Big data in Russian context: An overview

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CREMLIN meeting,
February 15th 2017, Moscow

Research areas (NRC KI)

Current Big Data providers:

1 HEP

- LHC (WLCG – RDIG)

2 Materials science (Nano – Bio)

- Synchrotron source
- Neutron source
- E Microscopy

3 Genomics

4 Brain science

Mega-science

THE PARTICIPATION IN INTERNATIONAL PROJECTS ABROAD

- LHC European Organization for Nuclear Research (Geneva, Switzerland)
- European X-Ray Free Electron Laser (Hamburg, Germany)
- International Thermonuclear Experimental Reactor (Cadarache, France)
- Facility for Antiproton and Ion Research in Europe (Darmstadt, Germany)
- European Synchrotron Radiation Facility (Grenoble, France)

PROJECTS ON ESTABLISHMENT OF MEGA SCIENCE FACILITIES WITH THE INTERNATIONAL PARTICIPATION ON TERRITORY OF THE RUSSIAN FEDERATION

- International Center for Neutron Research based on reactor PIK (Gatchina, Leningrad Region)
- Russian-Italian Project of Tokamak IGNITOR (Troitsk, Moscow)
- Specialized Synchrotron Radiation Source of the 4th Generation
- NICA (Nuclotron-based Ion Collider facility) complex (Dubna, Moscow Region)

e-infrastructure projects

- EGEE: took part in all three of them, as the part of the RDIG distributed Tier-2 infrastructure
- EGI: continuing to act within RDIG, new Tier-1 emerged, so coordination roles expanded
- Grid: not just a resource provider, also security coordination, operations and research (taking part in EGI CSIRT), national Certification Authority for Grid, regional monitoring, operations
- GLORIAD: KI led the RU part for the whole project duration

- **RDIG : part of WLCG**

e-infrastructure evolution

- Data Exchange
- Distributed Data management
- Data Analysis & Visualization
- Modelling & Simulation
- AA

- Both Grid/HTC (since 2003) and HPC (since 2007)
- HTC/HPC at our facilities already converge for some projects (when it is useful, e.g. for LHC and genomics)
- X.509 in the Grid and infrastructure; distributed LDAP used for HPC/cloud users with foreseen expansion to all KI sub-institutions

