



CSC

ICT Solutions for  
Brilliant Minds



## Nordic T&F activities

15.1.2020, GÉANT 4<sup>th</sup> SIG-NGN meeting, Geneva/CERN

Jani Myry, CSC/Funet



## Recent T&F activities in the Nordic region

- 1st Nordic T&F workshop held in Copenhagen September 2019
  - NORUnet and Nordic NRENs
  - National Time Labs (DK, FI, NO, SE)
  - IXPs (DK, SE) and regulators (FI, NO, SE)
- Situation vary in each country but was seen beneficial to work together
  - Enhancing sustainable support for official time keeping, critical infrastructures like 5G and smart power grids
- Knowledge sharing and working together when planning T&F transfer over optical systems
  - Do not “reinvent the wheel”
  - Interoperability between optical domains

## T&F transfer FI-SE

- Had STM-64 based T&F link Espoo (FI) – Stockholm (SE) few years ago
  - Now decommissioned
- Migration to federated NORDUnet next-gen network
  - Use existing national optical systems and CBF links
  - New FI-SE links will be build Q1/2020, opportunity to build T&F support for bi-directional signals from day 1
- Funet and SUNET have similar requirements
  - Hybrid amplification (EDFA + RAMAN) to optimize OSNR
  - Mixing data and T&F in C-band not desired
  - OTDR (1650 nm) in use or planned

# Bi-directional T&F challenges

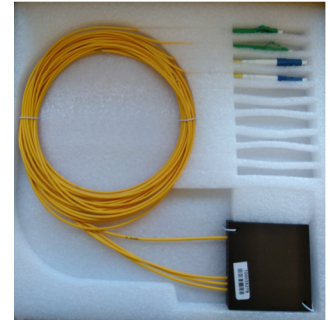
- RAMAN amplifiers
  - No filters can be installed in front of the RAMAN amplifier
  - $< \sim 1528$  nm wont pass RAMAN amplifiers
  - $\sim 2$  dB insertion loss for  $>$  C-band signals
    - Except: extensive loss in  $\sim 1570$  nm region
  - $\sim 2-3$  dB RAMAN gain in 1600 nm region
    - 2 dB gain measured for 1650 nm OTDR signals
- 1600 nm region between C-band and OTDR
  - Little bit higher loss per km in G.652 fibers
  - Higher chromatic dispersion
- Extra C-band loss to be avoided if possible
  - Daisy chaining different filters not an optimum solution

# Joint planning for T&F links

- Extensive discussions and planning late 2019
  - Funet and SUNET
  - Netnod/RISE (SE) and VTT (FI)
  - ADVA
- 1610 +-6,5 nm chosen for T&F
  - Already tested in Finland and Sweden by using ADVA 1605/1615 nm optics and separate 1610 +-6,5 nm filters
  - L-band DWDM optics available for ~ 1610 nm with required CD tolerance
  - EDFA noise filtered out so should not be an issue
- White Rabbit switches and low latency/jitter media converters
  - L-band optics will be tested by Netnod/RISE
- More optimization for filtering structure...

