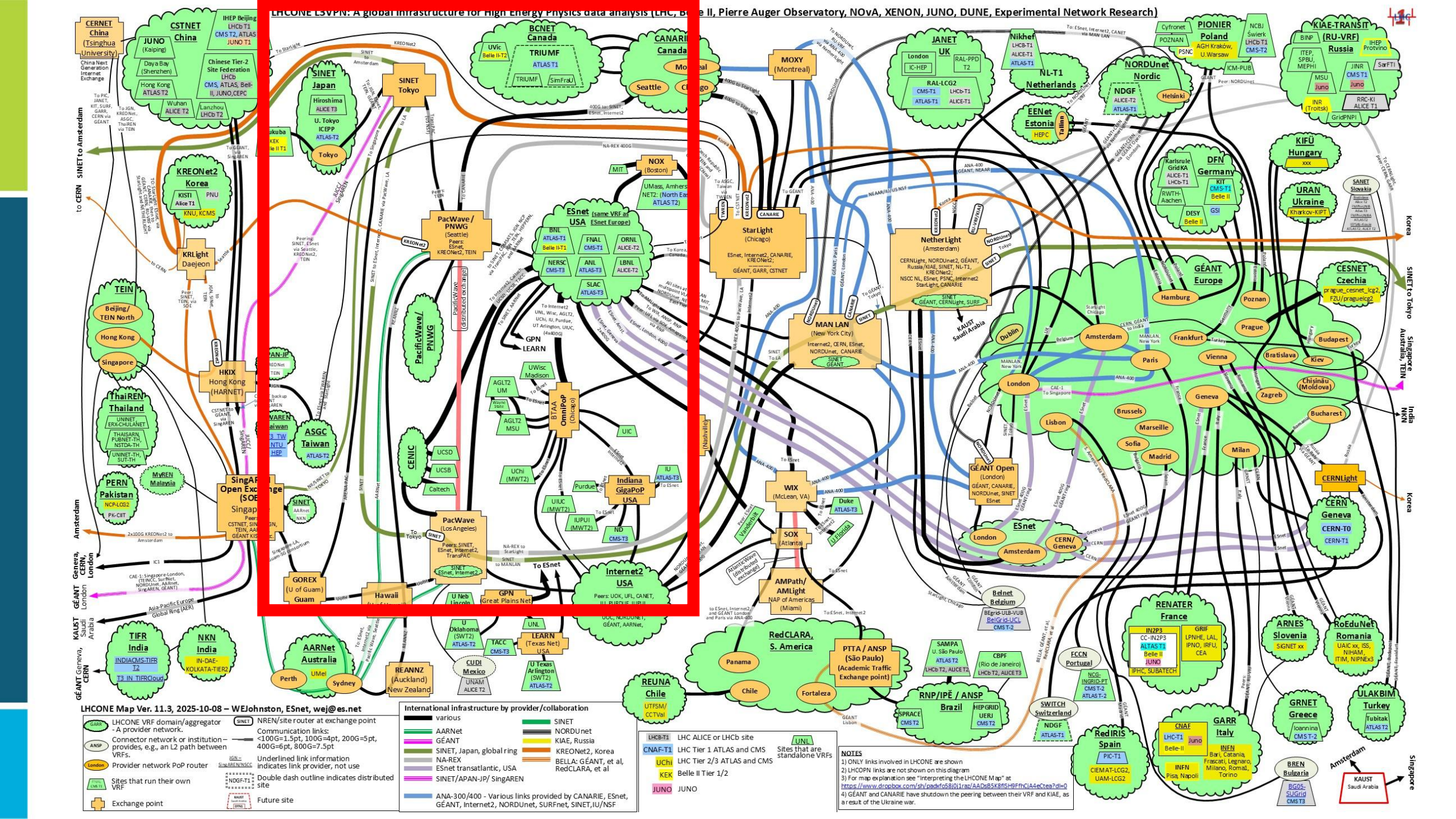
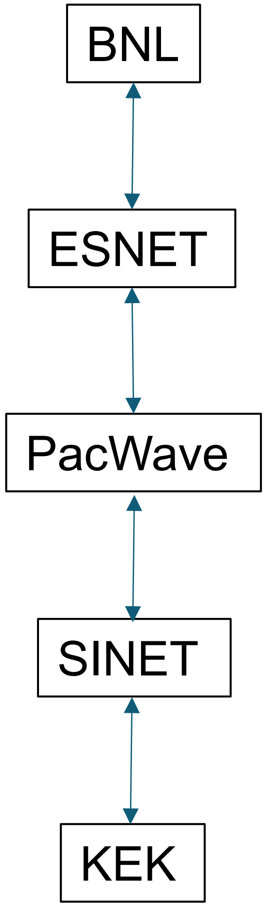
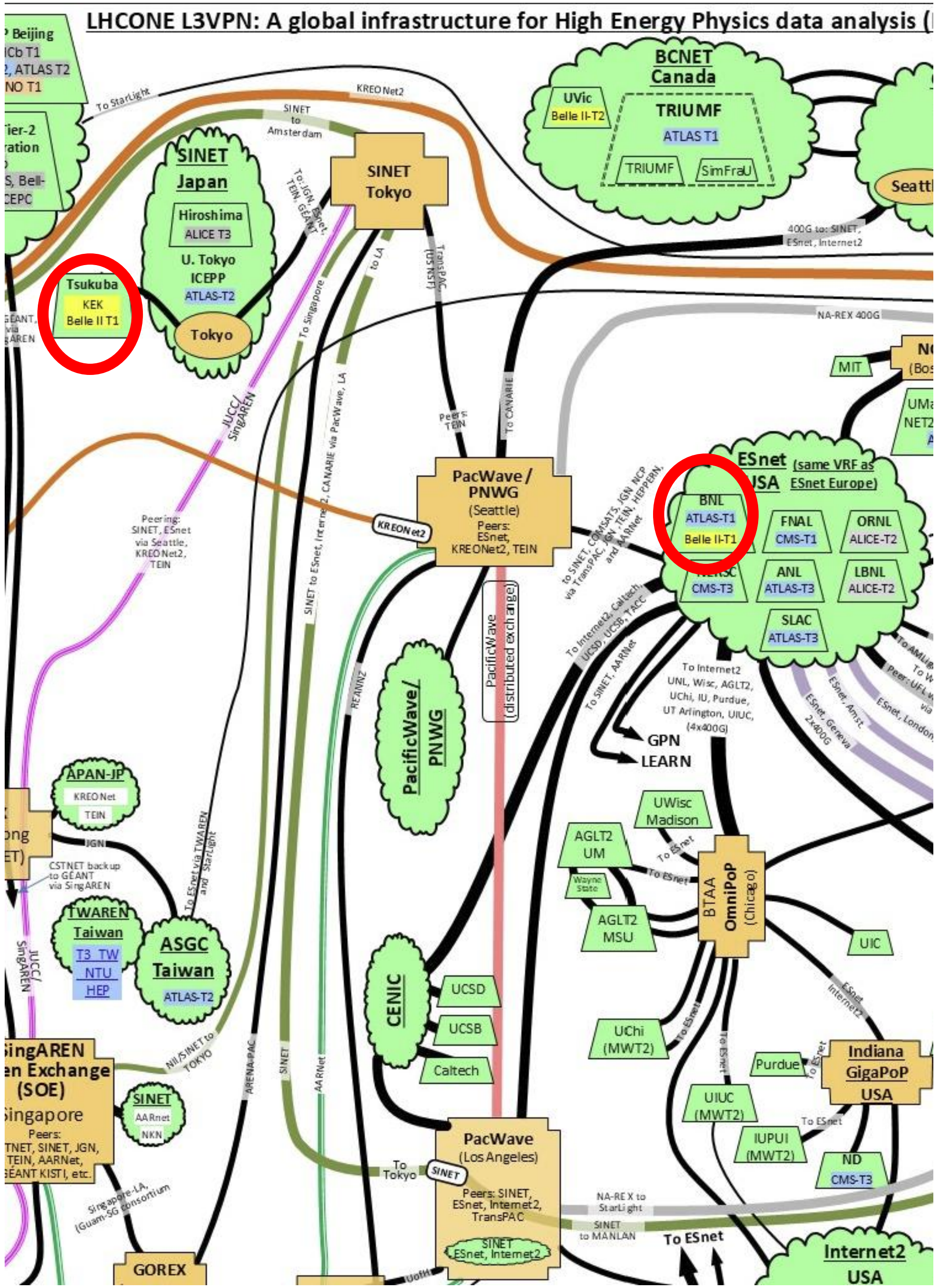
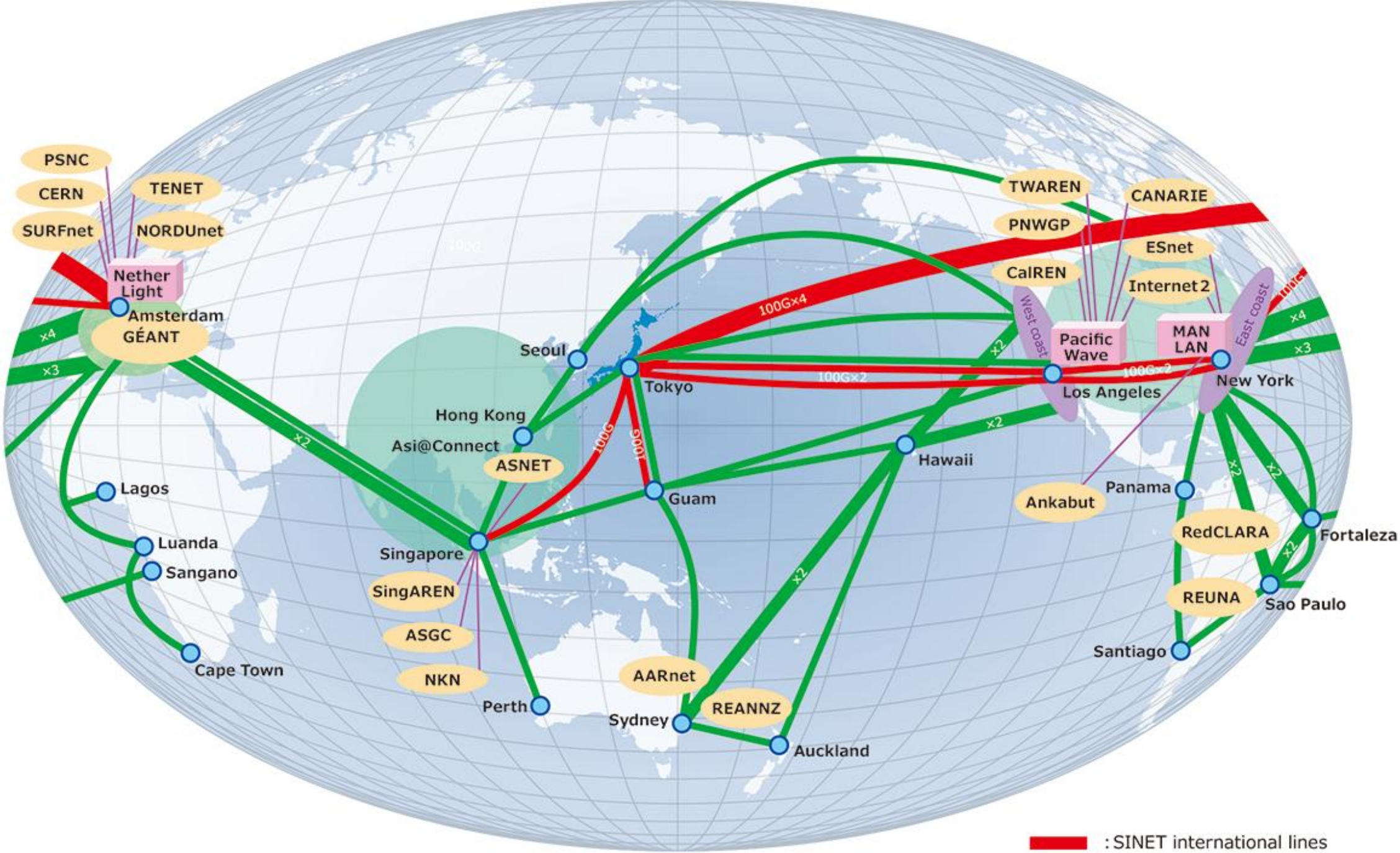
Belle II connectivity between BNL and KEK

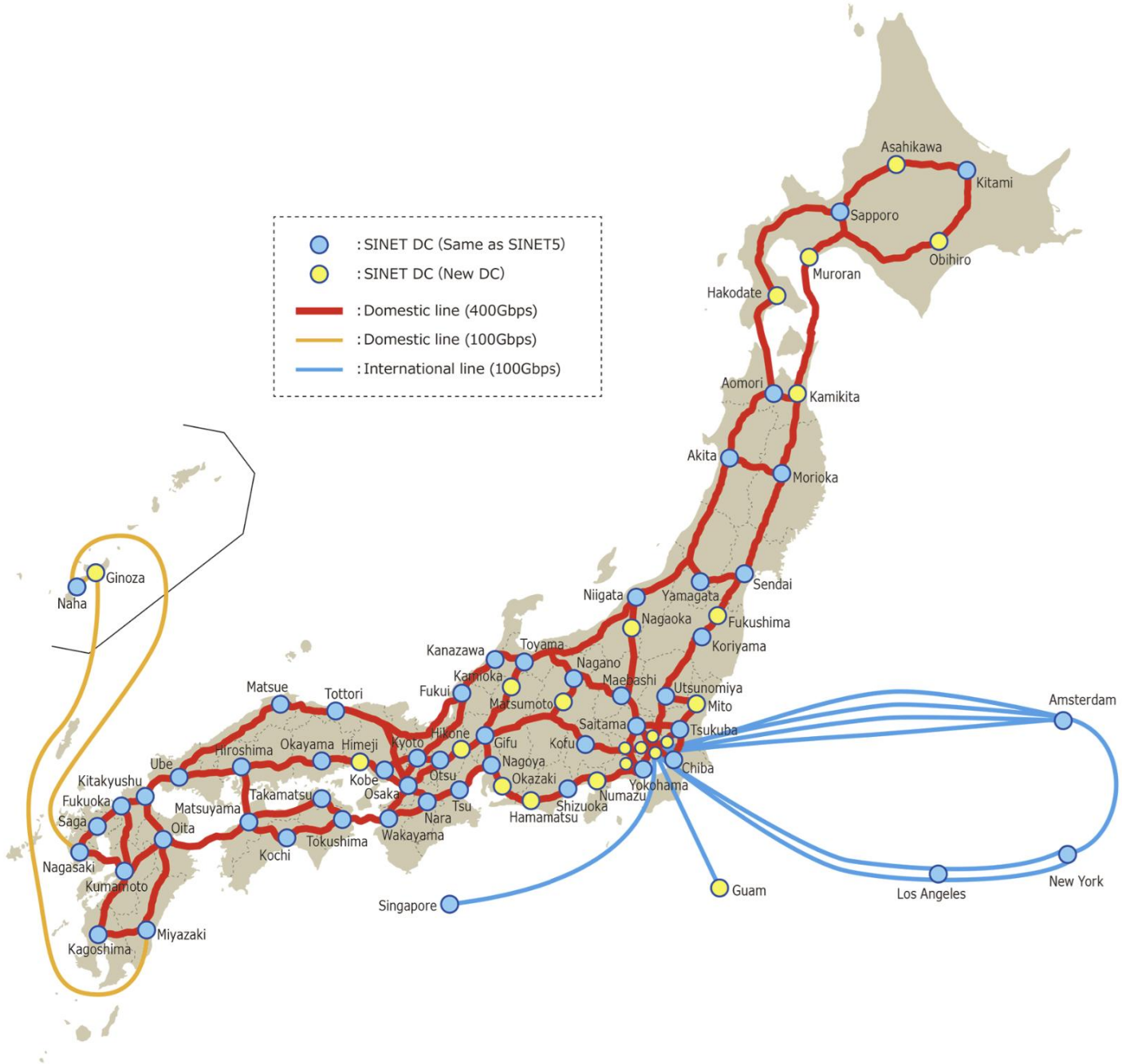
- Belle II is a part of LHCONE
- BNL is connected to LHCONE at 800 Gbps
  - In addition, BNL is also connected to LHCOPN at 800 Gbps (2x400Gbps) (used for between T1s in ATLAS)
- KEK is connected to LHCON at 100 Gbps


LHCONE L3VPN: A global infrastructure for High Energy Physics data analysis (LHC, Belle II, Pierre Auger Observatory, NOvA, XENON, JUNO, DUNE, Experimental Network Research)
CERNET China (Tsinghua University)
CSTNET China
JUNO (Kaiping)
Daya Bay (Shenzhen)
Hong Kong ATLAS T2
Wuhan ALICE T2
IHEP Beijing LHCb T1 CMS T2, ATLAS JUNO T1
Chinese Tier-2 Site Federation LHCb CMS, ATLAS, Belle-II, JUNO,CEPC
Lanzhou LHCb T2
