GÉANT Infoshare: Management and monitoring of time & frequency services

Optical carrier transfer (Frequency)

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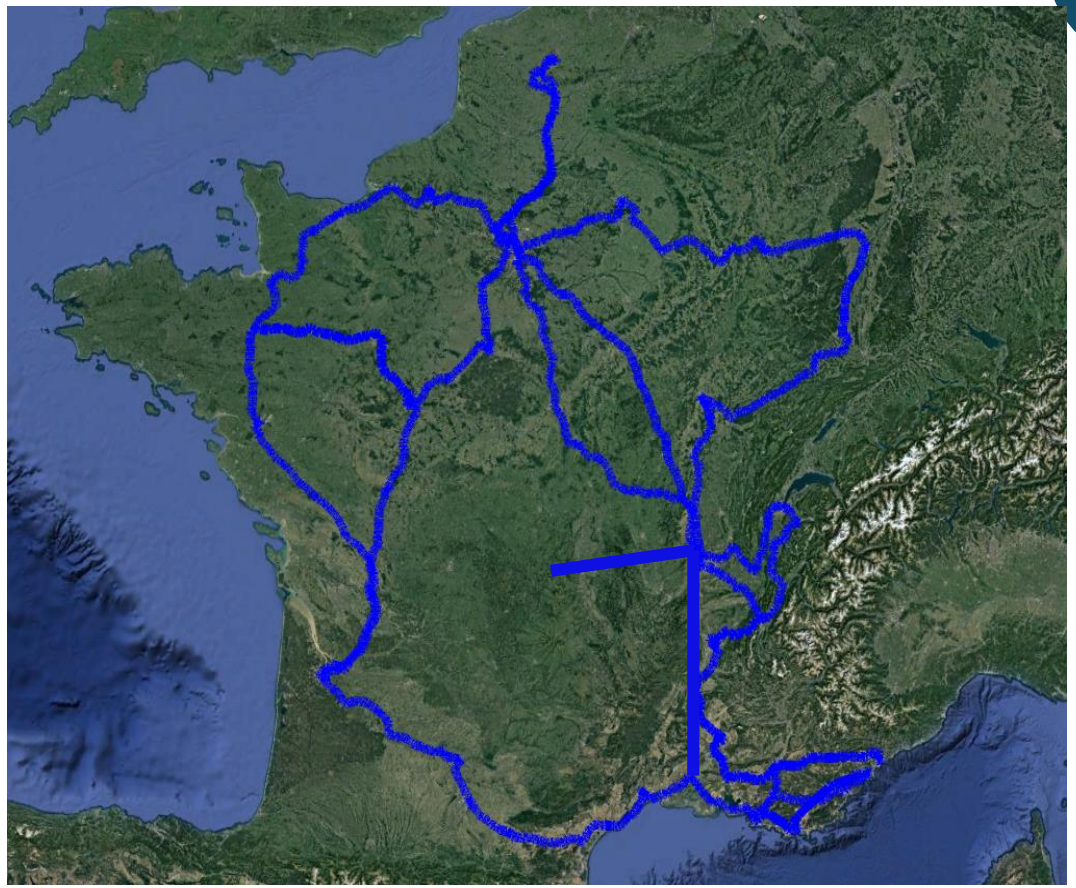
WP6 T1 OTFN
20 June 2022

Agenda

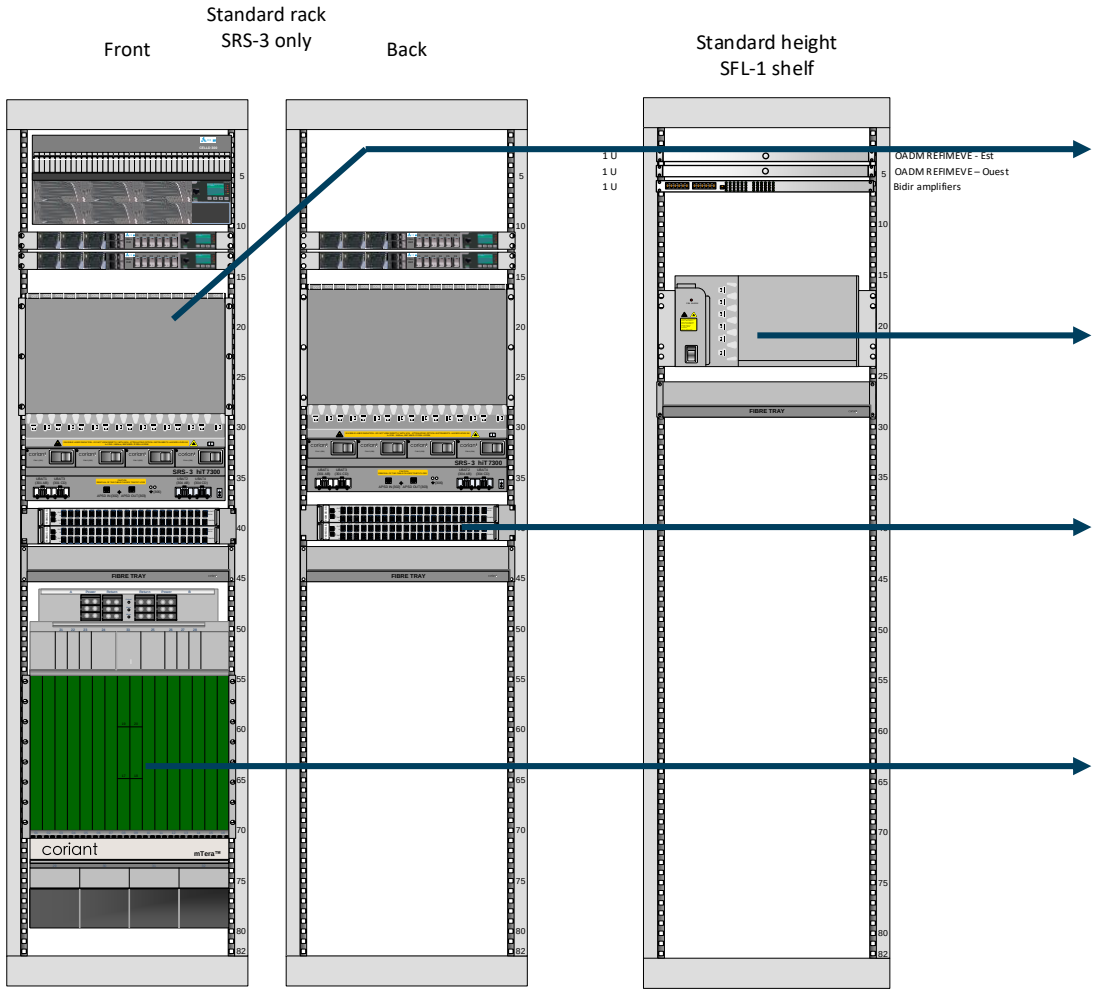
- RENATER optical network
- “REFIMEVE” T/F infrastructure in France
- IP connectivity in Inline Amplifier (ILA) sites
- Supervision and monitoring of T/F equipment
- Maintenance in operational condition and day-to-day routines