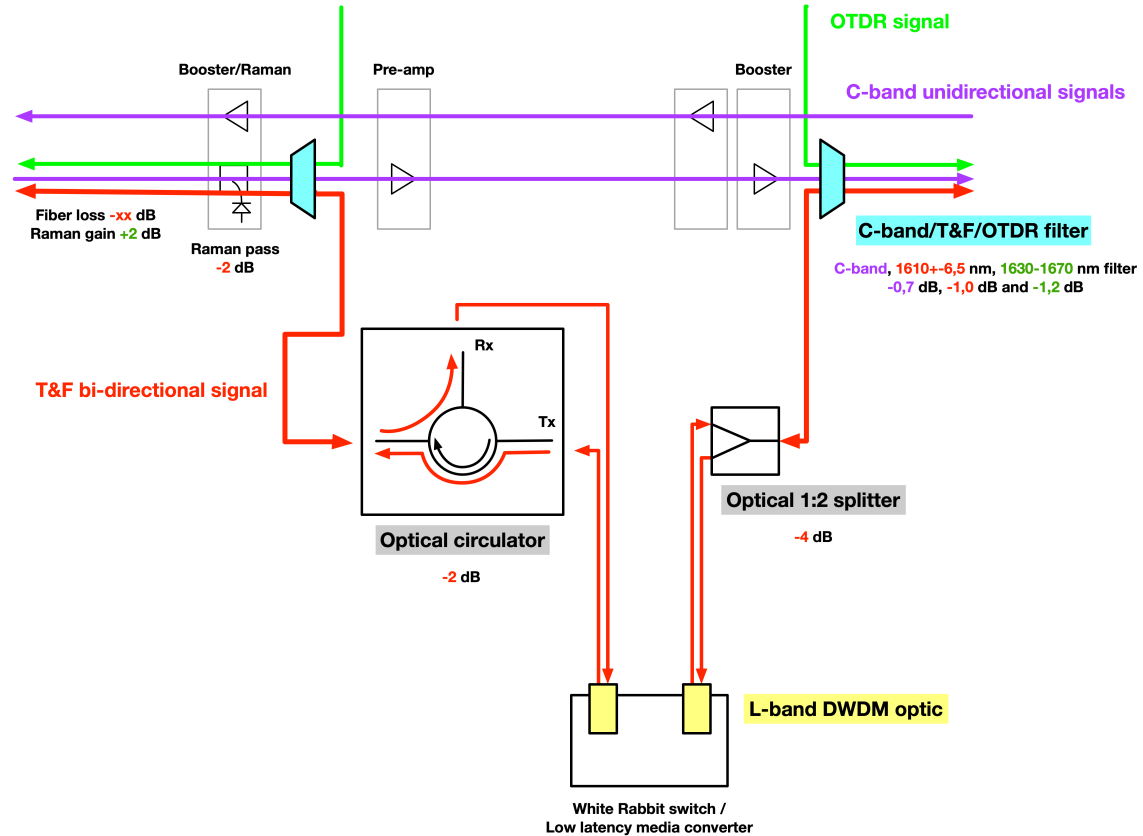
# T&F filter

- Customized C-band (1525-1570 nm), T&F (1610 +/-6,5 nm) and OTDR (1630-1670 nm) filter
  - 0,7 dB C-band loss (very important, similar with existing OTDR filter)
  - 1,0 dB T&F loss (very important on high loss links)
  - 1,2 dB OTDR loss (less important)
  - Fully bi-directional (no calibration needed)
- Customized optical circulator for high loss links (21+ dB)
  - 2 dB insertion loss
- Customized 1:2 optical splitter for low to medium loss links
  - 4 dB insertion loss
- Low CAPEX (fs.com)
  - < 70 EUR filter, < 10 EUR splitter, < 140 EUR circulator



Photos: CSC/Funet and Netnod

# T&F filters in a node



# T&F capability plans

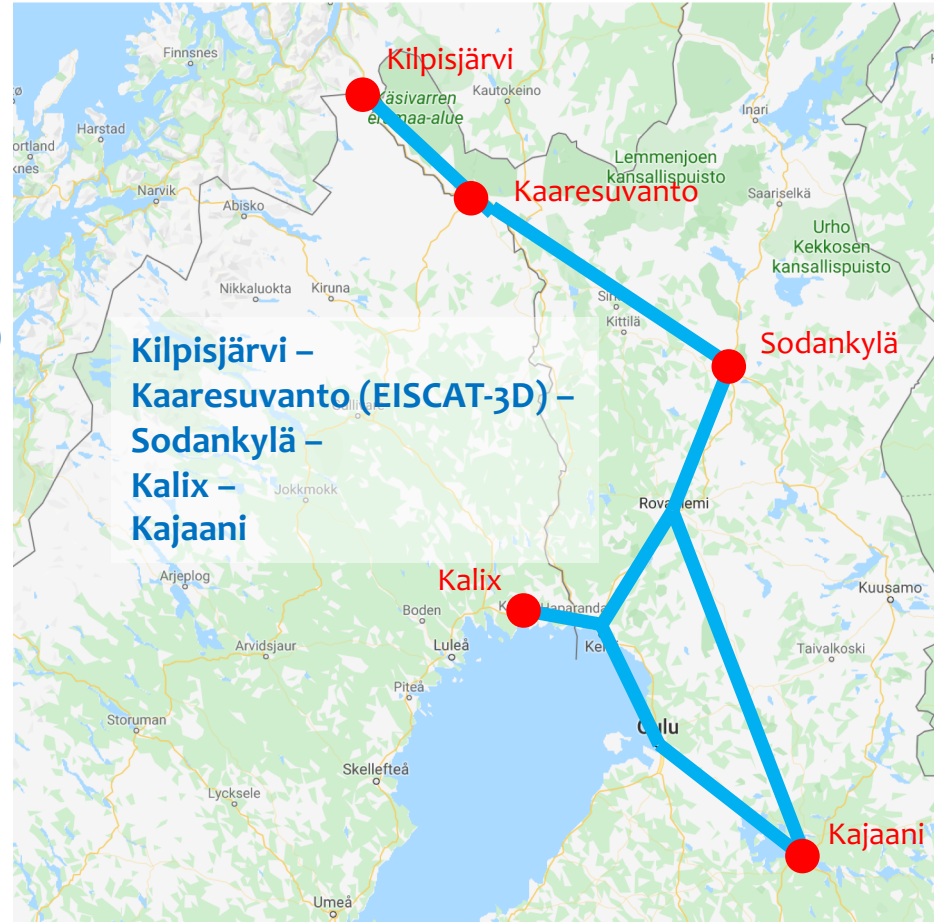
- Espoo – Turku – Stockholm
  - Turku – Stockholm (when build)
  - Espoo – Turku (filter change)
- Vaasa – Umeå (readiness)





# T&F readiness plans

- CBF to SUNET in Kalix
- CBF to UNINETT in Kilpisjärvi
- Kaaresuvanto (EISCAT-3D site in Finland)
- Sodankylä (observatory)
- Kajaani (HPC site in Finland)
  
- Further links per needs (already build)





## Jani Myyry

Senior Network Specialist  
Funet  
CSC – IT Center for Science Ltd.

[jani.myyry@csc.fi](mailto:jani.myyry@csc.fi)



[facebook.com/CSCfi](https://facebook.com/CSCfi)



[twitter.com/CSCfi](https://twitter.com/CSCfi)



[youtube.com/CSCfi](https://youtube.com/CSCfi)



[linkedin.com/company/csc---it-center-for-science](https://linkedin.com/company/csc---it-center-for-science)



[github.com/CSCfi](https://github.com/CSCfi)