SINET Japan
Hiroshima ALICE T3
U. Tokyo ICEPP ATLAS-T2
Tokyo
SINET Tokyo
BCNET Canada
UVic Belle II-T2
TRIUMF ATLAS T1
TRIUMF SimFraU
CANARIE Canada
Seattle
MOXY (Montreal)
JANET UK
London IC-HEP
RAL-PPD T2
RAL-LCG2 CMS-T1 LHCb-T1 ATLAS-T1 ALICE-T1
Nikhef LHCb-T1 ALICE-T1 ATLAS-T1
NL-T1 Netherlands
EENet Estonia HEPC
Tallinn
NORDUnet Nordic
NDGF ALICE-T2 ATLAS-T1
Helsinki
Cyfronet POZNAN
PIONIER Poland AGH Kraków, U.Warsaw
PSNC
NCBJ Świerk LHCb T1 CMS-T2
ICM-PUB
KIAE-TRANSIT (RU-VRF) Russia
BINP
IHEP Protvino
ITEP, SPBU, MEPHI
JINR CMS T1 Juno
SarFTI
MSU Juno
INR (Troitsk)
RRC-KI ALICE T1
GridPNPI
KIFÜ Hungary xxx
URAN Ukraine Kharkov-KIPT
SANET Slovakia
Karlsruhe GridKA ALICE-T1 LHCb-T1
RWTH-Aachen
DESY Belle II
DFN Germany
KIT CMS-T1 Belle II
GSI
KREONet2 Korea
KISTI Alice T1
PNU
KNU, KCMS
KRLight Daejeon
TEIN
Beijing/ TEIN North
Hong Kong
Singapore
