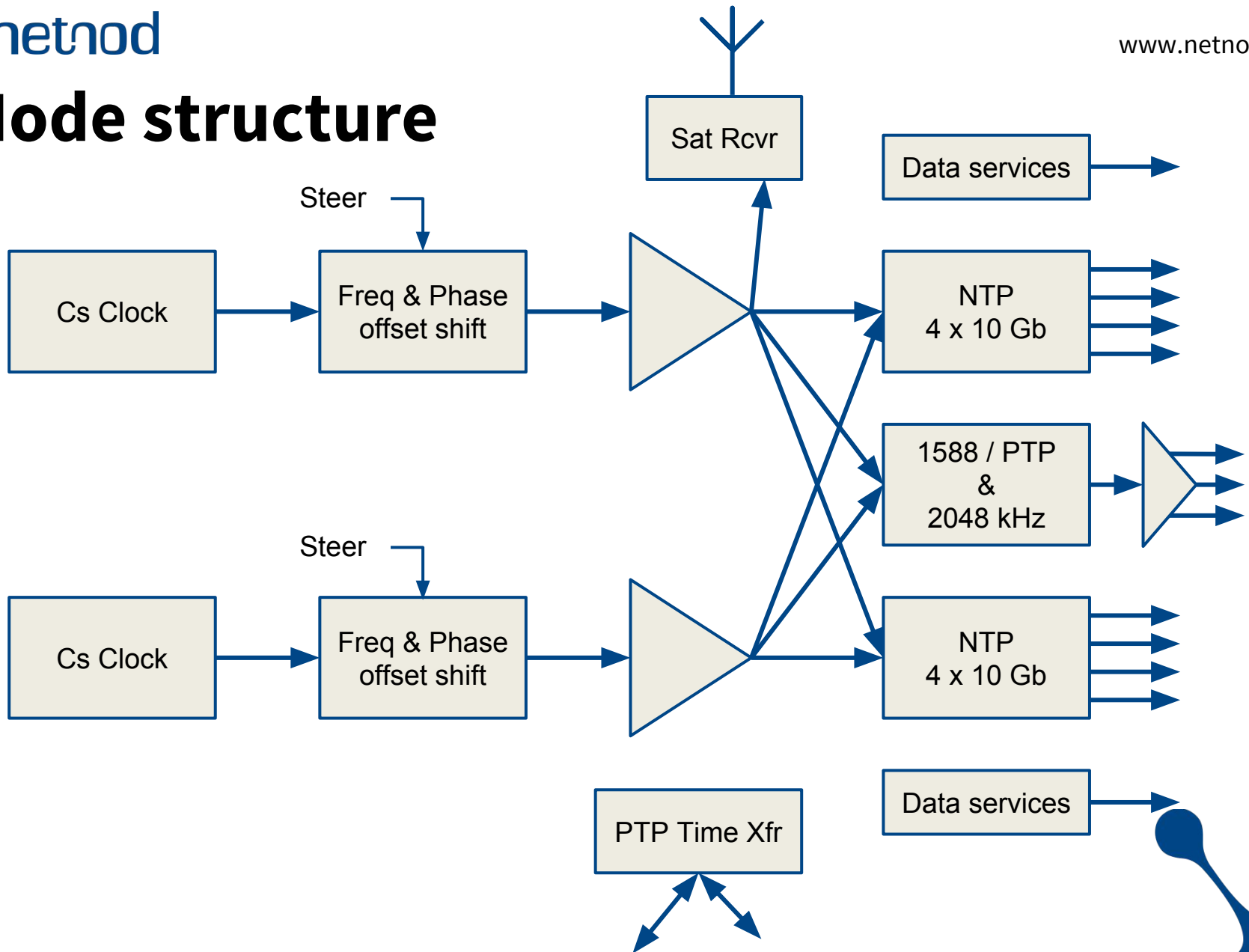
Backbone fiber network

Data I/O

Backup power

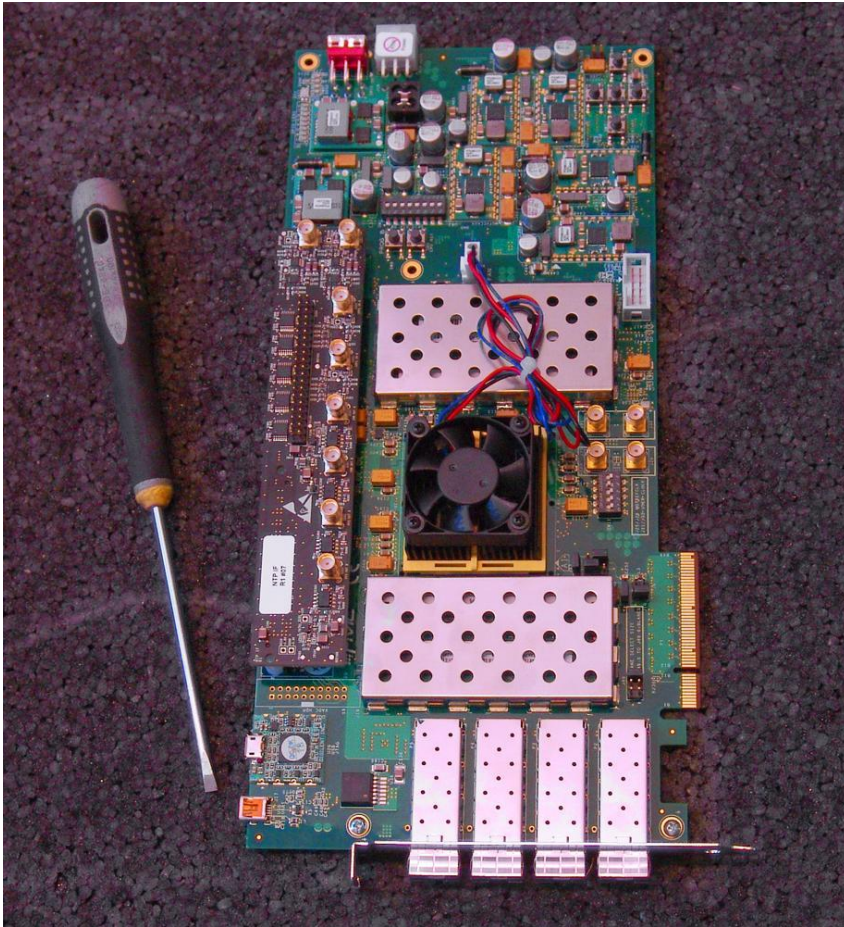


