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?

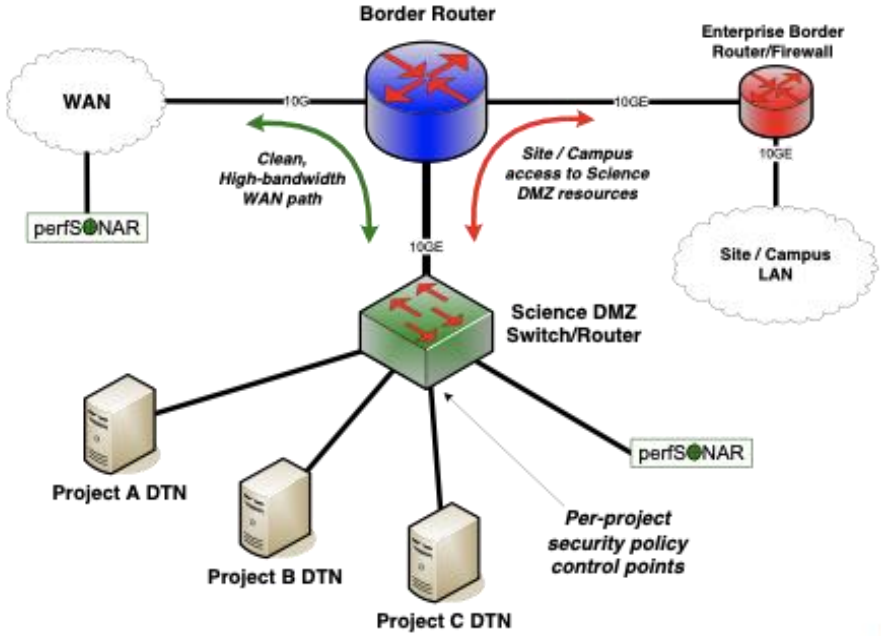
9 December 2020

www.geant.org

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?