HKIX Hong Kong (HARNET)
ThaiREN Thailand
UNINET, ERX-CHULANET
THAISARN, PUBNET-TH, NSTDA-TH
UNINET-TH, SUT-TH
MyREN Malaysia
PERN Pakistan
NCP-LCG2
PK-CIIT
ASGC Taiwan
ATLAS-T2
SINET
AARnet
NKN
GOREX (U of Guam)
Hawaii
U Neb Lincoln
GPN (Great Plains Net)
TIFR India
INDIACMS-TIFR T2
T3_IN_TIFRCloud
NKN India
IN-DAE-KOLKATA-TIER2
AARNet Australia
UMel
Perth
Sydney
REANNZ (Auckland) New Zealand
U Oklahoma (SWT2) ATLAS-T2
CUDI Mexico
UNAM ALICE T2
TACC CMS-T3
LEARN (Texas Net) USA
U Texas Arlington (SWT2) ATLAS-T2
UNL
REUNA Chile
UTFSM/ CCTVal
RedCLARA, S. America
Panama
Chile
Fortaleza
PTTA / ANSP (São Paulo) (Academic Traffic Exchange point)
SAMPA U. São Paulo ATLAS T2 LHCb T2, ALICE T2
CBPF (Rio de Janeiro) LHCb T2, ALICE T3
RNP/IPÊ / ANSP Brazil
SPRACE CMS T2
HEPGRID UERJ CMS T2
PacWave / PNWG (Seattle)
Peers: ESnet, KREONet2, TEIN
PacificWave/ PNWG
PacificWave (distributed exchange)
