GÉANT Infoshare: Management and monitoring of time & frequency services

Optical carrier transfer (Frequency)

Nicolas QUINTIN, GIP-RENATER
• RENATER optical network
• “REFIMEVE” T/F infrastructure in France
• IP connectivity in Inline Amplifier (ILA) sites
• Supervision and monitoring of T/F equipment
• Maintenance in operational condition and day-to-day routines
RENATER optical network

- Photonic layer
  - Mainly using Infinera equipment (ex CORIANT) to transmit, amplify and receive information
  - This equipment is procured on **8 years period**
  - **Contra-Raman pumps**, F-OADM, coherent network, QPSK or QAM modulations (up to 16 QAM)
  - In particular regions, some old CIENA equipment remains (10G QPSK)

- NSOC
  - **Outsourced** (8 years period contract)

- Fibre footprint
  - ≈ **12 000 km** of dark fiber (mainly G.652)
  - 4th European NREN with the largest dark fiber footprint (Compendium 2019),
  - IRU mostly, for a **10-13 years period contract**
RENATER optical network

**Hit 7300 SRS3 and SFL type shelves**
- Optical power amplification, channel power adjustment (VOA), power monitoring (MCP)
- Large range of amplifiers: inline, booster and pre-amplifier
- Combination with RAMAN pump to improve distance or Baud rate
- Optical (Och/OMS) protection

**Mux/Demux filter:**
- 40 channels in C-Band
- Channel central frequency spacing of 100 GHz

**mTera**
- Client service interfaces: 10 GE, 100 GE
- Line interface (transponders): OTU4, OTU4c2
- Cross-connect OTN
- Packet switching
- ODU protection
“REFIMEVE” T/F infrastructure in France

- Two projects
  REFIMEVE+ (2012-2024) and T-REFIMEVE (2021-2028)
  - Bidirectional propagation required
  - @1542.14nm, ch.44 ITU-T (dark channel setup)
  - Spectral occupation <10kHz, output power <3dBm
  - Ultrastable signal (fractional frequency stability $10^{-15}$ at 1s, ≈1000 better than White Rabbit $10^{-12}$)
  - Observatoire de Paris (NMI), Laboratoire de Physique des Lasers (LPL) + RENATER + 17&24 academic laboratories

https://www.refimeve.fr/
“REFIMEVE” T/F infrastructure in France

Feedbacks

3 123/4 898 km of fibre equipped, TRL 9
12 years of T/F cohabiting with data traffic
(Alcatel, Ciena and Coriant)
Supervised by successive RENATER NSOC (Thales and CCNS)
Propagating without garband
RENATER IP End-users have never been impacted by T/F service

REFIMEVE

• national Research Infrastructures (RI) since 2021,
• first national T/F network contribution to T/F European
Research Infrastructures
“REFIMEVE” T/F infrastructure in France

Typical T/F link in France
“REFIMEVE” T/F infrastructure in France

RLS
Repeater Laser Station

Standard height
SFL-1 shelf

OADM

SFL1

Bidirectional
T/F amplifier

Dedicated rack view

Shelter site rack view

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# “REFIMEVE” T/F infrastructure in France

**Reapeter Laser Station (RLS)**

![Image of Reapeter Laser Station](image)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optical</strong></td>
<td></td>
</tr>
<tr>
<td>Wavelength (THz or nm)</td>
<td>194.4THz</td>
</tr>
<tr>
<td>Spectral occupation</td>
<td>&lt;5GHz</td>
</tr>
<tr>
<td>Max Output power (dBm)</td>
<td>3dBm</td>
</tr>
<tr>
<td>Min Input power (dBm)</td>
<td>-60dBm</td>
</tr>
<tr>
<td>Connector type</td>
<td>FC/APC</td>
</tr>
<tr>
<td><strong>Hosting</strong></td>
<td></td>
</tr>
<tr>
<td>Typical Power consumption</td>
<td>120W</td>
</tr>
<tr>
<td>Alimentation</td>
<td>220V AC</td>
</tr>
<tr>
<td>Dimensions</td>
<td>19”, 540mm, 7RU</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>7kg</td>
</tr>
<tr>
<td><strong>IP</strong></td>
<td></td>
</tr>
<tr>
<td>Connectivity port</td>
<td>10/100/1000 Base-T port</td>
</tr>
<tr>
<td>Protocols</td>
<td>SNMPv3 and SSH</td>
</tr>
</tbody>
</table>

