

CERN Network activities update

SIG-NOC at CERN

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Agenda

Updates on:

- Networks at CERN IT
- LHCOPN
- LHCONE
- Cloud Activities
- IPv6 adoption

CERN IT

IT Communication Systems

The IT-CS group is responsible for communication services in use at CERN for data, control, voice and video

<http://information-technology.web.cern.ch/about/organisation/communication-systems>



Recent activities

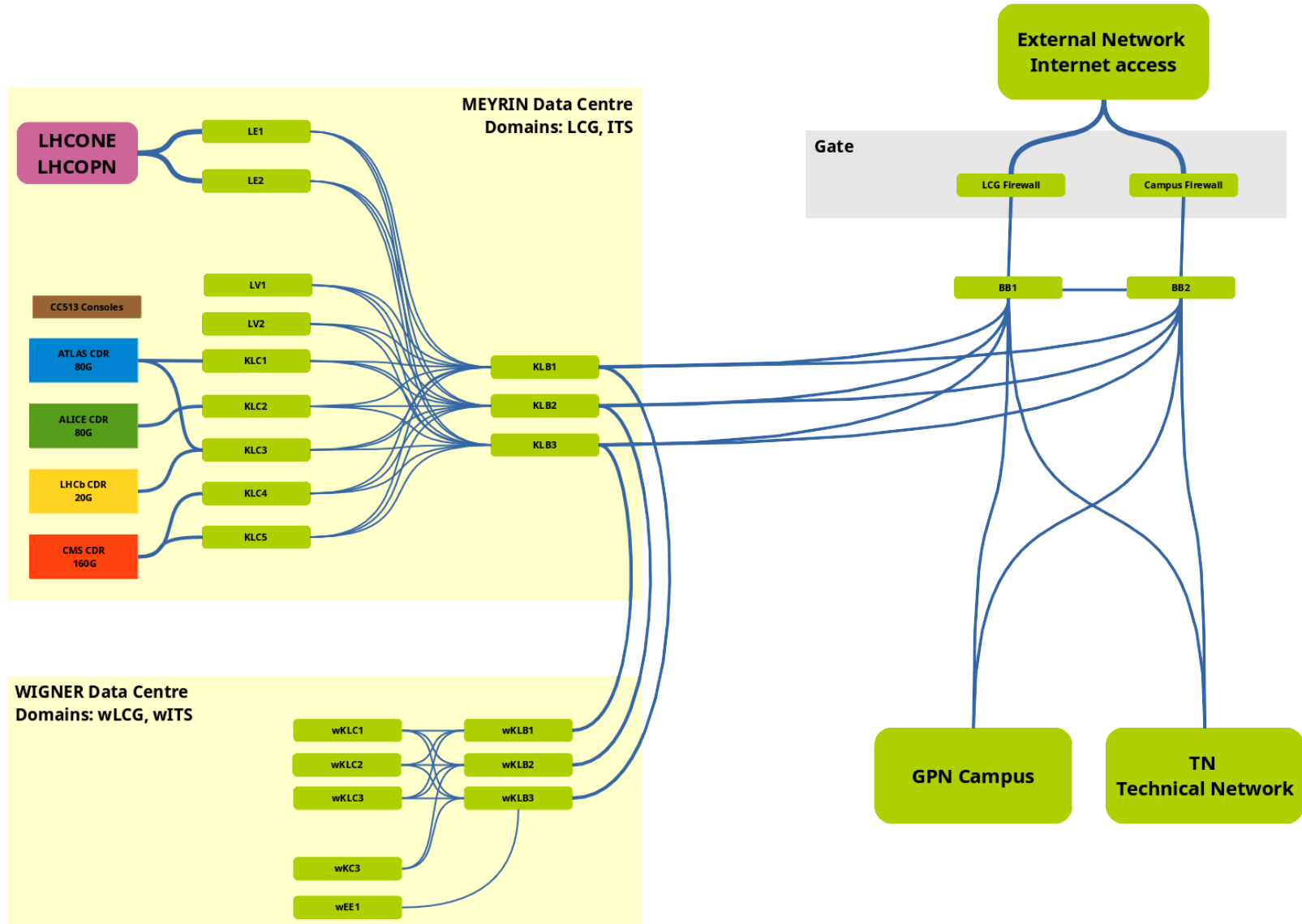
Wigner remote data-centre:

- added 3rd 100G link Geneva-Budapest
- re-configured network to increase local capacity

Tender for new datacentre routers

- to replace Brocade MLXE contract
- on going, waiting for replies
- to be concluded by September

CERN data centres - current setup



3rd 100G Geneva-Budapest link



Recent activities

Campus upgrades

- New WIFI network being deployed
- Planning for routers and switches upgrade

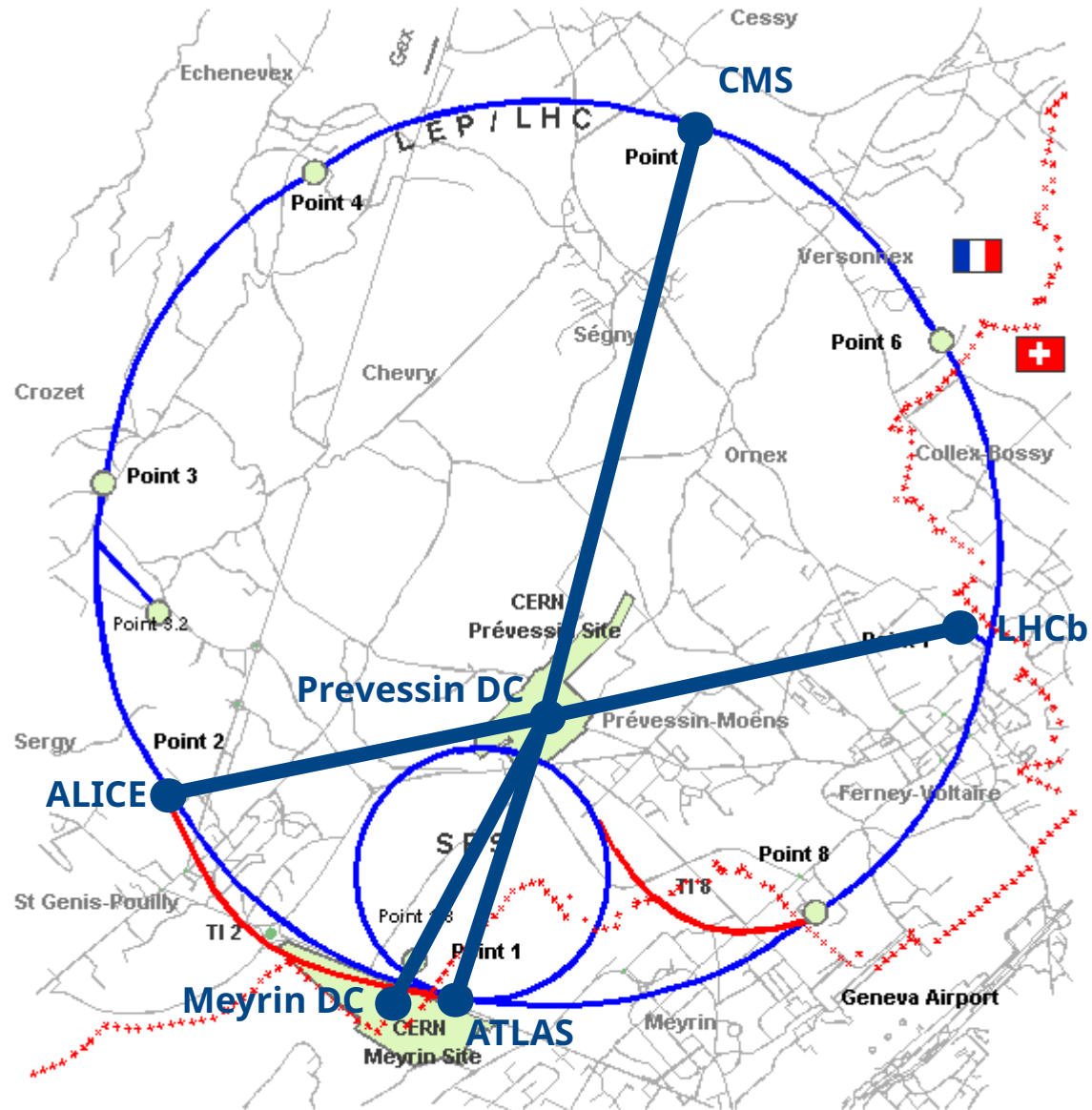
2nd network hub for business continuity in Preveessin

