# LHCONE European design & implementation

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LHCONE Meeting, Washington, June 13-14 2011

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# Outline

- Overview European Approach

- Implementation status

- US setup and transatlantic connectivity for LHCONE
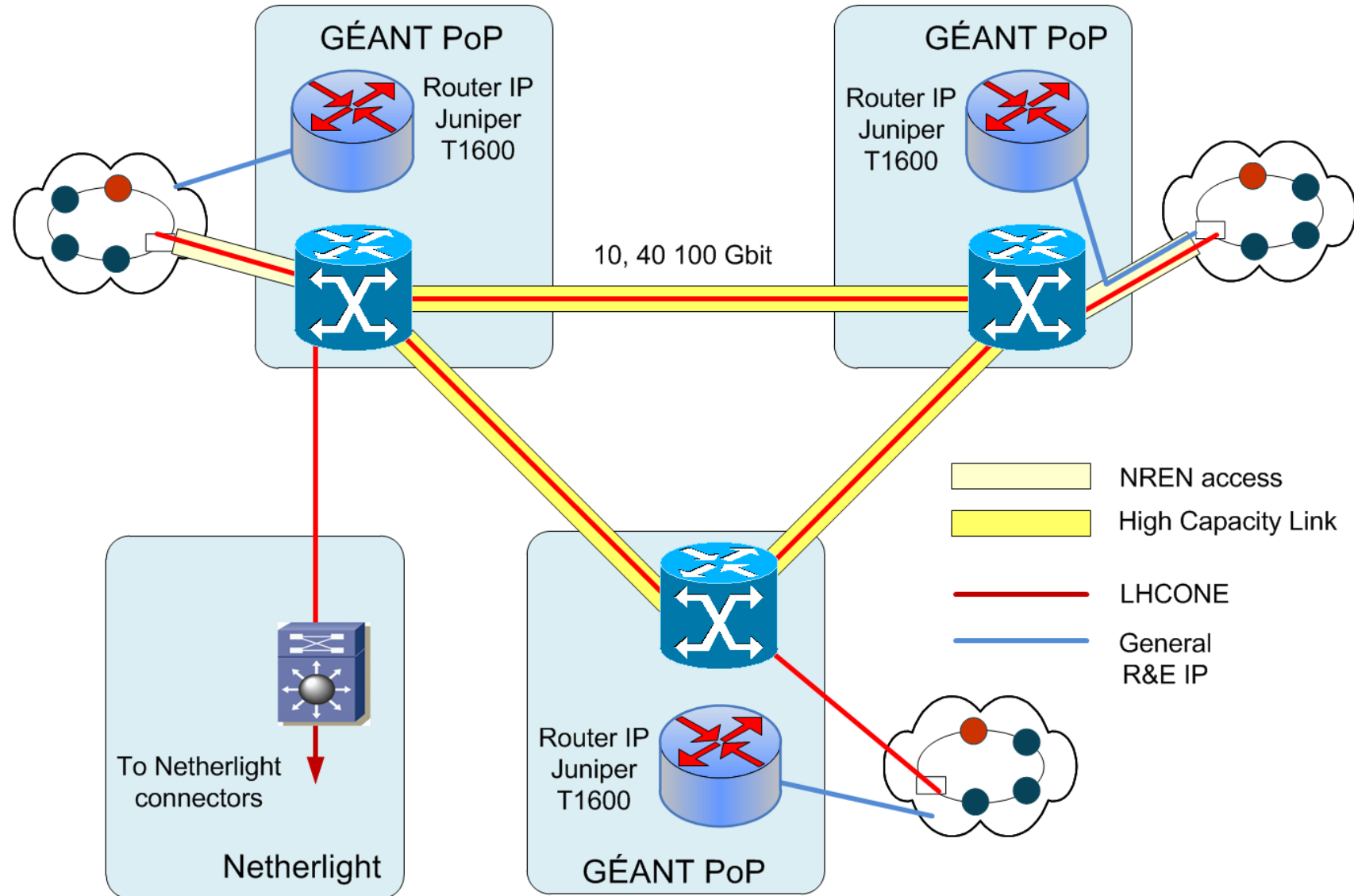
- Lessons learnt

- Conclusions

# Overview European Approach

- Designed according to European user's requirements
  - European workshop on 5th April agreed way forward