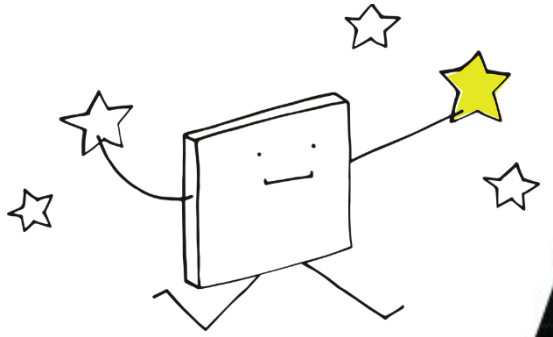


Image by Manfred Steger from Pixabay

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

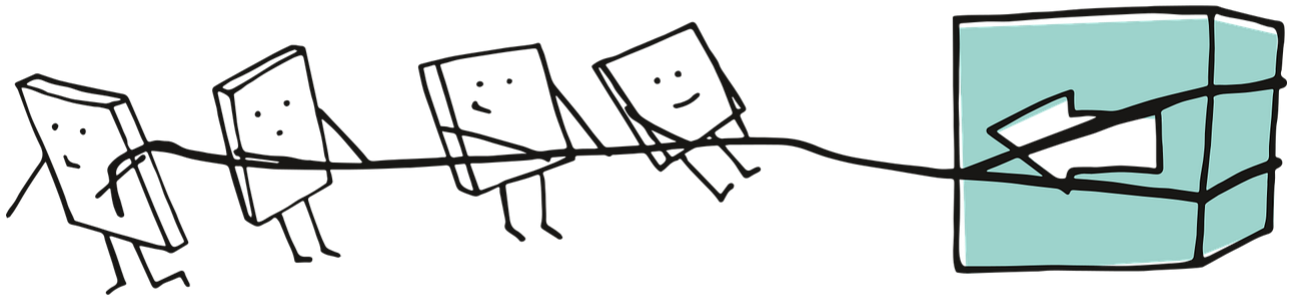
TECHNICAL AND NON-TECHNICAL CONSIDERATIONS

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

Image by Manfred Steger from Pixabay

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



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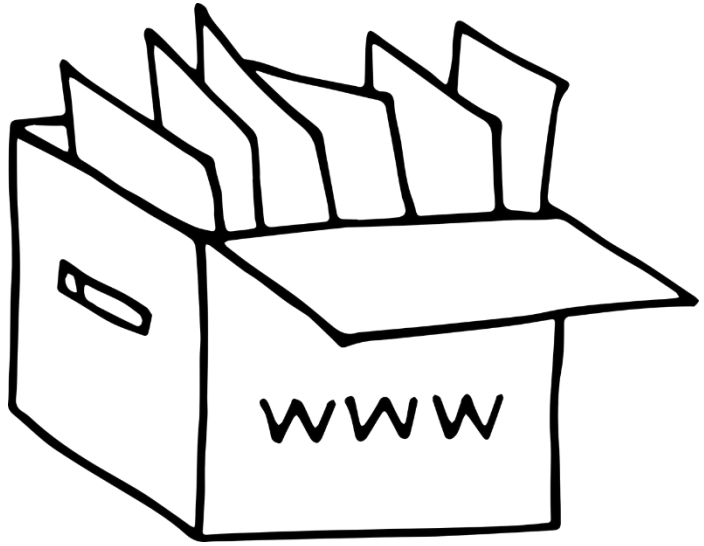
Non-Technical issues