- Construction works almost completed
- Installation of network devices will start in the summer

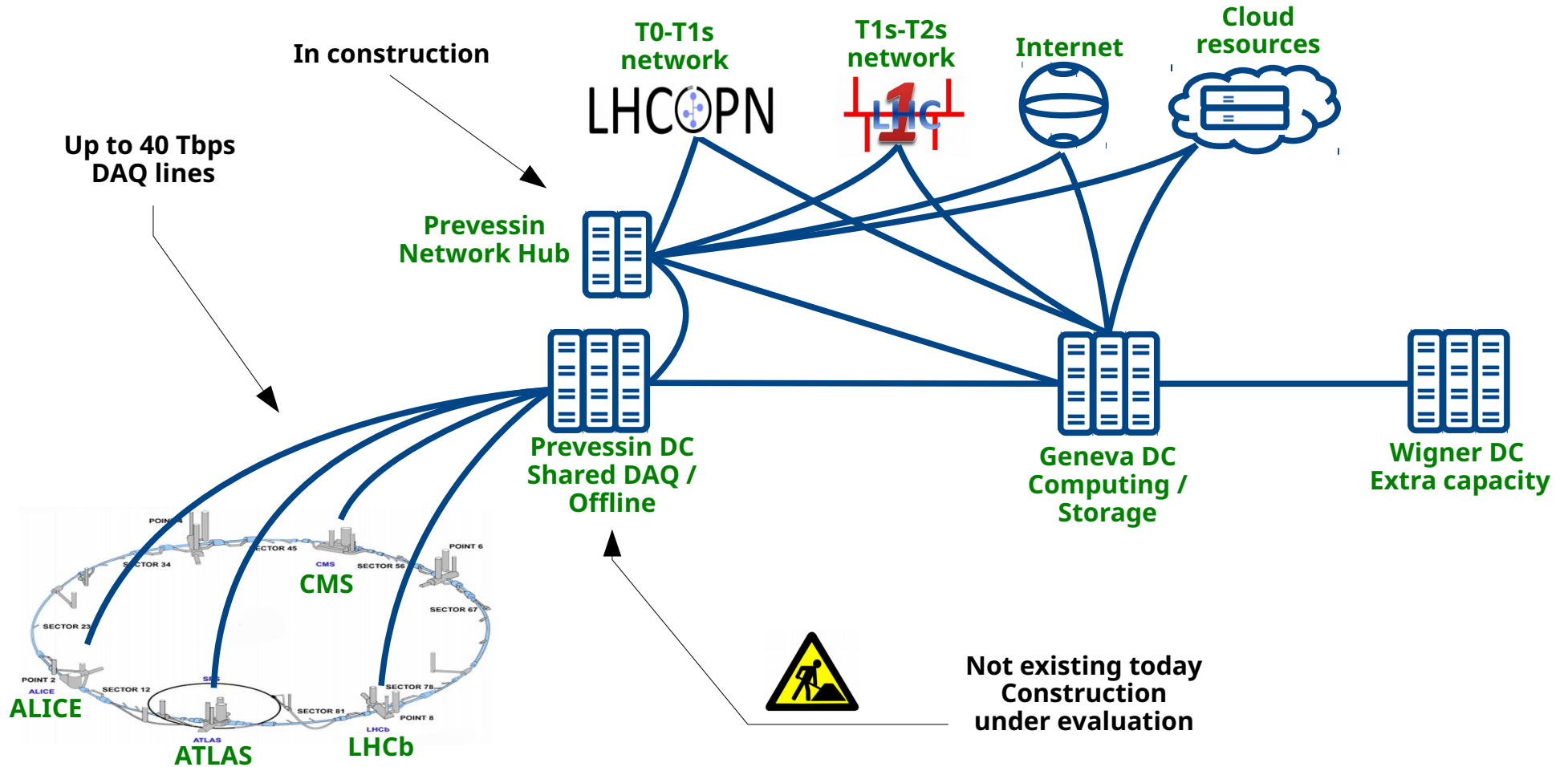
New datacentre in Preveessin

- evaluating feasibility and costs of a shared DAQ facility located in Preveessin (FR)

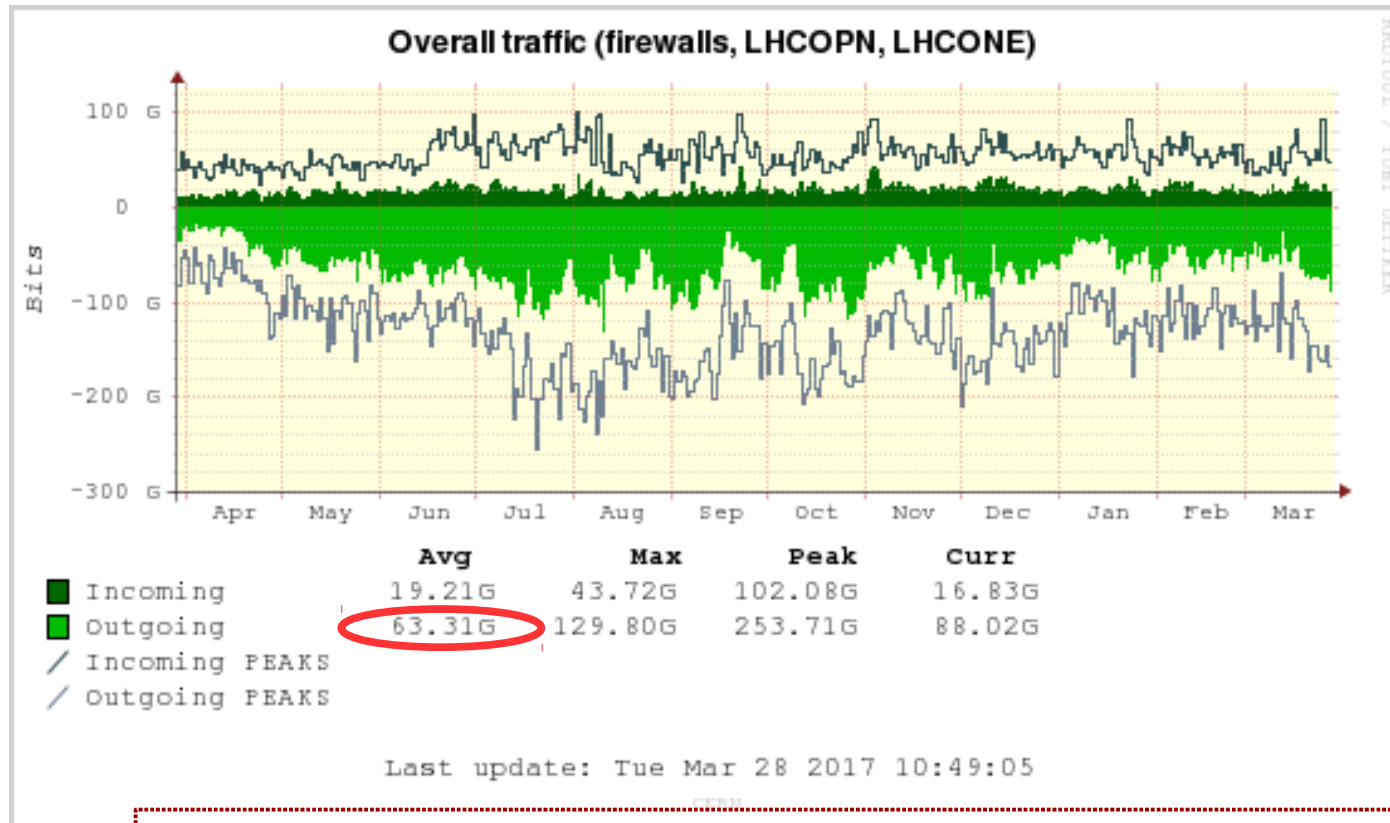
Shared DAQ



Network topology (TBC)

