Introduction to the DTN work in GÉANT

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WP6-T2 / Consensus Building

GÉANT Infoshare - Data Transfer Nodes: How Fast can your Data Travel?
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Why the work in GN4-3 on DTNs?

- NRENs had expressed interest during the GN4-3 project proposal phase
- There is good evidence of established best practices, in particular though the “Science DMZ” model published by ESnet in 2013
- Examples of good practices have evolved elsewhere, e.g., WLCG, PRP
- GÉANT has been involved in various tests, e.g. AENEAS (SKA) and to AARNet

- But what is the current position in the NRENs with respect to DTN usage?
Discovering NREN views on DTNs - the DTN Survey

We asked - what problems do your communities report to you around data transfers?

• Lack of high performance storage nodes
• Low expectations
• Firewalls
• Last mile issues

TECHNICAL AND NON-TECHNICAL CONSIDERATIONS

More details in the DTN wiki at https://wiki.geant.org/display/DTN/
Technical issues

• Tests on the GÉANT Testbed Service (GTS)
  • Bare Metal Servers
  • Virtual Machines
  • Containerised infrastructure with Docker
    • Easy way to set up DTNs and test software tools for “long-tail” science
    • GTS supports links up to 10Gbps

• Guidelines for tuning DTN parameters
  • Networking
  • Storage
  • Architecture
Non-Technical issues

• The DTN wiki
  • Use cases
  • Applied methodologies
  • Tools
  • GTS bare metal and containerised tests
  • Dissemination of best practices

https://wiki.geant.org/display/DTN/

• Join the DTN mail list: dtn-discuss@lists.geant.org
Introduction
Transfer of large science data over wide area networks require maximum usage of the network throughout with a combination of transfer tools for high-speed multi-terabyte data movement. The complexity of data sources from multiple and distributed teams and complex science workflow, scaling and spanning resources between multiple sites to store or process the data is becoming a challenge for hardware and software architecture.

To improve data transfer between different sites, dedicated computer systems and architectures are used to improve performance. Data Transfer Nodes (DTNs) are used to overcome this problem. DTNs are dedicated data transfer systems, with specific high-end hardware components and dedicated transfer tools and are configured specifically for wide area data transfer.

In science community many research groups employ a number of DTN instances, with dedicated network pipes for multiple high data file transfers, that bypass network firewall, filtering services, BSD or OS restrictions, etc. The challenge that research groups are facing is “that despite the high performance of the hardware equipment, data transfers are much slower than the bandwidth provided especially with bandwidth beyond 400Mb/s”.

Why do large scale data transfers matter to NRENs?
Research projects, like those related to high energy, geosciences or astronomy, need to transfer large amounts of data to complete calculations and get results in a relatively short period of time. In the past, the physical shipping of hard disks full of data was the fastest option. With the high bandwidth pipes offered by research and education networks and the use of DTN, the file transfer can be easily done just using the appropriate tools. There are many reasons to use dedicated DTNs in research and education networks. For instance:

- To support data-intensive science projects;
- To support short distance transfer of large data and examine it in terms of optimization parameters;
- To support long distance transfers and examine it in terms of optimization parameters;
- To avoid performance problems related to elements like firewalls, bandwidth management equipment, LANs, etc.
- To avoid the problems related to packet loss in TCP, as data transfers are very sensitive to it, specially in long distances (in most cases, TCP does not recover in a reasonable time from packet losses).
The DTN Wiki

DTN Dockerised Environment

This page focuses on the implementation of a dockerised environment to support specific file transfer services (i.e. Xrootd, GridFTP and FOT).

In parallel, the participating NRENs who are interested in the development of the data transfer service can deploy their own DTN servers following some general specifications. More specifications and guidelines can be provided on our main page and a good reference is: http://fasterdata.as.es/science-dmz/DTN/reference-implementation/.

Once this code is ready for testing, the participating NRENs who have servers will be able to do the initial testing and evaluation of the DTN software, which would include criteria like:

- Performance of data transfers for different data workflow characteristics: large bulk transfers, lots-of-small-file transfers, and streaming data transfers.
- Ease of use for end-users.
- Trust negotiation between the end hosts and security of the transfer.

Docker is a set of platforms as a service (PaaS) product that uses OS-level virtualisation to deliver software in packages called containers. Containers are isolated from one another and bundle their own software, libraries and configuration files; they can communicate with each other through well-defined channels. All containers are run by a single operating system kernel and therefore use fewer resources than virtual machines. The service has both free and premium tiers. The software that hosts the containers is called Docker Engine, it was first started in 2013 and is developed by Docker, Inc.