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



POP site rack view Shelter site rack view

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

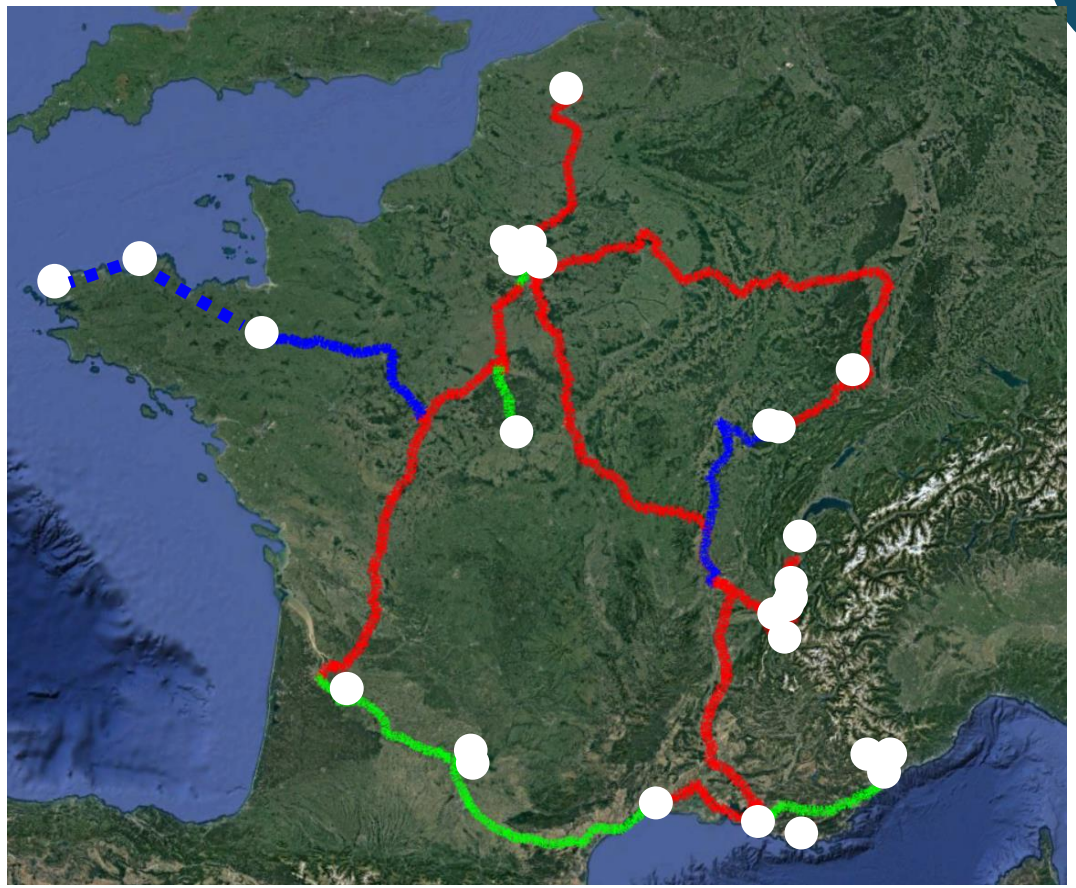
- **Two projects**

  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 **≈1 000 better than White Rabbit** 10^{-12})
  - Observatoire de Paris (NMI), Laboratoire de Physique des Lasers (LPL) + RENATER + 17&24 academic laboratories

Refimeve+

https://www.refimeve.fr/



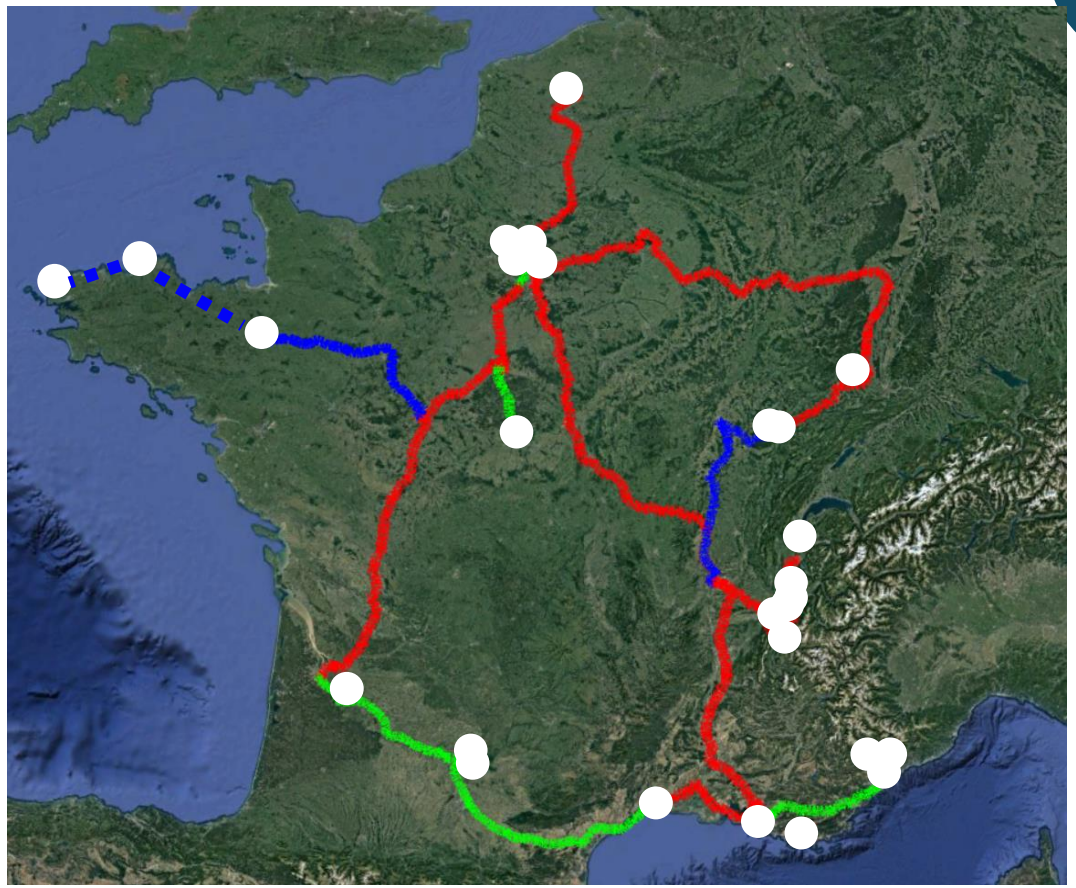
“REFIMEVE” T/F infrastructure in France

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 gardband
RENATER IP End-users have **never** been impacted by T/F service