ESnet (same VRF as ESnet Europe) USA
BNL ATLAS-T1 Belle II-T1
FNAL CMS-T1
ORNL ALICE-T2
NERSC CMS-T3
ANL ATLAS-T3
LBNL ALICE-T2
SLAC ATLAS-T3
NOX (Boston)
MIT
UMass, Amherst NET2: (North East ATLAS T2)
GPN LEARN
UWisc Madison
AGLT2 UM
AGLT2 MSU
BTAA OmniPoP (Chicago)
UIC
CENIC
UCSD
UCSB
Caltech
UChi (MWT2)
Purdue
Indiana GigaPoP USA
IU ATLAS-T3
UIUC (MWT2)
IUPUI (MWT2)
ND CMS-T3
PacWave (Los Angeles)
Peers: SINET, ESnet, Internet2, TransPAC
SINET ESnet, Internet2
Internet2 USA
Peers: UOK, UFL, CANET, IU, PURDUE, IUPUI, UIC, NORDUnet, GÉANT, AARnet,
StarLight (Chicago)
ESnet, Internet2, CANARIE, KREONet2; GÉANT, GARR, CSTNET
NetherLight (Amsterdam)
CERNLight, NORDUnet2, GÉANT, Russia/KIAE, SINET, NL-T1, KREONet2; NSCC NL, ESnet, PSNC, Internet2 StarLight, CANARIE
SINET GÉANT, CERNLight, SURF
KAUST Saudi Arabia
MAN LAN (New York City)
Internet2, CERN, ESnet, NORDUnet, CANARIE