# Node structure

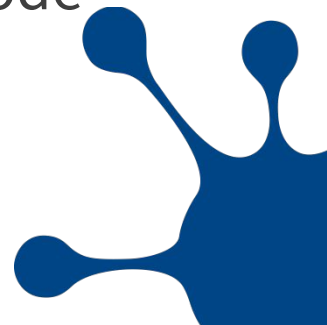




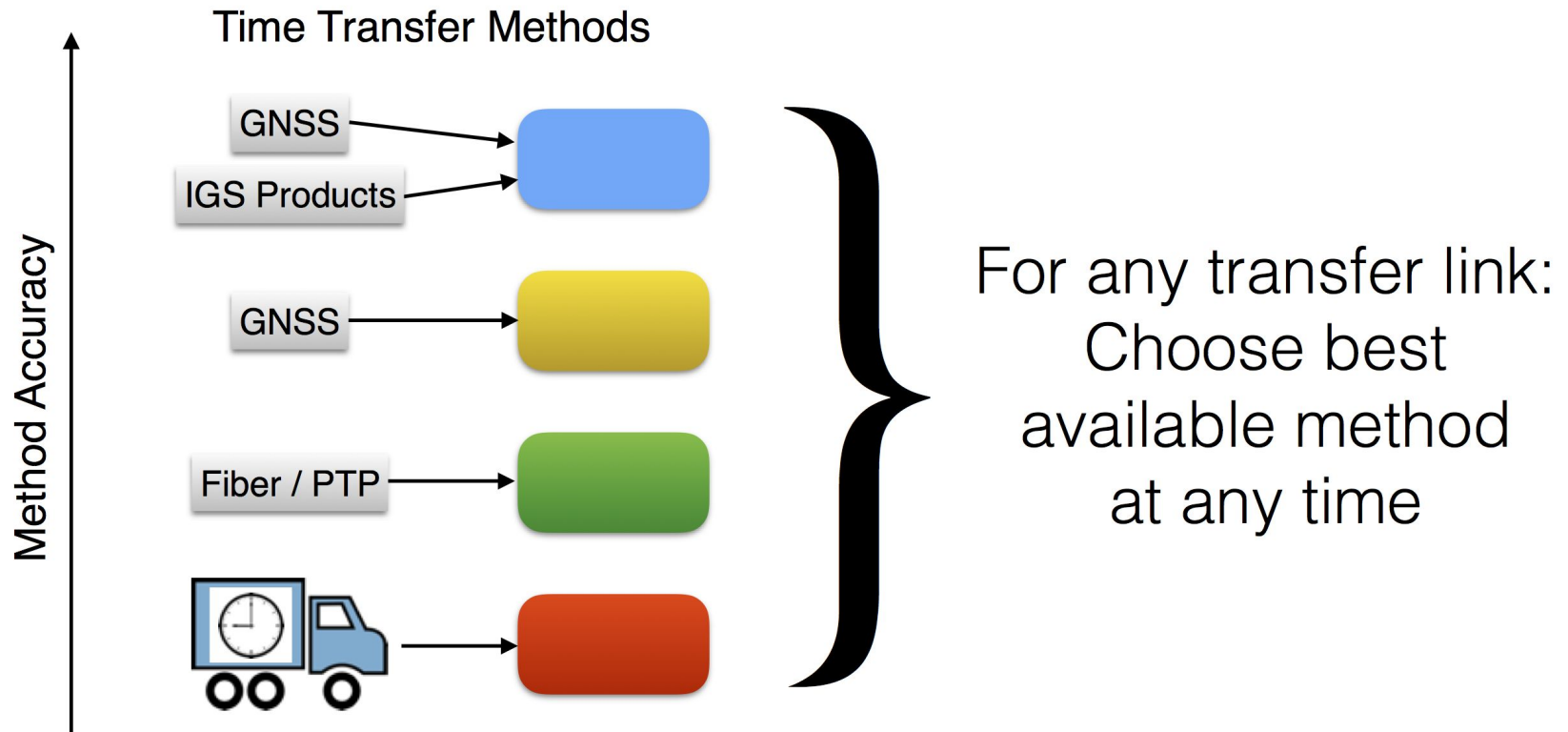
# Hardware (FPGA) NTP server



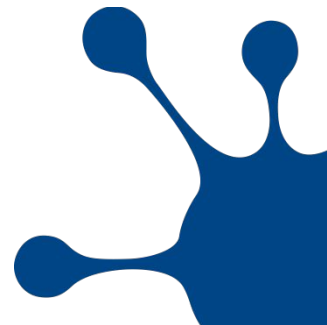
- Fast (4\*10Gb/s)
- IPv4 & IPv6
- Secure
- Symmetric key authentication
- Interface card for input and output (1PPS & 10MHz)
- Open source FPGA code



