

UNIVERSITÉ PARIS 13
NORD



Le progrès, une passion à partager

LNE



Recherche sur les Atomes Froids
Institut Francilien de
IFRAF
* île de France

AGENCE NATIONALE DE LA RECHERCHE
ANR



The REFIMEVE+ project calendar

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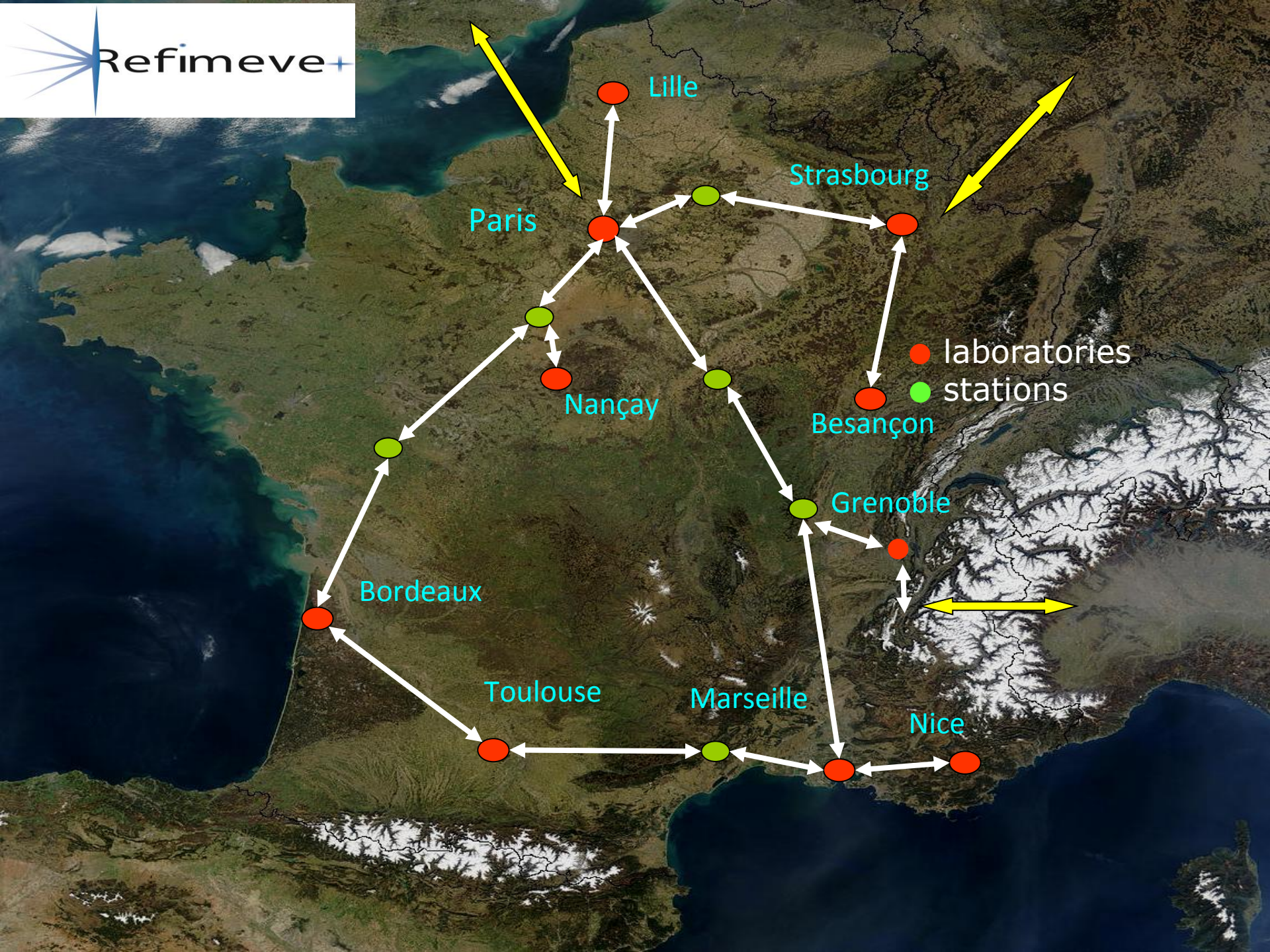
Systèmes de Référence Temps-Espace



- Introduction
- Project essentials
- Some technical aspects
- Preliminary schedule
- Long distance links
- Paris metro area network
- Organization bits

REFIMEVE+ : chronicle of a long quest

- 2002-2008 LPL-SYRTE early optical link developments
- 2008-2009 First demonstration of a multiplexed optical link
- 2009-2010 Long distance multiplexed link on a public telecom network
- 2010 First submission of the REFIMEVE to the French government
- 2011 Grant for the Paris region metro network (REMIF)
- 2011 Approval of the REFIMEVE+ by the French government
- 2012 REFIMEVE+ long-drawn-out administrative path.....
- 2013 End performance specifications document