- Set of Distributed Exchange Points based on GEANT infrastructure

- Interconnection with Netherlight

# Long-term solution
## Layout of (generic) Distributed Exchange

GÉANT

GÉANT PoP — Router IP Juniper T1600

GÉANT PoP — Router IP Juniper T1600

10, 40 100 Gbit

NREN access

High Capacity Link

LHCONE

General R&E IP

To Netherlight connectors

Netherlight

Router IP Juniper T1600

GÉANT PoP

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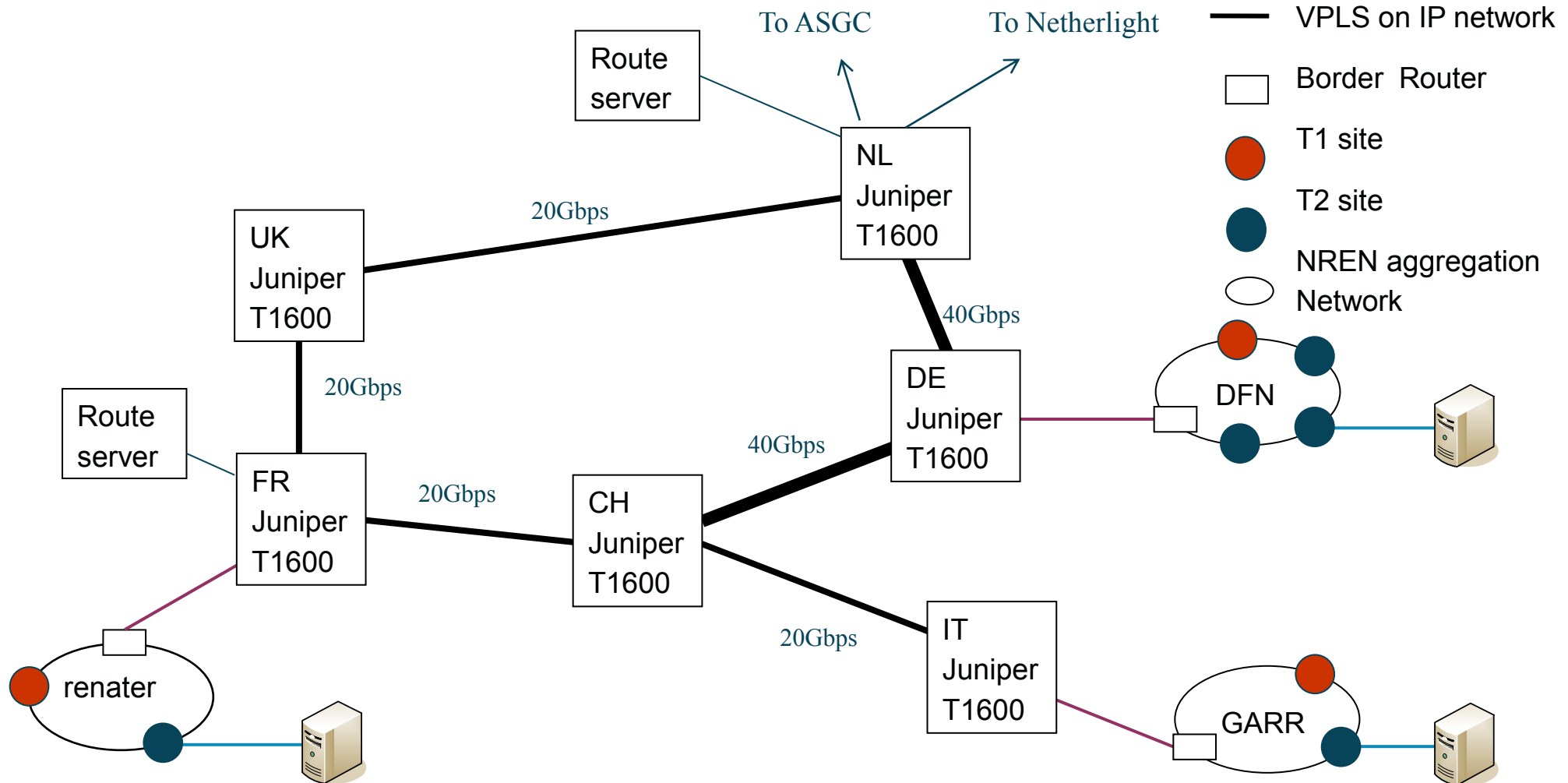
# Prototype design & implementation

- Logically identical to long term solution but
  - smaller in scope (# of sites connected)
  - Different technology, in core and in NREN connectors
  - Shared vs dedicated capacity

- Use VPLS technology on existing Juniper T1600 routers to emulate a distributed LAN
- Make use of existing shared (IP) capacity, with logical separation from general R&E IP traffic (with separate monitoring)
  - Confidence there is enough capacity on existing backbone links
  - 40Gbps CH-DE-AMS
  - 20Gbps NL-UK-FR-CH and IT-CH
  - May upgrade links if demonstrated necessary

# Access options for NRENs to LHCONE

- During prototype
  - Via a VLAN or LSP on existing port
  - Via additional separate physical port
  - Use backup IP port

- Long Term
  - Via a VLAN on main access (e.g if main access is > 10Gbps)
  - Via a VLAN on additional access
  - …other…TBD

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# European prototype overview



To ASGC

To Netherlight

Route server

NL Juniper T1600

UK Juniper T1600

20Gbps

20Gbps

40Gbps

Route server

FR Juniper T1600

20Gbps

CH Juniper T1600

40Gbps

DE Juniper T1600

DFN

renater

20Gbps

IT Juniper T1600

GARR

**Legend:**
- —— VPLS on IP network
- ▢ Border Router
- ● T1 site
- ● T2 site
- ⬭ NREN aggregation Network

GÉANT

# Services supported in prototype

- P2mp and static p2p services

- Dynamic services not yet available.  Expected 2012
    - GEANT-NREN pilot started now