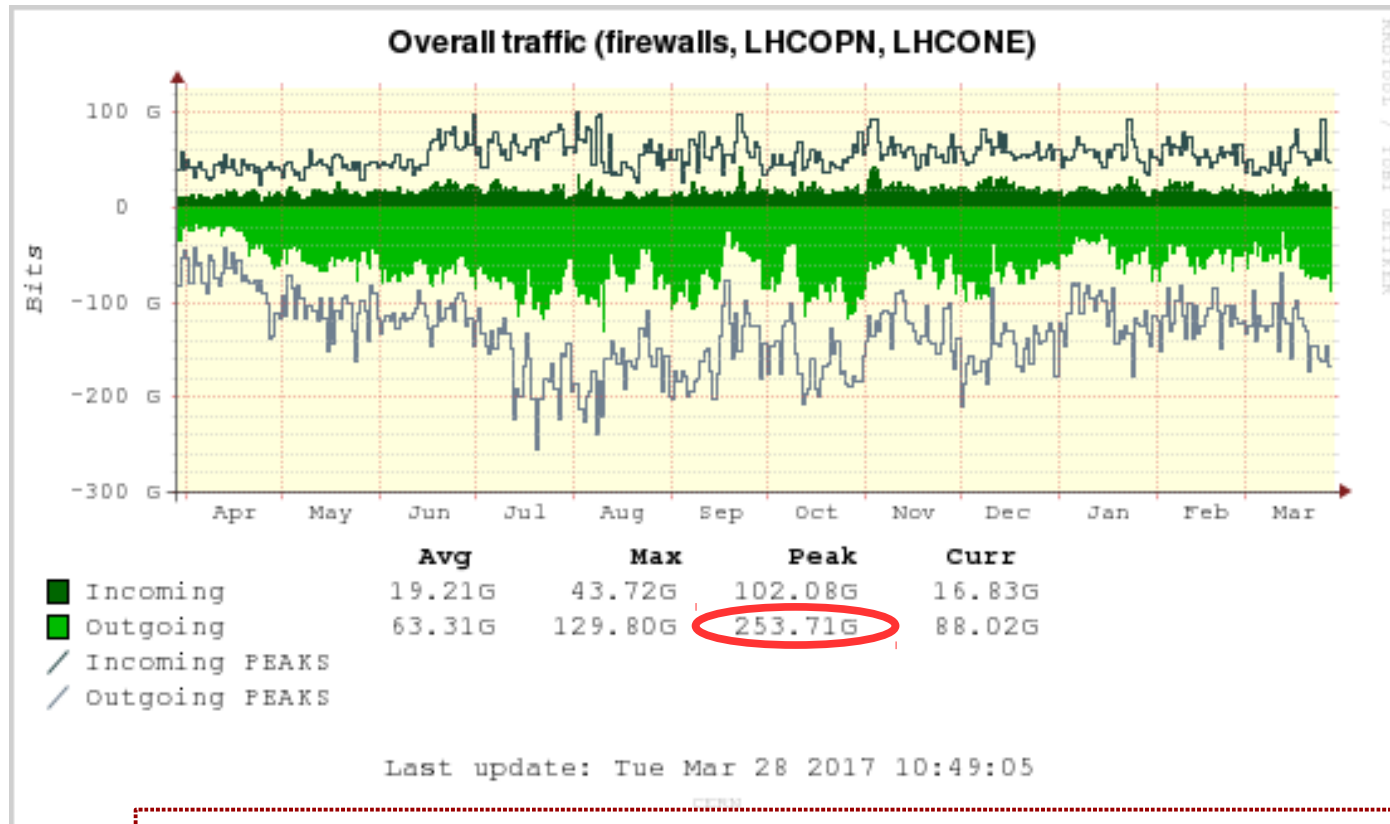


CERN external traffic - last 12 months



Average bandwidth increased of ~80% compared to previous year

CERN external traffic - last 12 months



Peak of 250Gbps outbound

LHCOPN

Private network connecting Tier0 and Tier1s

- Reserved to LHC data transfers and analysis
- Single and bundled long distance 10G and 100G Ethernet links
- Star topology
- BGP routing: communities for traffic engineering, load balancing
- Security: only declared IP prefixes can exchange traffic.

<https://twiki.cern.ch/twiki/bin/view/LHCOPN/WebHome>

Latest developments

IPv6 adoption:

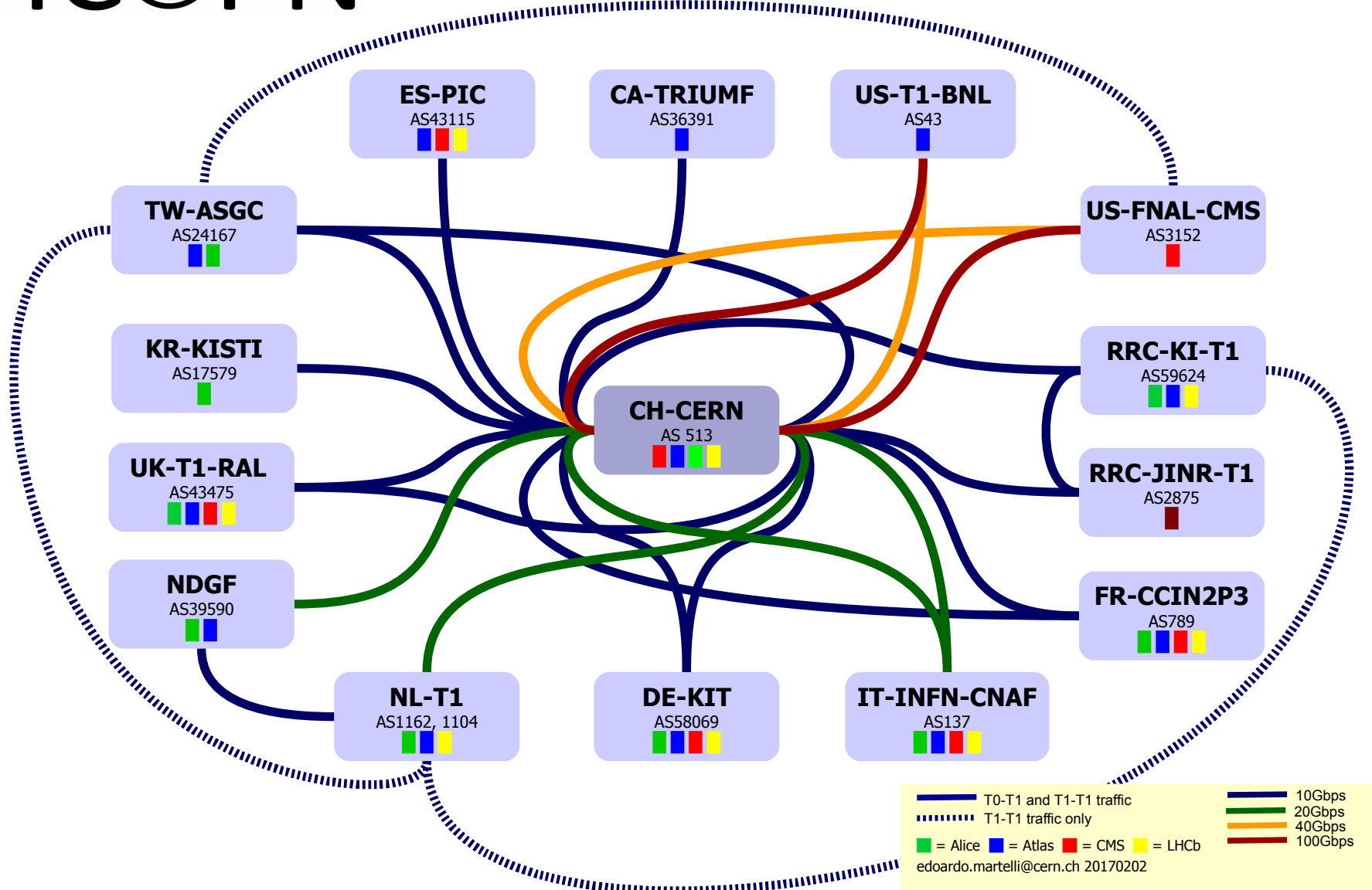
- 10 Tier1s and the Tier0 now have IPv6 connectivity
- dual-stack perfSONAR installed in all of them

Doubled link capacity during last year:

- NL-T1 (2x10G)
- FR-IN2P3 (2x10G)
- NDGF (2x10G)
- IT-INFN-GARR (4x10G)
- UK-T1-RAL (2x10G, load balancing on existing backup link, now procuring 3rd 10G link)

CA-TRIUMF: is moving to SFU; TRIUMF dismantled by 2020

LHCOPN



Plans

Complete IPv6 deployment:

- connect all Tier1s
- make all LHCOPN perfSONAR probes dual-stack
- use IPv6 for production data transfers

Upgrade Tier0-Tier1 links when necessary

- move to 100G when cost effective

LHCONE

LHCONE

LHCONE L3VPN: Routed Virtual Private Network

- Dedicated worldwide backbone connecting WLCH and other HEP sites at high bandwidth
- Bandwidth dedicated to HEP data transfers, no contention with other research projects
- Trusted traffic that can bypass slow perimeter firewalls

<https://twiki.cern.ch/twiki/bin/view/LHCONE/WebHome>

LHCONE L3VPN - status

- Over 20 national and international Research Networks
- Interconnections at Open Exchange Points including NetherLight, StarLight, MANLAN, WIX, CERNlight, Hong Kong and others
- Trans-Atlantic connectivity provided by ESnet, GEANT, Internet2, NORDUnet and SURFnet
- Trans-Pacific connectivity provided by ASGCnet, KREOnet, SINET
- Euro-Asia connectivity provided by GEANT, TEIN/Asia@connect, TIFR
- ~74 end sites connected:
 - 14 Tier1s
 - 60 Tier2s



LHCONE L3VPN - update

Traffic within LHCONE is steadily growing

- GÉANT has seen peaks of over 100Gbps
- Growth of over 65% from Q2 2015 to Q2 2016
- ESnet sees more LHCONE traffic than LHCOPN

Some NRENs and sites need to upgrade their connection

- GÉANT is already working with the NRENs for the upgrades

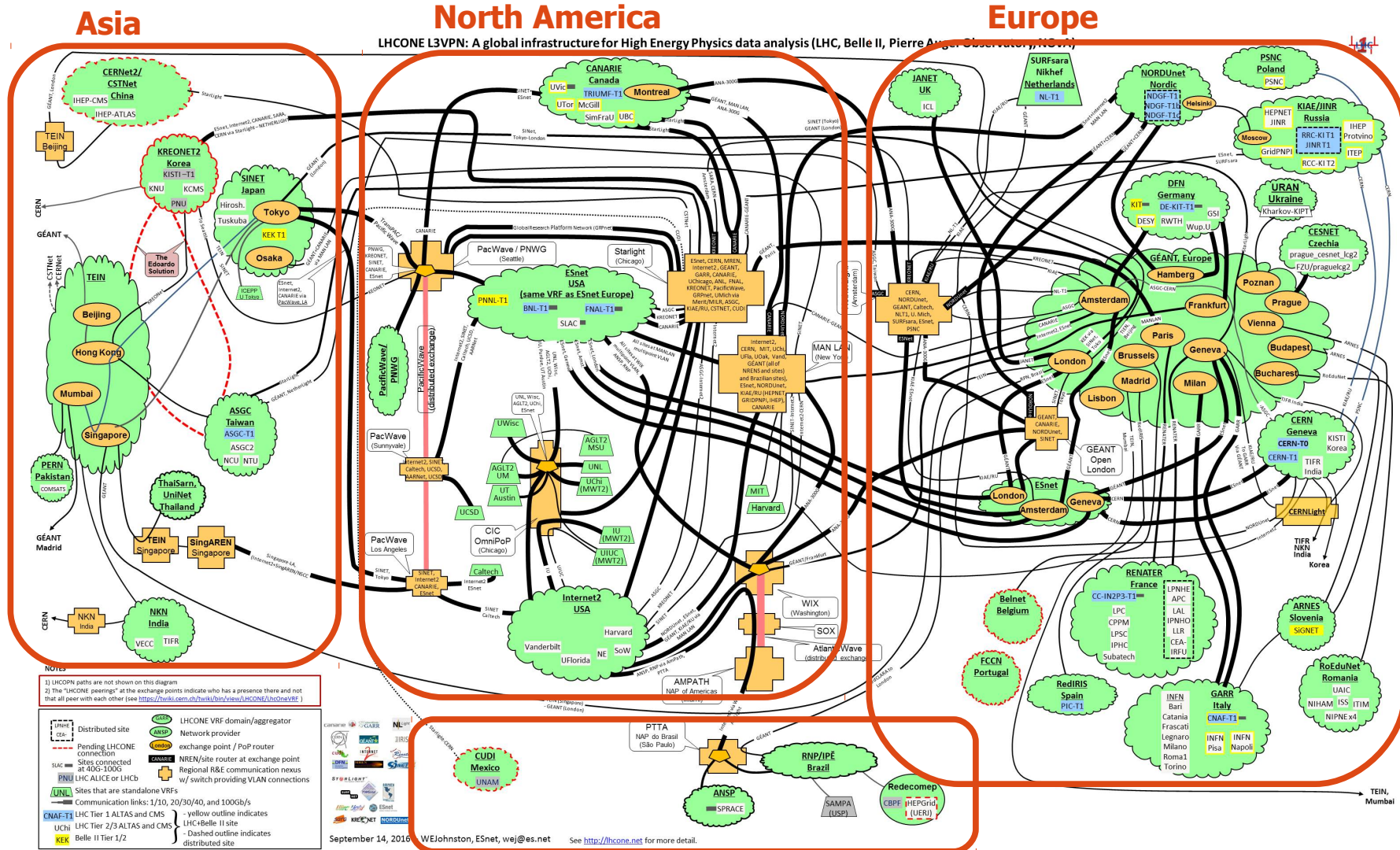
Expected to see further increases after the upgrades

LHCONE L3VPN - update

The LHCONE network is expanding

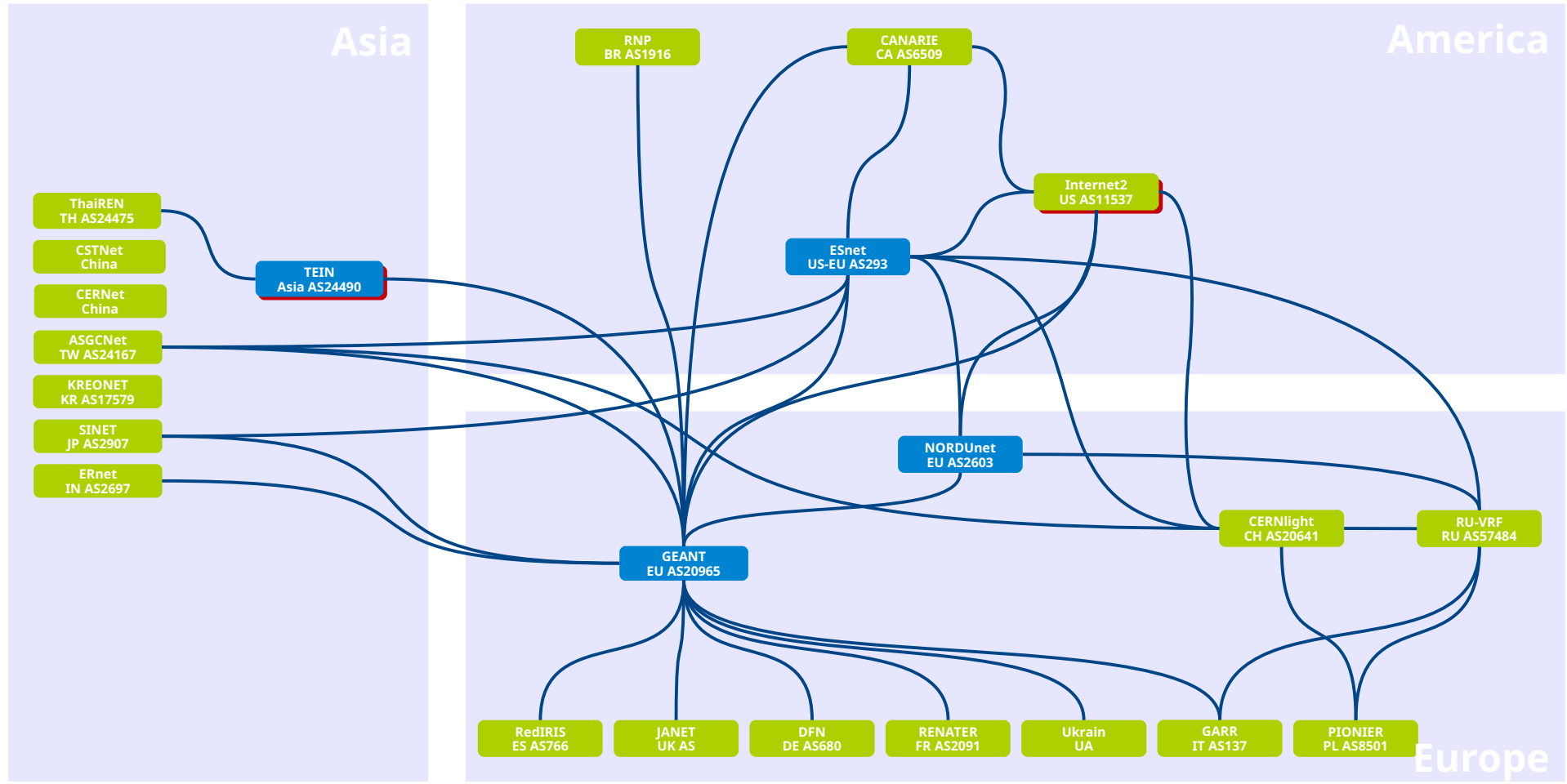
- Ukrain, Russia and Belgium connected to GÉANT (Russian ban finally lifted)
- Brazil connected to GÉANT, Chile is interested to join
- TEIN (Asia) connected to GÉANT, provides transit to Thailand