SINET GÉANT
WIX (McLean, VA)
SOX (Atlanta)
Duke ATLAS-T3
UFlorida
Vanderbilt
AMPath/ AMLight NAP of Americas (Miami)
AtlanticWave (distributed exchange)
GÉANT Europe
Hamburg
Poznan
Dublin
Amsterdam
Frankfurt
Prague
Paris
Vienna
Bratislava
Budapest
Kiev
Chisinău (Moldova)
London
Geneva
Zagreb
Brussels
Bucharest
Lisbon
Marseille
Sofia
Madrid
Milan
GÉANT Open (London) GÉANT, CANARIE, NORDUnet, SINET ESnet
ESnet London Amsterdam CERN/ Geneva
CESNET Czechia prague_cesnet_lcg2, FZU/praguelcg2
CERNLight
CERN Geneva CERN-T0 CERN-T1
Belnet Belgium BEgrid-ULB-VUB BelGrid-UCL CMS T2
RENATER France
IN2P3 CC-IN2P3 ATLAS T1 Belle II JUNO IPHC, SUBATECH
GRIF LPNHE, LAL, IPNO, IRFU, CEA
FCCN Portugal
NCG-INGRID-PT CMS T-2 ATLAS T-2
SWITCH Switzerland
NDGF ATLAS-T1
RedIRIS Spain
PIC-T1
CIEMAT-LCG2, UAM-LCG2
CNAF LHC-T1 Belle-II Juno
INFN Pisa, Napoli
GARR Italy