- perfSONAR release available May 2011

- Note: p2p circuits (with BW guarantees) are already available via GEANTPlus.
    - No need to establish new infrastructure
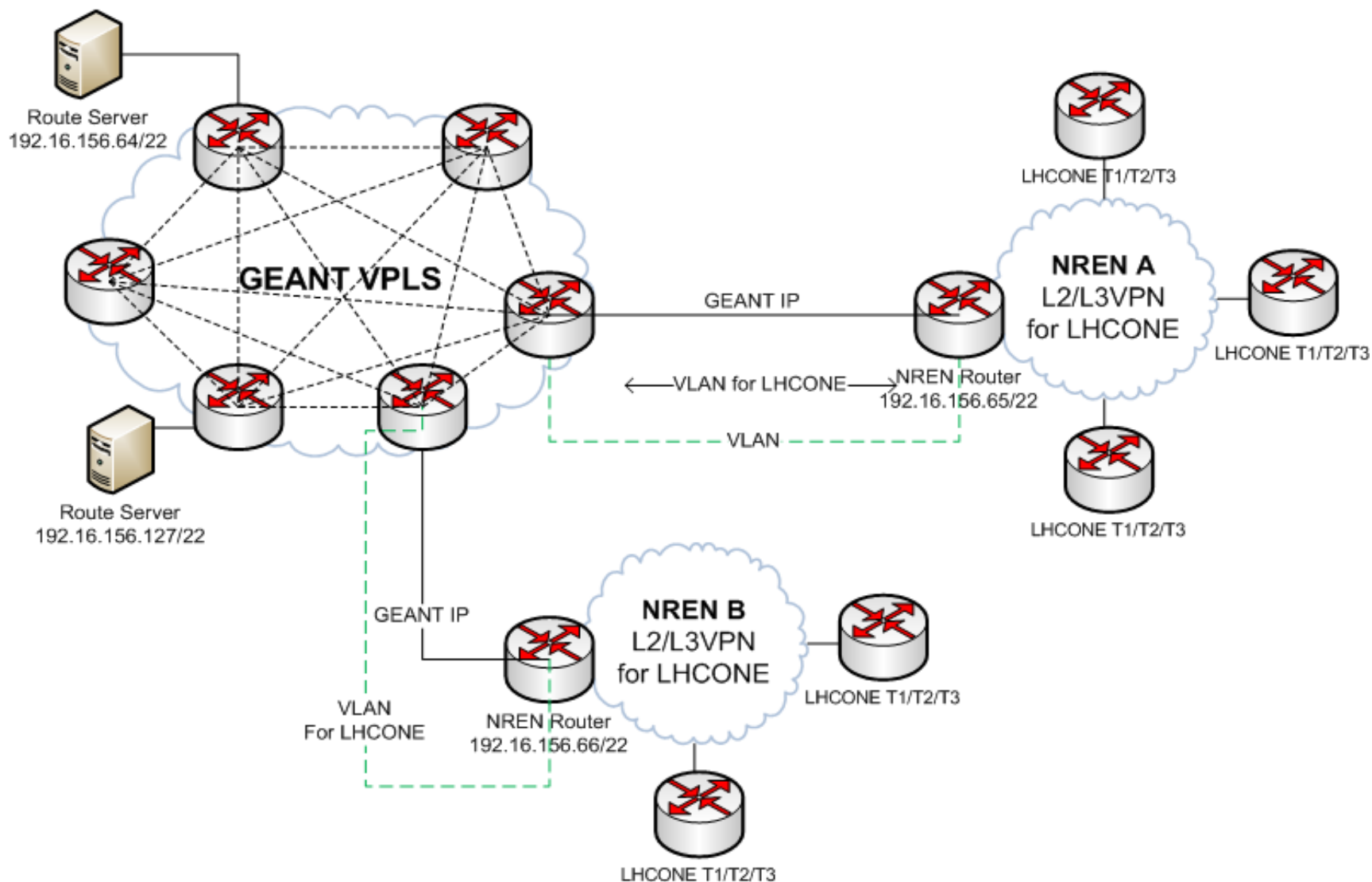    - May need to install additional capacity, depending on demand
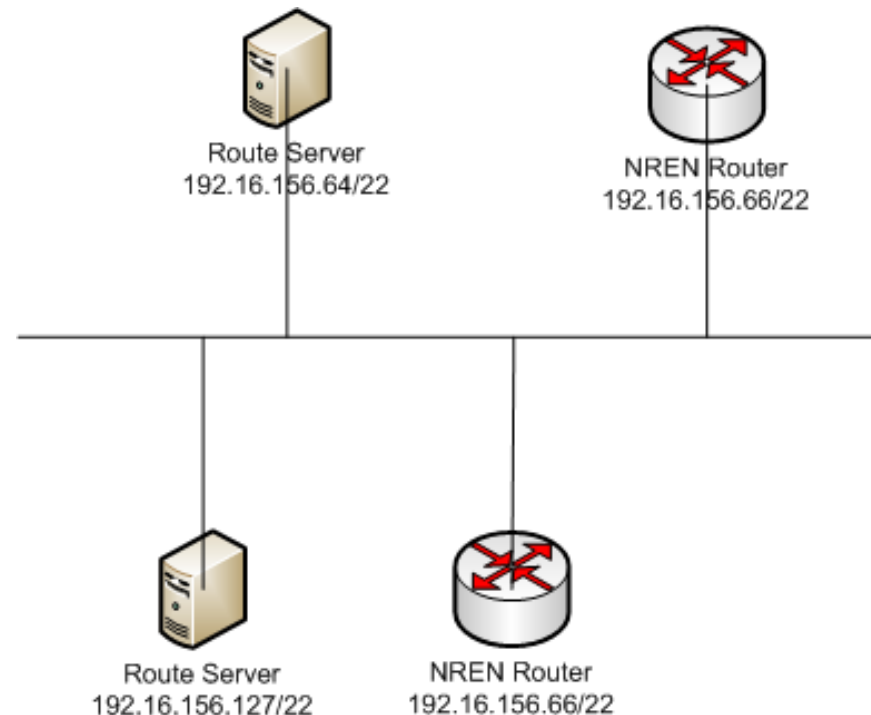
# Prototype costs within Europe

- Depending on how NREN aggregator networks (T2 clouds) connect, there may be an additional 10GE port in some locations