[https://www.ixblue.com/](https://www.ixblue.com/)
"REFIMEVE" T/F infrastructure in France

Bidirectional amplifiers and OADM

<table>
<thead>
<tr>
<th></th>
<th>T/F Amplifiers</th>
<th>OADM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max Output power (dBm)</td>
<td>3dBm</td>
<td>X</td>
</tr>
<tr>
<td>min Input power (dBm)</td>
<td>-50dBm</td>
<td>X</td>
</tr>
<tr>
<td>Typical gain (dB)</td>
<td>14dB</td>
<td>X</td>
</tr>
<tr>
<td>Connector type</td>
<td>FC/APC</td>
<td>FC/APC and LC/PC</td>
</tr>
<tr>
<td><strong>Hosting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typical Power consumption (W)</td>
<td>&lt;15W</td>
<td>passive</td>
</tr>
<tr>
<td>Alimentation</td>
<td>-48V DC</td>
<td>X</td>
</tr>
<tr>
<td>Dimensions</td>
<td>19&quot;, 240mm, 1RU</td>
<td>19&quot;, 240mm, 1RU</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>2kg</td>
<td>0.5kg</td>
</tr>
<tr>
<td><strong>IP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connectivity port</td>
<td>10/100 Base-T port</td>
<td>X</td>
</tr>
<tr>
<td>Protocols</td>
<td>SNMPv2 and SSH</td>
<td>X</td>
</tr>
</tbody>
</table>

https://www.lumibird.com

https://www.infractive.com
Easy in PoP thanks to routers

… but no OSC going through T/F amplifiers in ILA 😊
First solution in 2012 using GSM
Coriant controller card

### OSC specifications

<table>
<thead>
<tr>
<th>Number of generated channels</th>
<th>Without user channels:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (1 DCN and 2 User Channels)</td>
<td>OSC: 10 Mbit/s</td>
</tr>
<tr>
<td></td>
<td>Fast OSC: 20 Mbit/s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bandwidth for DCN channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>With 2 user channels:</td>
</tr>
<tr>
<td>OSC: 8 Mbit/s</td>
</tr>
<tr>
<td>Fast OSC: 20 Mbit/s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bandwidth for user channels (per user channel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSC: 1 Mbit/s</td>
</tr>
<tr>
<td>Fast OSC: 20 Mbit/s</td>
</tr>
</tbody>
</table>

**Source:** Infinera hiT7300 Product Description (PD)

**Point to point connectivity**
IP connectivity in Inline Amplifier (ILA) sites

Bringing it in ILA

Point Of Presence
RENATER

ILA#1
Finally

IP connectivity in Inline Amplifier (ILA) sites

GÉANT Infoshare: Management and monitoring of time & frequency services
Supervision and monitoring of T/F equipment

What are the key parameters required when implementing new equipment in a telecommunication network?

Tools and procedures are put in place to satisfy with telecom standards

- Ability to collect traps (day-to-day supervision)
  SNMPv2 (amplifiers) and SNMPv3 (RLS)
- Ability to switch on/off amplifiers/RLS (monitoring)
  SNMPv2 or SNMPv3 and SSH

Ticketing procedures (will be detailed further):

- to inform users
- to activate manufacturer or tierce party-company
Supervision and monitoring of T/F equipment

Different supervision layers

1. **Inventory**
   - Name, version, type, temperature...
   - **Turn off**

2. **Supervision software:**
   - Monitor and control the REFIMEVE+ performances

3. **Database:**
   - Store all the information useful to the network management

4. **Human-machine interface:**
   - For final users, academic teams and the network manager

- Metrological data processing
- Accuracy calculation
- Ultra-stable source management
- Fine tuning
Maintenance in operational condition and day-to-day routines

T/F integrated in day-to-day routine
Maintenance in operational condition and day-to-day routines

T/F Ticketing procedures
Wrap up

- Operating T/F network
  - Has to be easily integrated in day-to-day routine
  - Requires in-band connectivity to be performant (requires early consideration)

- Key aspects of monitoring and supervision
  - Responsibility layers for each actor
  - Monitored parameters for NOC => being able to turn off the T/F channel

REFIMEVE Infrastructure

- **Safe environment**: 12 years of background experience of T/F service propagating without incident with IP data traffic in real field
- 7 years of work with private companies and different NOC that understand, comply and work according with NREN processes and constraints

T/F services is safe, doable with high TRL equipment. T/F can be integrated in NREN day-to-day procedures
Thank you

Any questions?

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