INFN Bari, Catania, Frascati, Legnaro, Milano, Roma1, Torino
ARNES Slovenia SIGNET xx
RoEduNet Romania UAIC xx, ISS, NIHAM, ITIM, NIPNEx3
GRNET Greece Ioannina CMS T-2
ULAKBIM Turkey Tubitak ATLAS T2
BREN Bulgaria BG05-SUGrid CMS T3
KAUST Saudi Arabia
to SINET to Amsterdam
to CERN
Korea
SINET to Tokyo
Singapore Australia, TEIN
India NKN
Korea
Amsterdam
Geneva, CERN, London
GÉANT London
KAUST Saudi Arabia
Geneva, CERN
GÉANT
LHCONE Map Ver. 11.3, 2025-10-08 – WEJohnston, ESnet, wej@es.net
LHCONE VRF domain/aggregator - A provider network.
Connector network or institution – provides, e.g., an L2 path between VRFs.
Provider network PoP router
Sites that run their own VRF
Exchange point
NREN/site router at exchange point
Communication links: <100G=1.5pt, 100G=4pt, 200G=5pt, 400G=6pt, 800G=7.5pt
Underlined link information indicates link provider, not use
Double dash outline indicates distributed site
Future site
International infrastructure by provider/collaboration
various
AARNet
GÉANT
SINET, Japan, global ring
NA-REX
ESnet transatlantic, USA
SINET/APAN-JP/ SingAREN
ANA-300/400 - Various links provided by CANARIE, ESnet, GÉANT, Internet2, NORDUnet, SURFnet, SINET, IU/NSF
SINET
NORDUnet
KIAE, Russia
KREONet2, Korea
BELLA: GÉANT, et al, RedCLARA, et al
LHCB-T1 LHC ALICE or LHCb site
CNAF-T1 LHC Tier 1 ATLAS and CMS
UChi LHC Tier 2/3 ATLAS and CMS
KEK Belle II Tier 1/2
JUNO JUNO
UNL Sites that are standalone VRFs
NOTES
1) ONLY links involved in LHCONE are shown
2) LHCOPN links are not shown on this diagram
3) For map explanation see "Interpreting the LHCONE Map" at https://www.dropbox.com/sh/padxfo58j0j1raz/AADsB5K8fiSH9FfhCjA4eCtea?dl=0
4) GÉANT and CANARIE have shutdown the peering between their VRF and KIAE, as a result of the Ukraine war.