LHCONE L3VPN - current topology



South America

Map of VRFs



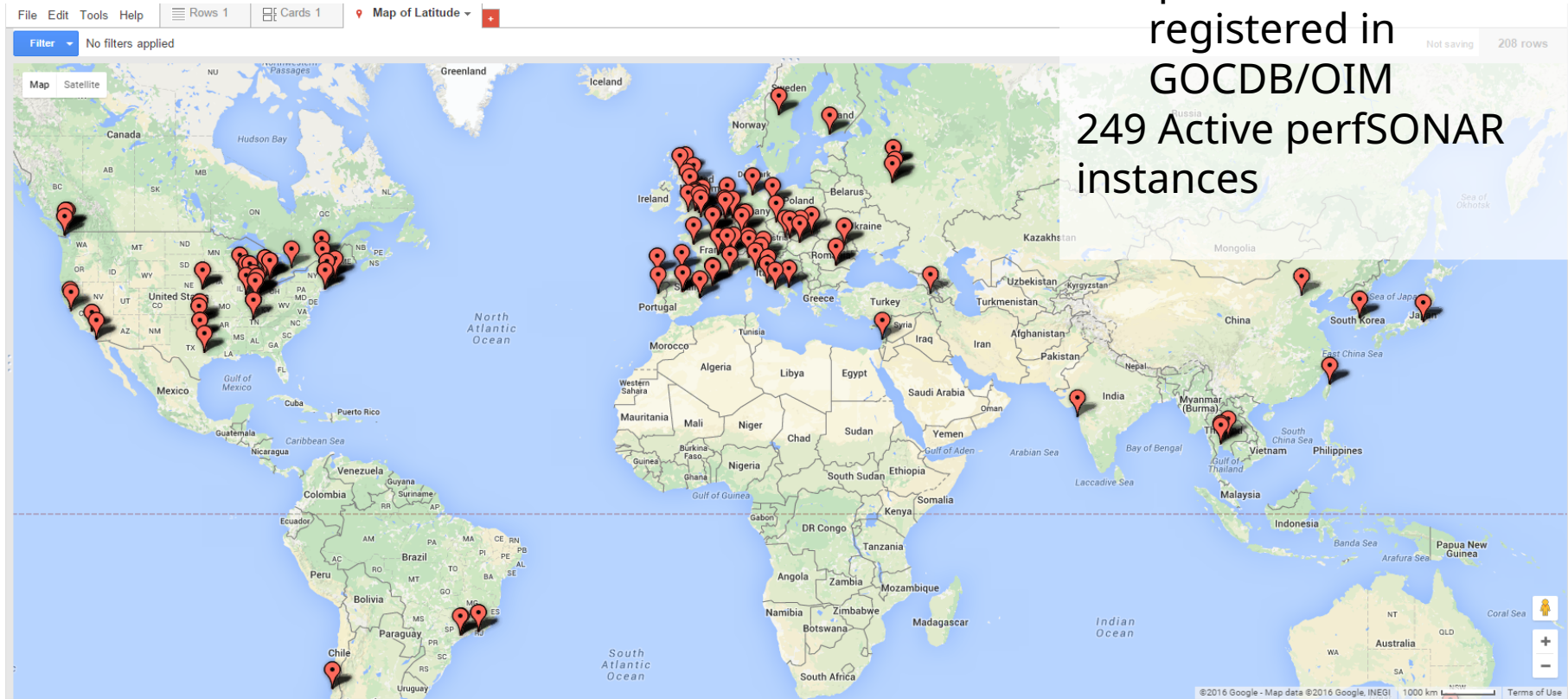
International VRF

National VRF

Transit

WLCG perfSONAR

278 perfSONAR instances
registered in
GOCDB/OIM
249 Active perfSONAR
instances



perfSONAR - update

Mesh have been reconfigured/optimized. There are now experiment specific meshes: ATLAS, CMS and LHCb which allow daily bandwidth tests

All the LHCOPN and LHCONE data is available in ElasticSearch via OSG (ongoing)

Some degradation in the data retrieving of the LHCOPN/ONE MaDDash. Upcoming upgrade to v4 should be the opportunity to make the nodes more resilient

perfSONAR - update

ATLAS is working on getting network metrics into an analytics platform:

- packet loss from perfSONAR
- network stats and flows from ESnet routers
- stats from CERN routers will be added

Looking for more router sources

Completed MCA (Mesh Configuration Admin) tool

WLCG is working on ETF (Experiment Test Framework) to monitor perfSONAR services

Open to other HEP collaborations

The L3VPN is now used also by:

- Belle II experiment



- NOvA neutrino experiment



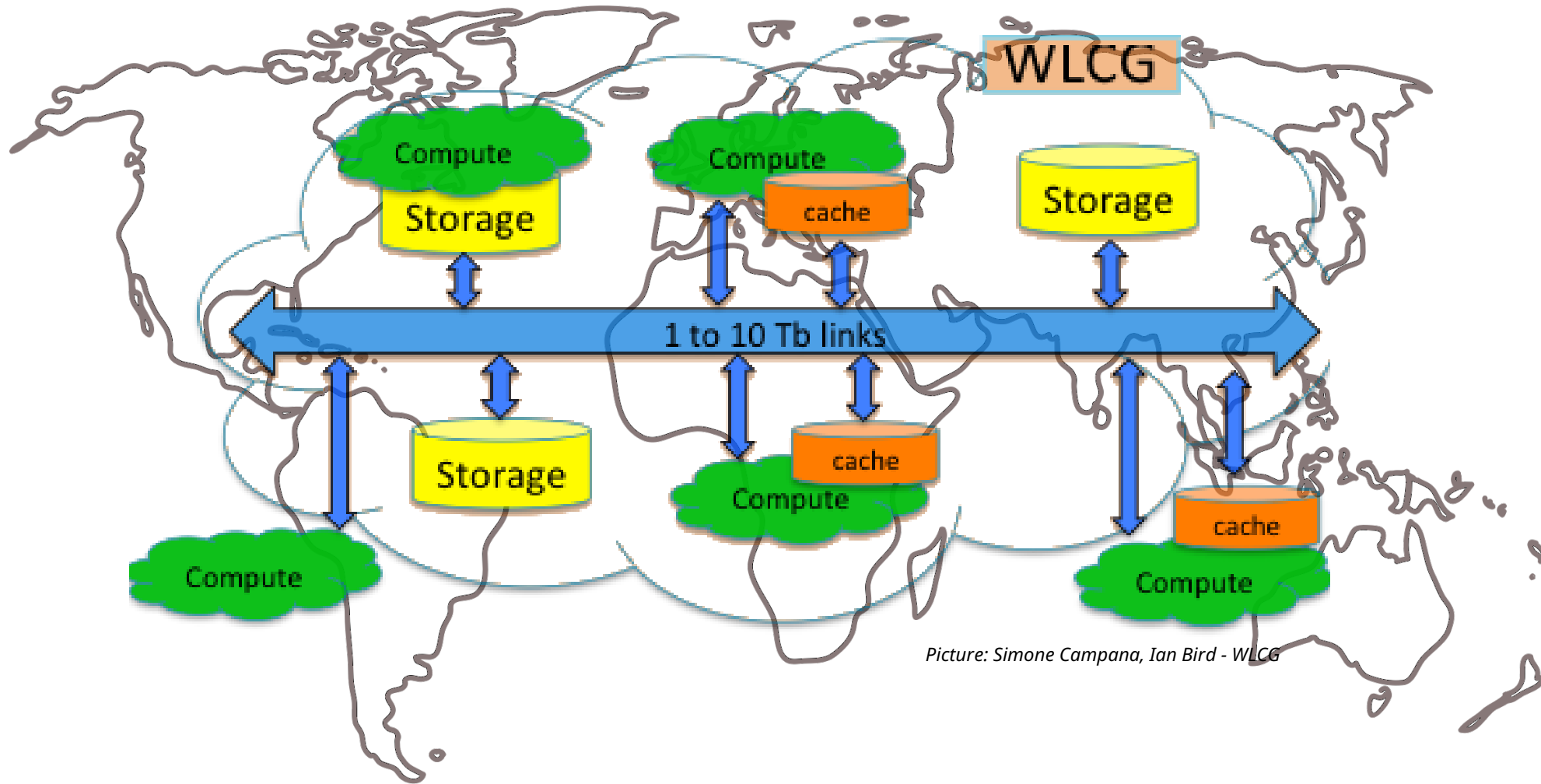
- Pierre Auger observatory



- XENON dark matter project



Possible change of computing model

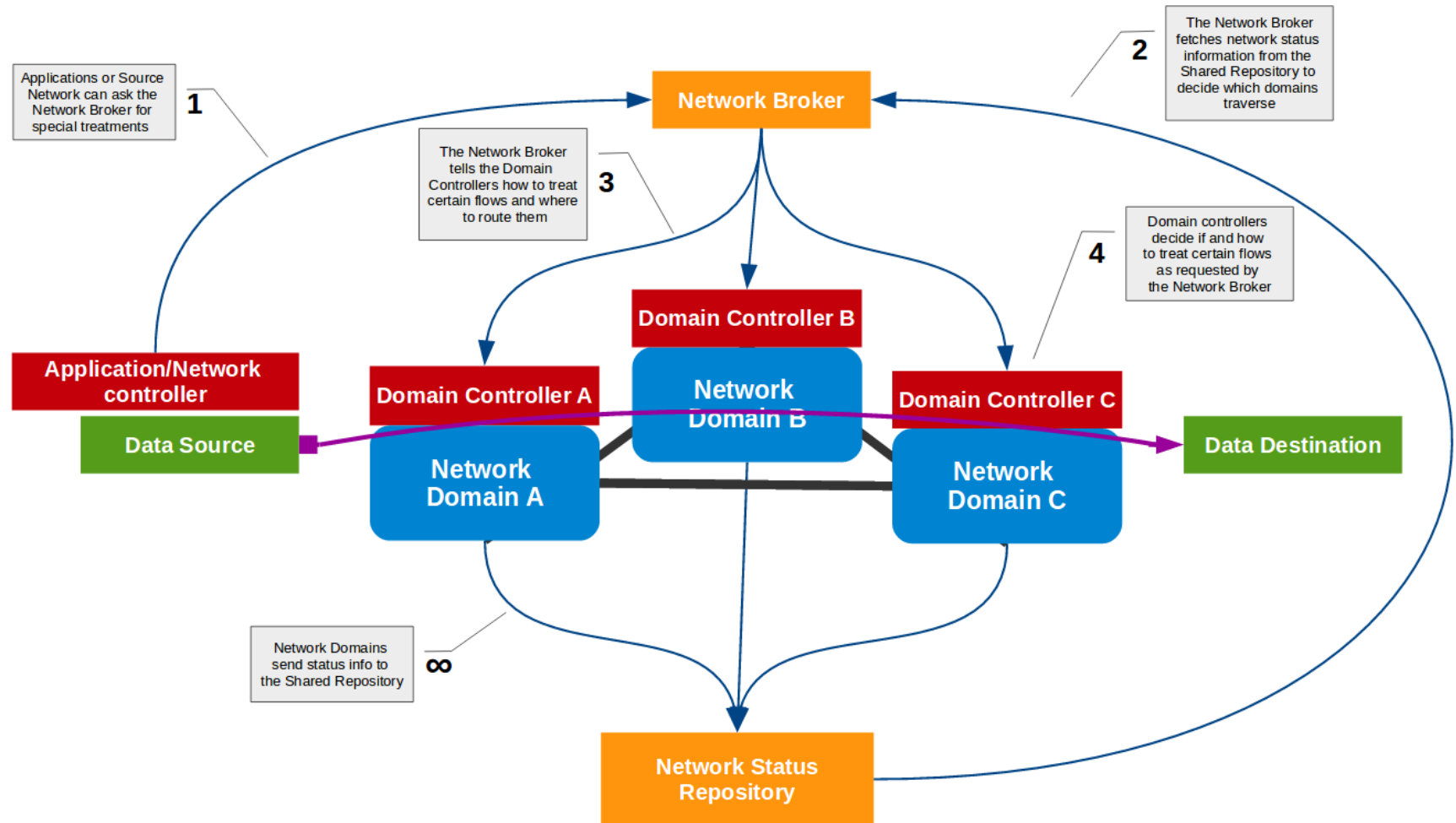


Picture: Simone Campana, Ian Bird - WLCG

"Consolidate storage in few locations to decrease costs"

Networking for Run4

Proposed project to improve network utilization efficiency



GNA - Global Network Architecture

Sharing of R&E network resources for common benefit

Extend benefits gained with ANA-300G experience
(sharing of three 100G transatlantic links)

Pillars:

- resource sharing
- aligning operational standards
- maximizing funding and investments
- knowledge sharing and outreach
- increasing global collaboration



global network architecture

Clouds activities

HELIX NEBULA the Science Cloud

Procurers: CERN, CNRS, DESY, EMBL-EBI, ESRF, IFAE, INFN, KIT, SURFSara, STFC

- Procurers have committed funds (>1.6M€), manpower, use-cases with applications & data, in-house IT resources

Objective: procure innovative IaaS level cloud services

- Fully and seamlessly integrating commercial cloud (IaaS) resources with in-house resources and European e-Infrastructures
- To form a hybrid cloud platform for science

Services will be made available to end-users from many research communities: High-energy physics, astronomy, life sciences, neutron/photon sciences, long tail of science

Co-funded via H2020 (Jan'16-Jun'18) as a Pre-Commercial Procurement (PCP) project: Grant Agreement 687614, total procurement volume: >5M€



HNSciCloud challenges

Innovative IaaS level cloud services integrated with procurers in-house resources and public e-infrastructure to support a range of scientific workloads

Compute and Storage

support a range of virtual machine and container configurations including HPC working with datasets in the petabyte range