21 Partners

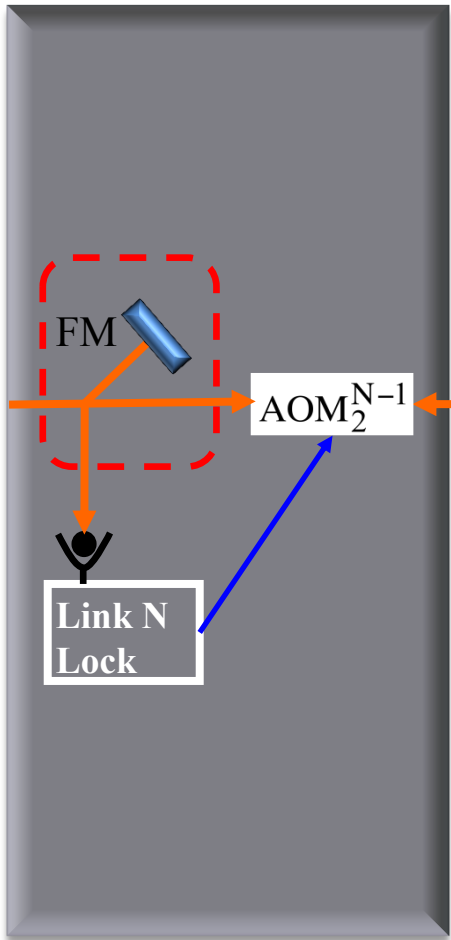
- 18 public research labs + CNES
- RENATER (NREN)
- IDIL (industrial partner)

Fiber infrastructure for ultra-stable optical signal dissemination

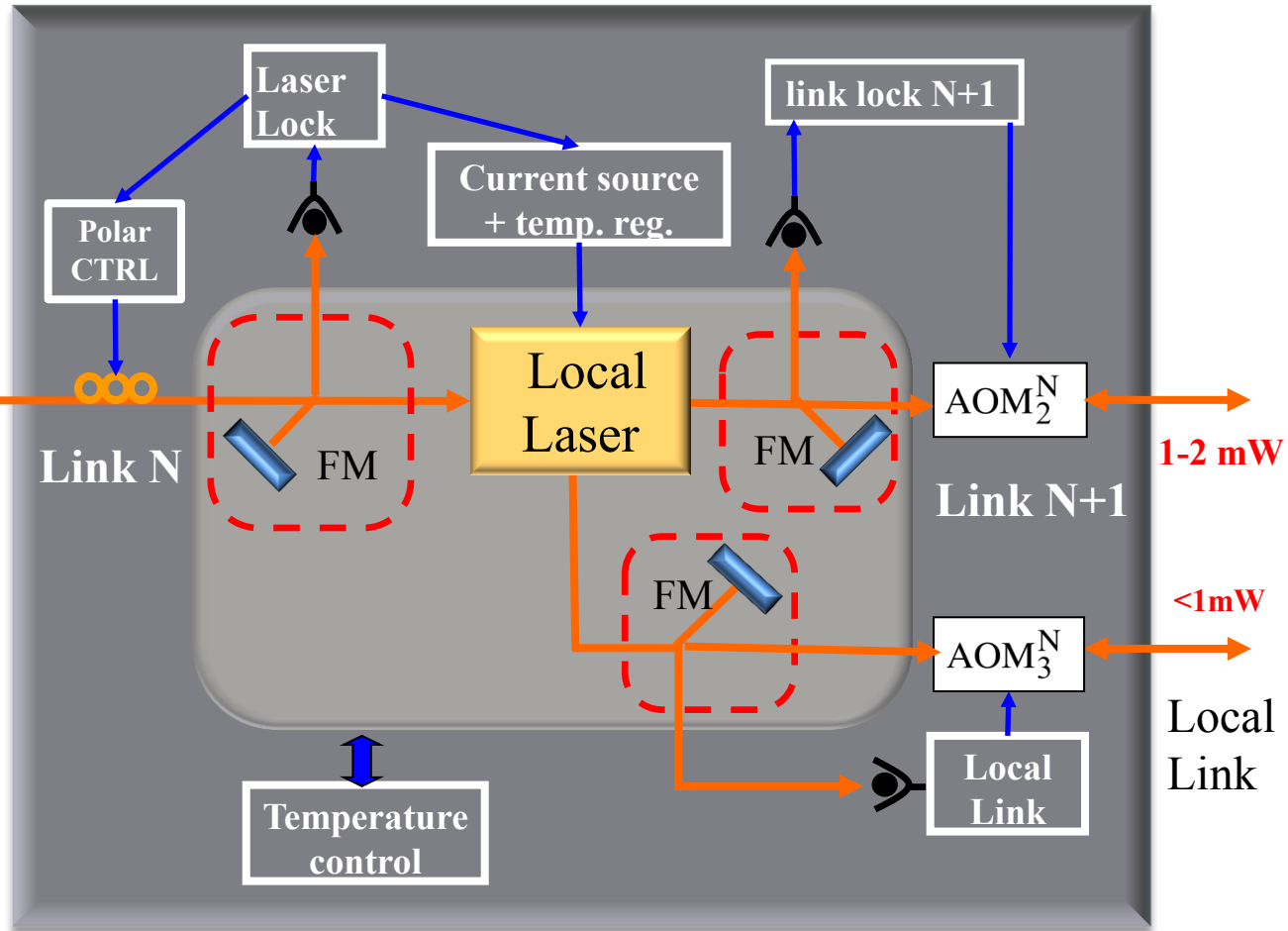
- ~100 bypass optical amplifiers
- ~50 optical regeneration stations
- Software supervision system
- Development phase and construction 3yrs ~ 4.0 M€,
- Maintenance 4yrs ~ 1.5 M€