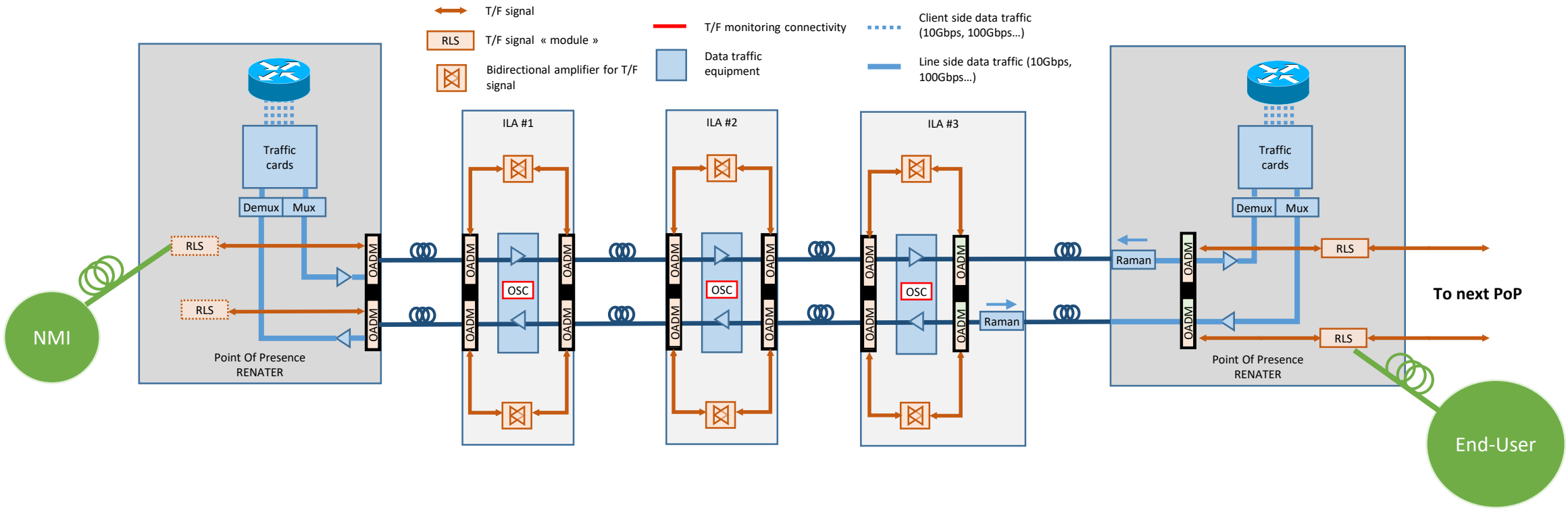
REFIMEVE

- national Research Infrastructures **(RI)** since **2021,**
- first national T/F network contribution to **T/F European Research Infrastructures**