- We do not expect to have to add additional backbone capacity, for the prototype
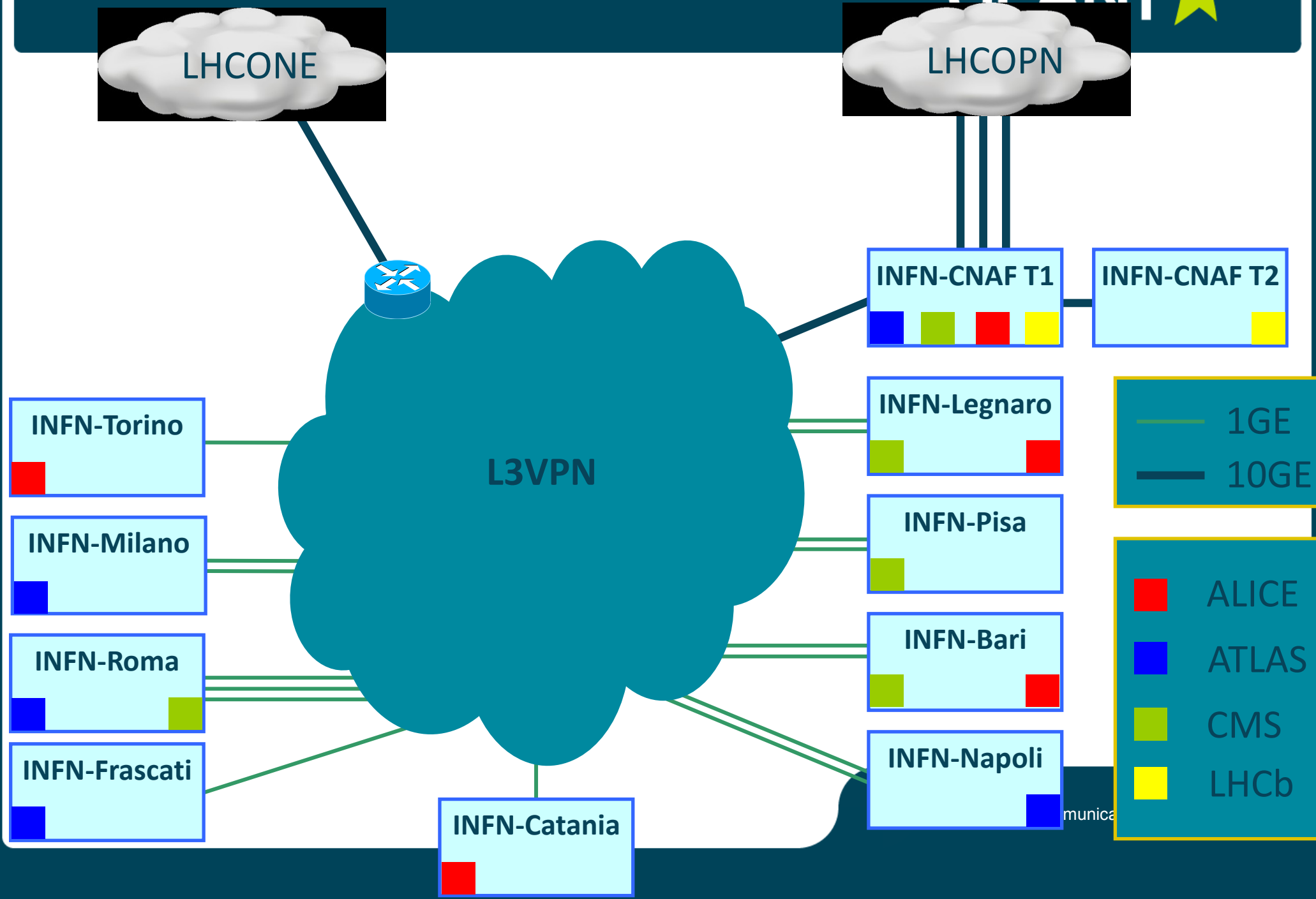  - There may be exceptions, depending on traffic growth

- Route Server

# LHCONE Setup in GEANT

- GEANT IP Network will be invisible to T2 sites (via LHCONE)

- All LHC connectors will be within the same IP subnet

- All sites should peer with all route servers
  - Looking for a workaround

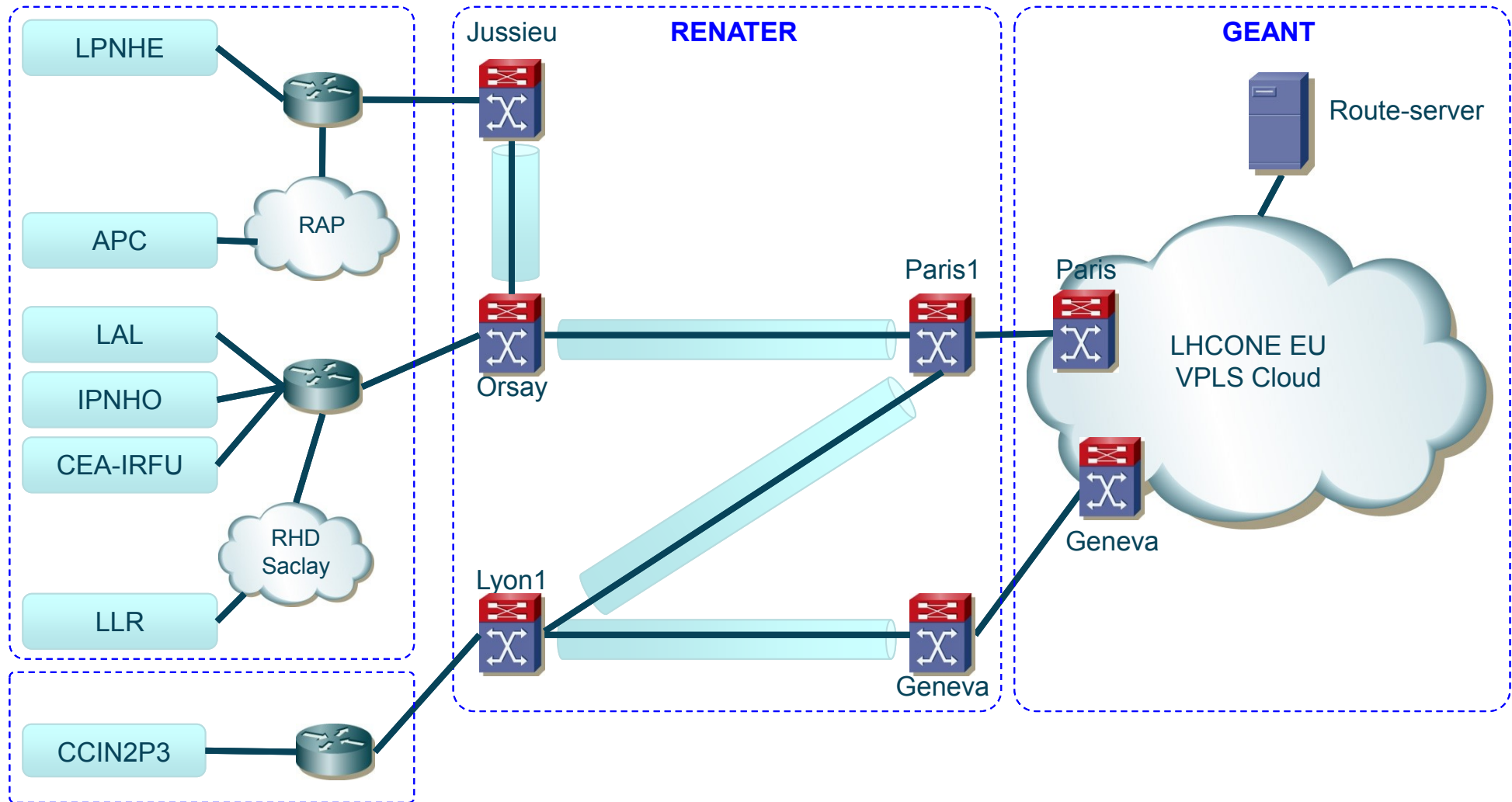- Technical service guidelines agreed with participants