Optical regeneration station

Station N-1



Station N



- Automated with remote control (IP)
- Robust & cost effective

- 2013Q3-2014Q3 Industrial development phase (IDIL)
- 2013 Q3-Q4 Paris–Strasbourg link completion (LPL-SYRTE)
- 1st Priority Paris-Nançay-Bordeaux-Toulouse (PHARAO-ACES)
- 2nd Priority Paris Metro Area network (3-year Region contract)
partial deployment during 2013Q3-2014Q4

- **Agenda dependent on the production capabilities and man power effort of the industrial partner IDIL**

- **Agenda dependent on network operational constrains RENATER**

Note link Paris-Strasbourg before the industrial developments

- Home made stations (LPL + SYRTE)
- Industrial grade amplifiers (elementary supervision)
- Scope: high end optical frequency standards frequency comparison
- Test bed for the REFIMEVE+ industrial hardware
- Full multi-segment long distance link for full scale concepts validation

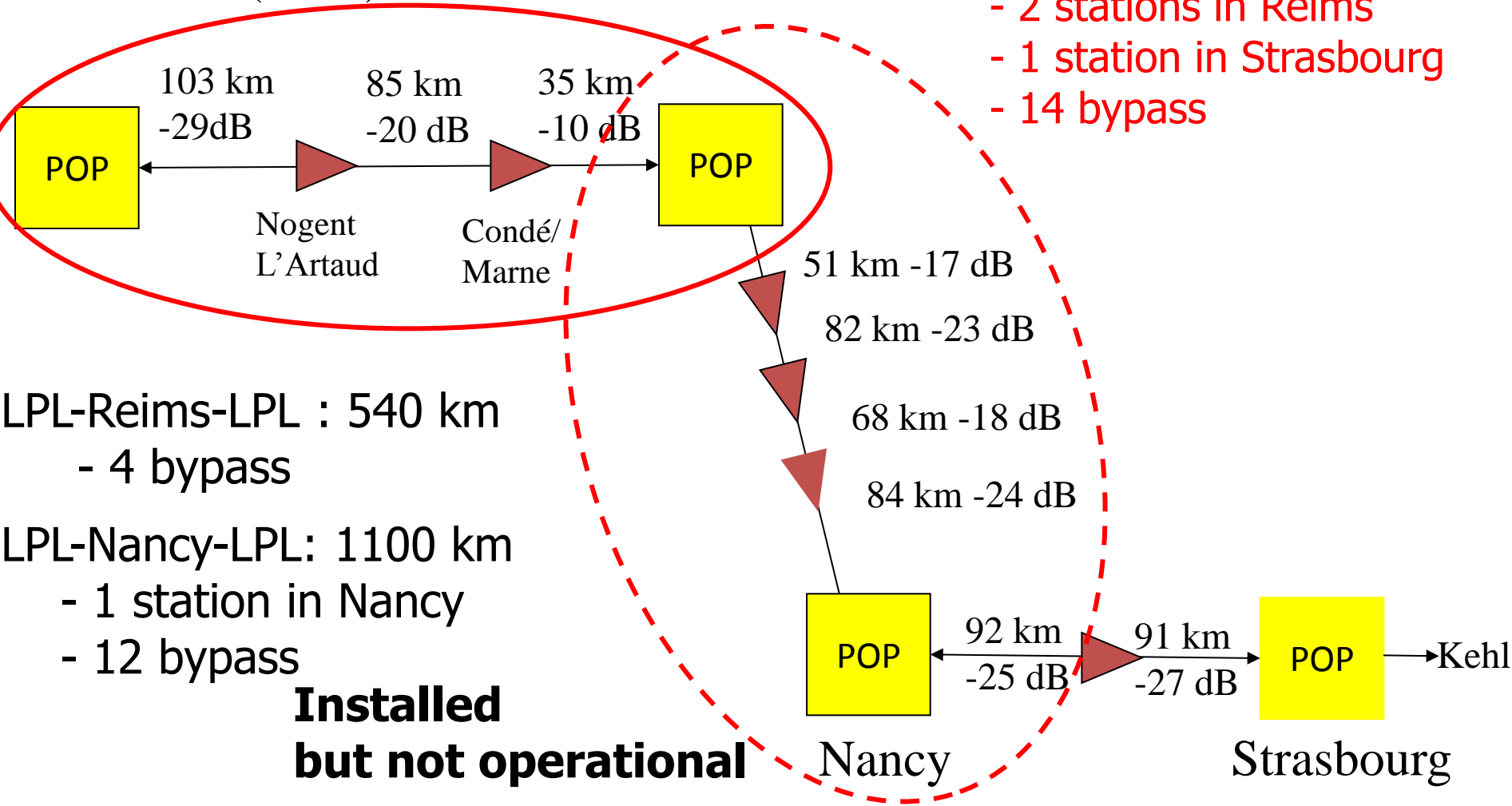
Towards the German border...