“REFIMEVE” T/F infrastructure in France

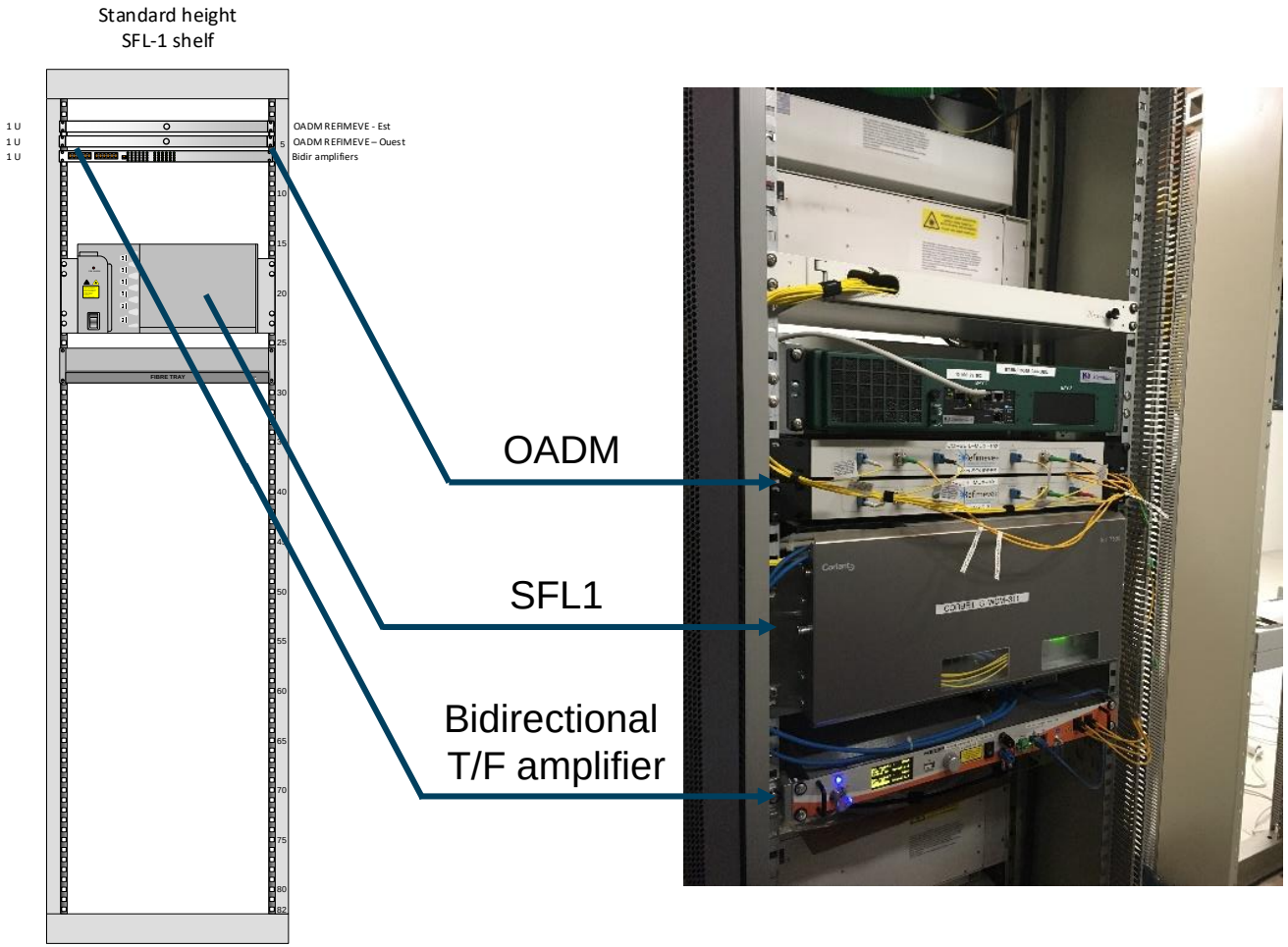
Typical T/F link in France



“REFIMEVE” T/F infrastructure in France

RLS
Repeater Laser Station

Dedicated rack view



Shelter site rack view

“REFIMEVE” T/F infrastructure in France

Reapeter Laser Station (RLS)

iXblue

https://www.ixblue.com/

Optical	Wavelength (THz or nm)	194.4THz
	Spectral occupation	<5GHz
	max Output power (dBm)	3dBm
	min Input power (dBm)	-60dBm
	Connector type	FC/APC
Hosting	Typical Power consumption	120W
	Alimentation	220V AC
	Dimensions	19", 540mm, 7RU
	Weight (kg)	7kg
IP	Connectivity port	10/100/1000 Base-T port
	Protocols	SNMPv3 and SSH

“REFIMEVE” T/F infrastructure in France

Bidirectional amplifiers and OADM

LUMIBIRD
MORE THAN LASERS

https://www.lumibird.com/

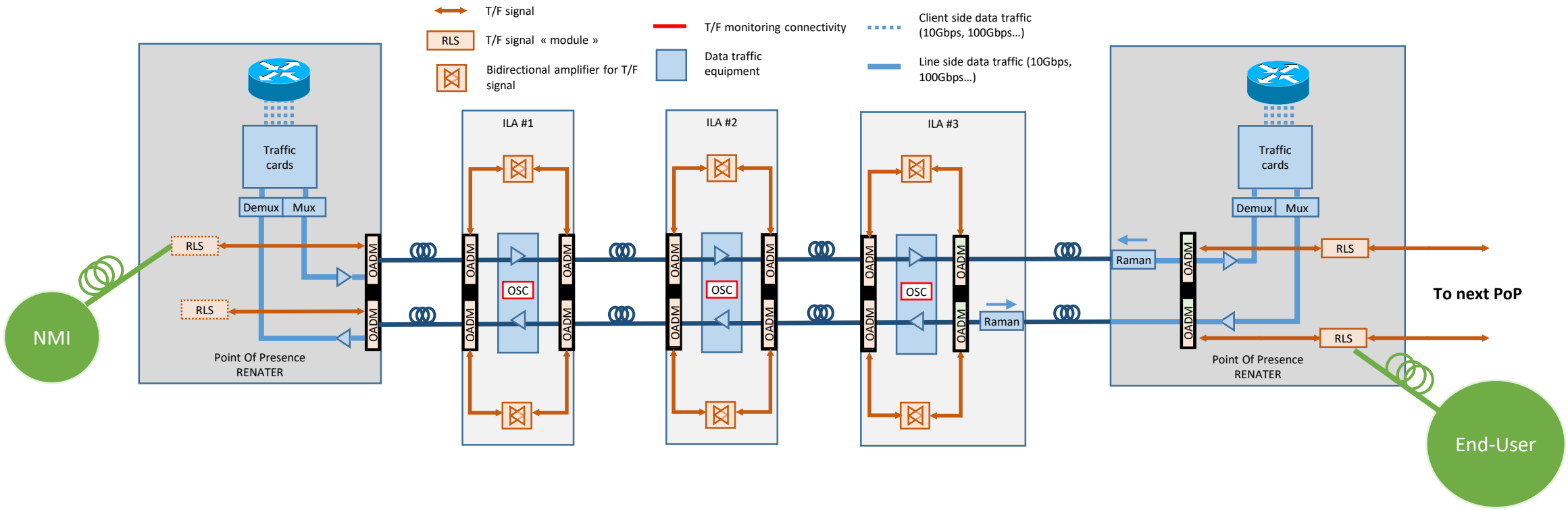
		T/F Amplifiers	OADM
Optical	max Output power (dBm)	3dBm	X
	min Input power (dBm)	-50dBm	X
	Typical gain (dB)	14dB	X
	Connector type	FC/APC	FC/APC and LC/PC
Hosting	Typical Power consumption (W)	<15W	passive
	Alimentation	-48V DC	X
	Dimensions	19", 240mm, 1RU	19", 240mm, 1RU
	Weight (kg)	2kg	0,5kg
IP	Connectivity port	10/100 Base-T port	X
	Protocols	SNMPv2 and SSH	X

Infractive
Vitalisez votre réseau

https://www.infractive.com/

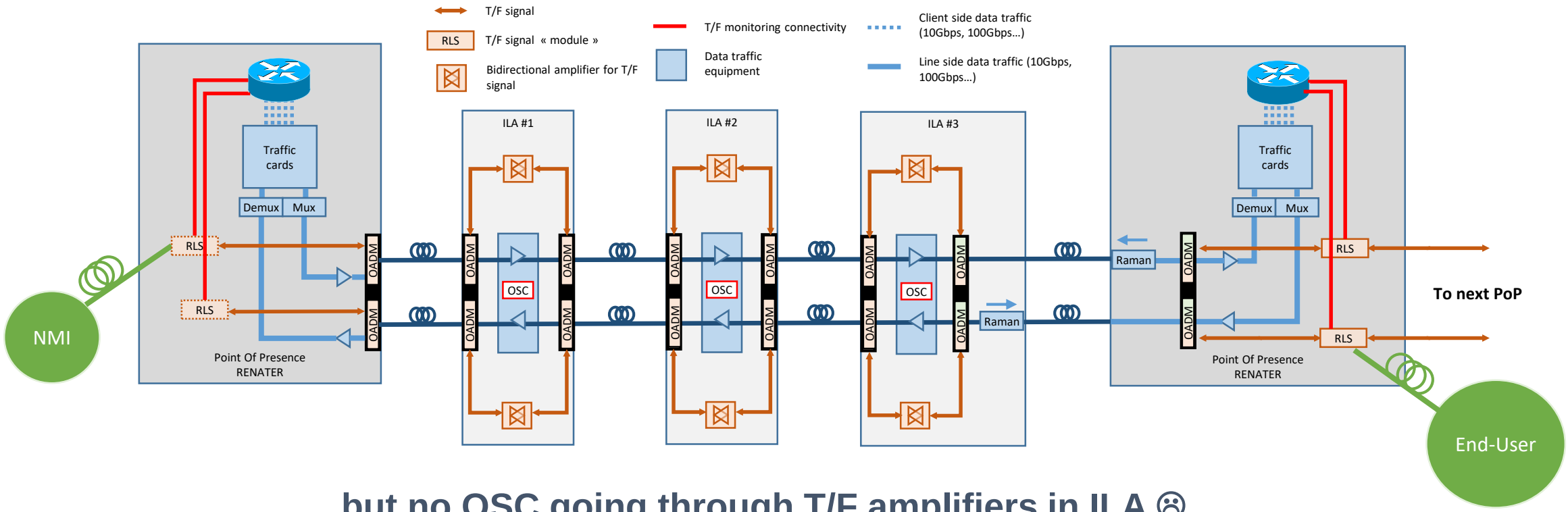
IP connectivity in Inline Amplifier (ILA) sites