Route Server
192.16.156.64/22

NREN Router
192.16.156.66/22

Route Server
192.16.156.127/22

NREN Router
192.16.156.66/22

# Italian Tier2 prototype

# LHCONE FR Prototype target architecture



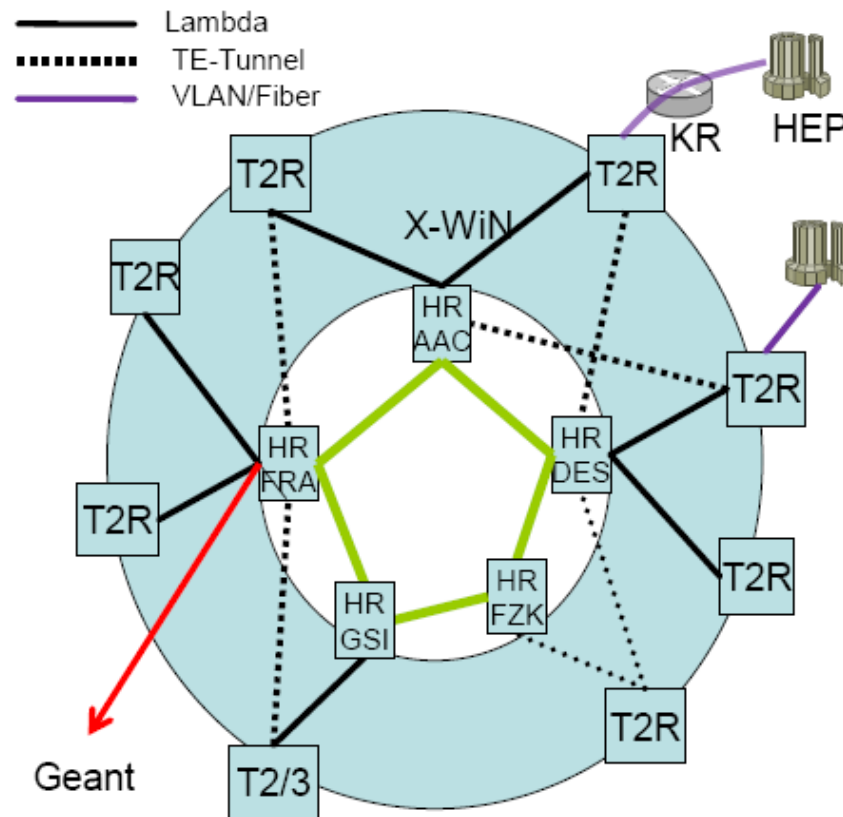**We are also currently investigating if a VRF LITE implementation would be more appropriate**

# X-WiN and HEPPI (schematic)

Lambda
TE-Tunnel
VLAN/Fiber

HR: Heppi Router (P/PE)
T2R: PE Router
**normal X-Win core routers!**

- green: inner core with 10GE
- all traffic in L3VPN
- Traffic flow HEP1<->HEP2 via HR
  - except if connected to same T2R
- additional Loopback interfaces on all routers that are part of HEPPI
  - serve as BGP next-hops in L3VPN
- separate OSPF process to distribute next-hops
- TE-Tunnels: OSPF not possible -> static routing for Loopbacks
- GN access as VLAN on existing 2x10GE channel

KR    HEP

T2R    T2R    X-WiN    HR AAC

T2R    HR FRA    HR DES    T2R

T2R    HR GSI    HR FZK    T2R

Geant    T2/3    T2R

LHCONE tech workshop May 2011    Thomas Schmid, schmid@dfn.de    Seite 7

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# Timescale

- VPLS Implementation
    - Routers configured 10th June-11
    - Tests will be performed till 17th June-11

- Route Server Implementation
    - Route servers deployed 10th June-11
    - Tests will be performed till 17th June-11