A link to Strasbourg ~750 km (- 230 dB)

Telehouse2 (Paris)

Reims

Paris-Strasbourg-Paris: 1480 km
 - 2 stations in Reims
 - 1 station in Strasbourg
 - 14 bypass



LPL-Reims-LPL : 540 km
 - 4 bypass

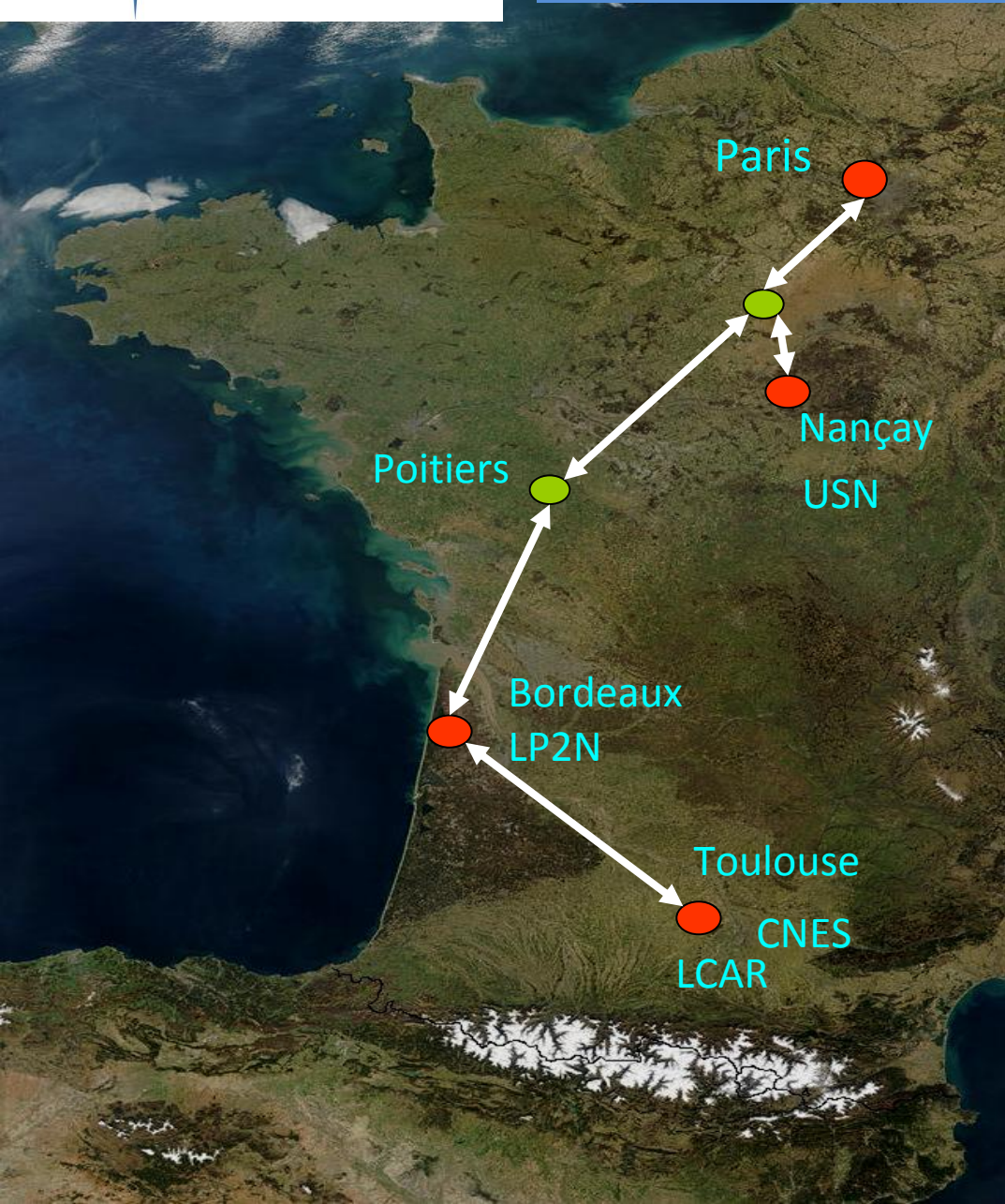
LPL-Nancy-LPL: 1100 km
 - 1 station in Nancy
 - 12 bypass

