RENATER
CONNECTEUR DE SAVOIRS

Time service deployment in RENATER network using White Rabbit Switches

Nicolas Quintin[1], Yadav Neelam[2], Philip Tuckey[2], Michel Abgrall[2], Anne Amy-Klein[3], Etienne Cantin[3], Christian Chardonnet[3], and P.-E. Pottie[2]

1 RENATER

2 Laboratoire Temps Espace (LNE-OP), Observatoire de Paris, Université PSL, Sorbonne Université, Université de Lille, LNE, CNRS

3 Laboratoire de Physique des Lasers, Université Sorbonne Paris Nord, CNRS

nicolas.quintin@renater.fr

Time and frequency in France

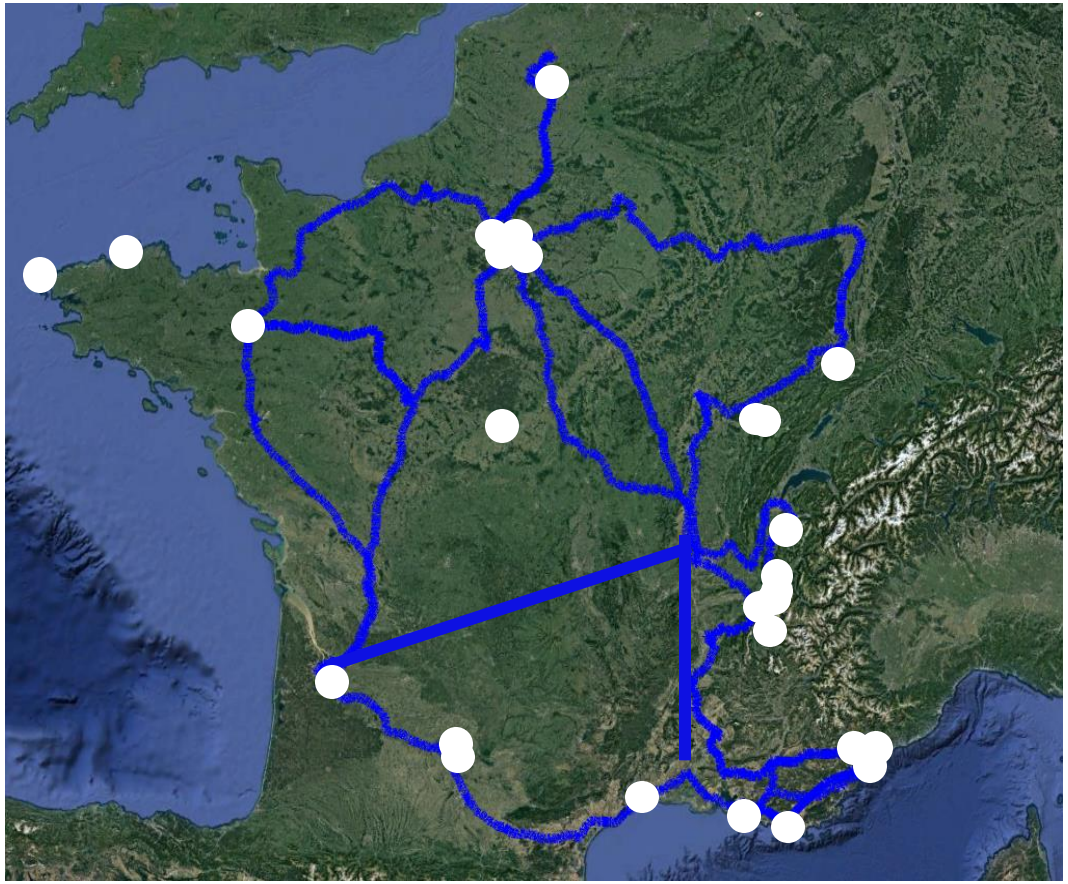
- **FIRST TF**, a strong T/F community in France
  Facilities for **I**nnovation, **R**esearch, **S**ervices and **T**raining in **T**ime & **F**requency