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ИССЛЕДОВАТЕЛЬСКИЙ ЦЕНТР
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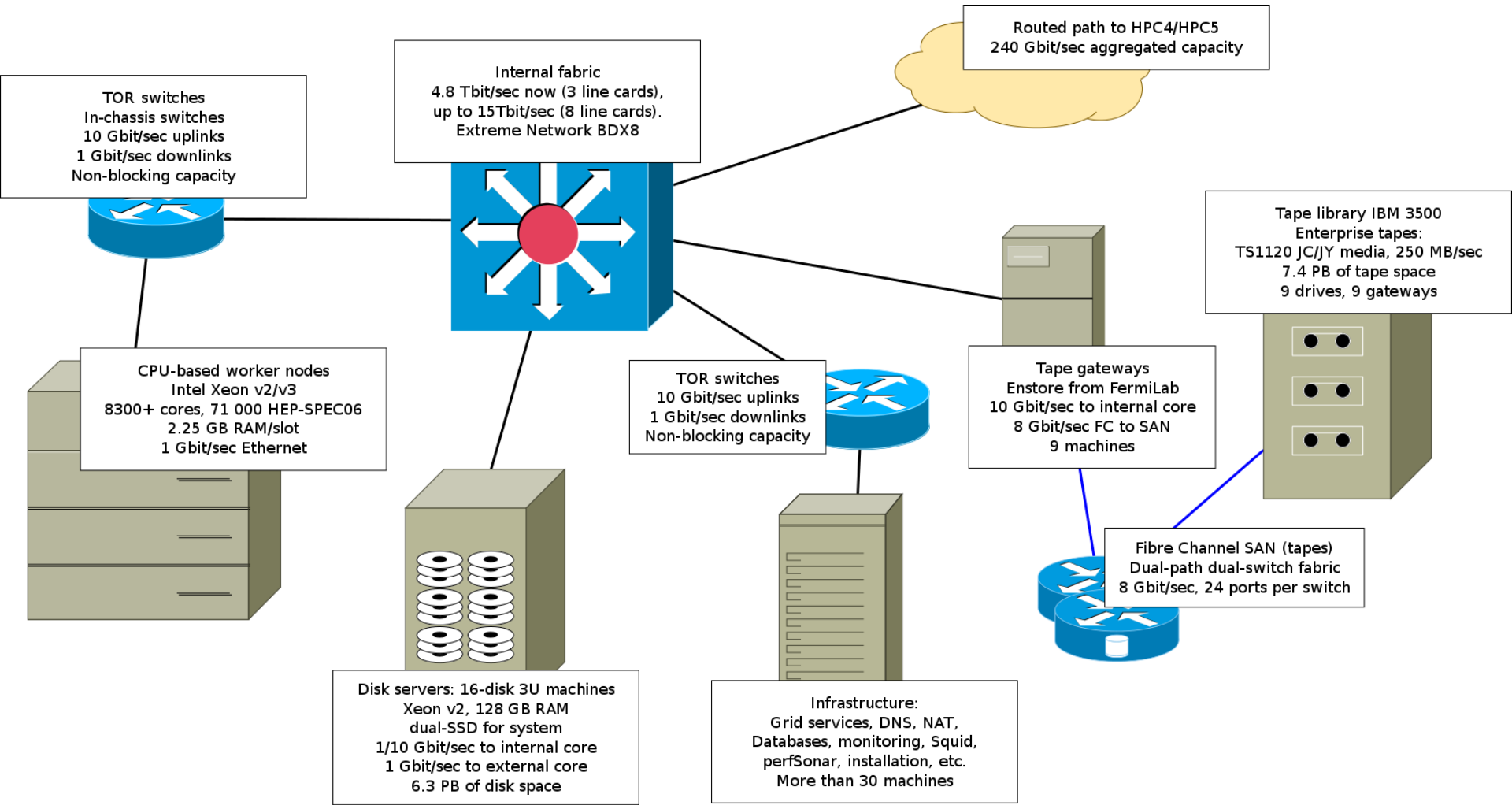
Tier1



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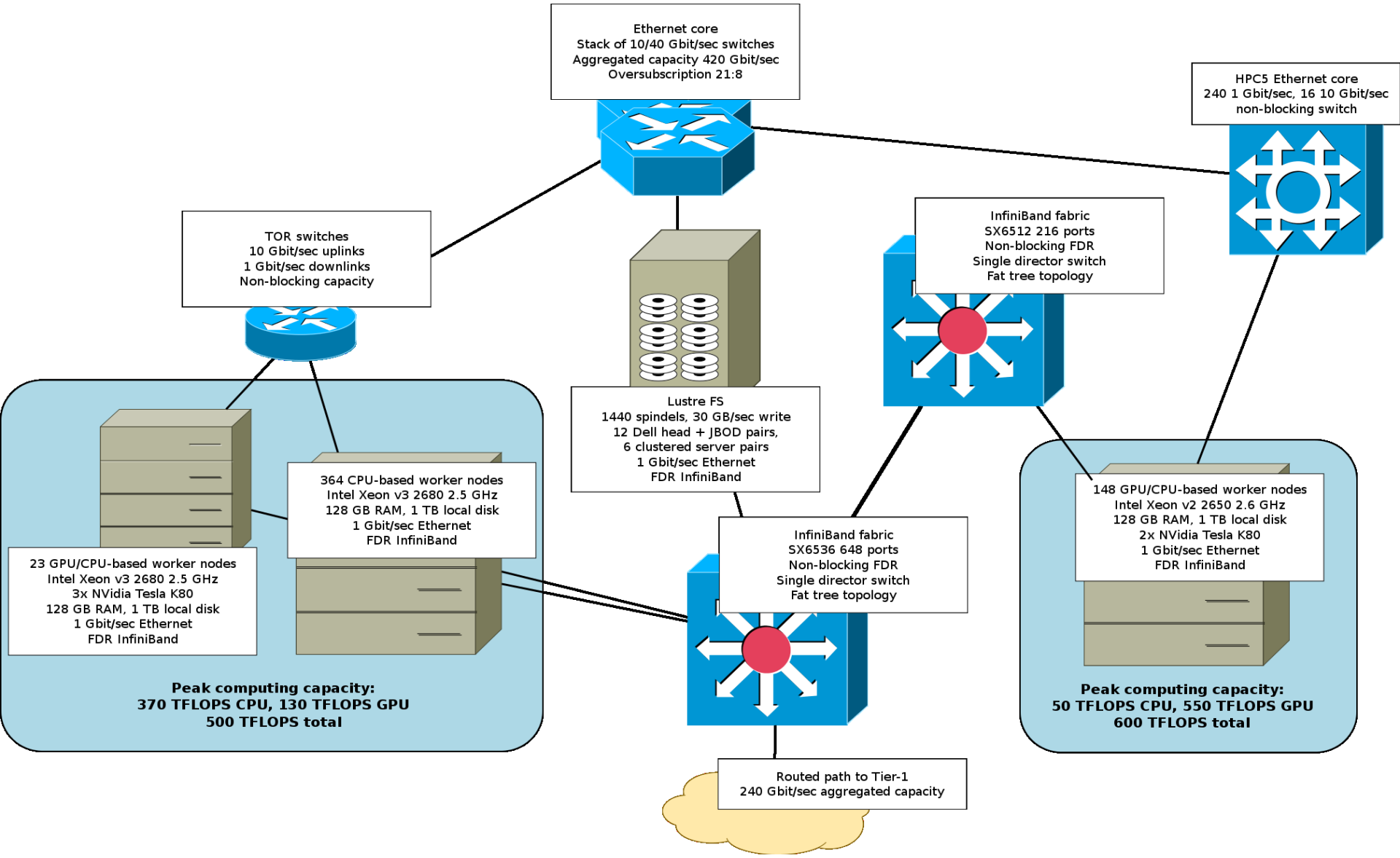
HPC 4&5