- NREN Connections
    - NRENs will be able to connect LHC T2/3s from week starting 20th June-11

- Trans-Atlantic Connectivity
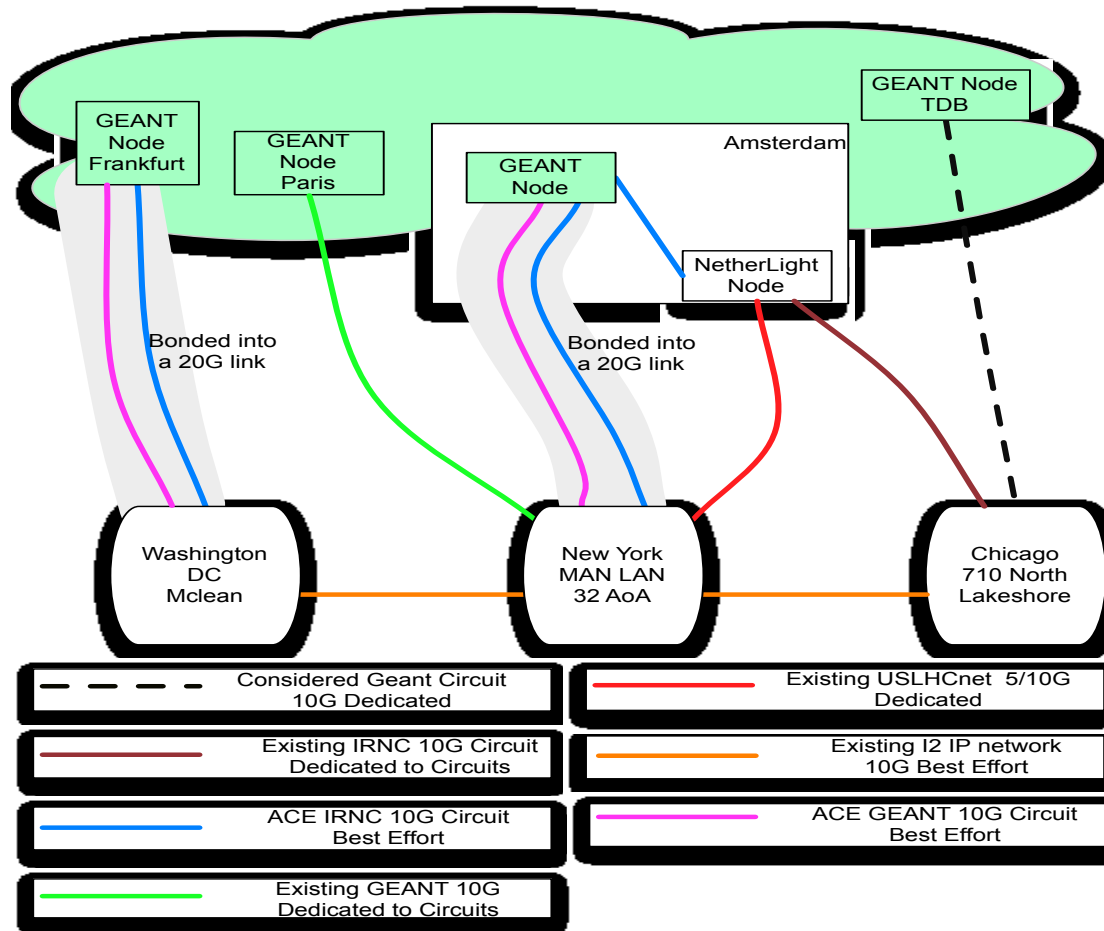    - GEANT ready to connect on 20th June-11
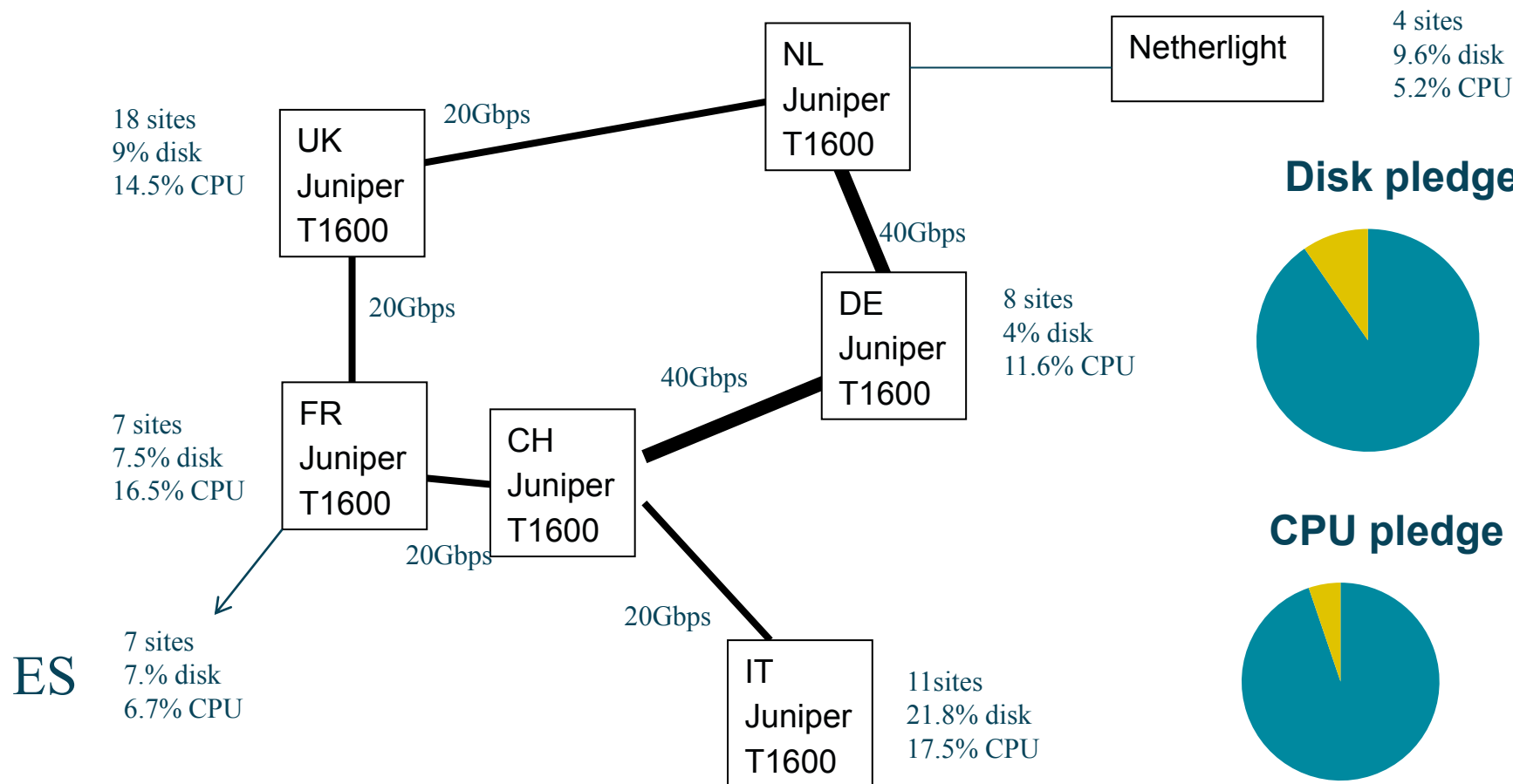
# Conclusions Intra European set-up