23 laboratories,
30 companies,
5 consulting companies,
4 technical agencies
2 associated foreign structures

*”to **gather all the actors** involved in time-frequency on a national scale […] **support collaborative projects** in Time & Frequency metrology with a broad spectrum of applications”*

Time and frequency in France

First TF community



Fibre footprint of RENATER

T/F Projects involving RENATER

General Information		
Acronym	REFIMEVE+	T-REFIMEVE
Total Funding	6 700 000 €	9 894 000 €
RENATER Funding	X	1 261 440 €
Coordinating Institution and Project Lead	Université Sorbonne Paris Nord Christian CHARDONNET	Université Sorbonne Paris Nord Christian CHARDONNET since 2023
Duration	2012 – 2024	01/06/2021 – 31/05/2029
Objective	Connect 19 research laboratories across France with an ultra-stable frequency signal	Connect additional laboratories and add a time metrology service

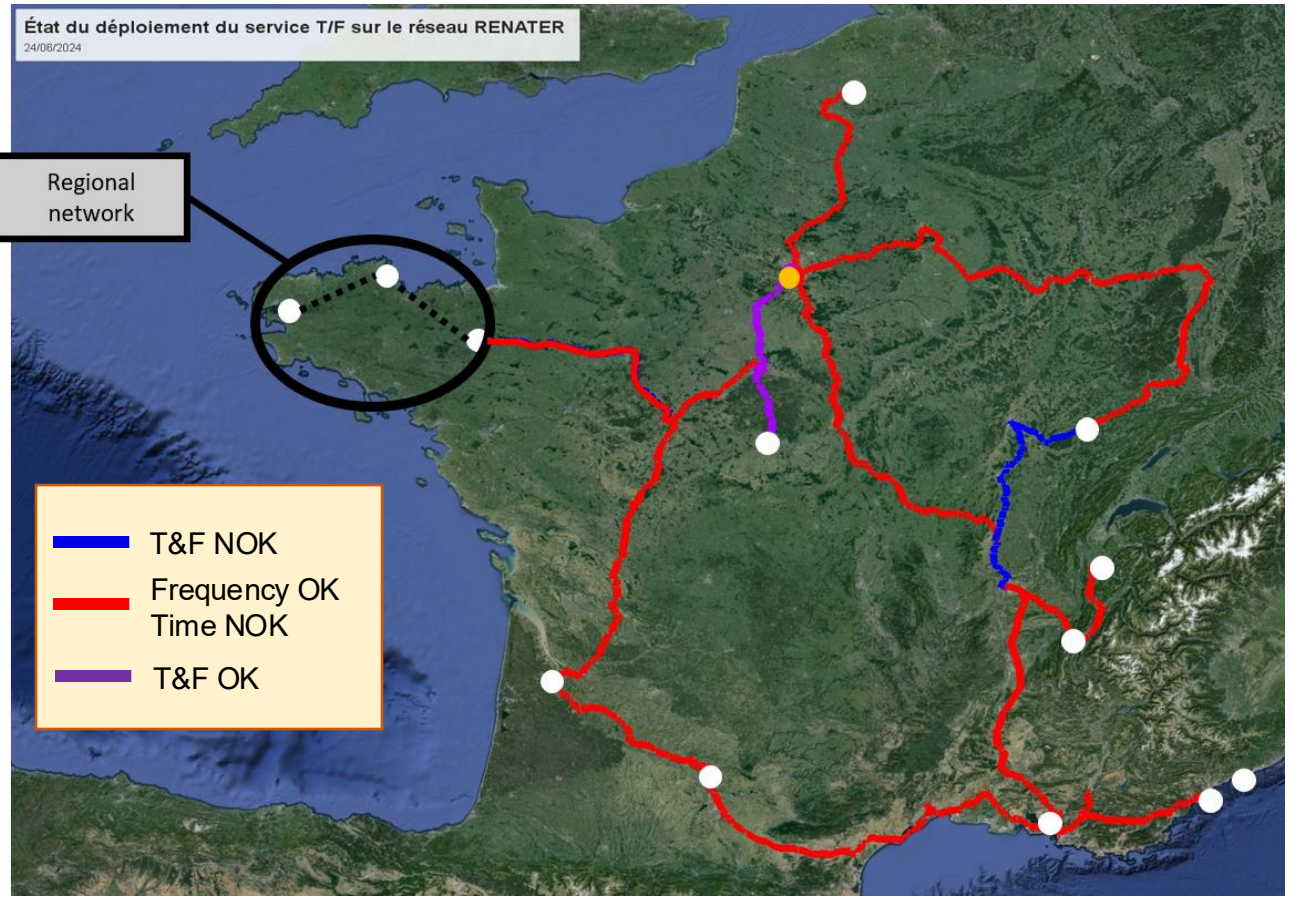
Tip => It is necessary to develop a sustainable cost model that does not rely on competitive calls for proposals

