LHCONE L3VPN Status Update

Mian Usman
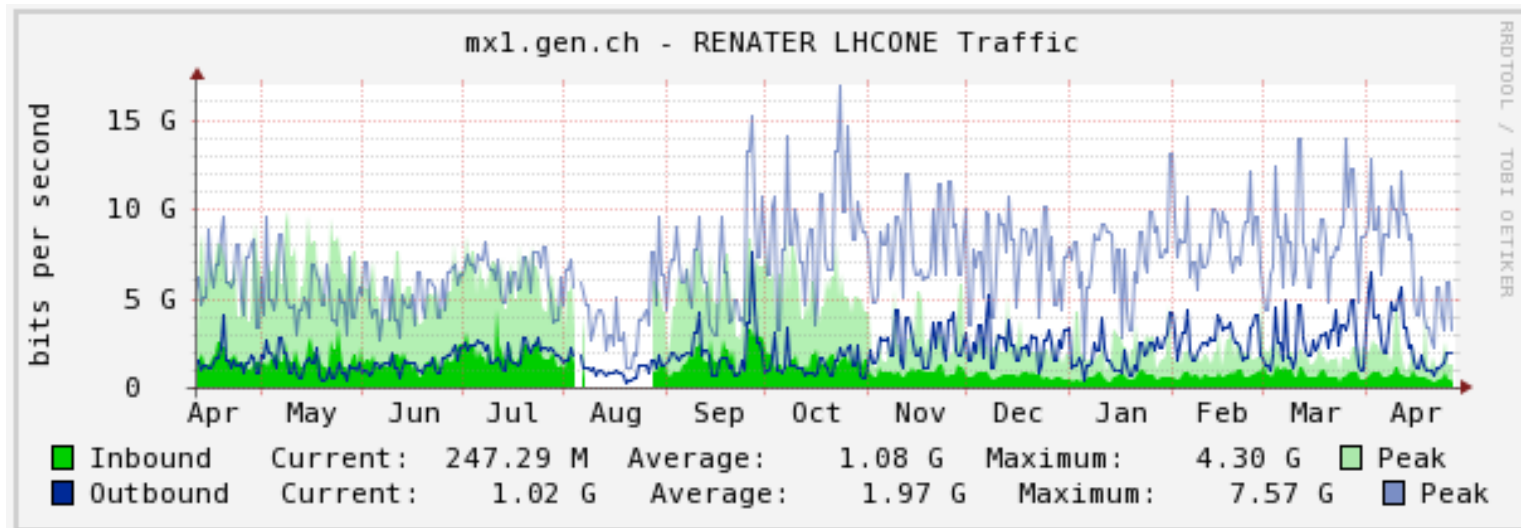
LHCONE Meeting Rome 28th – 29th Aprils 2014

Upgrades and Changes

- NL – T1 now to connected to LHCONE
  - Peering established with GEANT LHCONE VRF in Jan-2014

- Russian T2 now connected to LHCONE
  - Peering established with NORDunet LHCONE VRF

- CNAF (Italian T1), DE-KIT (German T1) and IN2P3 (French T1) now exchanging traffic between them over LHCONE

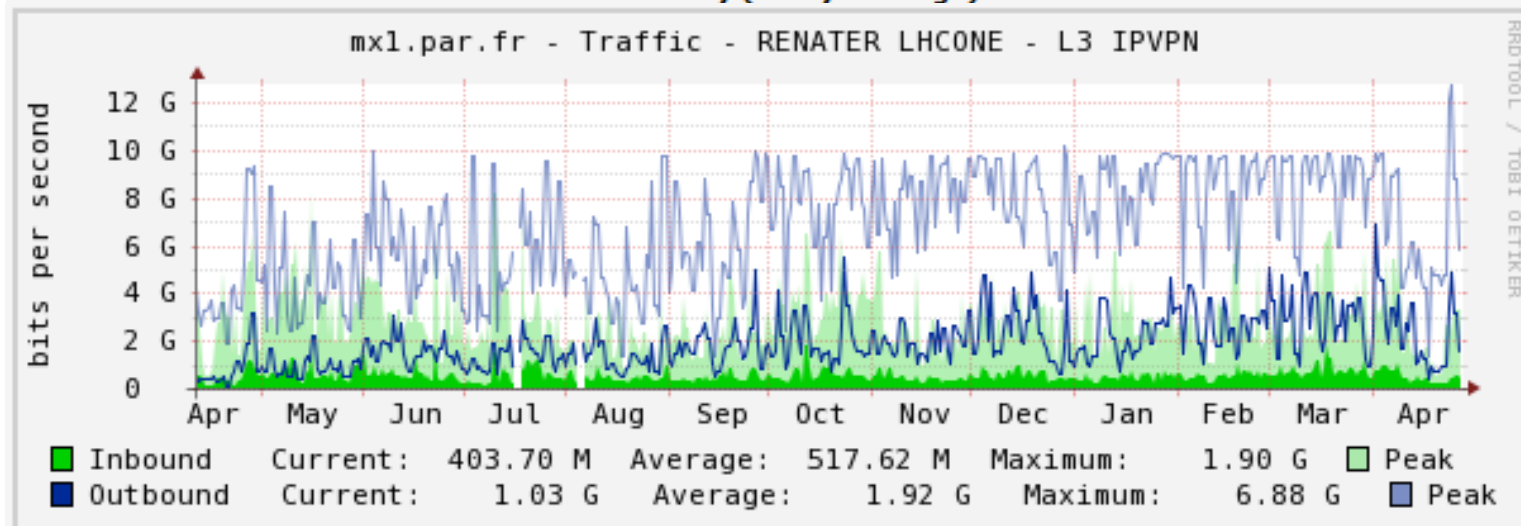- RENATER Link to GEANT LHCONE VRF upgraded in Paris
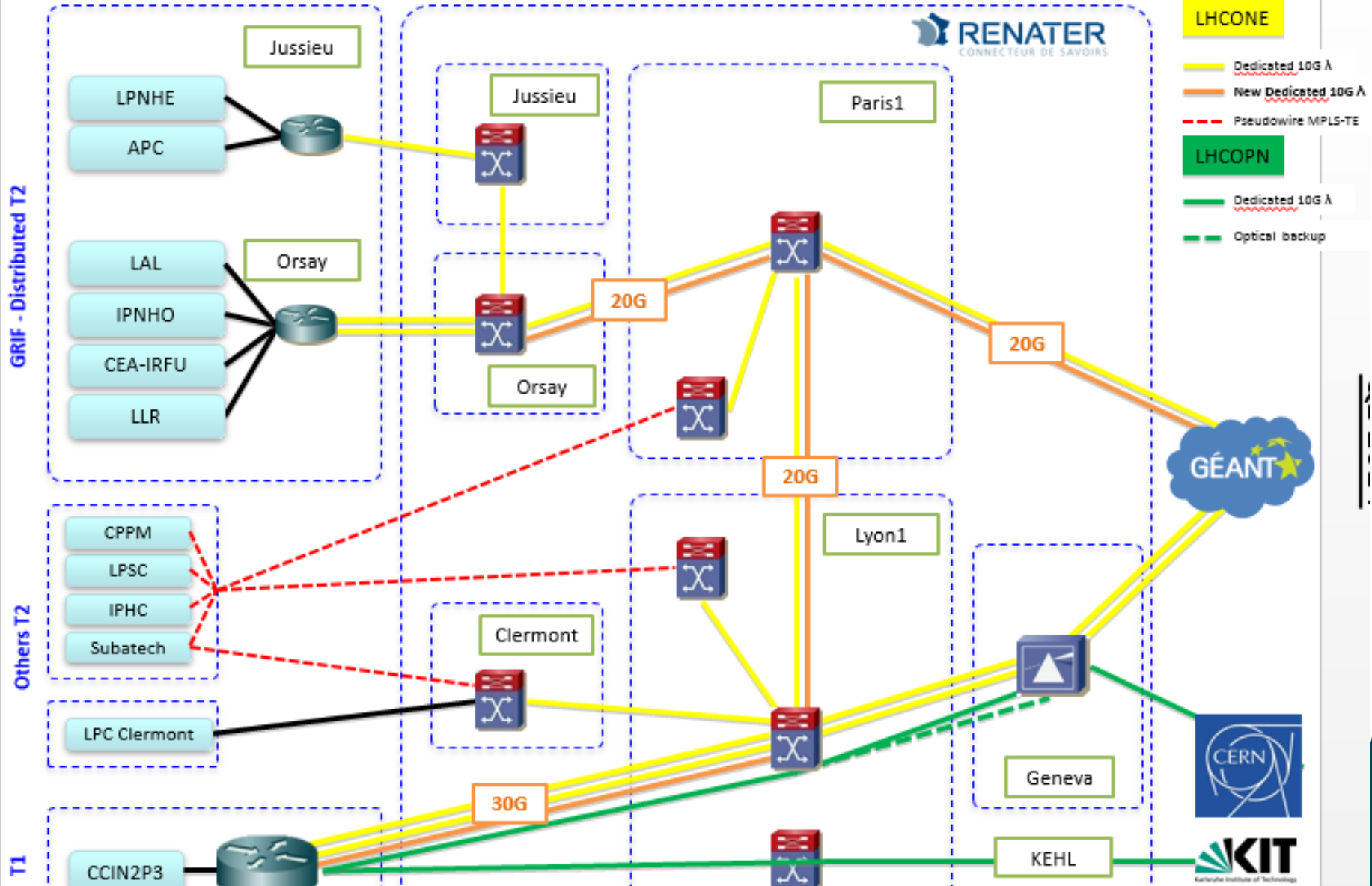
connect • communicate • collaborate