- Conforms to LHCONE architecture
- LHCONE "core" in Europe provided by a set of distributed exchange points in GEANT PoPs, interconnected to Netherlight
  - New equipment in 2012, with allocated capacity from 10G up to 100G
  - VPLS on existing Juniper T1600 for prototype. No need for additional capacity (bar possible exceptions)
- NREN aggregator networks

- Costs:
  - Minimal during prototype
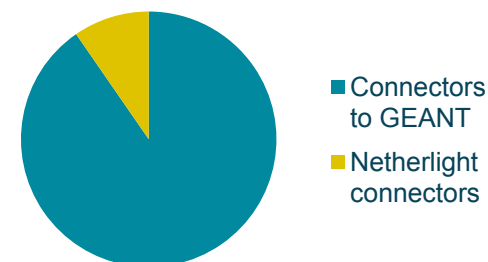- Prototype implementation well under way
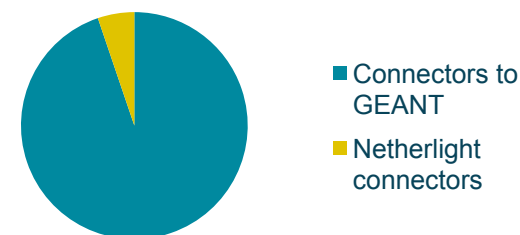
# Transatlantic connectivity - general

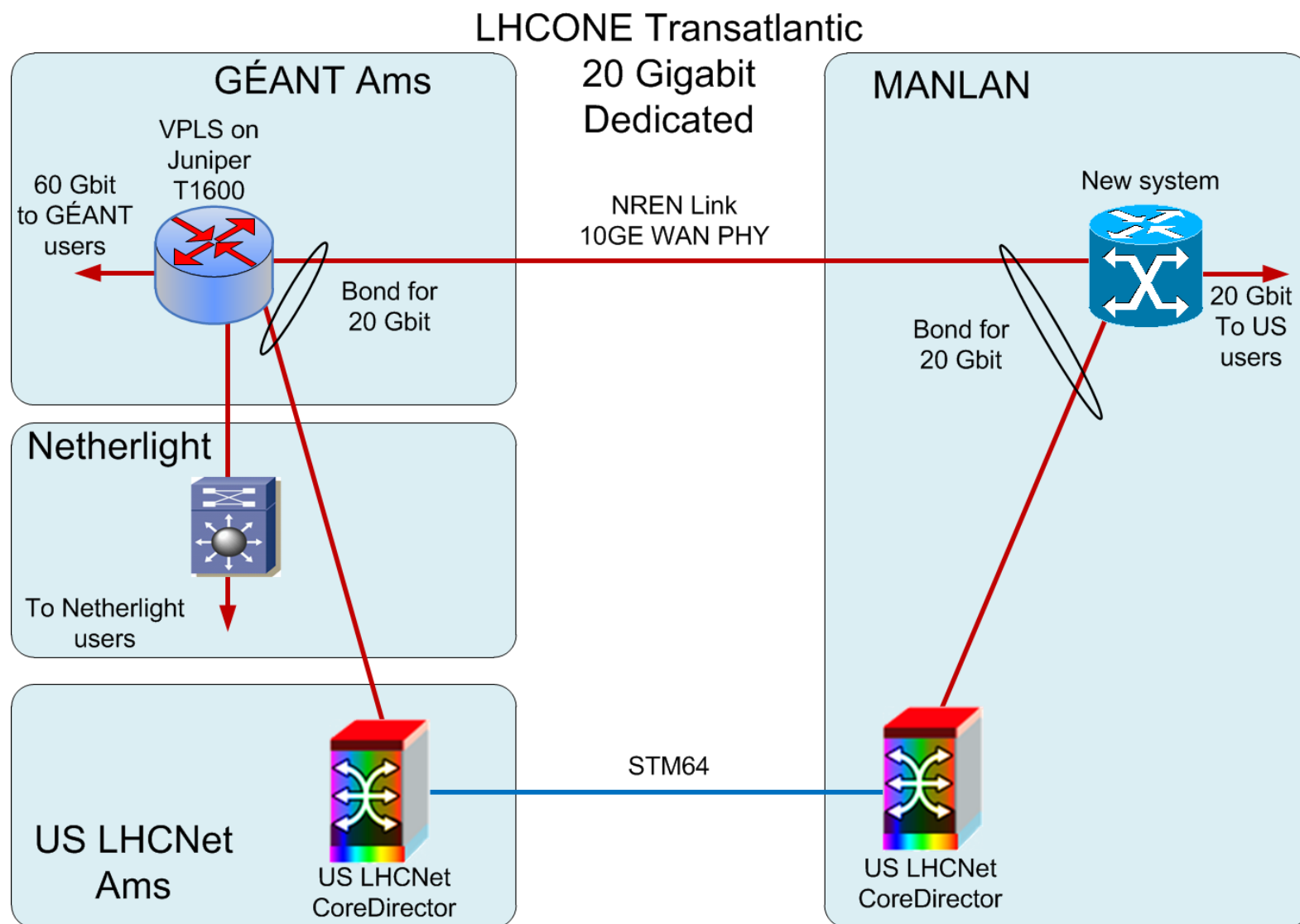# Distribution of European Resources for experiments (from WSLCG)