A National Research Infrastructure

Two services generated by LTE-OP (NMI) and distributed through RENATER network

- **Frequency ultrastable service**
  - Bidirectional dark channel setup, propagation required to suppress noise,
  - Deployment ~ 4 586/4 898 km (
  - @1542,14nm, **ch.44** ITU-T
  - spectral occupation **<10kHz**, output power **<3dBm**
  - 20 end-users
- **Time service**
  - Unidirectional setup “classical” alien wavelength (ch.21 => 192,1 THz mainly)
  - Deployment ~ 307/4 898 km
  - 80 WR switches
  - 40+ end-users (high energy physics, astronomy…)

Paper to be published soon!

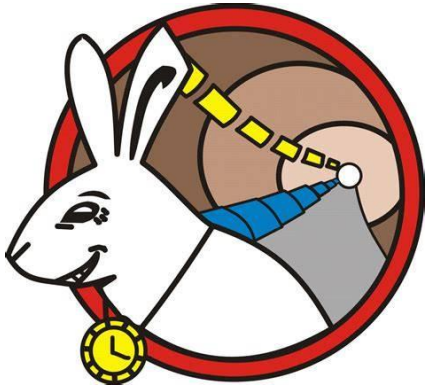


Became a national Research Infrastructure in 2021

White Rabbit deployment in RENATER

- **First objectives**
  - Time accuracy <10 ns
  - Time instability < 1 ns

  } Not aiming for ultimate performances

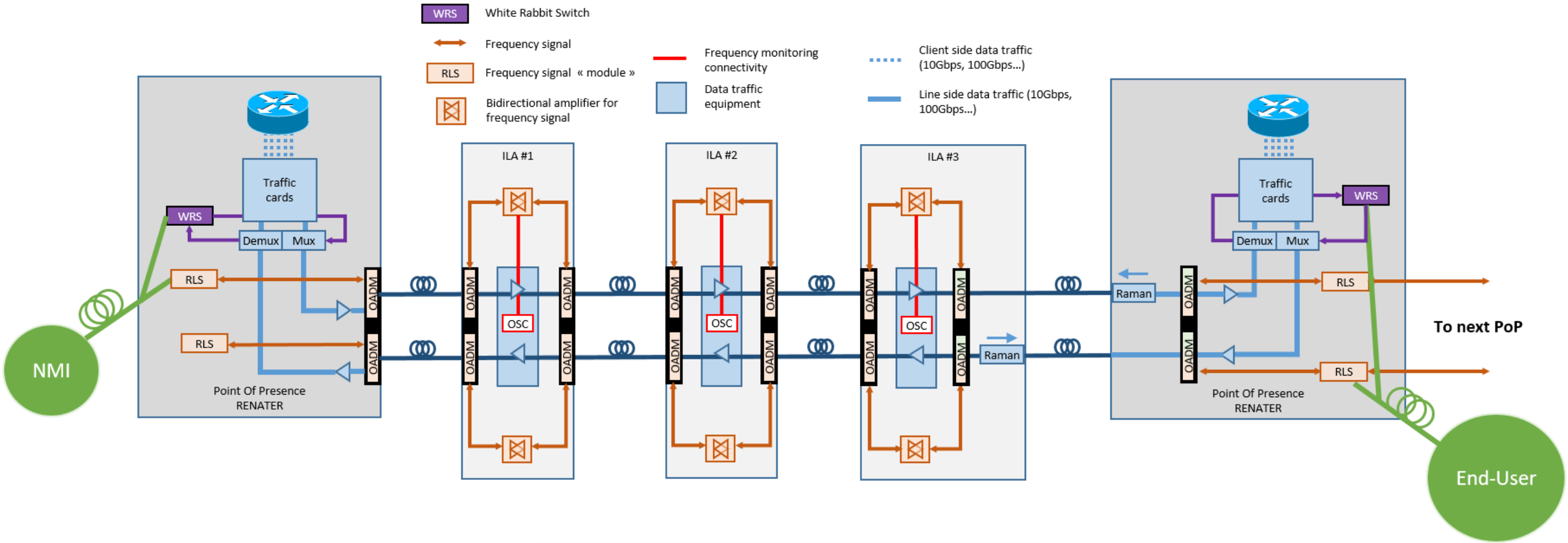


- 2 architectures possible
  - **1 wavelength, 2 fibers << in RENATER network**
  - 2 wavelengths, 1 fiber

Pros
- Cost reduction (no additional optical amplifiers: saving CAPEX&OPEX)
- Faster deployments (only need to go to extremity sites)
- Design that is more “telco” friendly

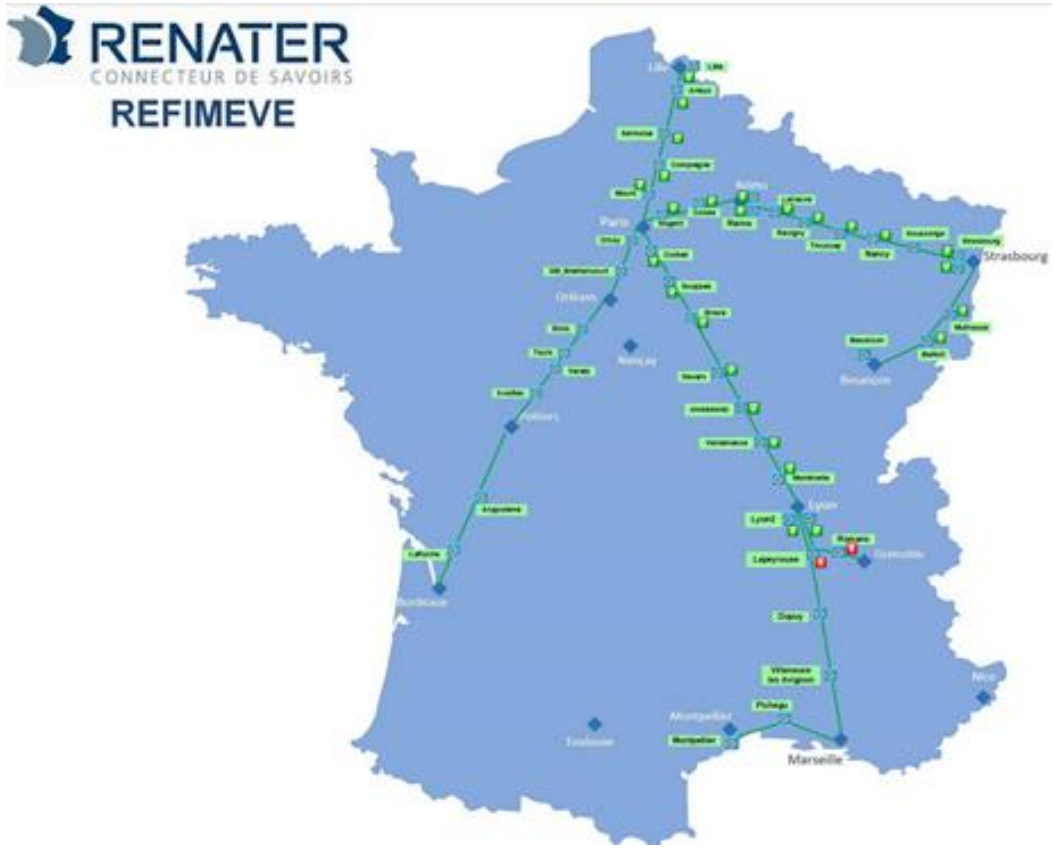
Cons
- Mitigate link asymmetry (1m ⇔ 5ns) fibres are in the same cable