IP connectivity in PoP and ILA



IP connectivity in Inline Amplifier (ILA) sites

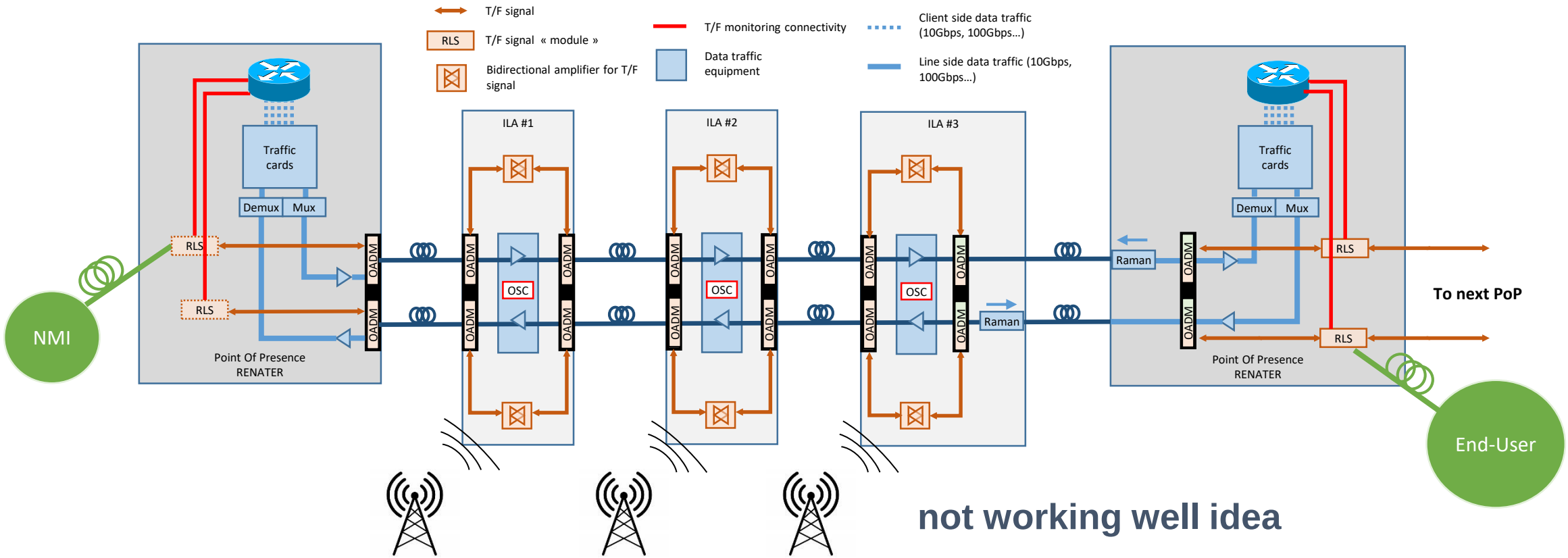
Easy in PoP thanks to routers 🏆



…. but no OSC going through T/F amplifiers in ILA ☹

IP connectivity in Inline Amplifier (ILA) sites

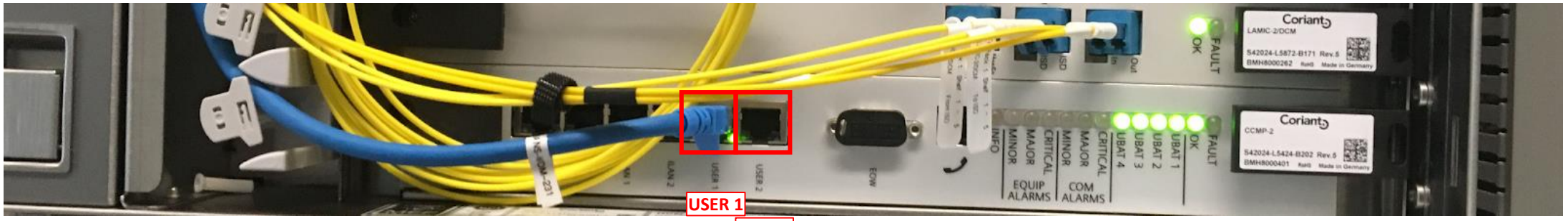
First solution in 2012 using GSM



not working well idea

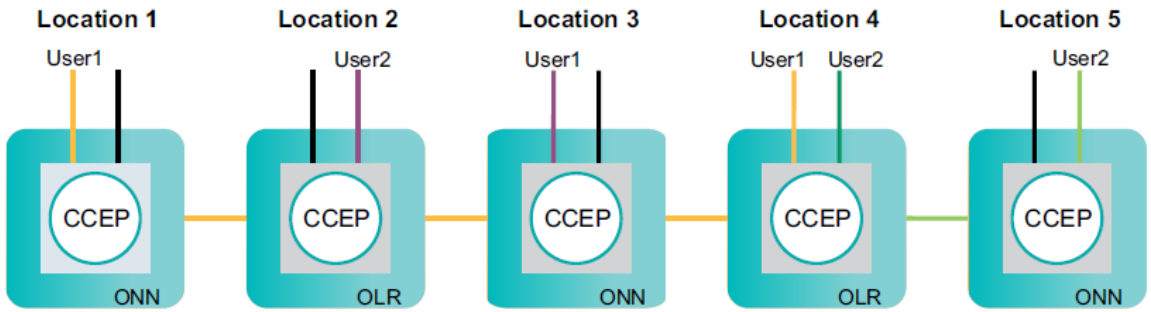
IP connectivity in Inline Amplifier (ILA) sites