LHCONE in Europe
RENATER (French NREN)

LHCONE in Europe
RENATER (French NREN)

mx1.gen.ch - RENATER LHCONE Traffic

	Current	Average	Maximum	
Inbound	247.29 M	1.08 G	4.30 G	Peak
Outbound	1.02 G	1.97 G	7.57 G	Peak

Yearly (1 Day Average)

mx1.par.fr - Traffic - RENATER LHCONE - L3 IPVPN

	Current	Average	Maximum	
Inbound	403.70 M	517.62 M	1.90 G	Peak
Outbound	1.03 G	1.92 G	6.88 G	Peak

Yearly (1 Day Average)

LHCOPN/LHCONE GARR Q1 2014

Consortium GARR

Site	Connection
INFN-CNAF Bologna (T1)	4x10G (LHCONE+LHCOPN)
INFN-Bari (T2)	10G (LHCONE)
INFN-Catania (T2)	10G (LHCONE)
INFN-Frascati (T2)	10G (LHCONE)
INFN-Legnaro (T2)	2x10G (LHCONE+GP)
INFN-Napoli (T2)	10G (LHCONE)
INFN-Milano (T2)	10G (LHCONE)
INFN-Pisa (T2)	2x10G (LHCONE+GP)
INFN-Roma1 (T2)	10G (LHCONE)
INFN-Torino (T2)	10G

LHCONE links
LHCOPN links

GÉANT
LHCONE
GÉANT
CERN
KIT — Karlsruhe Institute of Technology

100G LHCONE backup
100G LHCONE Primary
2x10G
10G

MI2
MI1
6x10G
6x10G
12x10G
RM2
BO1
6x10G

General purpose
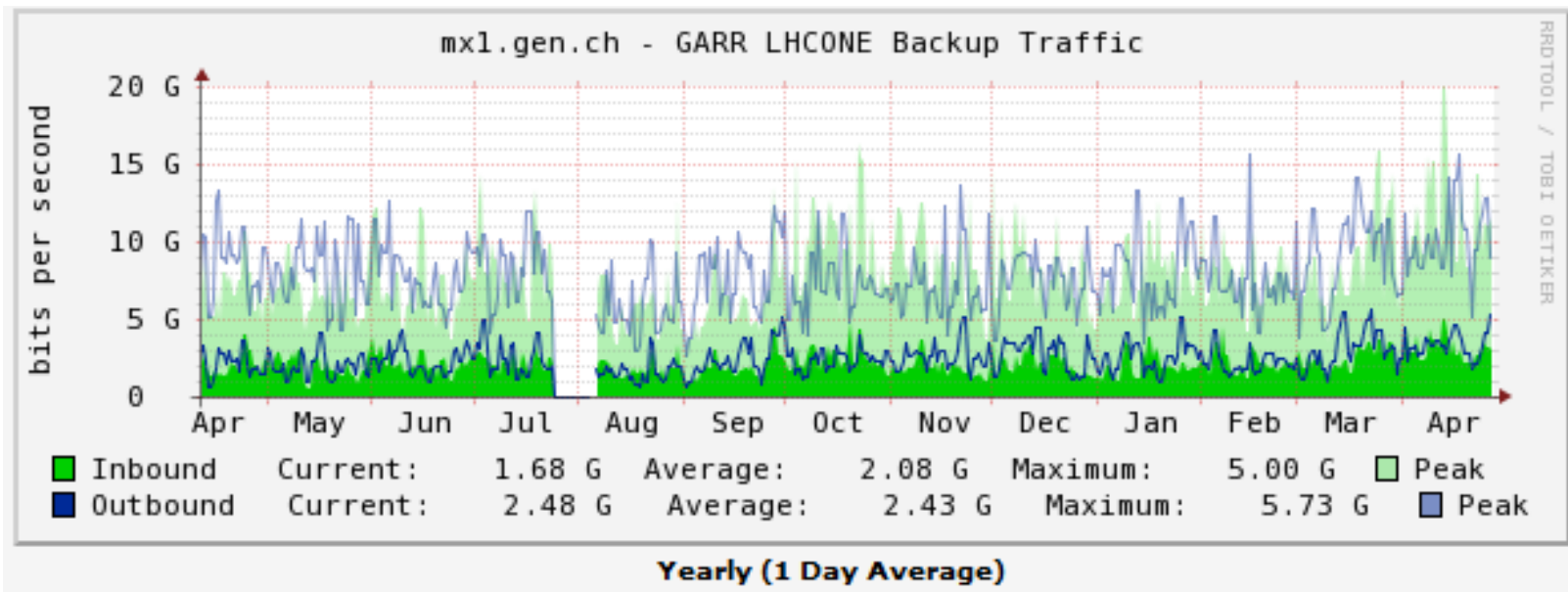10G
4x10G
LHCOPN+LHCONE

INFN CNAF
INFN CNAF T1
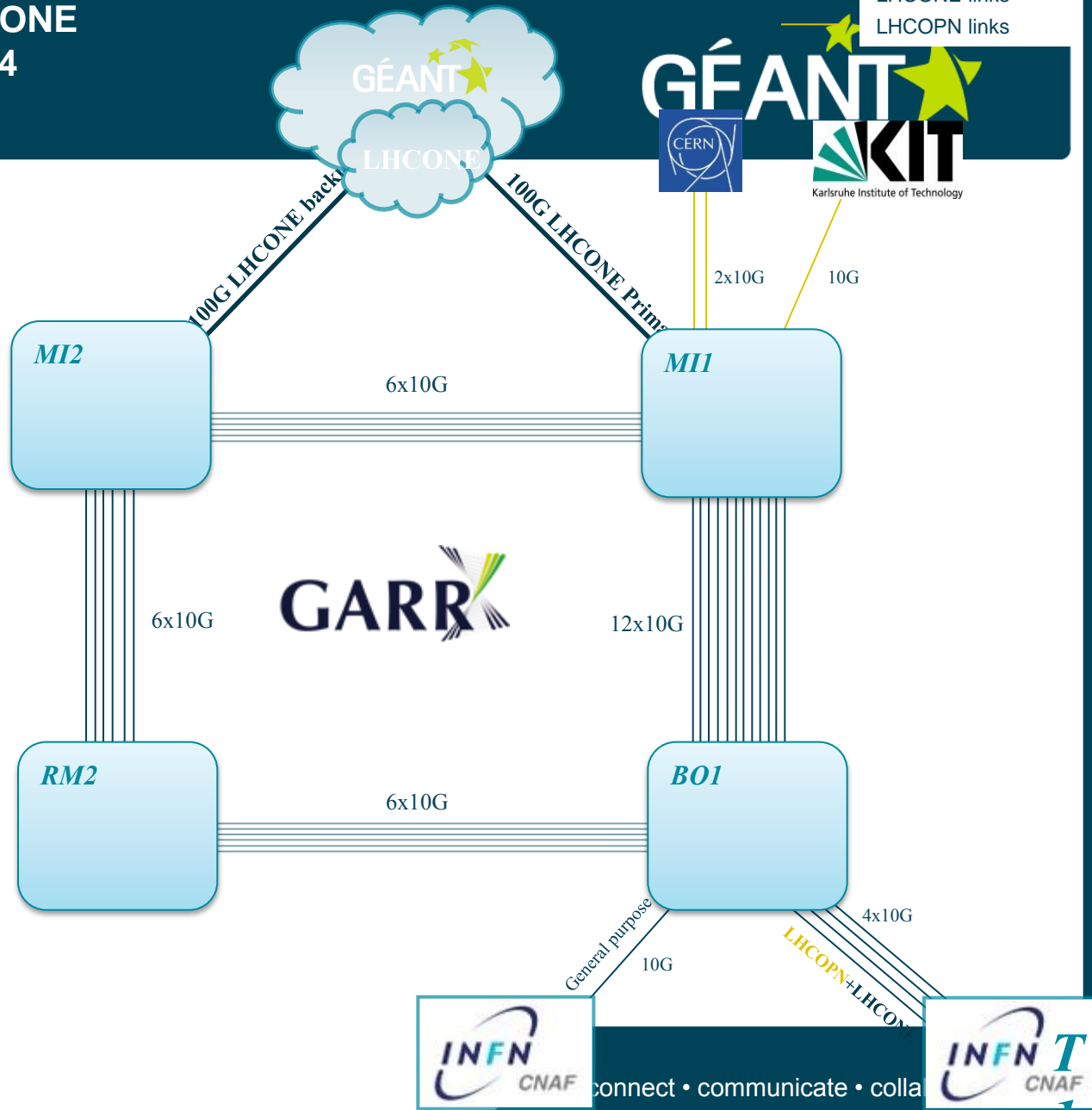
connect • communicate • colla

