DFN-Services - what is the benefit for large scientific collaborations?

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01.02.2010, DESY Hamburg
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Large scientific collaborations via networks
Large Scientific Collaborations

• A large scientific collaboration has in almost all cases an international dimension

• Their user groups
  – are often related to specific scientific instruments but distributed in different countries and organisations
  – need IT Services (compute and storage) accessible over networks
  – have very different levels of know-how in networking and other IT disciplines
  – need networking support to do their scientific work
Example 1(1): LHC community

- Criteria for large scientific collaboration:
- Specific scientific topic: particle physics grouped around the new LHC@CERN
- Need IT services: summarized in a report on compute strategy
- IT-Know-How: well developed
- Networking necessary?: The whole process of LHC data evaluation is based on the availability of high-speed networks
Example 1 (2): Tier concept

• Data are collected by four experiments at CERN (Tier 0) and immediately transferred to regional Tier 1 centers, which are used as IT competence centers and large storage and compute facilities

• The evaluation starts at Tier 2 /3 centers

• LHCOPN is THE network for the T0-T1 data transfer, designed by the T1 centers, NRENs and CERN
LHC TIER0 – TIER1 OPN, scenario based on work by R. Sabatino (DANTE)
Example 1(4): LHCOPN in Europe

- **T1-T0 primary connection** through „Geant/NREN fibre cloud“
- **T0-T1 and T1-T1 secondary connection** based on path diverse fibre. Secondary connections provide resilience.
- **VPN approach**; permanent data flow with high data volume expected, Grid middleware driving this approach; „low“ prices for optical links due to liberalized situation per country
- LHCOPN is tested and already running under production conditions since roughly 12 months
Example 1(5): T1-T2/T3 in DE

- No full implementation yet but specification for „HEPPI“ covering T1-T2/T3 communication available
- In DE T2- and T3 sites are known – networking them is now on the agenda
- Design principles for this part of networking:
  - T2 sites need 1G access to T1 (which one?)
  - Build resilient ring of core-T2 sites (=cloud) in DE
  - T3 sites access data through DFNInternet service guaranteeing access to this cloud.
- 10 G Link DESY –GRIDKa as part of HEPPI is already working
Example 1(6): HEPPI T2/T3 „cloud“

- GridKA
- L3 VPN
- Other T1? (not connected)
- Access router X-WiN
- Access link X-WiN
- CERN
Example 1(7) Situation in DE

• Open Issues:
  – Which pattern of T2-T1 data flows is expected? Only GridKa or other T1s in other world wide areas as well?
  – Which pattern of T2-T3 data flows is expected?
  – First overload effects can be observed on DFNInternet. In so far it’s time to implement HEPPI which offers scalable (up to 10G) capacity reserved for this large scientific collaboration.
Example 2(1): DEISA

- Distributed European Infrastructure for Supercomputing Applications
- is based on a coupling of eleven national supercomputing centres from seven European countries
- using dedicated network interconnections of GÉANT2 and the NRENs.
Example 2(2): DEISA Network overview

- GÉANT2 footprint
- SURFnet
- UKERNA
- FUNET
- RENATER
- GARR
- RedIris
- DFN/GÉANT
- Frankfurt
- DFN
- HLRIS
- RZG IPP
- sara

Dedicated
10 Gb/s wavelength
1 Gb/s GRE Tunnel

Networking in the DEISA project 11.12.2009

Ralph Niederberger
Example 3: XFEL

- Scientists from 12 countries participating
- Operating 2014
- Up to 10 GB/s per detector
- Total data volume (measurement data) ca. 10PB/a
- Remote access to data probably needed
- Data- / compute-model and hence traffic matrix not known yet, ongoing task to develop it including network infrastructure
Analysis:
What is needed from NRENs?
Analysis (1)

• No catch all approach possible
• Analysis for each large scientific collaboration needed
• Solution is dependant on compute- / data-model of the project
• Problem: As traffic matrix is not available yet, requirements are often unclear
• Conclusion: Use the time to estimate the upcoming network requirements of the ESFRI Projects as a collaboration between scientific collaborations, NRENs and Geant.
• Goal: Shape NREN portfolio of services according to (normally) high-end needs
Possible **generic services** may be (amongst others)

- **IP Service** (shared bandwith)
  - in DFN DFNInternet
- **L3 VPN Service** (dedicated Bandwidth at L3)
  - in DFN specialised part of DFNInternet
- **L2 VPN** (dedicated Bandwidth at L2, wavelength)
  - in DFN DFNVPN
- **PKI** (Publik Key Infrastructure)
  - in DFN DFNPKI
- **Videoconference Service**
  - in DFN DFNVC
DFN Network Services
• (General) DFNInternet:
  Scalable access (2 Mbps – 10 Gbps)
  Redundant access line as standard
  High availability (Target is 99.99%)
• L3 VPN Service (dedicated Bandwith at L3):
  scalable with requirements, very high availability
  through using DFNInternet platform, customized for
  specific user groups
  Example: HEPPI is designed as a VPN with that
  characteristics
• L2 VPN (dedicated Bandwith at L2, wavelength)
  1Gbps, 10 Gps available
  Example: LHCOPN is designed as a L2 VPN
Technology (1): Design targets