**Installed
 but not operational**

Nancy

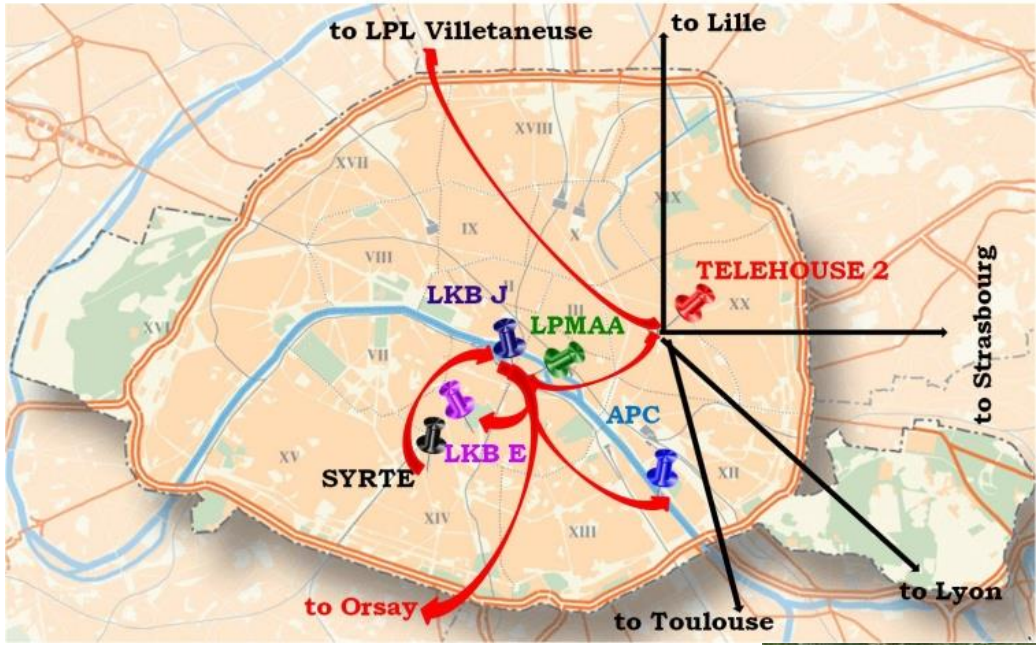
Strasbourg

Kehl



- ✓ 8 stations
- ✓ New network system vendor
- ✓ Raman amplifier online
- ✓ PHARAO in Toulouse
- ✓ Multiple users

Paris Metro Area Network



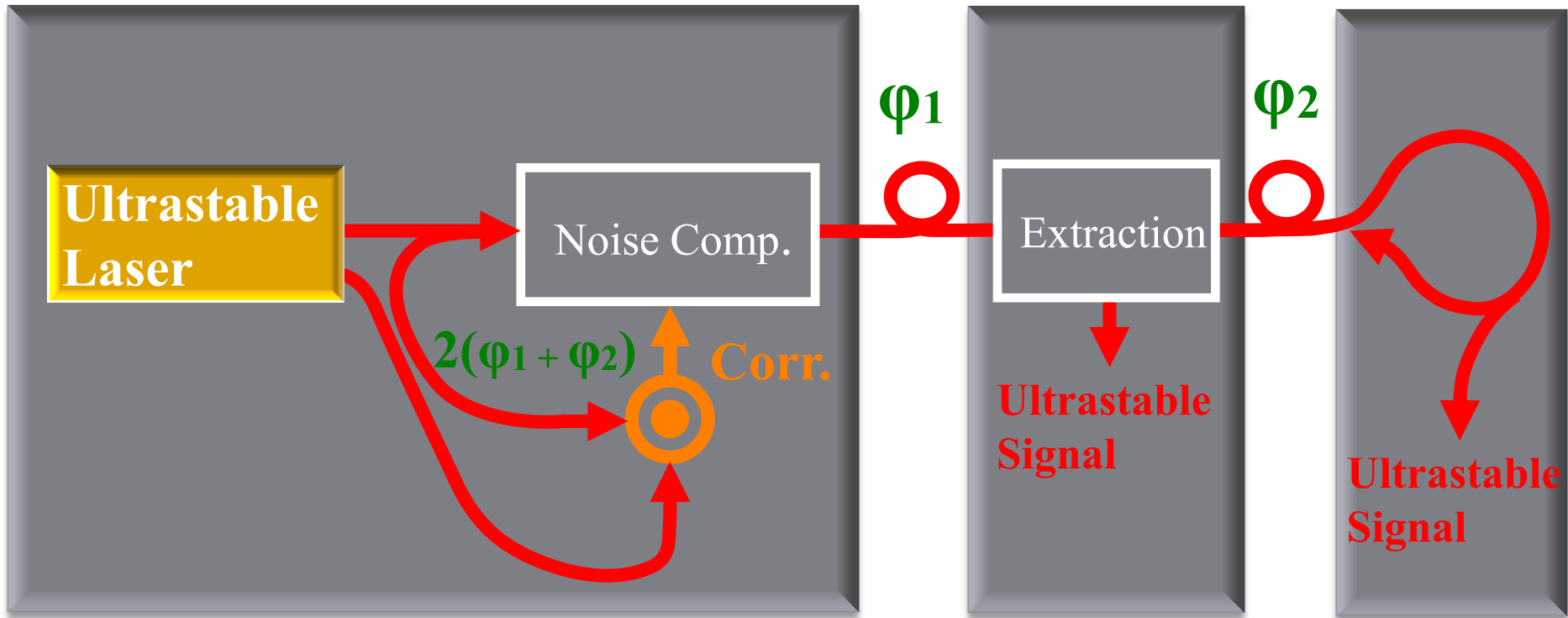
Partners :