LHCONE in Europe
GARR (Italian NREN)

- Link to GEANT 100G primary and 100G backup (Shared)

- CNAF T1 connected at 40G (4x10G)

- The T2s might be upgraded to 2x10G in 2014

mxl.gen.ch - GARR LHCONE Backup Traffic

		Current:	Average:	Maximum:	Peak
■ Inbound		1.68 G	2.08 G	5.00 G	☐ Peak
■ Outbound		2.48 G	2.43 G	5.73 G	☐ Peak

Yearly (1 Day Average)

LHCONE in Europe
DFN (German NREN)

- Connects KIT, DESY, GSI, RWTH Aachen and Frankfurt

- Peer with GEANT VRF in Amsterdam and Frankfurt at 100GE(Shared)

- Recent changes
  - Upgrade of DE-KIT link in Frankfurt and Erlangen
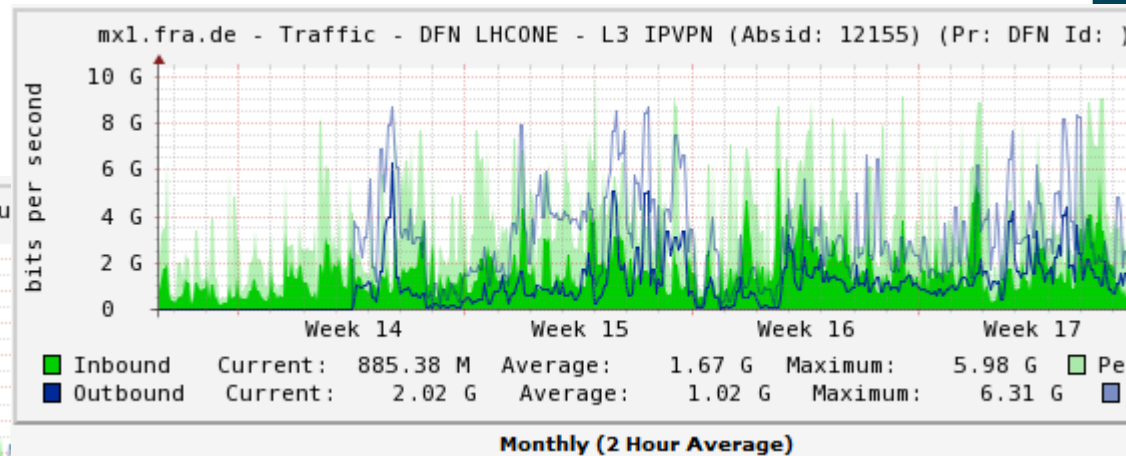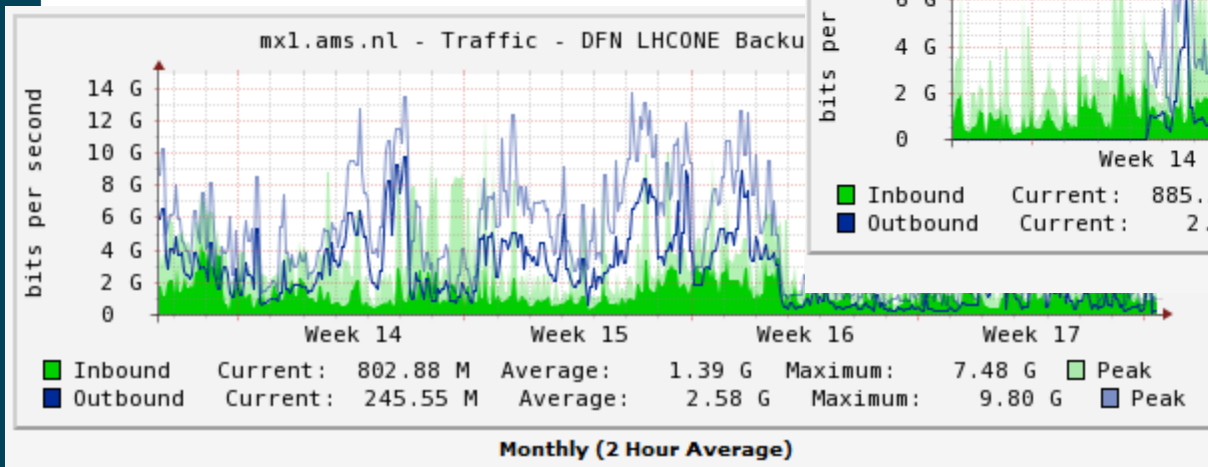
LHCONE in Europe
DFN (German NREN)
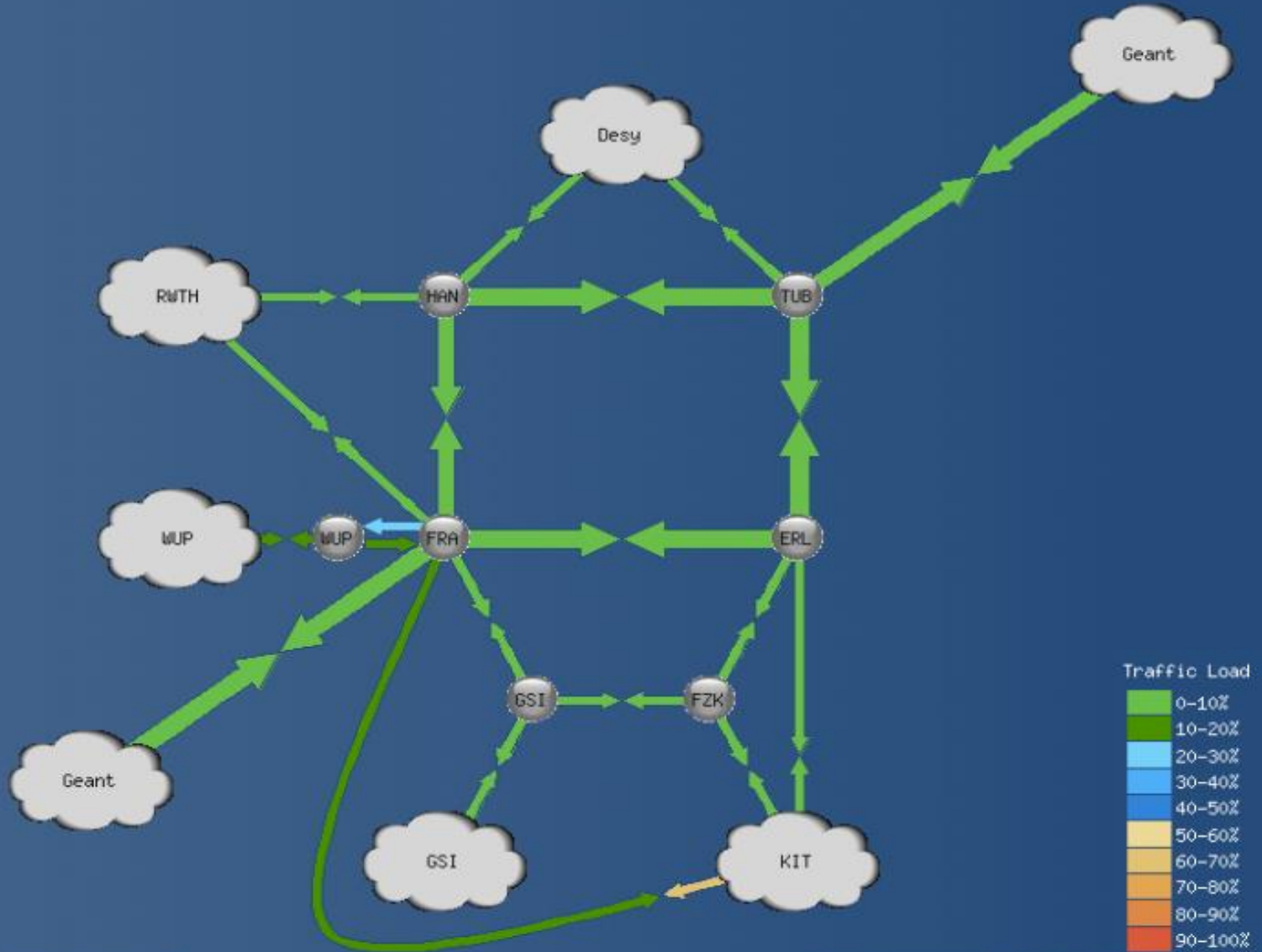
LHCONE in Europe
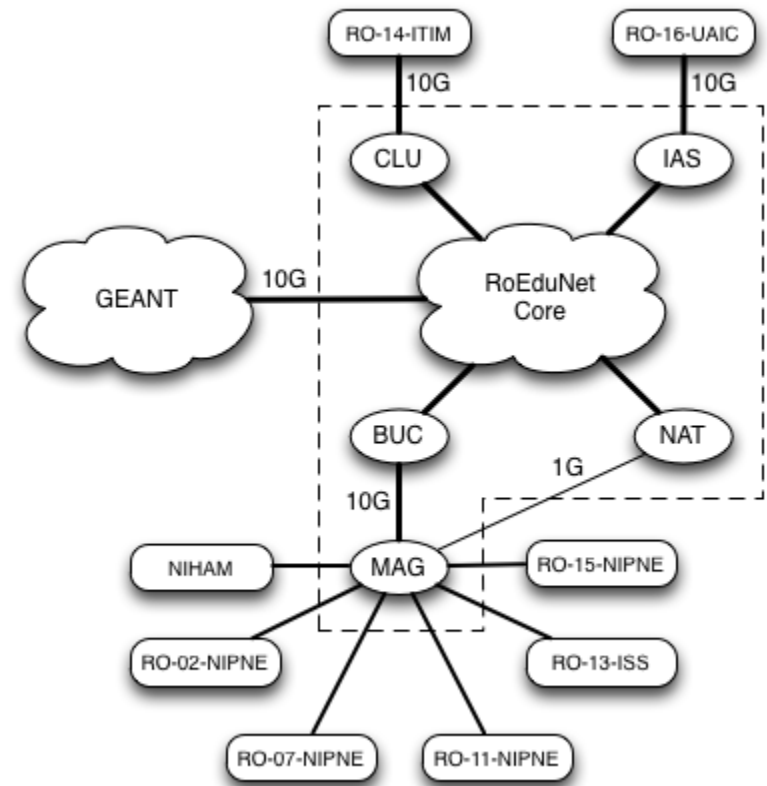# RoEduNet (Romainian NREN)