# Transatlantic – p2mp service



LHCONE Transatlantic
20 Gigabit
Dedicated

**GÉANT Ams**

VPLS on
Juniper
T1600

60 Gbit
to GÉANT
users

Bond for
20 Gbit

NREN Link
10GE WAN PHY

**MANLAN**

New system

Bond for
20 Gbit

20 Gbit
To US
users

**Netherlight**

To Netherlight
users

**US LHCNet
Ams**

US LHCNet
CoreDirector

STM64

US LHCNet
CoreDirector
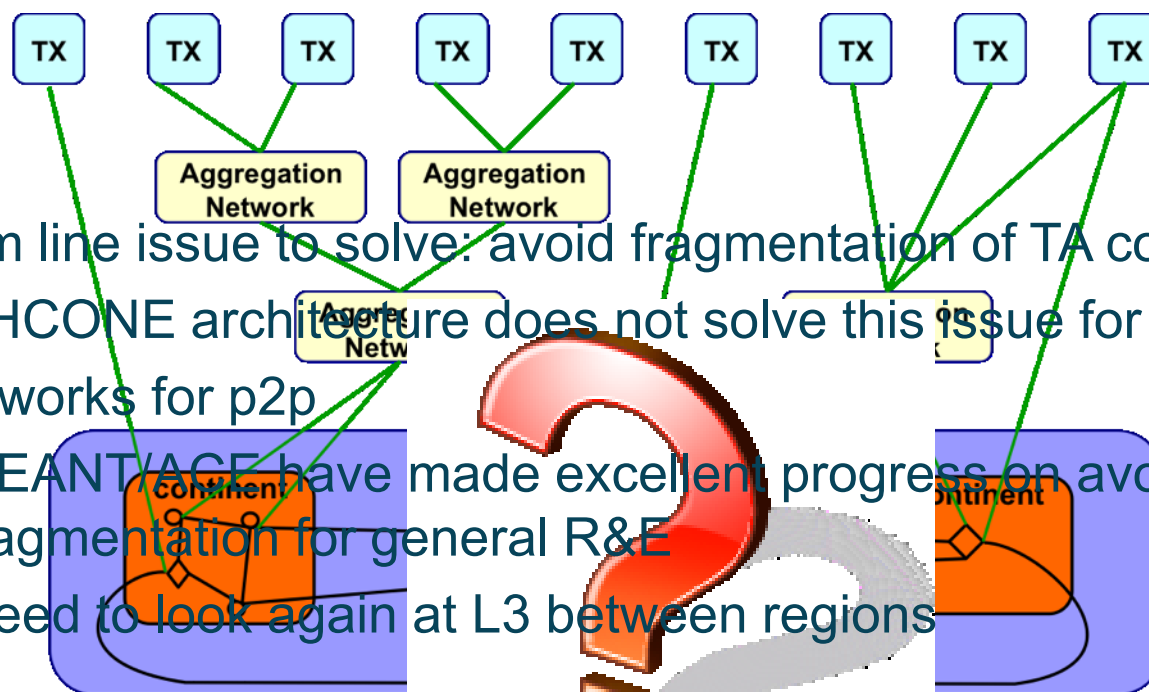
# Prototype lesson N.1: Architectural issues

- L2 architecture does not support multi-continent/region p2mp service well:
  - Loop avoidance
  - Resilience
  - NA – Europe – Asia  or Asia – NA – Europe   Or Europe – Asia – NA ?



- Bottom line issue to solve: avoid fragmentation of TA connectivity
  - LHCONE architecture does not solve this issue for p2mp
  - It works for p2p
  - GEANT/ACE have made excellent progress on avoiding fragmentation for general R&E
  - Need to look again at L3 between regions

# Conclusion

- Progress within Europe/GEANT on prototype implementation

- Initial proposal for T.A setup that meets the connectivity needs of the users (*for the prototype, within its limitations*)
  - Partnership between EU NREN funded connectivity and USLHCNET
  - Based on GEANT PoPs in Europe, US to choose PoPs in US
  - GEANT ready from June 20<sup>th</sup>

- Study lessons learnt from prototype, feed into next architecture iteration
  - Recognition of limitation of LHCONE architecture to support p2mp services
    - *Start prototype with one path between EU-N.A*
  - Review architecture

- Objectives & success criteria of prototype need to be clear