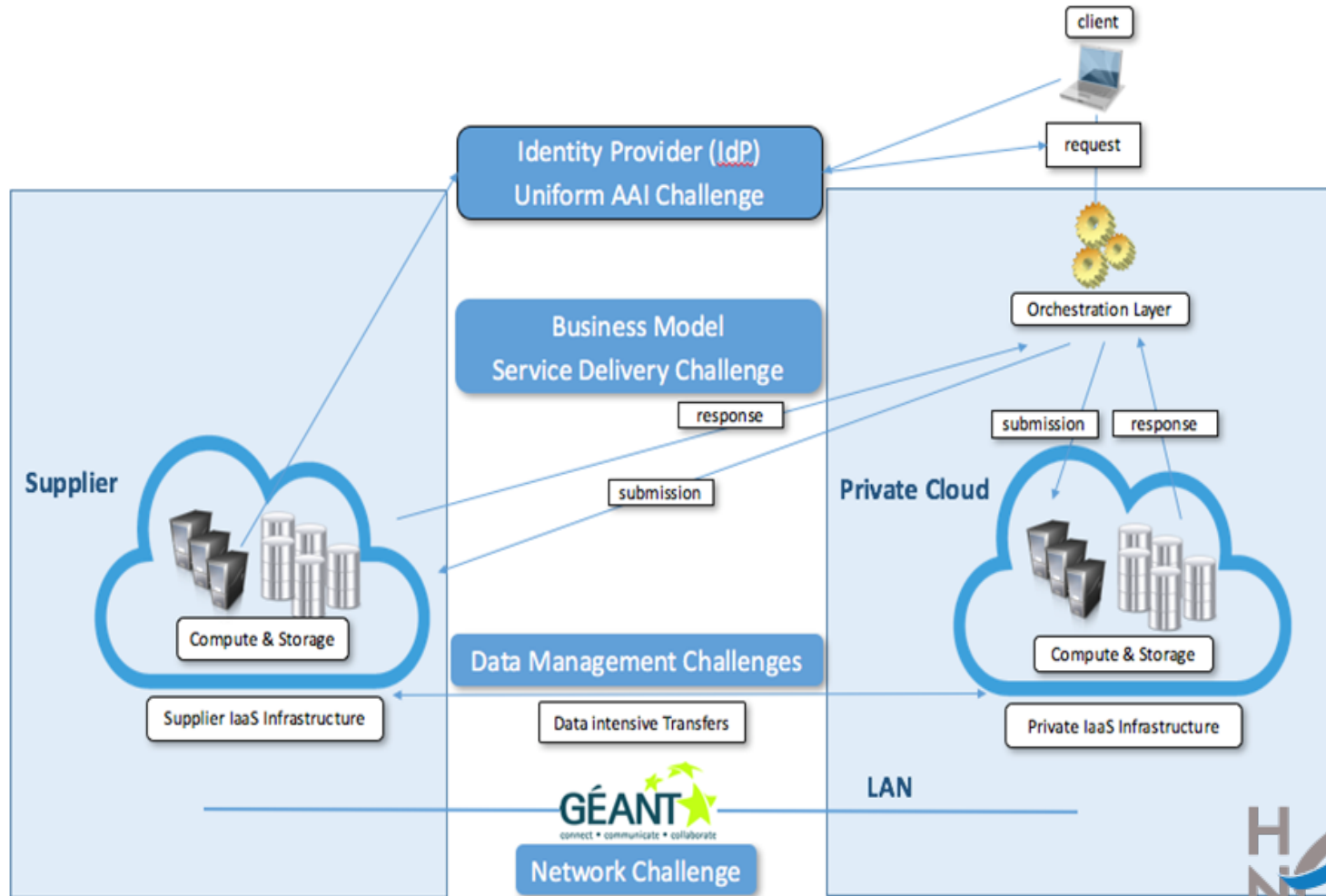
Network Connectivity and Federated Identity Management

provide high-end network capacity via GEANT for the whole platform with common identity and access management

Service Payment Models

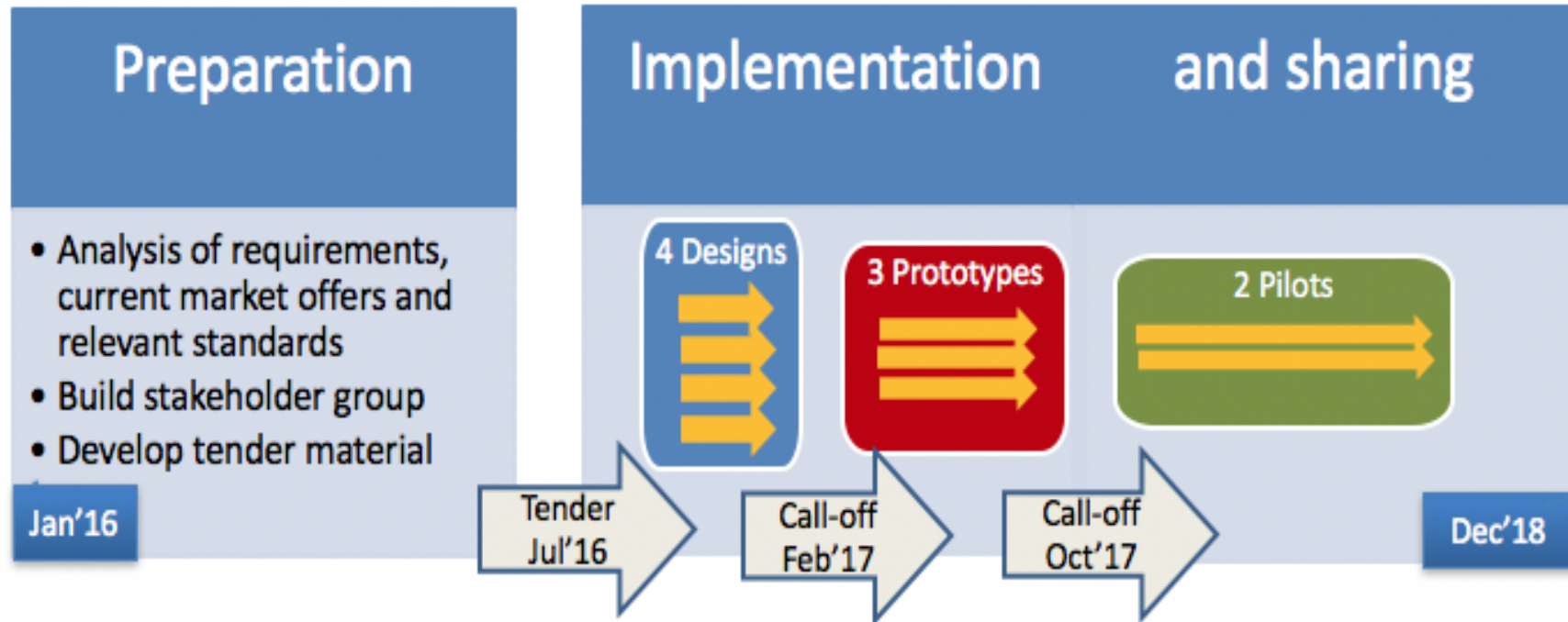
explore a range of purchasing options to determine those most appropriate for the scientific application workloads to be deployed

High Level Architecture of the Hybrid Cloud Platform including the R&D challenges



Project phases

We are here



Each step is **competitive** - only contractors that successfully complete the previous step can bid in the next

Selected bidders

Admitted to the Design Phase

- T-Systems, Huawei, Cyfronet, Divia
- IBM
- RHEA Group, T-Systems, exoscale, SixSq
- Indra, HPE, Advania, SixSq