Docker architecture [https://docs.docker.com/get-started/overview/]

The docker architecture is very straightforward. It is a client-server architecture. The client communicates among the Docker daemon that can be installed on the identical or separate remote machine, which does the building, running, and distributing of the Docker containers. The Docker client and daemon communicate using a REST API over UNIX sockets or a network interface.

Figure 1.1: Docker architecture (from https://docs.docker.com/get-started/overview/)
The DTN Wiki

The DTN (Data Transfer Node) Focus Group has performed several tests on GTS (GEANT Testbed Service) in order to get useful results that the NRENs can compare and replicate for their own tests. The following matrix shows a summary of the setup of each test, the parameters tuned, the software installed, and the performance achieved, as well as the links to the information on how to install each software in GTS. Finally, some comments related to the setup and the test are included.

**Setting up DTN tests on GTS**

The “GEANT Testbed Service” (GTS) provides the user with definite experimental infrastructure at the network research community. The aim of GTS is the testing of novel networking and telecommunications concepts; at scale, and across a geographically practical European footprint. In terms of the GTS Users, GTS is intended to aid research teams exploring novel technology-based solutions and requiring a high performance distributed infrastructure. GTS can furthermore be utilized by application and software development teams needing an isolated testbed to demonstrate their designs without affecting live Internet traffic. GTS is normally isolated from the production GEANT network to guarantee the integrity of live applications and can support multiple isolated networks concurrently permitting teams to work without affecting each other (GTS).

The following figure shows the GTS nodes setup map in Europe:

The tests run in the GTS tested were:

1. Virtual Machines, short distance (A40-A40):
   - 1 CPU
   - 2 CPU
   - 4 CPU

2. Virtual Machines, long distance (A40-LON):
   - 1 CPU
   - 2 CPU
   - 4 CPU

3. Bare Metal servers, short distance (A40-A40):

4. Bare metal servers, long distance (A40-LON):

5. Docked environment on bare metal servers, short distance (A40-A40):

6. Docked environment on bare metal servers, long distance (A40-LON):

### Simplified table:

<table>
<thead>
<tr>
<th>Virtual machine</th>
<th>1 CPU</th>
<th>2 CPU</th>
<th>4 CPU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodes/Tests</td>
<td>AMS</td>
<td>AMS</td>
<td>AMS</td>
</tr>
<tr>
<td>iperf</td>
<td>9.20</td>
<td>9.00</td>
<td>9.00</td>
</tr>
<tr>
<td>gridFTP</td>
<td>8.20</td>
<td>8.30</td>
<td>8.60</td>
</tr>
<tr>
<td>FDT</td>
<td>9.22</td>
<td>7.20</td>
<td>1.10</td>
</tr>
</tbody>
</table>

The DTN Focus Group has performed several tests on GTS in order to get useful results that the NRENs can compare and replicate for their own tests using up to four Bare Metal Servers (BMS) with two different setups. Both BMS setups were connected directly with 10Gbps links. It has also produced examples of tests and setups in Bare Metal Server (BMS) and virtualized environments using both VNAs (provided as setup from the GTS testbed administrative page) and Docker.
Today’s agenda:

• "Tuning Parameters for DTN" - Joseph Hill (UVA/ SURF)

• "Dockerised DTN" - Iacovos Ioannou (CYNET)

• "DTN tests using the GÉANT Testbed Service (GTS)" - Damir Regvart (CARNET)

• Wrap-up and open discussion
  • Your input is very valuable to us – is there more work to be done? If so, what?
Thank you

Any questions?

Email us:

gn4-3-wp6-dtn@lists.geant.org

www.geant.org
More information is available in the GÉANT White Paper:

"Data Transfer Nodes (DTN) on the GÉANT Testbed Service (GTS)"

https://www.geant.org/Resources/Documents/GN4-3_White-Paper_DTN.pdf

or

https://www.geant.org/Resources/#white
Presentations from today's infoshare

are available at the events page:

https://events.geant.org/e/DTN/
Future WP6 Events – see https://events.geant.org

16 December 2020 – GÉANT Infoshare
- Orchestration, Automation and Virtualisation in the NRENs. Ready, Steady, Go!

20 January 2021 – GÉANT Infoshare
- Quantum Technologies - Principles, Challenges and Applications

10 March 2021 - Workshop
- European Time and Frequency services - Principles, Challenges and Use cases

24 March 2021 - Workshop
- Workshop on Network Management and Monitoring Tools

14 April – 15 April 2021 - Workshop
- European perfSONAR User Workshop
Thank you

Any questions?

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