- 8 research labs in Paris area
- ~20 bypass multiplexer
- ~8 simplified hardware (Inline ext.)
- ~ 700 k€ hardware

LAB A

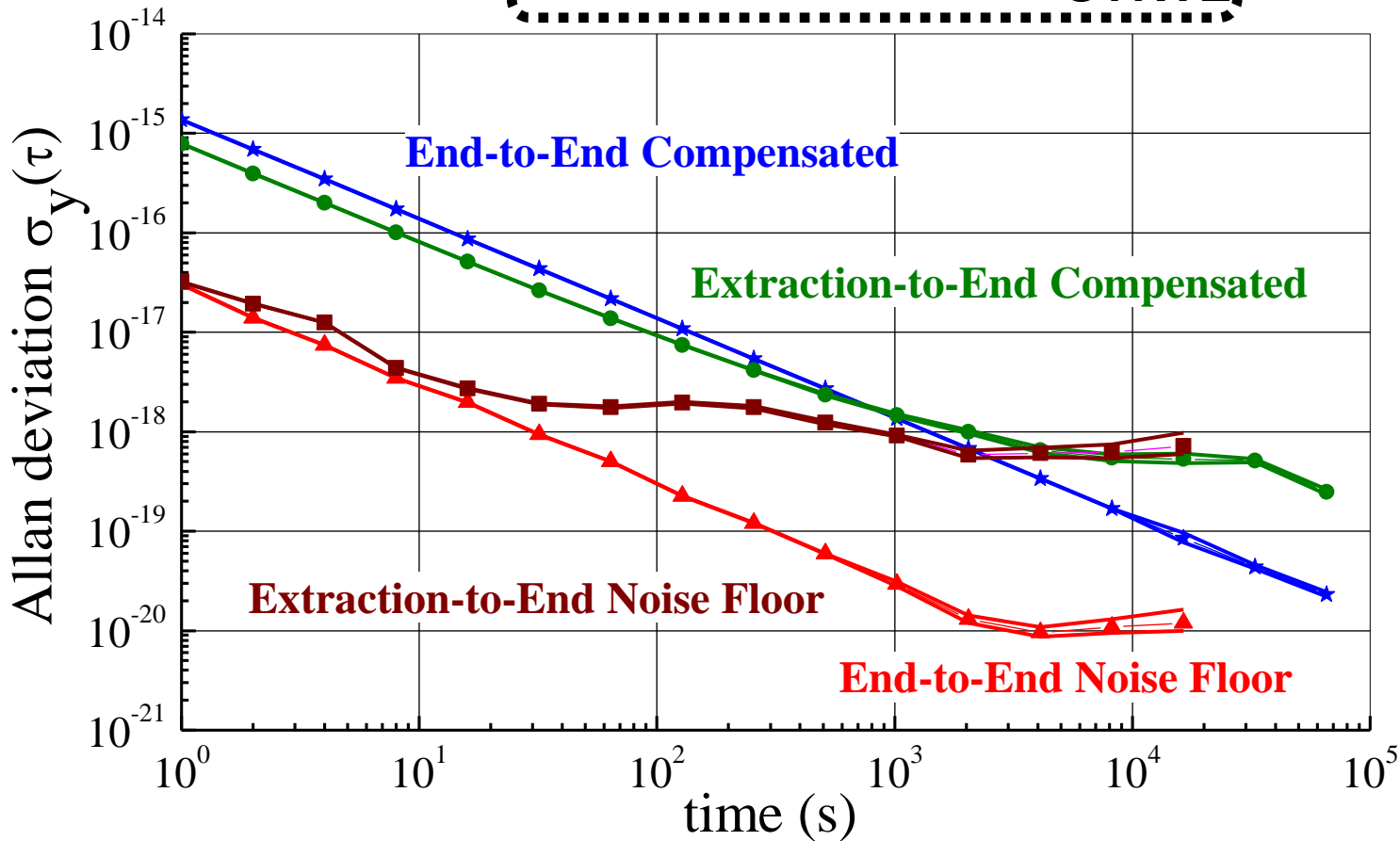
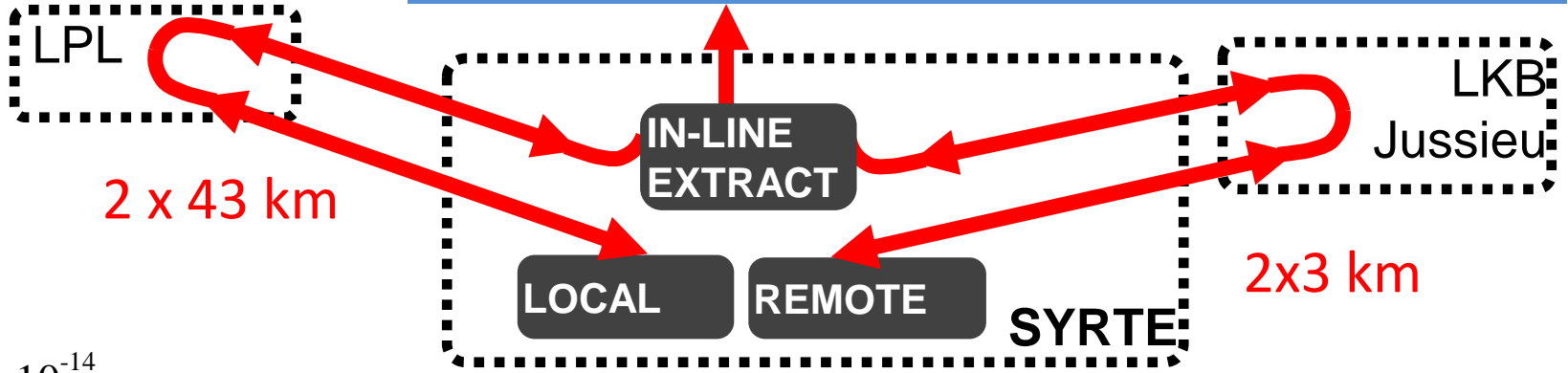
LAB C