Other major players not interested or dropped out just before tender submission

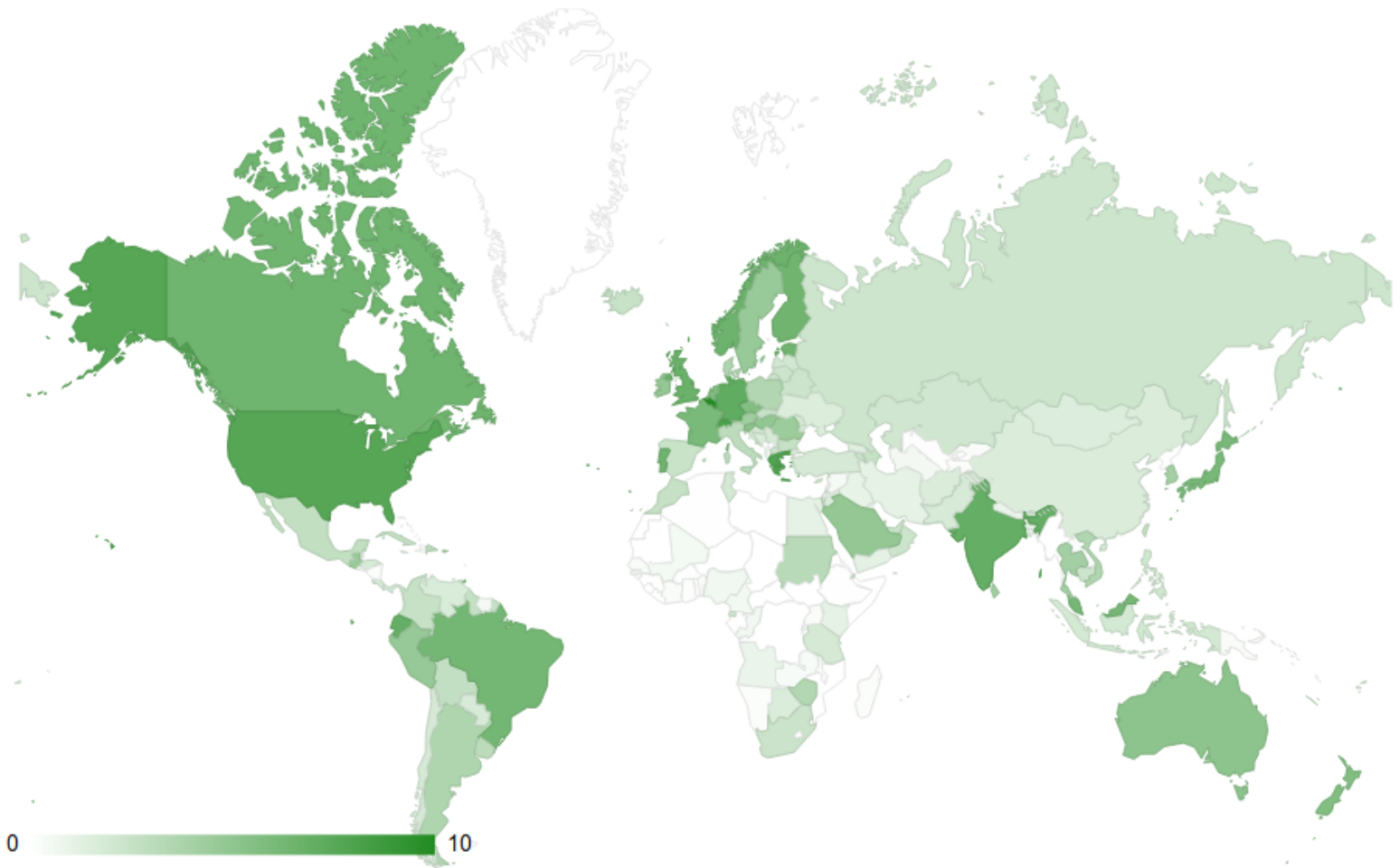
Admitted to the Prototype Phase

- T-Systems, Huawei, Cyfronet, Divia
- IBM
- RHEA Group, T-Systems, exoscale, SixSq

Current Status: Evaluation of Bids in the Prototype Phase

IPv6 deployment

IPv6 adoption



<http://6lab.cisco.com/stats/>

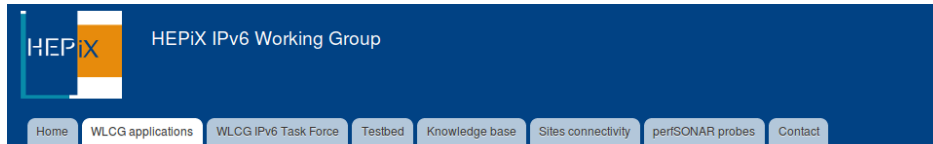


HEPiX IPv6 working group

IPv6 deployment have been followed up by the HEPiX IPv6 working group

It surveys IPv6 compliance of HEP applications and IPv6 connectivity of HEP sites

Lists are maintained at the web site: <http://hepixon.web.cern.ch/>



Home

IPv6 compliance of WLCG applications

Software Component	Type	Used by Experiment	Version	IPv6 Compliance
AIEN	LHC Experiment Application	ALICE		
ARC CE	Middleware	ATLAS, CMS		YES
ARGUS	Middleware	ALICE, ATLAS, CMS, LHCb		Unknown
BDII	Middleware	ATLAS, CMS, LHCb	EMI 2	YES
BestMAN	Middleware	ATLAS, CMS		YES
CASTOR	Middleware	ALICE, ATLAS, CMS, LHCb		NO
cfengine	Monitoring			Unknown
CMS Tag Collector	LHC Experiment Application	CMS		Unknown
CMSSW	LHC Experiment Application	CMS		Unknown
cmsweb	LHC Experiment Application	CMS		YES
CRAB 2	LHC Experiment Application	CMS		Unknown
Cream CE	Middleware	ALICE, ATLAS, CMS, LHCb	1.16.2	YES

Home

Sites IPv6 connectivity

Name	Type	LHCOPN IPv6 peering	LHCONE IPv6 peering	LHCONE IPv6 peers	NREN IPv6 peers	IPv6 LAN	dualstack perSONAR	dualstack storage percentage by 1st April 2017	dualstack storage percentage by 31st May 2017	dualstack storage percentage by 31st July 2017	Network Statistics
UKI-LT2-IC-HEP	Tier2		Yes	Janet	Janet	Yes		100			
TRIUMF	Tier1	Yes	Yes	Canarie	BCNET	Yes	Yes	0			
RAL	Tier1	No			JANET	No	Yes	0			
pragueicg2 (FZU)	Tier2	No	Yes	CESNET	CESNET	Yes	Yes	100			http://netreport.cesnet.cz/netreport/hep-cesnet-experimental-facility2/
NL-T1-Nikhef	Tier1	Yes	No	GEANT	SURFnet	Yes	No				



IPv6 only worker nodes

IPv6 requirements for LHC Experiments have been discussed at the GDB

A plan to support IPv6 only worker nodes has been proposed.

The aims are:

- provide a migration path for sites
- allow long term planning for network setups
- give the possibility to make use of IPv6 only resources, should they become available

It is essential to provide dual-stack access to storage



Dual-stack storage

Most storage solutions and protocols now work in dual-stack mode

- dCache, DPM, StoRM, FTS
- XrootD 4, GridFTP, WebDAV

Several sites have been running dual-stack for some time

Production data transfers over IPv6 are happening!

IPv6 at Tier0-Tier1s

Good IPv6 adoption

10 Tier1s and the Tier0 peering over IPv6
dual-stack perfSONAR installed in all of them

LHCOPN IPv6 still missing from:

- KR-KISTI (new router hardware needed - by June 2016?)
- RRC-KI-T1 KIAE (IPv6 deployment started)
- RRC-KI-T1 JINR (will follow KIAE)

No IPv6 storage in most of them though, including CERN

IPv6 at Tier2s

IPv6 connectivity provide by most of the LHCONE VRFs
12 Tier2s have IPv6 connectivity with LHCONE

HEPiX is writing an How-To deploy IPv6 at a Tier2:

<https://hepixon.web.cern.ch/content/how-deploy-ipv6-wlcg-tier-2-site>

A tutorial is tentatively scheduled for the WLCG workshop in Manchester in June. TBC

IPv6 Monitoring

Network performance on perfSONAR

<http://psmad.grid.iu.edu/maddash-webui/index.cgi?dashboard=Dual-Stack%20Mesh%20Config>

FTS transfers in MONIT

<https://monit.cern.ch/>

(add "data.ipv6:true" to any FTS monitor page for IPv6 only traffic)

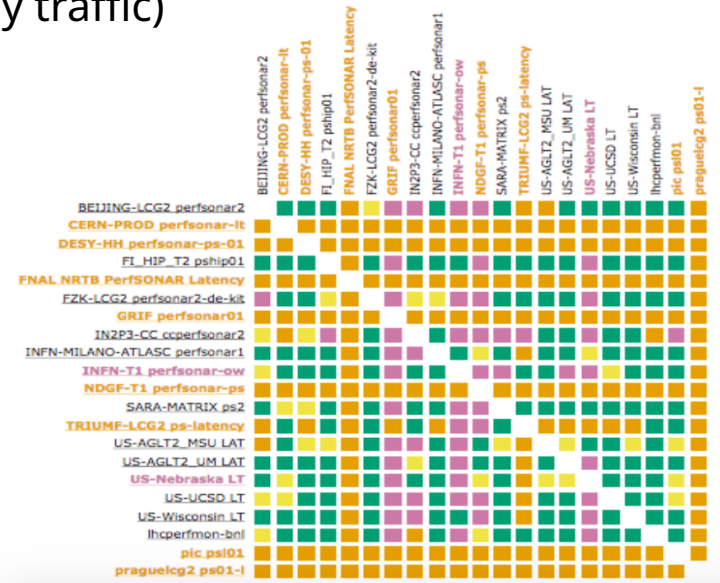
ETF

https://etf-ipv6-dev.cern.ch/etf/check_mk/

Dual-Stack Mesh Config - IPv6 Latency Test

Loss rate is <= 0 Loss rate is >= 0 Loss rate is >= 0.01 Unable to retrieve data Check has not yet run

Found a total of 10 problems involving 10 hosts in the grid



Conclusion

Summary

CERN: planning for RUN3 and better redundancy

LHCOPN: stable, almost fully dual-stack, upgraded when needed

LHCONE: expanding, works need to be done in Asia

Clouds: testing integration with orchestration tools to answer to peaks of computing demands

IPv6: good progress in WAN networks, less in campus and datacentres. More dual-stack storage needed in WLCG

Questions?

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