- Configured as separate VRF on RoEduNet

- All Seven T2s in Romania connected:
    - 1. RO-02-NIPNE
    - 2. RO-07-NIPNE
    - 3. RO-11-NIPNE
    - 4. RO-13-ISS
    - 5. RO-15-NIPNE
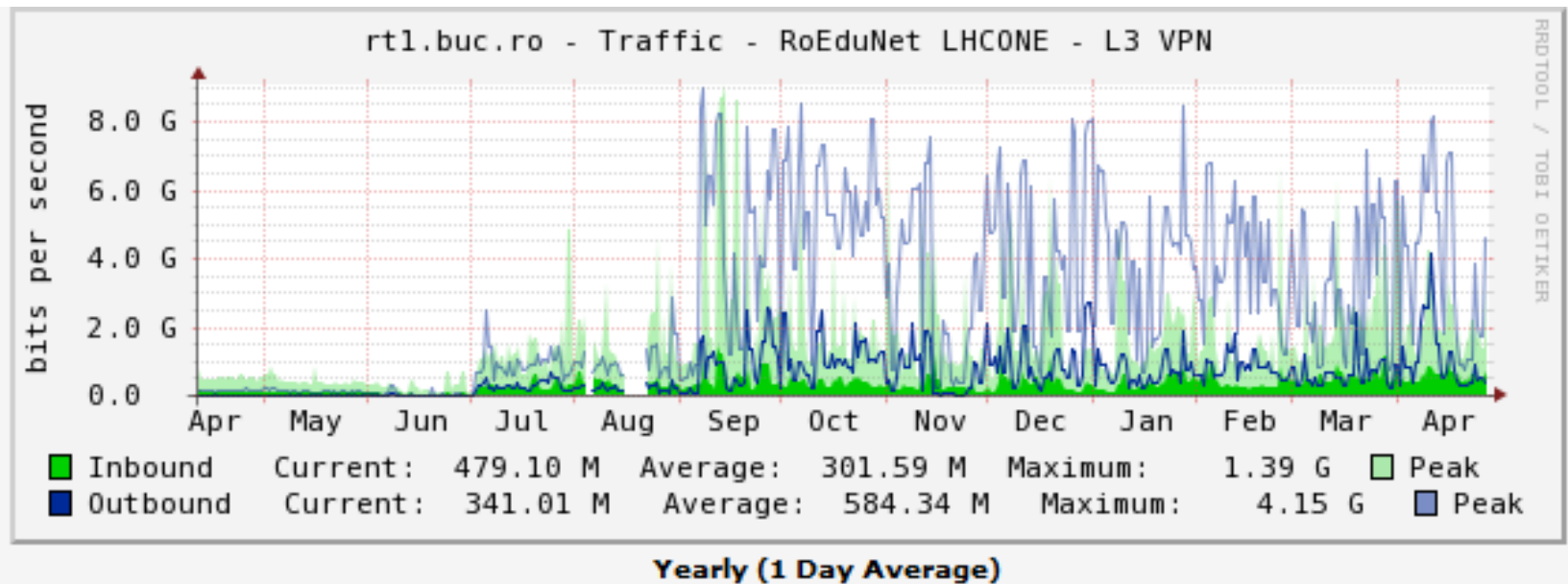   - 6. RO-14-ITIM
    - 7. RO-16-UAIC

- Peers with GEANT LHCONE VRF

LHCONE in Europe
RoEduNet (Romainian NREN)

- Average Traffic to GEANT ~2Gbps
- Sustained peaks of over 6 Gbps

rt1.buc.ro - Traffic - RoEduNet LHCONE - L3 VPN

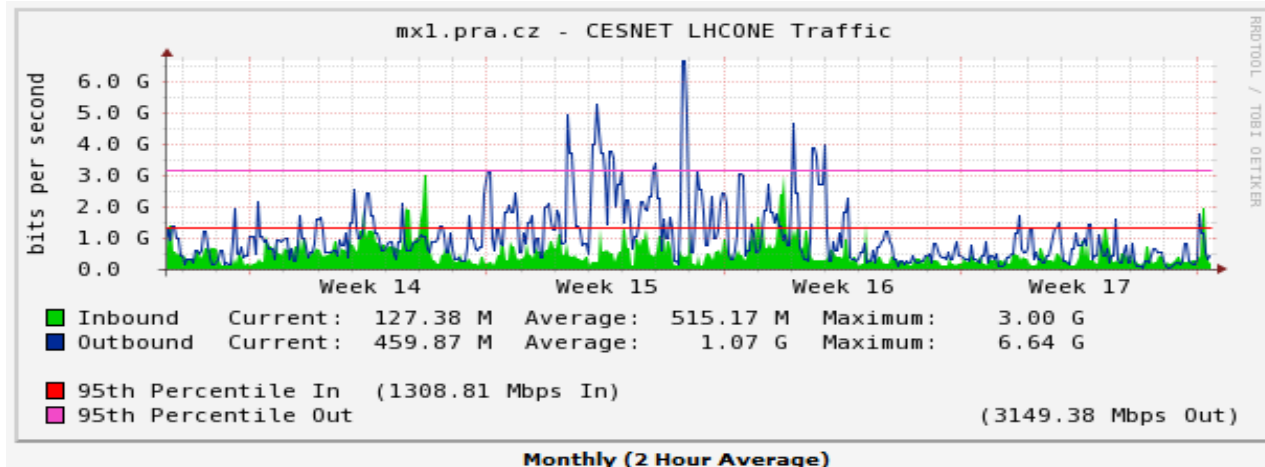|		Current	Average	Maximum	
■	Inbound	479.10 M	301.59 M	1.39 G	▢ Peak
■	Outbound	341.01 M	584.34 M	4.15 G	▢ Peak