LAB B



- First demonstrated by G. Grosche PTB
- Cost effective
- Short –links local distribution

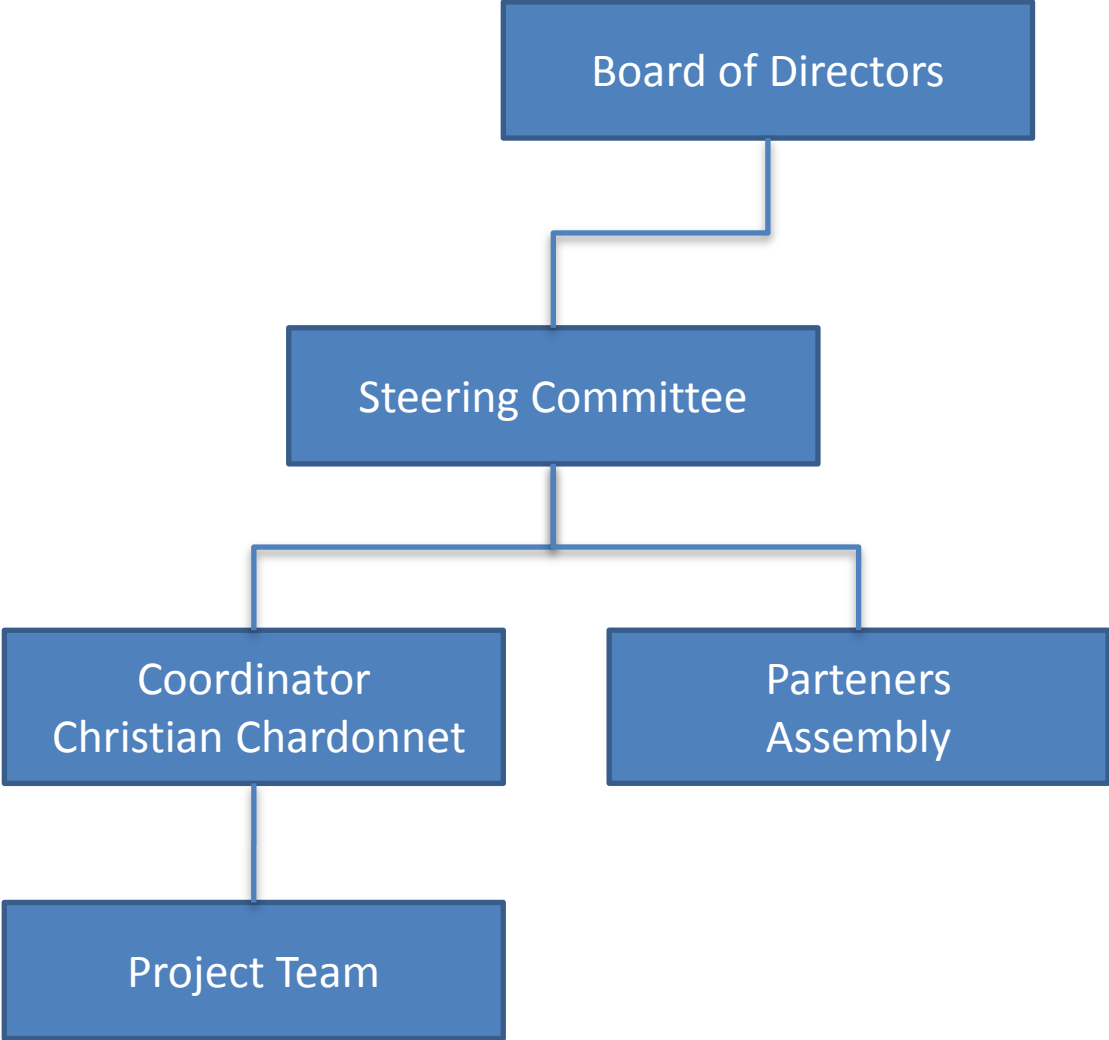
In-line extraction



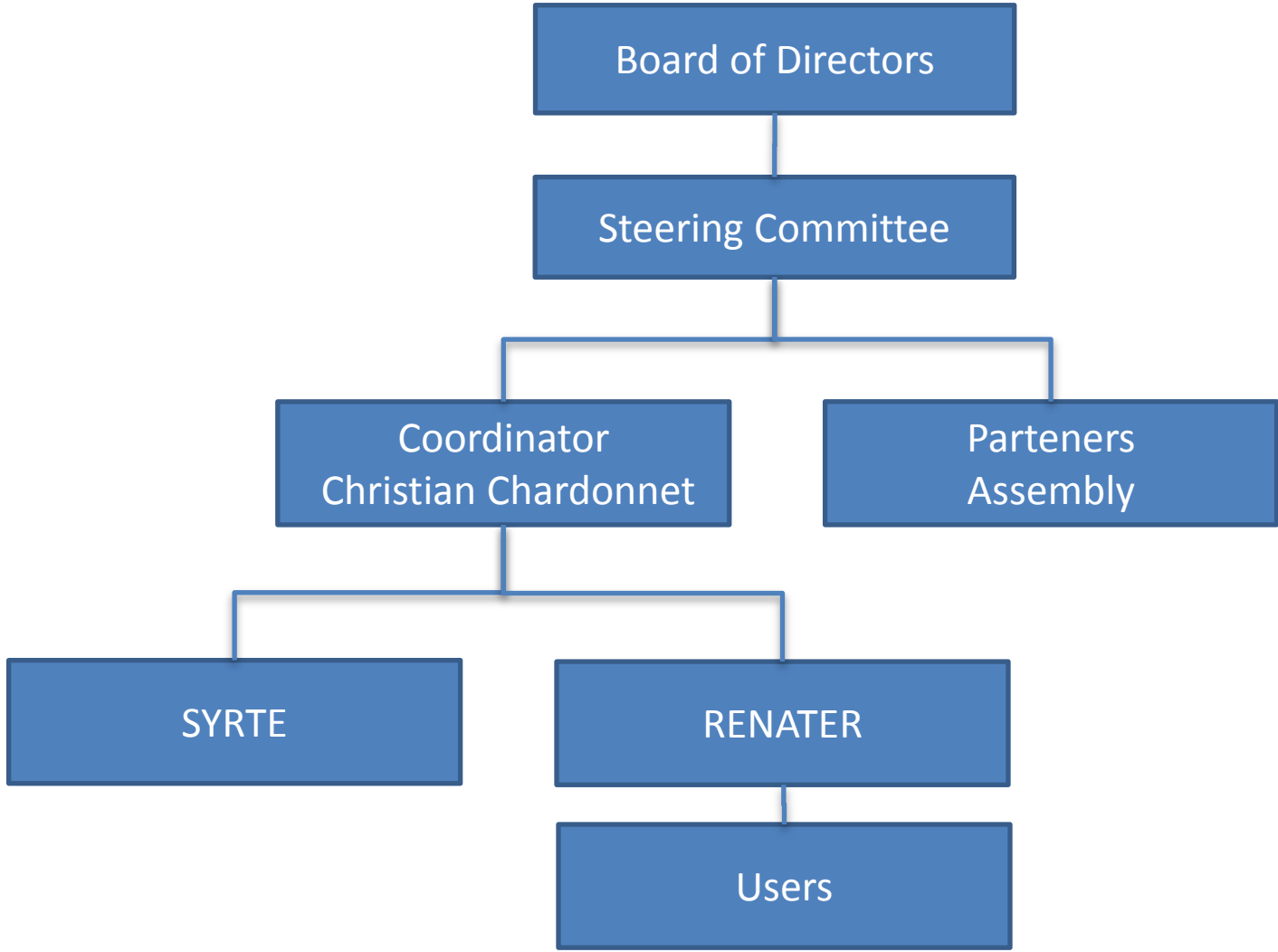
A. Bercy
A. Amy-Klein
O. Lopez
PE Pottie

- Technical background skill transfer&training
- Non disclosure agreement (NDA)
- Know-how transfer agreement
- Industrialization& prototyping contract finalization

Governance



Governance



- The partners shall procure and prepare the “last mile” connections to the RENATER POP
- Support available from the REFIMEVE+ engineer
- Annual National&European partner meeting
- Steering committee meetings (new connections, special request...)

- This project is the result of many years of focused and hard work
- In addition of the project team several Ph.D PostDocs and Colleagues have contributed (non exhaustive list):
 - ✓ F. Narbonneau
 - ✓ C. Daussy
 - ✓ M. Lours
 - ✓ H. Jiang
 - ✓ S. Crane
 - ✓ F. Kéfélian
 - ✓ A. Haboucha
 - ✓ B. Chanteau
- And contributes still now :
 - ✓ A. Bercy
 - ✓ F. Stefani