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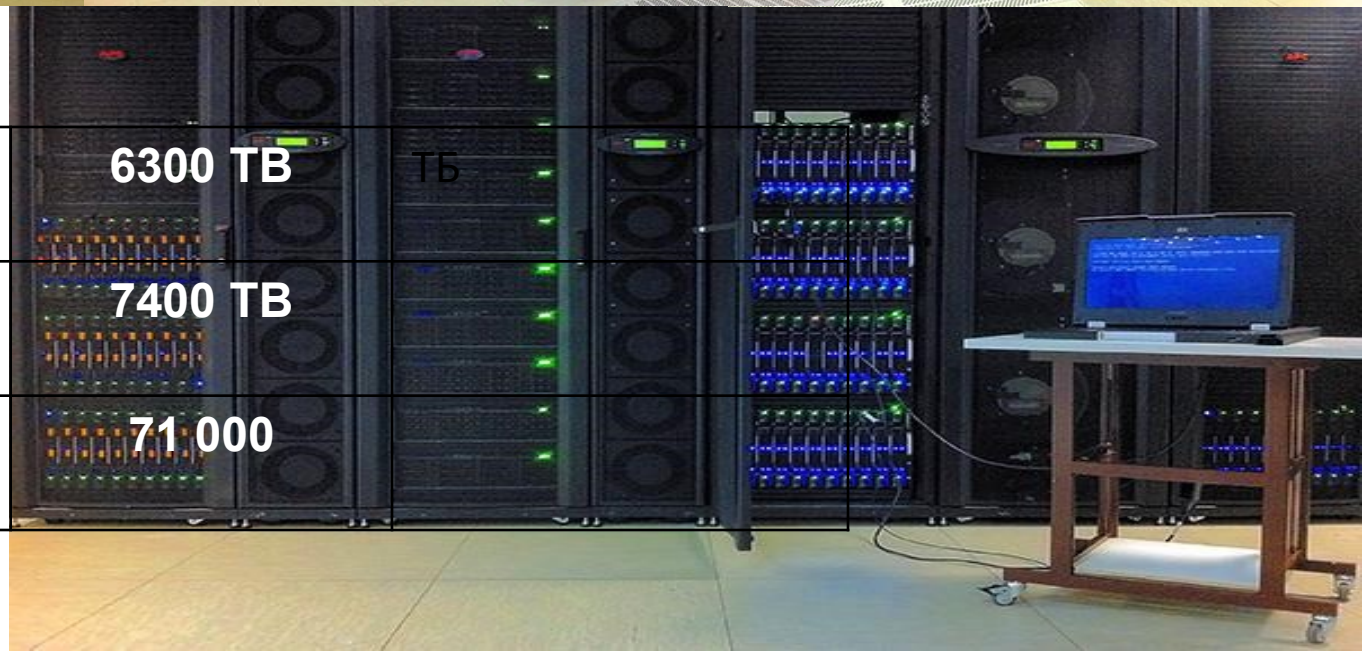
Tier1