Yearly (1 Day Average)
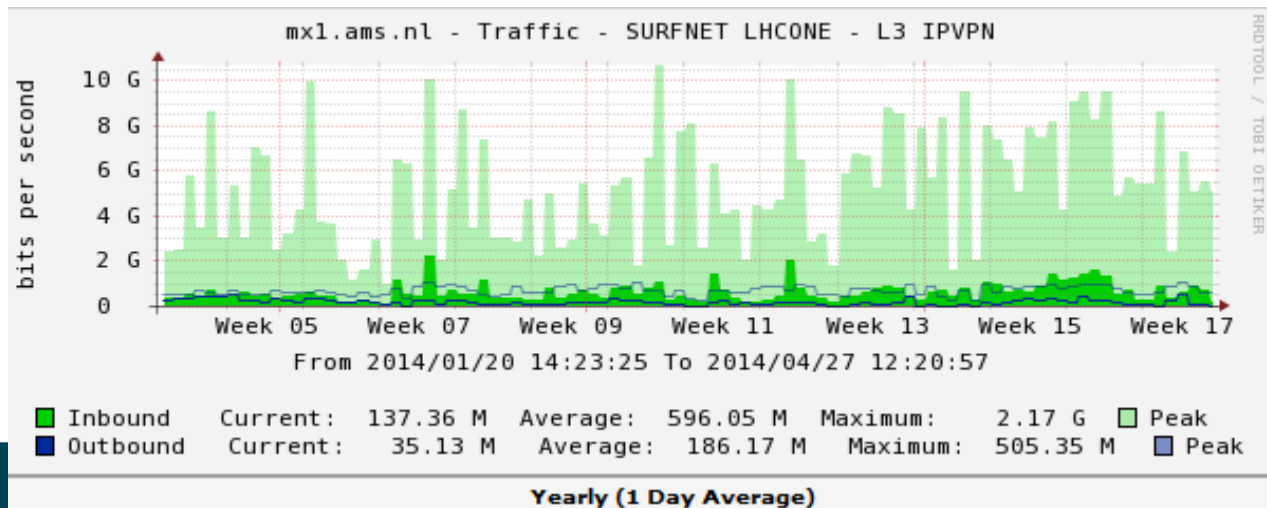
LHCONE in Europe
CESNet (Czech Republic), NL-T1

- Link between CESNet and GEANT 10G dedicated:

- NL-T1 now connected to LHCONE via SURFNet in Amsterdam:

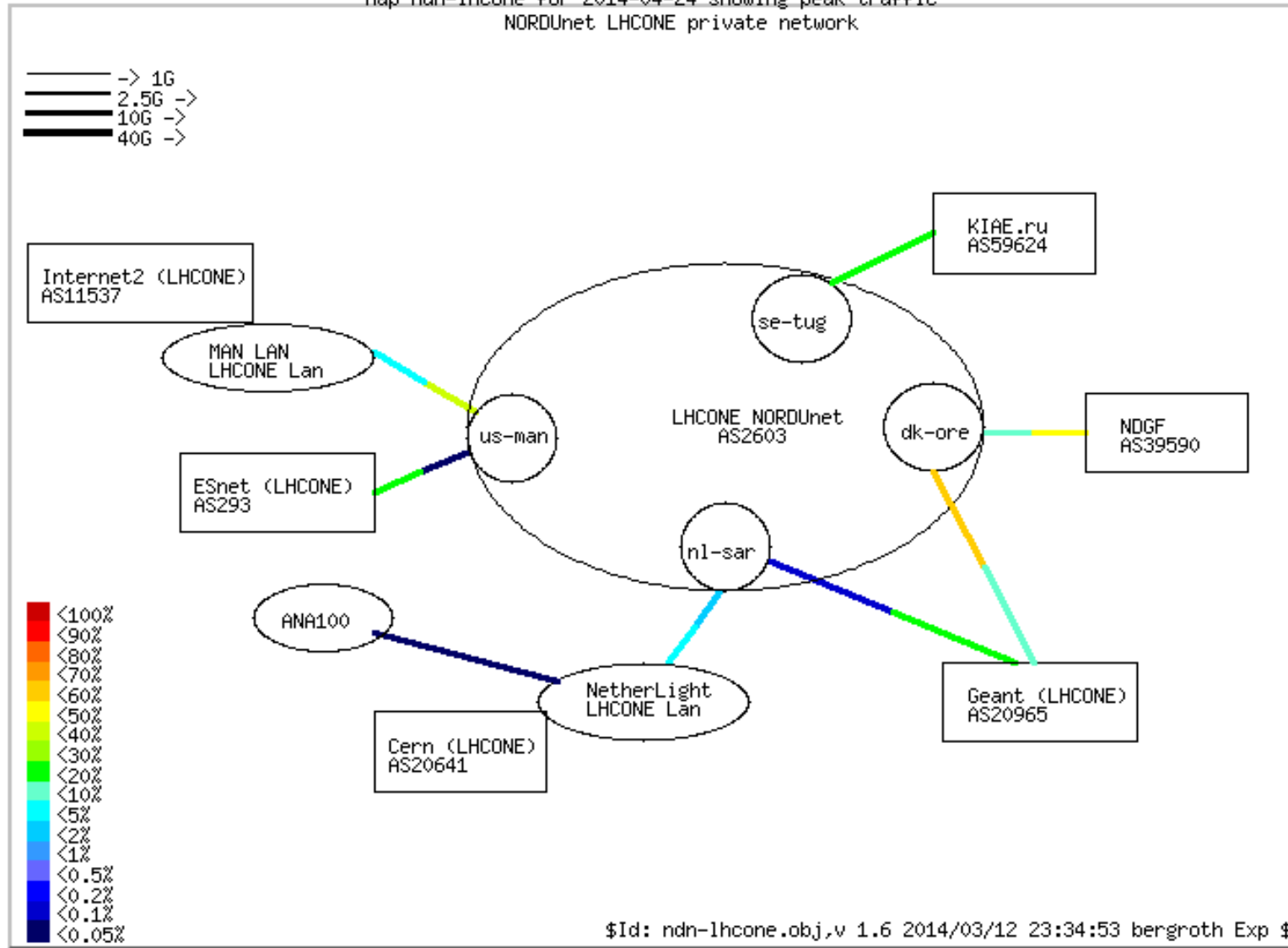# LHCONE in Europe
ARNES (Slovenian NREN)

- Configured as separate VRF on ARNES network and peers with GEANT and GARR (Italian) VRF