BNL
ESNET
PacWave
SINET
KEK


LHCONE L3VPN: A global infrastructure for High Energy Physics data analysis
BCNET Canada
UVic
Belle II-T2
TRIUMF
ATLAS T1
SimFraU
SINET Japan
Hiroshima
ALICE T3
U. Tokyo
ICEPP
ATLAS-T2
Tsukuba
KEK
Belle II T1
Tokyo
SINET Tokyo
SINET to Amsterdam
KREONet2
To StarLight
PacWave / PNWG
(Seattle)
Peers: ESnet, KREONet2, TEIN
Peering: SINET, ESnet via Seattle, KREONet2, TEIN
ESnet USA
(same VRF as ESnet Europe)
BNL
ATLAS-T1
Belle II-T1
FNAL
CMS-T1
ORNL
ALICE-T2
NERSC
CMS-T3
ANL
ATLAS-T3
LBNL
ALICE-T2
SLAC
ATLAS-T3
MIT
NA-REX 400G
PacificWave / PNWG
PacificWave (distributed exchange)
GPN
LEARN
To Internet2
UNL, Wisc, AGLT2, UChi, IU, Purdue, UT Arlington, UIUC
(4x400G)
UWisc Madison
AGLT2 UM
AGLT2 MSU
BTAA OmniPoP (Chicago)
UIC
UChi (MWT2)
UIUC (MWT2)
IUPUI (MWT2)
Purdue
Indiana GigaPoP USA
ND
CMS-T3
CENIC
UCSD
UCSB
Caltech
PacWave (Los Angeles)
Peers: SINET, ESnet, Internet2, TransPAC
NA-REX to StarLight
SINET to MANLAN
To ESnet
Internet2 USA
APAN-JP
KREONet
TEIN
TWAREN Taiwan
T3_TW NTU HEP
ASGC Taiwan
ATLAS-T2
JUCC/ SingAREN
SingAREN Open Exchange (SOE) Singapore
Peers: CSTNET, SINET, JGN, TEIN, AARNet, GÉANT KISTI, etc.
SINET
AARnet
NKN
GOREX
To Tokyo
SINET


PSNC
CERN
TENET
SURFnet
NORDUnet
Nether Light
Amsterdam
GÉANT
x4
x3
Lagos
Luanda
Sangano
Cape Town
x2
Seoul
Tokyo
Hong Kong
Asi@Connect
ASNET
100G
100G
Guam
Singapore
SingAREN
ASGC
NKN
Perth
AARnet
Sydney
REANNZ
Auckland
TWAREN
CANARIE
PNWGP
ESnet
CalREN
Internet2
100G×4
West coast
Pacific Wave
MAN LAN
East coast
100G×2
100G×2
Los Angeles
New York
x2
Hawaii
x2
Ankabut
Panama
RedCLARA
Fortaleza
REUNA
Sao Paulo
Santiago
x2
x2
x2
x4
x3
:SINET international lines
※Figure includes 100Gbps lines only for each country.


: SINET DC (Same as SINET5)
: SINET DC (New DC)
: Domestic line (400Gbps)
: Domestic line (100Gbps)
: International line (100Gbps)
Asahikawa
Kitami
Sapporo
Obihiro
Muroran
Hakodate
Aomori
Kamikita
Akita
Morioka
Sendai
Niigata
Yamagata
Nagaoka
Fukushima
Koriyama
Kanazawa
Toyama
Nagano
Kamioka
Maebashi
Utsunomiya
Mito
Fukui
Matsumoto
Saitama
Tsukuba
Matsue
Tottori
Hikone
Kyoto
Gifu
Kofu
Chiba
Hiroshima
Okayama
Himeji
Nagoya
Okazaki
Yokohama
Ube
Kobe
Osaka
Otsu
Numazu
Kitakyushu
Takamatsu
Tsu
Shizuoka
Fukuoka
Matsuyama
Nara
Hamamatsu
Saga
Oita
Wakayama
Tokushima
Kochi
Nagasaki
Kumamoto
Miyazaki
Kagoshima
Ginoza
Naha
Singapore
Guam
Amsterdam
Los Angeles
New York

Data Management by RUCIO in Belle II

- Data is managed by RUCIO
  - Catalogs data sets and their constituent files
  - Catalogs data locations
  - Catalogs data metadata
  - Request the data transfers between storage elements to FTS
    - Typical storage elements are dCache, XRootD and Storm, etc...
    - Sites are responsible for maintaining own storage elements of requested capacity with required bandwidth to LHCONE network.
- FTS initiate data transfers and monitors them.
  - FTS supports WebDAV and XRootD as data transfer protocols.
- For Belle II, BNL runs RUCIO and main FTS while KEK runs another FTS for RAW data export.