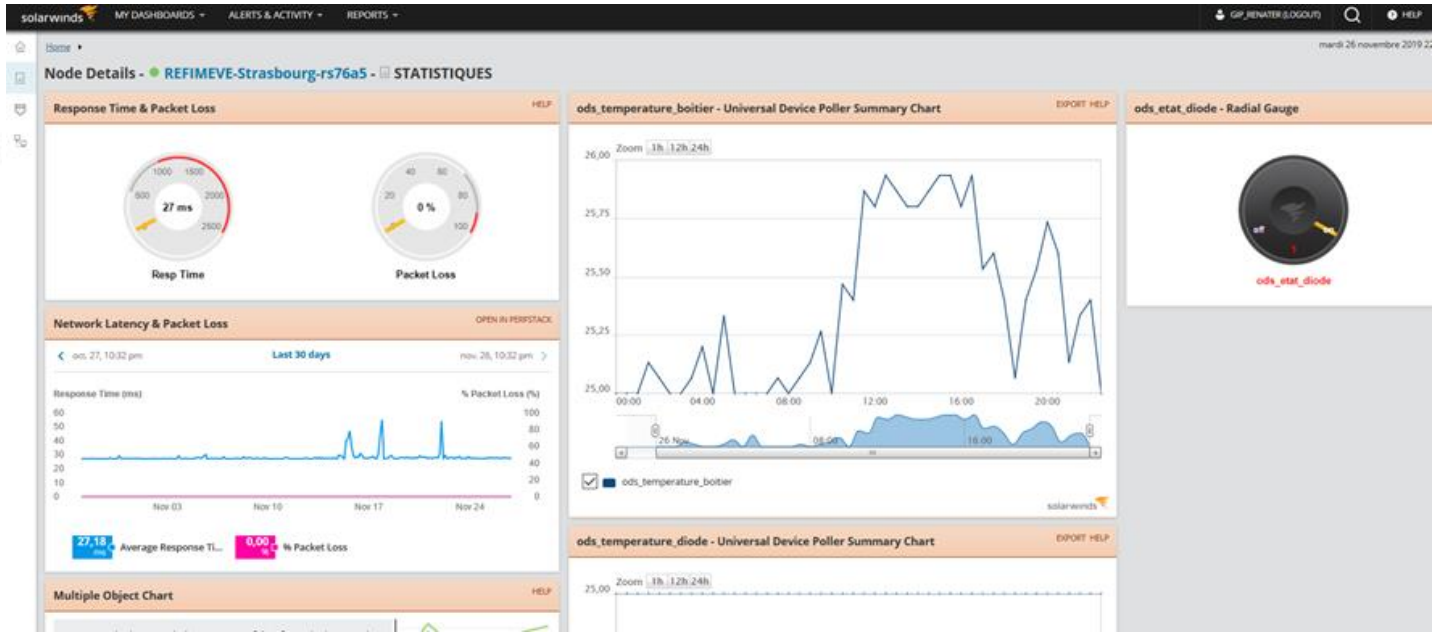
White Rabbit deployment in RENATER



Typical design

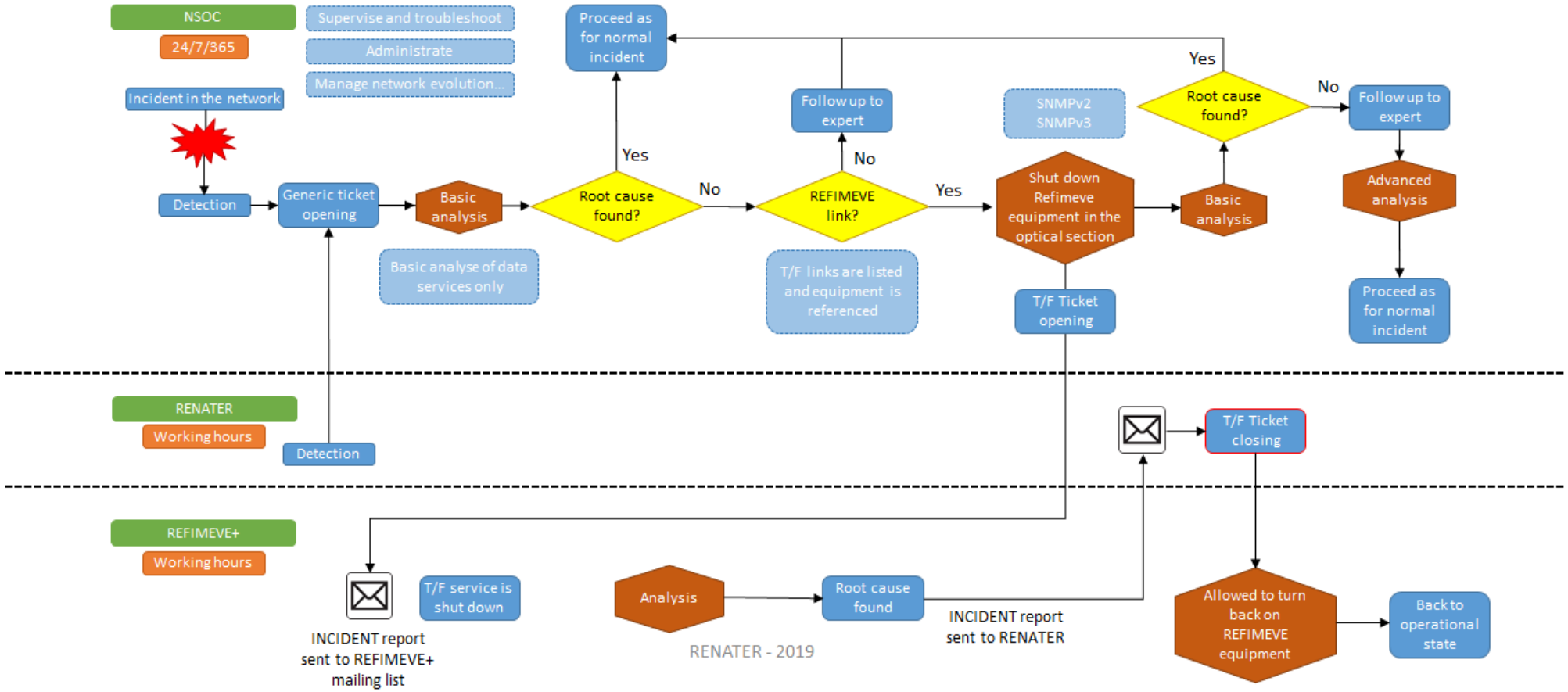
Maintenance in operational condition and day-to-day routines





Solarwinds monitoring solution

T/F Ticketing procedures



Decision tree diagram

Wrap up

- Deployment status of Time service within RENATER
  - 307/4 898 km
  - ~ 4 500 km by T1 2027

- Monitoring of T/F equipment
  - Needs to be as standard as any other equipment to be easily integrated in day-to-day routine
  - Identify clearly responsibility of each actor (NOC, NMI)

- REFIMEVE Research Infrastructure
  - Sharing the fibre to save time and money
  - 16 years of background experience of Frequency service
  - 1 year of background experience for White Rabbit time service **(paper soon to be published!)**

  …without any incident with IP data traffic in real field

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

Any question?

Feel to contact me => nicolas.quintin@renater.fr