- Connects Slovenian T2

- Traffic to/from GEANT VRF average ~2.5Gbps and peaks at ~7Gbps

Map ndn-lhcone for 2014-04-24 showing peak traffic
NORDUnet LHCONE private network
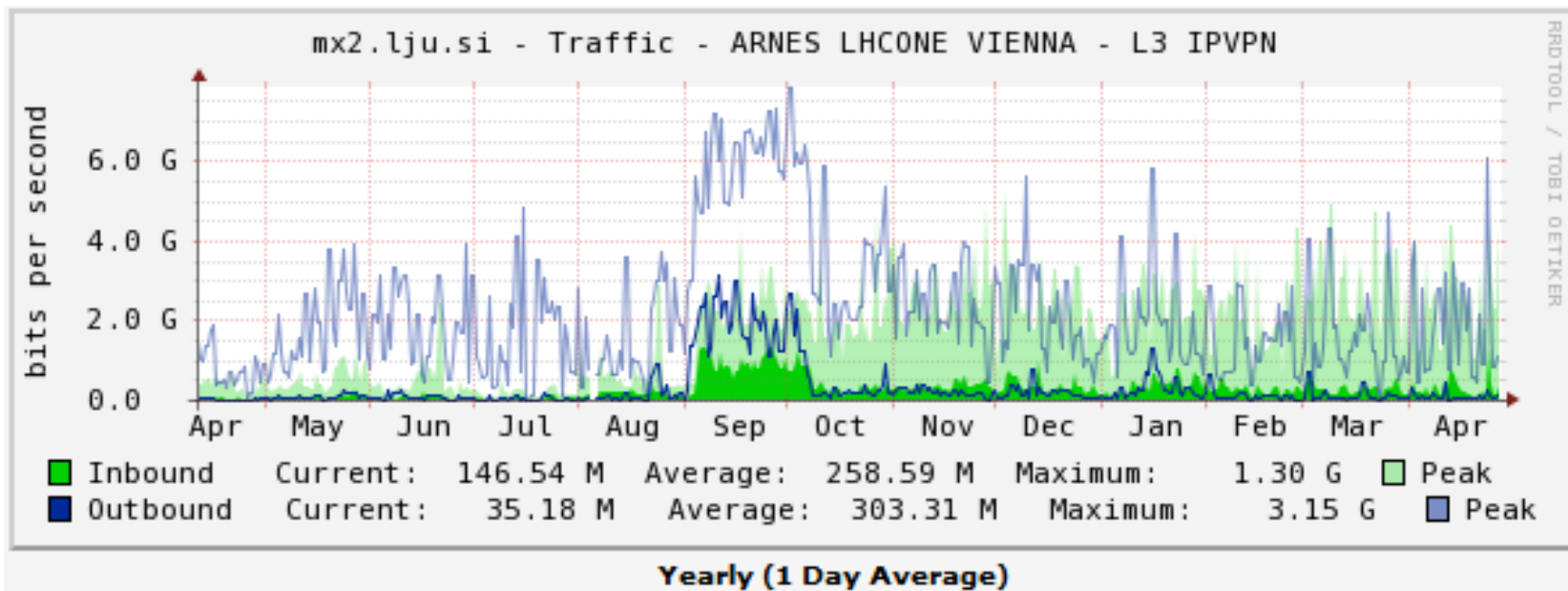
LHCONE in Europe
NORDUNet

- Configured as VRF on NORDUnet backbone network
  - Connects Nordic T1 NDGF and Russian T2

- NORDUnet VRF peers with GEANT, CERNLight, ESNet and Internet2 VRF

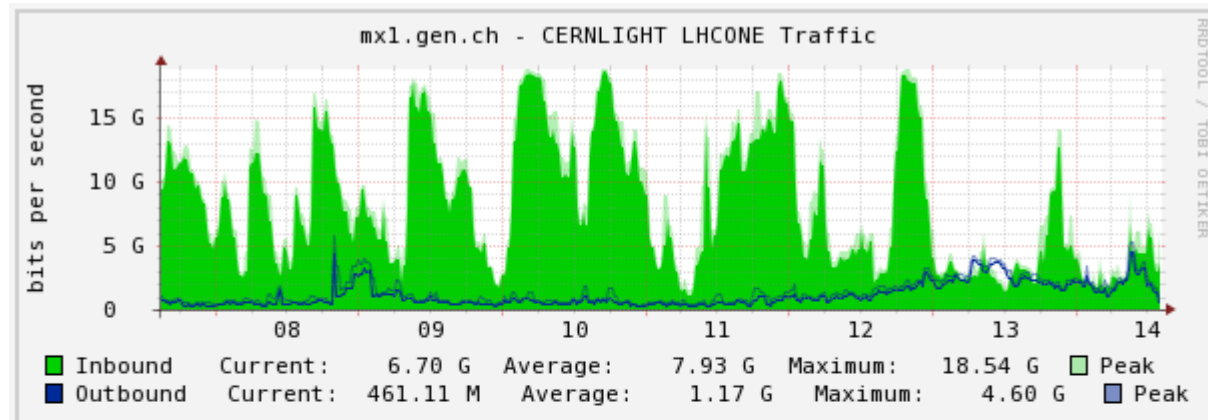- NORDUnet present at MANLAN and NetherLight
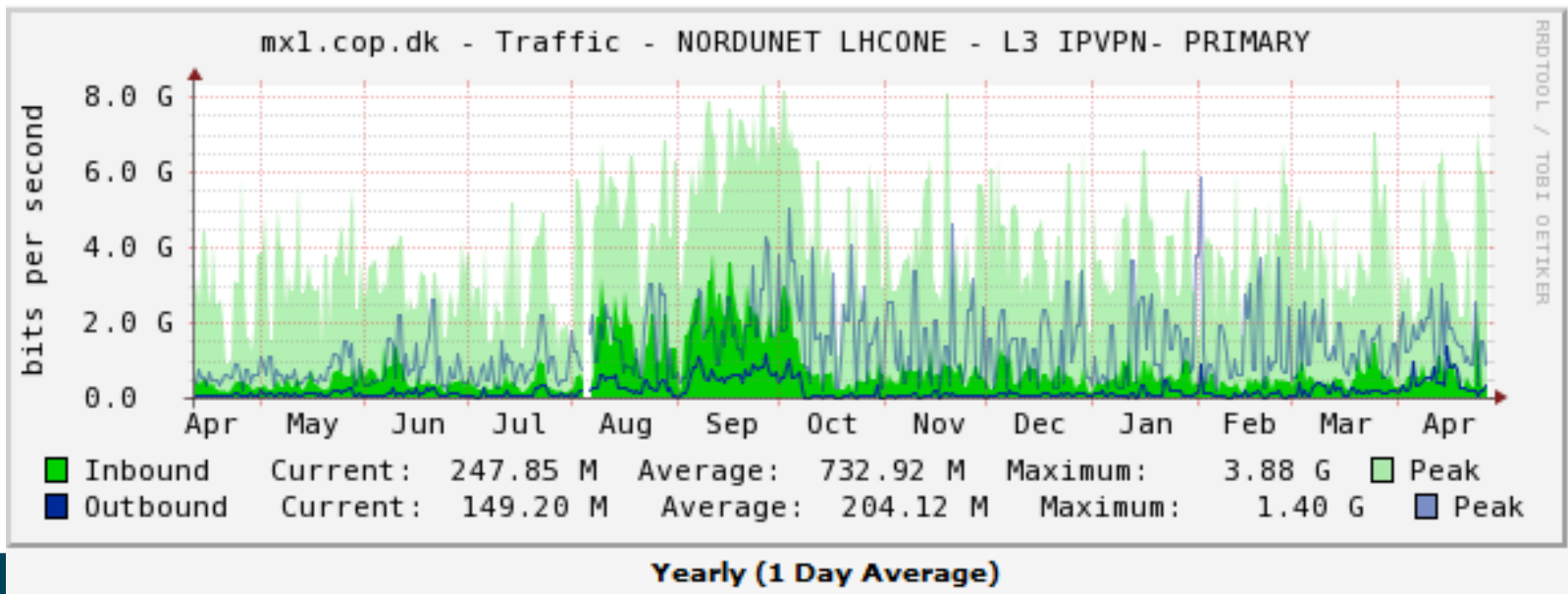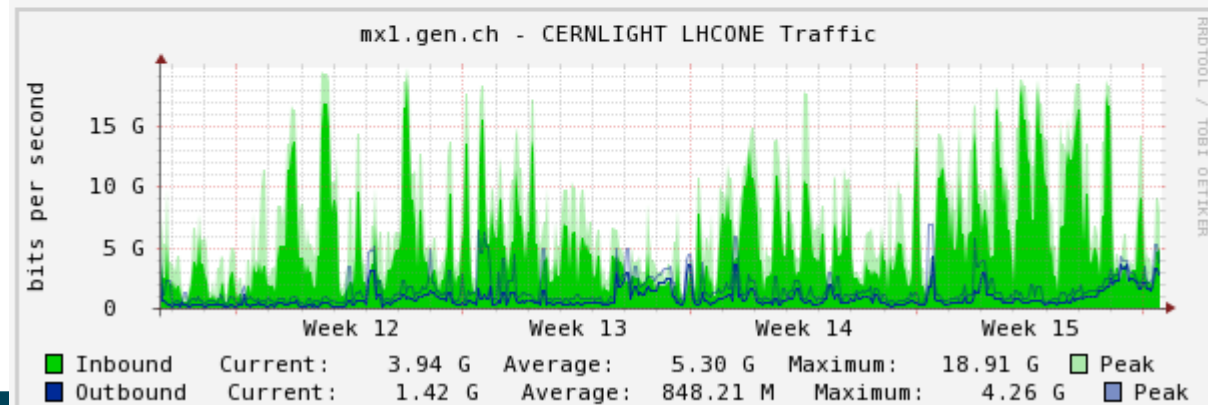
LHCONE in Europe
CERNLight