# Time Transfer - multiple methods used

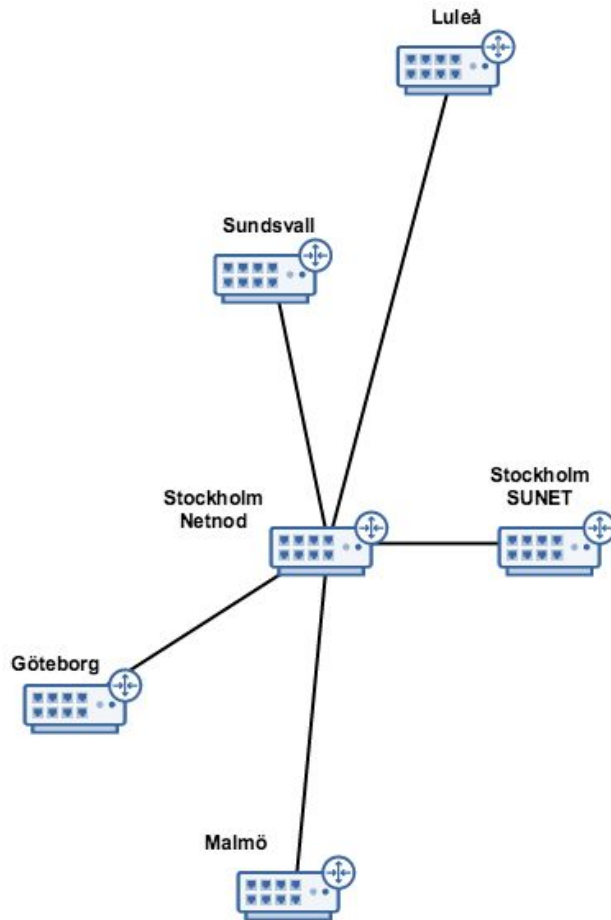


If methods disagree: Do nothing and sound alarm

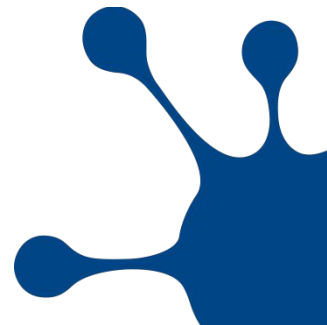




# Network



Dedicated wavelengths  
Backup to GNSS  
1588v2 (PTP)

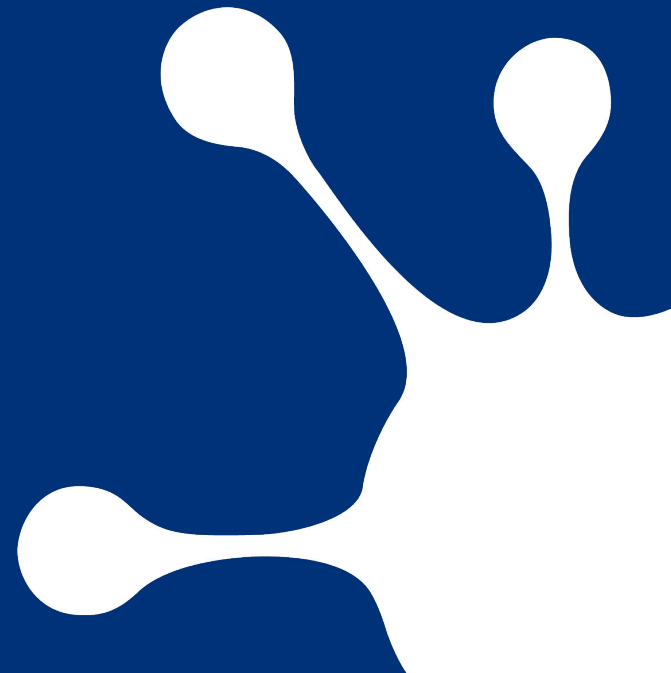


## Future work

- 100 Gb or possibly analog, optically coherent, long haul time, frequency and phase transfer.
- Store all data in a transactional DHT (Distributed Hash Table) database, where the I/O nodes are the data nodes. This would allow near real time access to all data and results.
- Provide better data integrity and authentication/signing of measurement data tied to actual equipment calibrations.
- More software with machine learning to automatically resolve operational problems.



THANK YOU!



QUESTIONS?

[www.ntp.se](http://www.ntp.se)