DISC	**6300 TB** Тб
TAPE	**7400 TB**
COMP (HEP-SPEC06)	**71 000**



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Networking

- Historically KI is good here: first connection between RU and Internet done from here via Finland
- Runs LHCONE backbone VRF for RU: connects all major Tier-1/Tier-2, peers with most of other VRFs
- We provide general IP and R&E connectivity for all KI sub-institutions: ITEP, PNPI and IHEP (with new ones coming), over 10 Gbit/sec (and growing) of transit traffic
- Network presence at Amsterdam, Budapest, Finland
- Aggregated channel capacity to the rest of the world: 60 Gbit/sec

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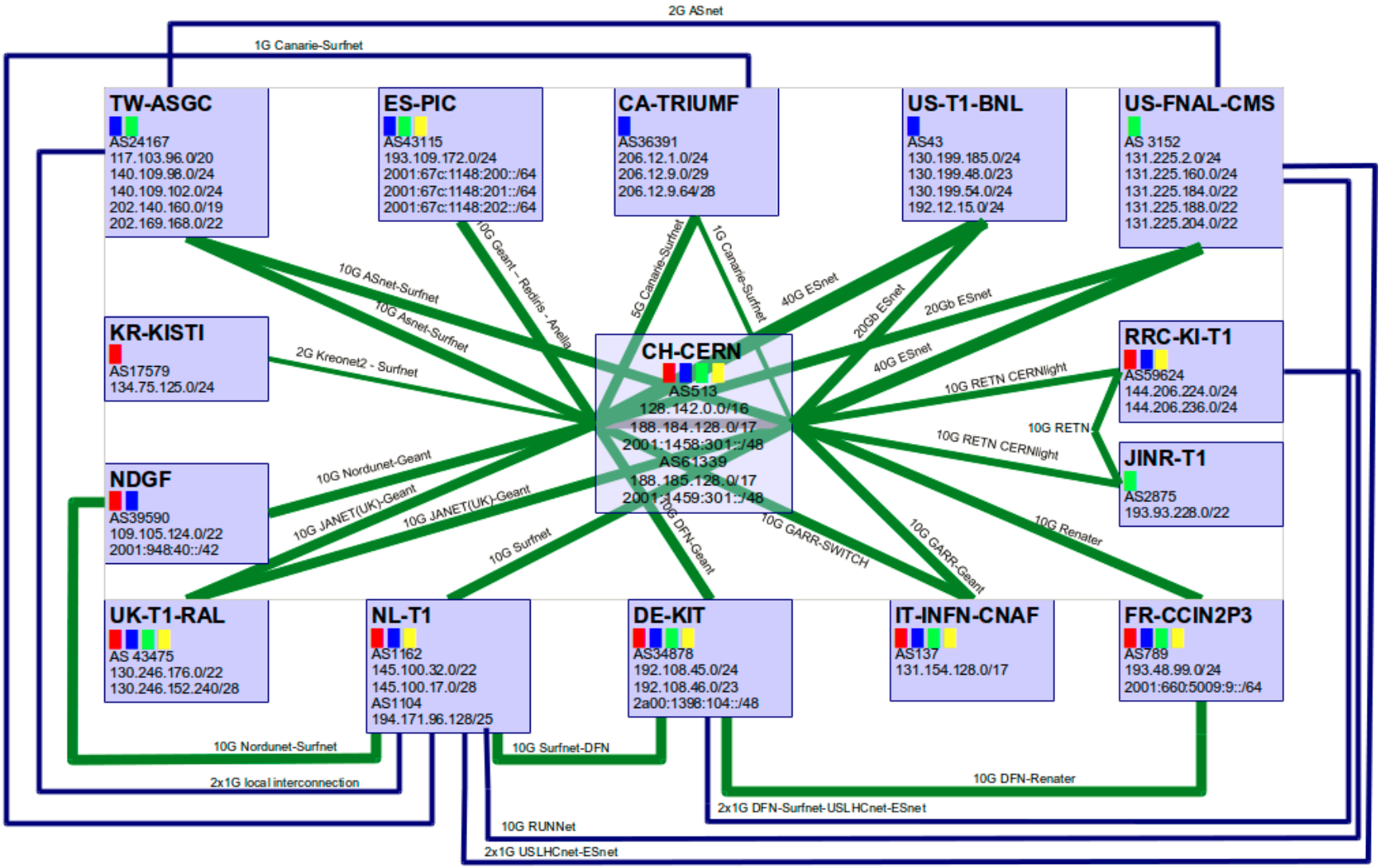
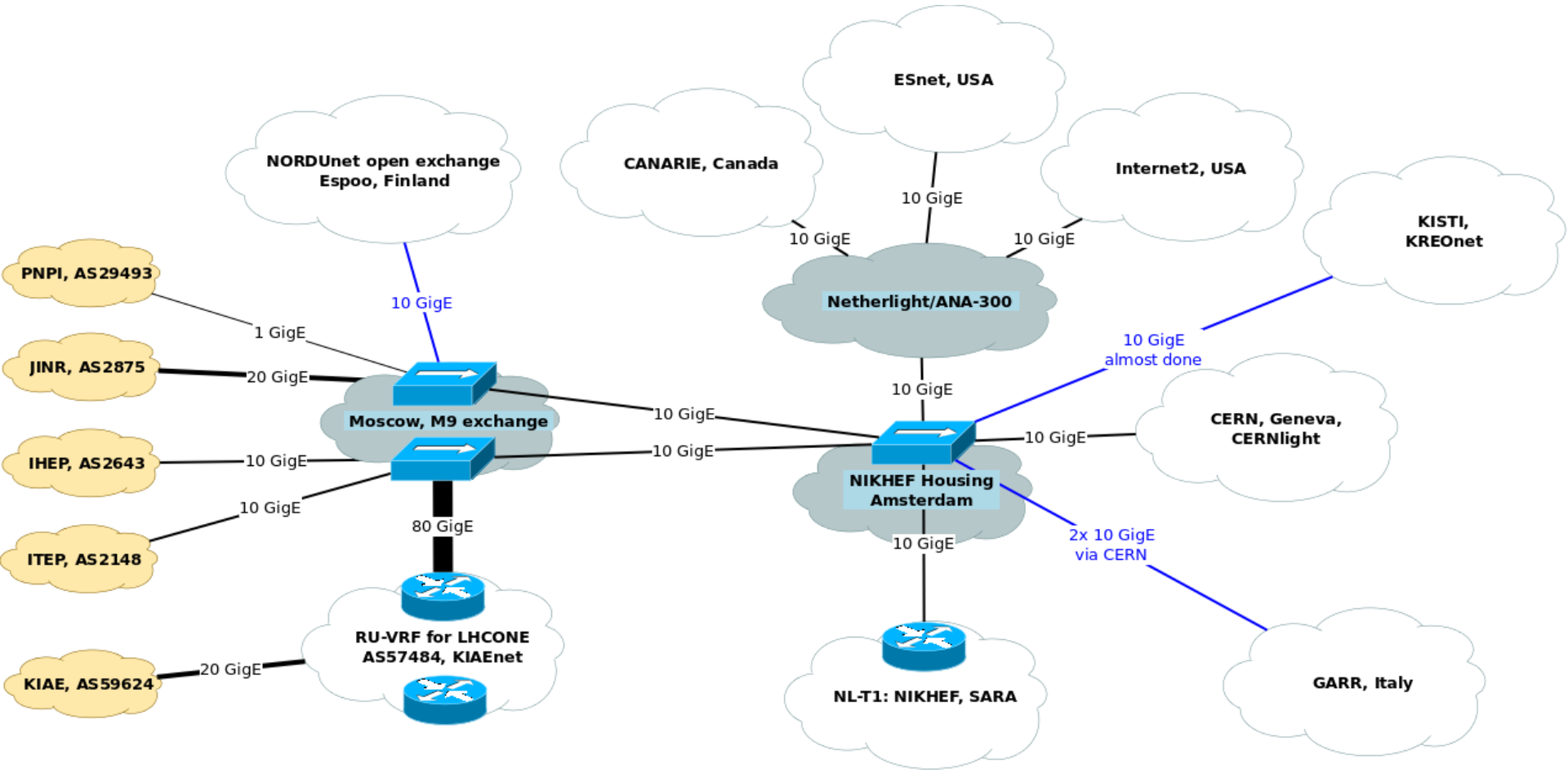
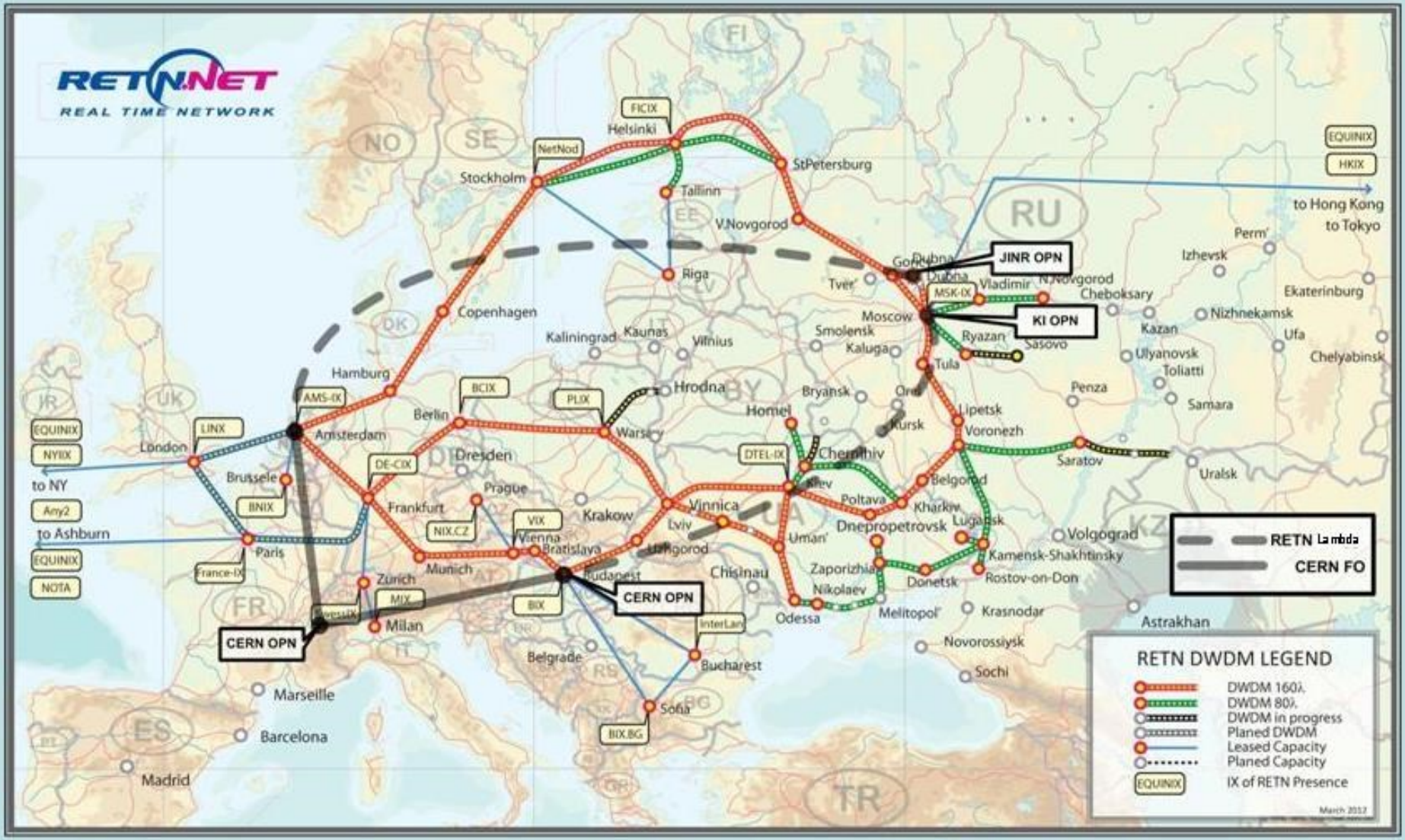
LHCOPN