Coriant controller card



OSC specifications	
Number of generated channels	3 (1 DCN and 2 User Channels) **10/100 ports**
Bandwidth for DCN channel	Without user channels: OSC: 10 Mbit/s Fast OSC: 20 Mbit/s With 2 user channels: OSC: 8 Mbit/s Fast OSC: 20 Mbit/s
Bandwidth for user channels (per user channel)	OSC: 1 Mbit/s Fast OSC: 20 Mbit/s

Source: Infinera hiT7300 Product Description (PD)



Point to point connectivity

IP connectivity in Inline Amplifier (ILA) sites

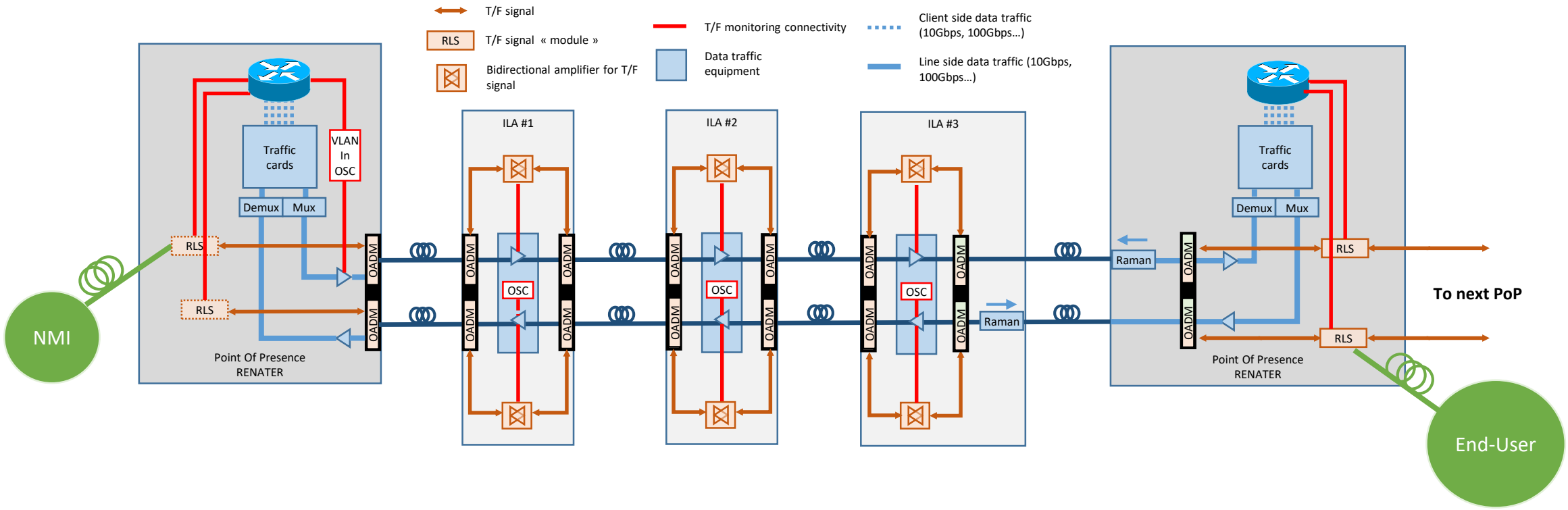
Bringing it in ILA

Point Of Presence
RENATER

ILA#1

IP connectivity in Inline Amplifier (ILA) sites

Finally 🏆🏆



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

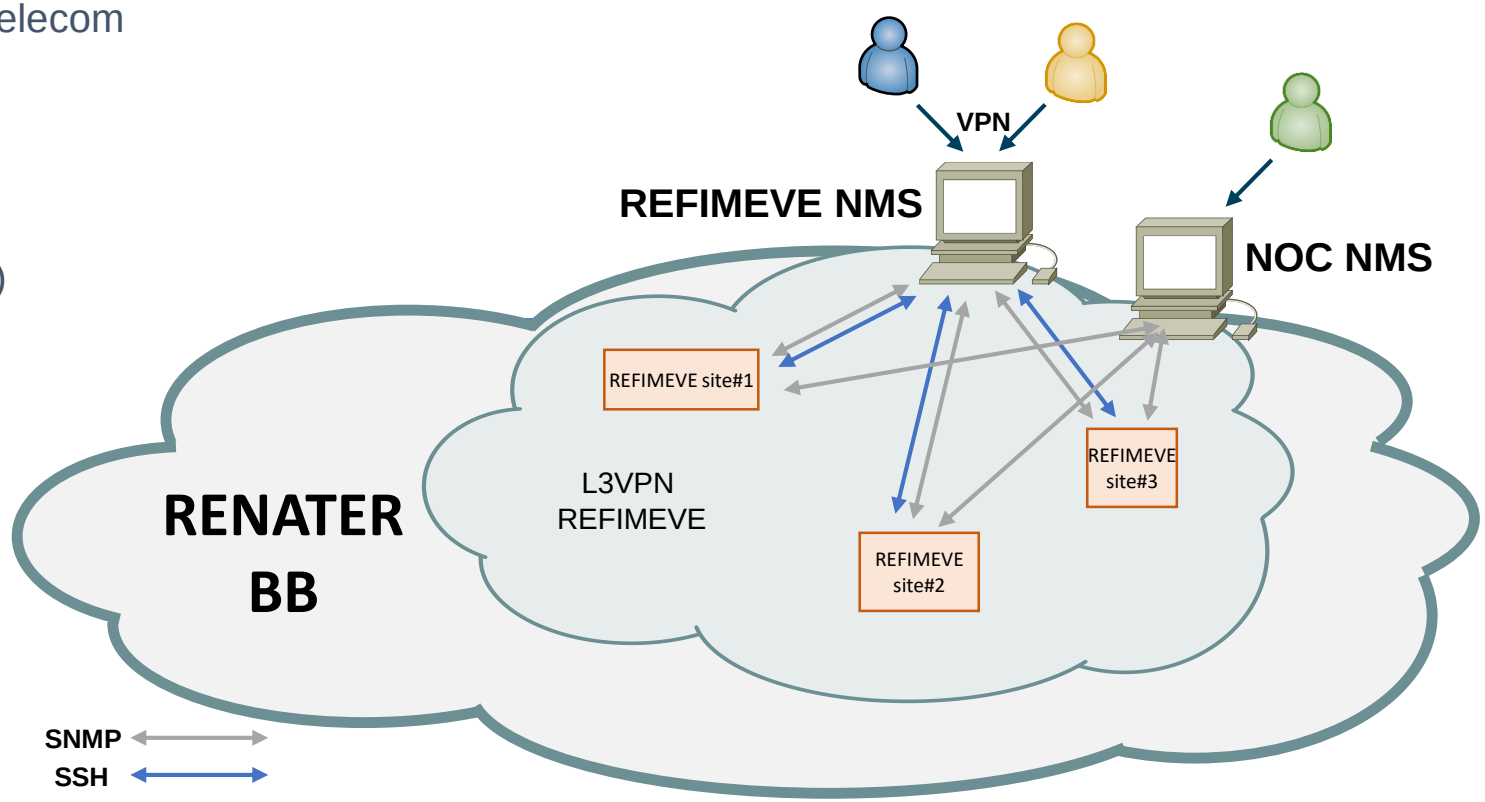
Ticketing procedures (will be detailed further):