GÉANT

- Configured as L3VPN VRF on CERN Brocade MLXe

- CERNLight VRF peers with GEANT, NORDUNet, ESNet and Internet2 VRF

- Connects 2 Sites:
  - CERN T1
  - TIFR (Indian T2)

- Upgrade required

mx1.gen.ch - CERNLIGHT LHCONE Traffic

■ Inbound	Current: 6.70 G	Average: 7.93 G	Maximum: 18.54 G	□ Peak
■ Outbound	Current: 461.11 M	Average: 1.17 G	Maximum: 4.60 G	■ Peak

Weekly (30 Minute Average)

mx1.gen.ch - CERNLIGHT LHCONE Traffic

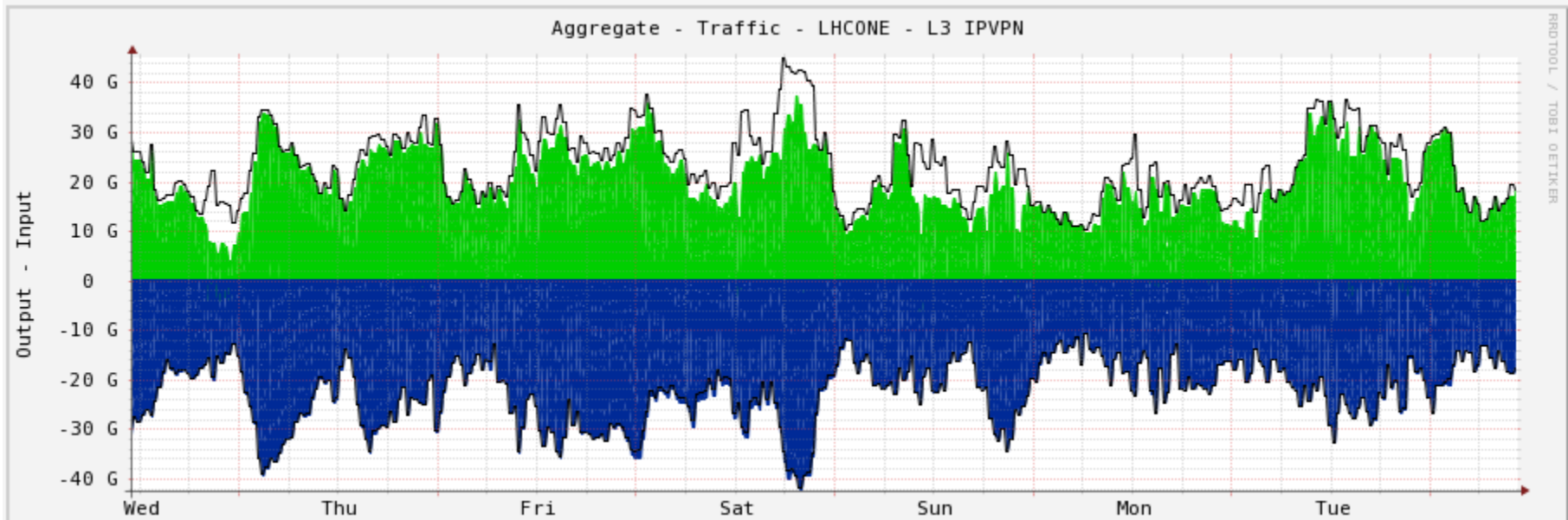|				
■ Inbound	Current: 3.94 G	Average: 5.30 G	Maximum: 18.91 G	□ Peak
■ Outbound	Current: 1.42 G	Average: 848.21 M	Maximum: 4.26 G	■ Peak

Monthly (2 Hour Average)

LHCONE in Europe GEANT

LHCONE in Europe GEANT

- Aggregate LHCONE traffic from all the NRENs and Peers
  - Average traffic ~25Gbps
  - Sustained Peaks ~35Gbps
  - Trans-Atlantic Traffic ~ 15Gbps (Peak)

Aggregate - Traffic - LHCONE - L3 IPVPN

LHCONE in Europe Summary

- LHCONE IP Service in Europe is deployed in:

  - ARNES (Slovenia)
  - CERNLight (Switzerland)
  - CESnet (Czech Republic)
  - DFN (Germany)
  - GARR (Italy)
  - GEANT
  - NORDUnet
  - RENATER (France)
  - RoEduNet (Romania)
  - SURFnet (Netherlands)

- RENs in these countries connect:

  - Six Tier 1s in Europe to LHCONE
  - 30 Tier 2s in Europe to LHCONE
  - Indian T2
  - Russian T2

LHCONE in North America CANARIE

- Configured as L3VPN VRF and following sites connected:
  - T2s - Universities (5) - McGill, UofT, UofA, SFU, UVIC
  - T1 - Triumf - Canada's National Laboratory for Particle and Nuclear Physics

- CANARIE LHCONE VRF peers with ESNet, GEANT and Internet2 LHCONE VRF

- CANARIE is present at StarLight, MANLAN and Pacific Wave

- Peak traffic from T1 is around 10Gbps most other sites have average 3-6Gbps traffic

- Traffic graphs available at
http://weathermap.canarie.ca/lhcone/index.html

LHCONE in North America ESNet

- Configured as L3VPN VRF and connects following sites:
  - BNL (Atlas T1) FNAL (CMS T1) SLAC (ATLAS T2)
  - KAIE RU, Kurchatov Institute (Limited Connectivity)

- ESNet LHCONE VRF peers with Internet2, GEANT, NORDUNET, CERNLight and CANARIE LHCONE VRF

- ESNET is present at StarLight, MANLAN, WIX and PNWG

- Aggregate peak traffic in ESNET LHCONE VRF ~10Gbps

LHCONE in North America
Internet2

- Internet2 LHCONE VRF peers with ESNet, GEANT, NORDUNET, CERNLight and CANARIE LHCONE VRF

- Internet2 is present at StarLight, MANLAN, WIX and several other exchange points

- Internet2 connects following sites:
  - University of Illinois
  - University of Nebraska
  - MIT
  - University of Michigan
  - MERIT
  - Indiana University
  - University of Chicago
  - Vanderbilt

LHCONE in North America Summary

- Three Tier 1s in North America Connected to LHCONE
  - *BNL (via ESnet)*
  - *FNAL (via ESnet)*
  - *TRIUMF (via CANARIE)*

- 13 Tier 2s in North America Connected to LHCONE

  - *SLAC (via ESnet)*
  - *McGill (via CANARIE)*
  - *UofT (via CANARIE)*
  - *UofA (via CANARIE)*
  - *SFU (via CANARIE)*
  - *UVIC (via CANARIE)*

  - *University of Illinois*
  - *University of Nebraska*
  - *MIT*
  - *University of Michigan*
  - *Indiana University*
  - *University of Chicago*
  - *Vanderbilt*

# LHCONE in Asia
Taiwan and Japan

- ASGC connected to NetherLight and StarLight and peers with GEANT LHCONE VRF in Amsterdam

- Connects following sites:
  - ASGC-T1+T2: 117.103.96.0/20, 202.169.168.0/22, 202.140.160.0/19
  - ASGC-2: 140.109.102.0/24
  - TWAREN (Tiawan)
  - NCU-T2: 140.115.32.0/24
  - NTU-T2: 140.112.101.0/24, 140.112.102.0/24,140.112.104.0/24
  - Kyungpook National University Daegu, Korea