ESnet, USA
NORDUnet open exchange
Espoo, Finland
CANARIE, Canada
Internet2, USA
KISTI,
KREOnet
10 GigE
10 GigE
10 GigE
PNPI, AS29493
10 GigE
Netherlight/ANA-300
1 GigE
10 GigE
almost done
JINR, AS2875
20 GigE
10 GigE
Moscow, M9 exchange
10 GigE
CERN, Geneva,
CERNlight
IHEP, AS2643
10 GigE
10 GigE
10 GigE
NIKHEF Housing
Amsterdam
10 GigE
80 GigE
2x 10 GigE
via CERN
ITEP, AS2148
RU-VRF for LHCONE
AS57484, KIAEnet
KIAE, AS59624
20 GigE
NL-T1: NIKHEF, SARA
GARR, Italy


RETN.NET
REAL TIME NETWORK
Helsinki
FICIX
NetNod
Stockholm
StPetersburg
Tallinn
V.Novgorod
Riga
Copenhagen
Kaliningrad
Kaunas
Vilnius
Hamburg
AMS-IX
Amsterdam
London
LINX
EQUINIX
NYIIX
to NY
Any2
to Ashburn
EQUINIX
NOTA
Brussele
BNIX
Paris
France-IX
Berlin
BCIX
PLIX
Warsaw
Dresden
DE-CIX
Frankfurt
Prague
Zurich
MIX
Milan
Munich
NIX.CZ
VIX
Vienna
Bratislava
Budapest
Krakow
Hrodna
Vinnica
Lviv
Uzhgorod
Chisinau
BIX
CERN OPN
CERN OPN
InterLan
Bucharest
Belgrade
Sofia
BIX.BG
Marseille
Barcelona
Madrid
Odessa
Nikolaev
Zaporizhia
Dnepropetrovsk
Uman'
Poltava
Kharkiv
Lugansk
Donetsk
Rostov-on-Don
Volgograd
Kamensk-Shakhtinsky
Melitopol'
Krasnodar
Astrakhan
Novorossiysk
Sochi
Homel
Bryansk
Orel
Kursk
Chernihiv
DTEL-IX
Kiev
Belgorod
Lipetsk
Voronezh
Saratov
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Ufa
Chelyabinsk
Tver'
Gorki
Rybna
Vladimir
N.Novgorod
MSK-IX
JINR OPN
KI OPN
Moscow
Smolensk
Kaluga
Ryazan
Sasovo
Tula
EQUINIX
HKIX
to Hong Kong
to Tokyo
RETN Lambda
CERN FO
RETN DWDM LEGEND
DWDM 160λ
DWDM 80λ
DWDM in progress
Planed DWDM
Leased Capacity
Planed Capacity
EQUINIX
IX of RETN Presence
March 2012

Infrastructure development

- Looking at ways to improve our infrastructure for the current and foreseen tasks
- Workbench approach for synchrotron-like use-cases
- Current research for LHC, Run-3 timeline: developing new approach for building Tier-1/Tier-2 (distributed) facilities
- Current research for 2019-2020: next-generation HPC which includes new interconnects (Omni-Path, photonics), liquid cooling, large SSDs (3D NAND & Co), convergence of GPGPU and x86 (Intel MIC), new FPGA and ARMs, dense (watt/rack) packaging

Technologies we use/extend

- CERN EOS and dCache: both as parts of a production in Tier-1 and R&D activity for federated cloud + WLCG/XFEL demonstrators, also CERNbox/EOS as KI infrastructure project
- Job management/scheduling: Torque/Maui, Slurm, CREAM CE, ARC CE
- Storage: Lustre, UFS/ZFS-based NFS, CERN VM FS, HTTP/Rsync/SSH-based access
- Management: HP CMU, CFEngine, Puppet, own deployment engine
- Pipeline engines: for some end-user activity
- Analysis : ANN & ML algorithms

Thank You!