- to inform users
- to activate manufacturer or tierce party-company

Core REFIMEVE+ team: set up metrological signal

iXblue: Manufacturer + maintenance

NOC + RENATER: control optical layer 24/7

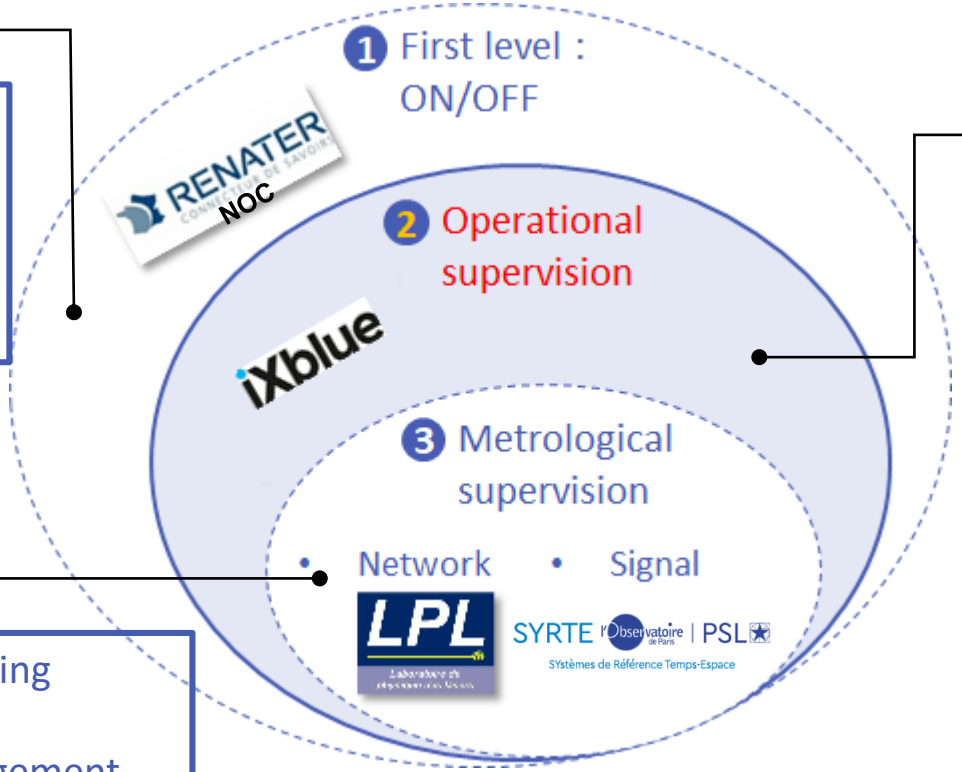


Supervision and monitoring of T/F equipment

Different supervision layers

1

- ✓ **Inventory**
  Name, version, type, temperature…
- ✓ **Turn off**



2

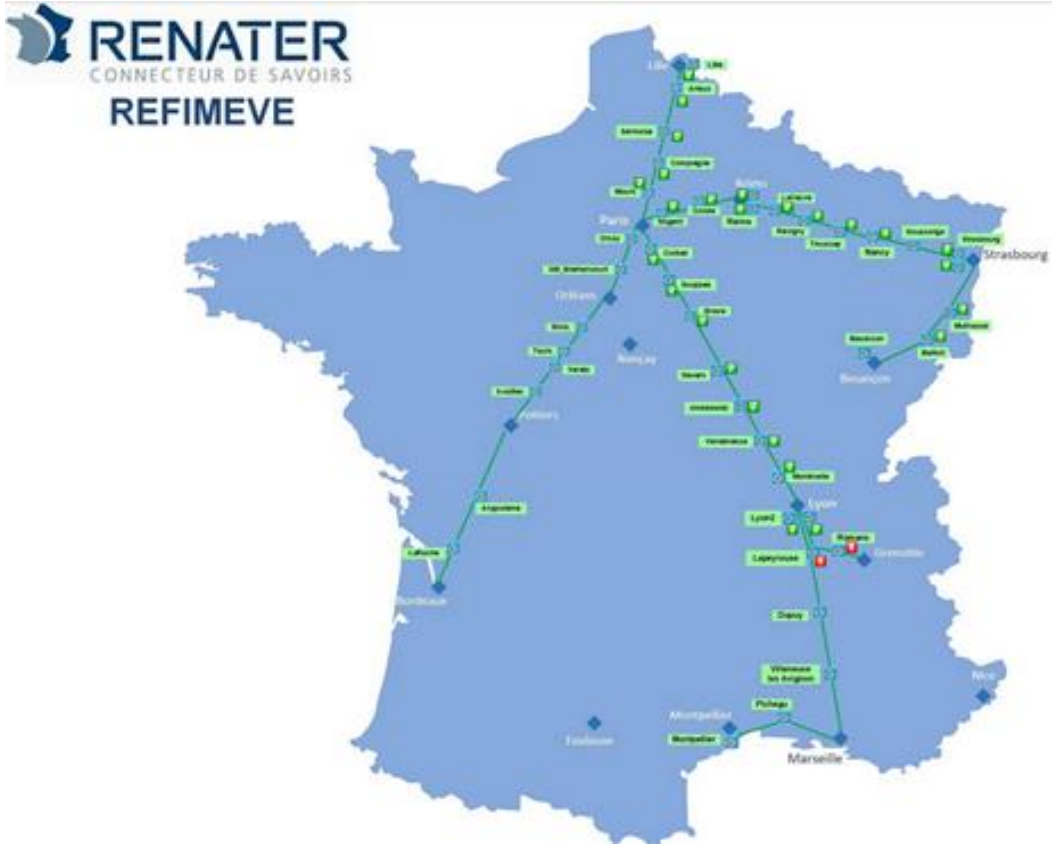
- ✓ **Supervision software:** monitor and control the REFIMEVE+ performances
- ✓ **Database:** store all the information useful to the network management
- ✓ **Human-machine interface:** for final users, academic teams and the network manager