- SINET (Japanese NREN) peers with GEANT at WIX and MANLAN
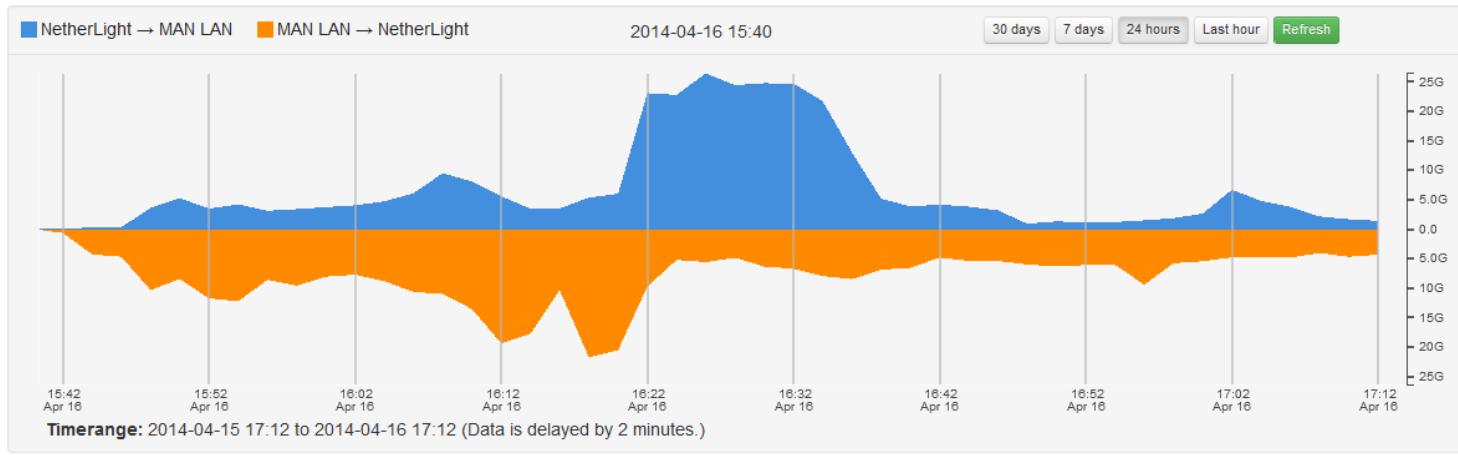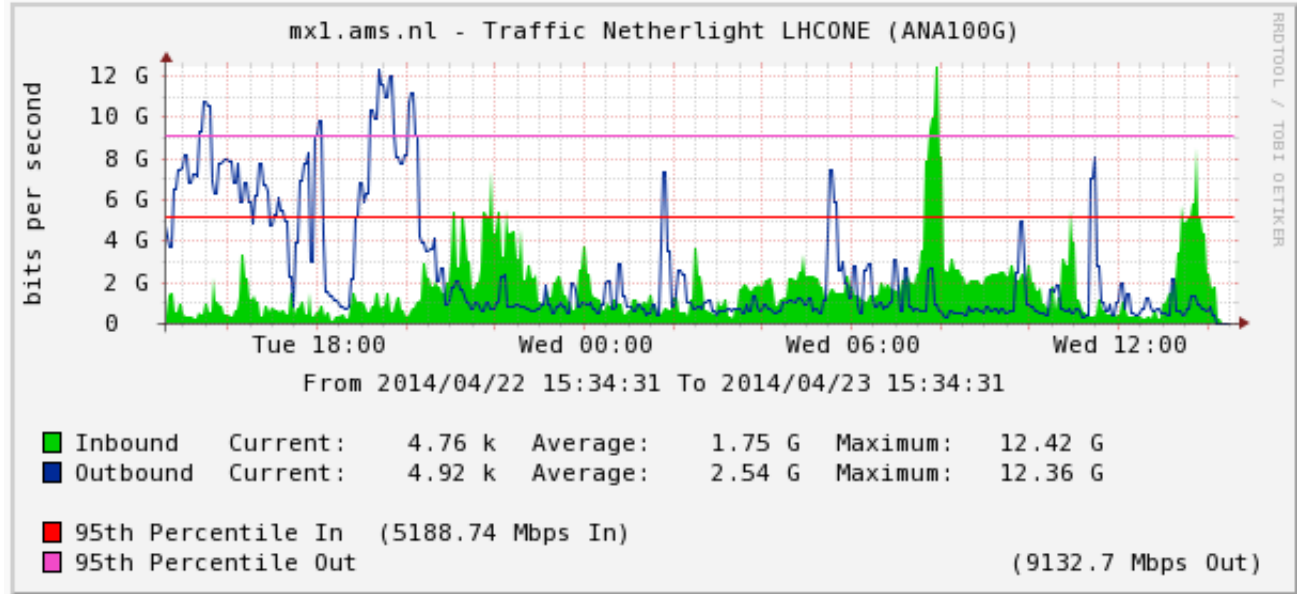- We are in discussion with TEIN about setting up LHCONE VRF in TEIN Network

SINET4 LHC Traffic using L3VPN(LHCone) -1ˢᵗ step(now testing)
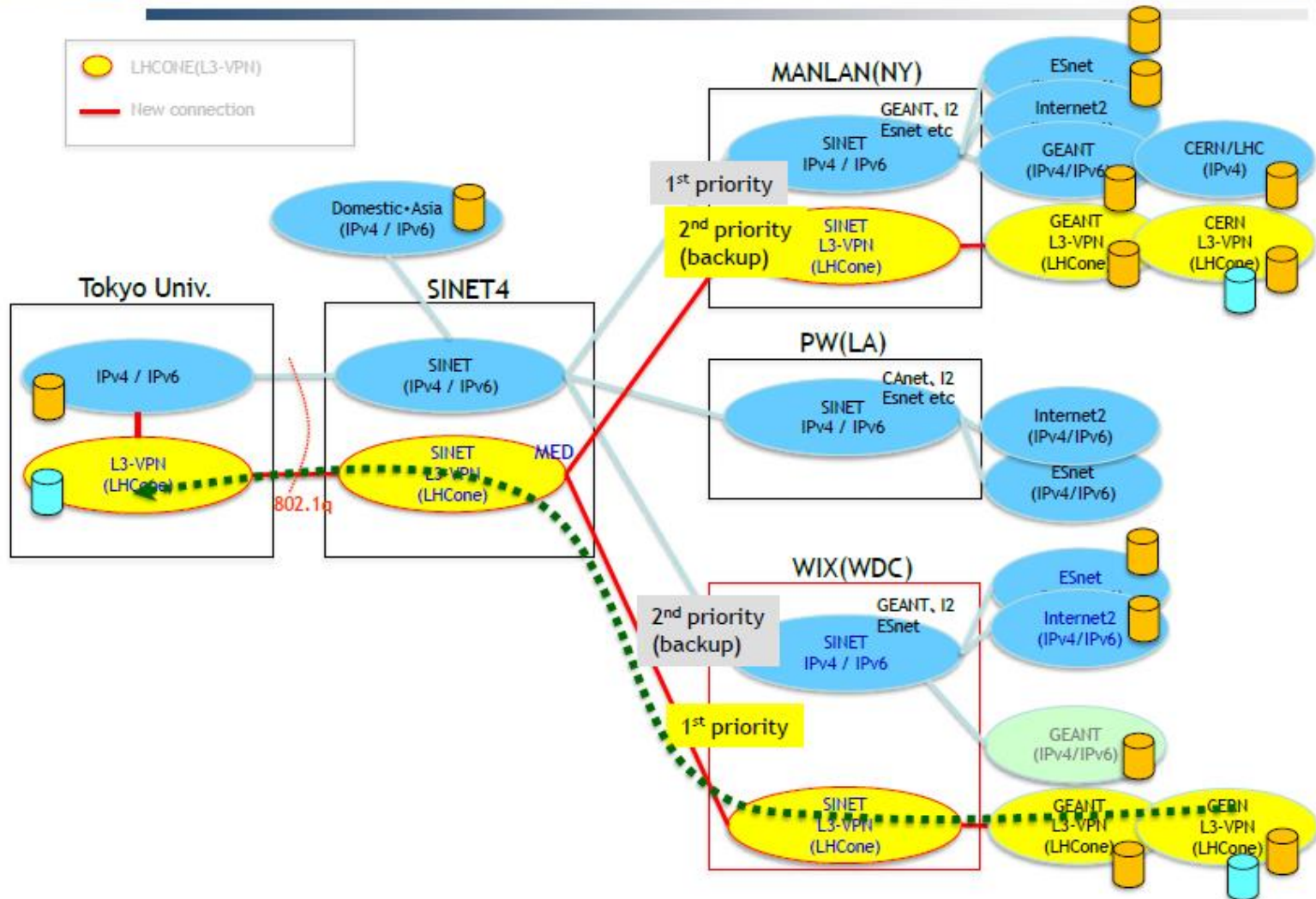
Trans-Atlantic Links

LHCONE in Open Exchanges

	MANLAN	StarLight	WIX	NetherLight	CERNLight
GEANT	★	★	★	★	★
NORDUnet	★			★	
Internet2	★	★	★		
ESnet	★	★	★		
CANARIE	★	★			
ASGC		★		★	

Summary

- LHCONE backbone supported by
  - Over 15 national and international RENs
  - Several Open Exchange Points including NetherLight, StarLight, MANLAN and others
  - Trans-Atlantic connectivity provided by ACE, GEANT, NORDUNET and USLHCNET

- Over 50 end sites connected to LHCONE
  - 45 Tier 2s
  - 10 Tier 1s

  https://twiki.cern.ch/twiki/bin/view/LHCONE/LhcOneVRF#Connected_sites

connect • communicate • collaborate

Questions?

- Questions?