• **More performance for services**
  performance increase (same costs) by a factor of 4 since 01/06
  more performance available

**More flexibility for services**
no volume charging (and no usage limitation)
Ethernet as additional access technology
Hybrid PoPs enable VPNs

• **More service availability**
during design for both optical and Internet backbone implicitly
taken into account
Technology (2): X-WiN Fibre Topology

[Map of fibre topology with various cities and networks connected, including Dark fibre, SURFNET / NL, GEANT2, RENATER / FR, PSNC / PL, SWITCH / CH, and others.]
Technology (3): Hybrid network

• Platform available for national VPNs, for the national part of international VPNs and for the DFN Internet Backbone

• Optical technology delivers ample bandwidth, i.e. 160*10G per link

• Costs per 10G link are relatively low (as in Geant2) - in the order of 89 K€/a for long distance (>400 fibre-km) links
Technology (4): IP-Platform

as of January 2010
Technology (5): Redundant Access

User-Site

USER-LAN

MAIN-LINK (ML)

BY-PASS (BP)

X-WiN-Node A

X-WiN-Node B

X-WiN

XR A

XR B

KR
Technology (6): Service availability

Availabilty DFNInternet in 2009 (total)

Verfügbarkeit [%]

100,00
99,95
99,90
99,85
99,80
99,75
99,70
99,65

0 10 20 30 40 50 60 70 80 90 100
relative Anzahl Einrichtungen [%]

1h 0m (99,999%)
4h 0m (99,954%)
8h 0m (99,909%)
8h 46m (99,900%)
12h 0m (99,863%)
15h 0m (99,829%)
18h 0m (99,795%)
21h 0m (99,766%)
24h 0m (99,728%)
27h 0m (99,692%)
30h 0m (99,653%)
Technology (7): Service availability

Monthly Availability (average) DFN Internet 2009

- Mehrfach (red)
- Einfach (blue)

Jan Feb Mär Apr Mai Jun Jul Aug Sep Okt Nov Dec
Technology (8): GÉANT2 footprint

GÉANT2 is operated by DANTE on behalf of Europe's NRENs.
Generic DFN Application Services
A PKI is an infrastructure „generating“ certificates and consisting of the following main components.

- Registration Authorities (RA)
- Certification Authorities (CA)
- Policies
- Directory Service for certificates
- (PKI-aware applications)
PKI (2): Certificate

- Certificate = digital identity card for use on the internet
- Once I have a certificate and use it in electronic communication, everyone can proven that I am who I claim to be

- E.g. on a „chipcard“
  (but: not every chipcard contains a certificate)
PKI (3): Use of certificates

- Confidentiality
  - encryption of documents and e-mails

- Signature
  - signing .pdf documents
  - signing e-mails
  - creating time stamps on documents

- Authentication (not authorization!!)
  - server identification (SSL, https)
  - ID for access to protected websites
  - ID for access to databases etc. (ssh, IPsec)
• DFN offers different kinds of certificates
  – regular, grid, SLCS
  – share of regular certificates is around 98%
  – for the time being grid users need at least two certificates
• Obtaining a certificate is quite easy and about 300 sites use DFN-PKI
• More information
  – www.pki.dfn.de
  – pki@dfn.de
DFNVC (1): H.323-Technology

- Technology is standard based (ITU H.323)
- Integrated in world wide VC infrastructure of addressing capability global dialing system (GDS)
- Access from all kinds of H.323 compatible end-systems via Internet access or ISDN
- High availability by overprovisioning technical resources
- High redundancy of DFNVC resources by placing them into two different locations
DFNVC (2): H.323 service characteristics

- Access to service via portal
- Can be used in “ad-hoc-mode“ i.e. spontaneously (no reservation necessary)
- Optional: streaming
- Optional: password protection
DFNVC (3): H.323 operational data

- Contract wise DFNVC is part of DFNInternet i.e. nearly all institutions in DE have access to the service
- Ca. 4,000 MCU hours aggregated usage per month
- In addition to that ca. 1,000 point-to-point VCs (without MCU but gatekeeper usage) per month
DFNVC (4): Webconferencing

• Adobe Acrobat Connect
• Stable operation
• Positive feedback from users
• Collaboration with H.323 available

• More information: https://www.vc.dfn.de/
Conclusion

• Major NRENs have a similar service portfolio
• NRENs and Geant offer a bundle of generic network and application services for large scale scientific collaboration
• NRENs and Geant look for cooperation with high-end users (i.e. large scale scientific collaborations) to further develop and enhance these generic services