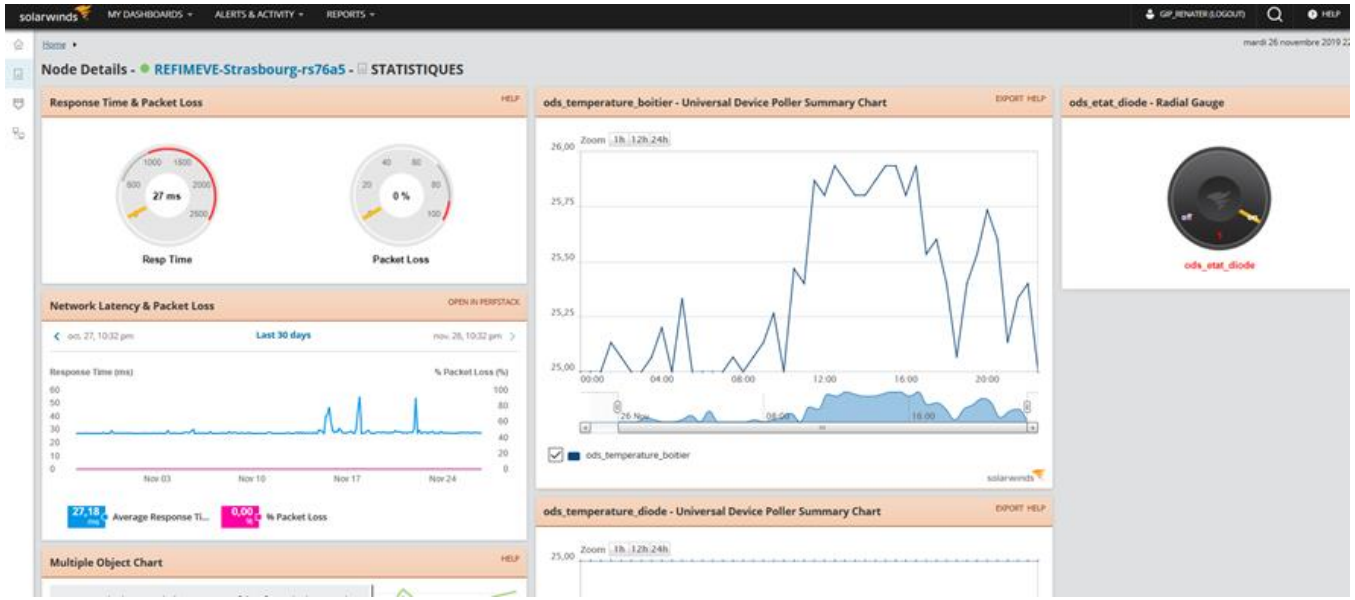
3

- ✓ Metrological data processing
- ✓ Accuracy calculation
- ✓ Ultra-stable source management
- ✓ Fine tuning

Maintenance in operational condition and day-to-day routines

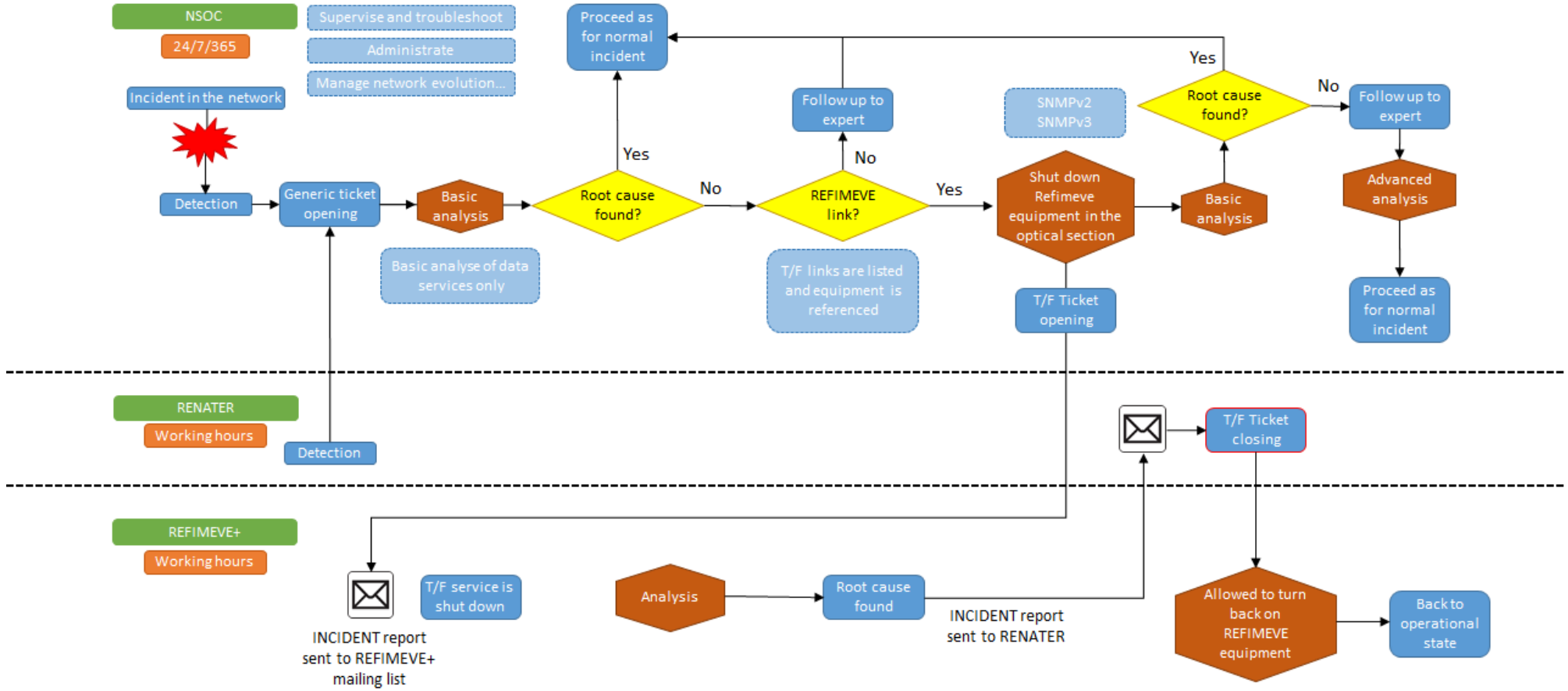
T/F integrated in day-to-day routine





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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