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

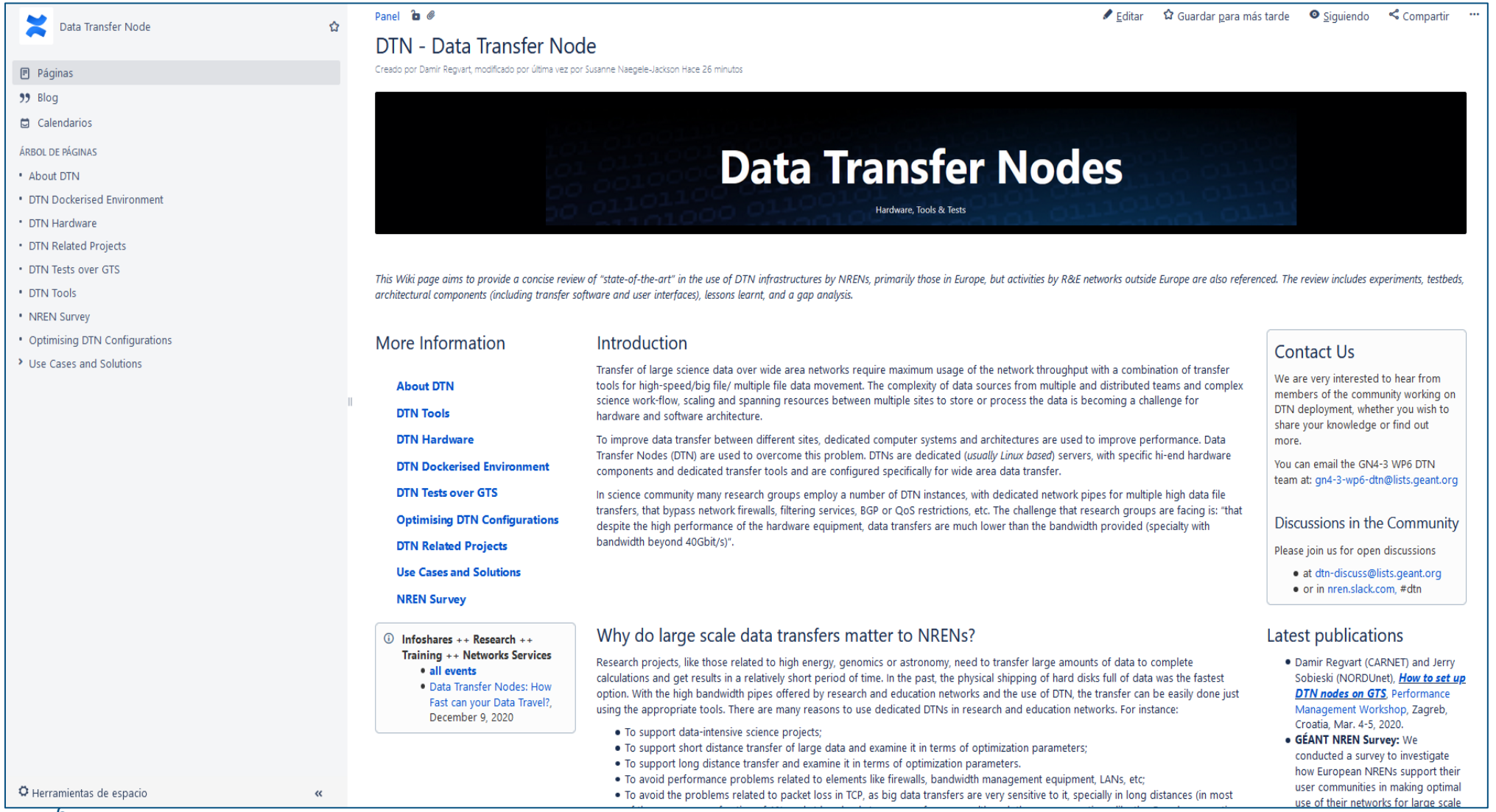
  https://wiki.geant.org/display/DTN/



- Join the DTN mail list: dtn-discuss@lists.geant.org

Image by Manfred Steger from Pixabay

The DTN Wiki



Data Transfer Node

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ÁRBOL DE PÁGINAS

- About DTN
- DTN Dockerised Environment
- DTN Hardware
- DTN Related Projects
- DTN Tests over GTS
- DTN Tools
- NREN Survey
- Optimising DTN Configurations
- Use Cases and Solutions

Herramientas de espacio

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DTN - Data Transfer Node

Creado por Damir Regvart, modificado por última vez por Susanne Naegele-Jackson Hace 26 minutos

Data Transfer Nodes

Hardware, Tools & Tests

This Wiki page aims to provide a concise review of "state-of-the-art" in the use of DTN infrastructures by NRENs, primarily those in Europe, but activities by R&E networks outside Europe are also referenced. The review includes experiments, testbeds, architectural components (including transfer software and user interfaces), lessons learnt, and a gap analysis.

More Information

About DTN
DTN Tools
DTN Hardware
DTN Dockerised Environment
DTN Tests over GTS
Optimising DTN Configurations
DTN Related Projects
Use Cases and Solutions
NREN Survey

Infoshares ++ Research ++ Training ++ Networks Services
- **all events**
- Data Transfer Nodes: How Fast can your Data Travel?, December 9, 2020

Introduction

Transfer of large science data over wide area networks require maximum usage of the network throughput with a combination of transfer tools for high-speed/big file/ multiple file data movement. The complexity of data sources from multiple and distributed teams and complex science work-flow, 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 (DTN) are used to overcome this problem. DTNs are dedicated (*usually Linux based*) servers, with specific hi-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 firewalls, filtering services, BGP or QoS restrictions, etc. The challenge that research groups are facing is: "that despite the high performance of the hardware equipment, data transfers are much lower than the bandwidth provided (specialty with bandwidth beyond 40Gbit/s)".

Why do large scale data transfers matter to NRENs?

Research projects, like those related to high energy, genomics 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 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 transfer 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 big data transfers are very sensitive to it, specially in long distances (in most

Contact Us

We are very interested to hear from members of the community working on DTN deployment, whether you wish to share your knowledge or find out more.

You can email the GN4-3 WP6 DTN team at: gn4-3-wp6-dtn@lists.geant.org

Discussions in the Community

Please join us for open discussions

- at dtn-discuss@lists.geant.org
- or in nren.slack.com, #dtn

Latest publications

- Damir Regvart (CARNET) and Jerry Sobieski (NORDUnet), ***How to set up DTN nodes on GTS***, Performance Management Workshop, Zagreb, Croatia, Mar. 4-5, 2020.
- **GÉANT NREN Survey:** We conducted a survey to investigate how European NRENs support their user communities in making optimal use of their networks for large scale

The DTN Wiki

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DTN Dockerised Environment

Creado por Susanne Naegele-Jackson, modificado por última vez hace 3 horas

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

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.es.net/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.

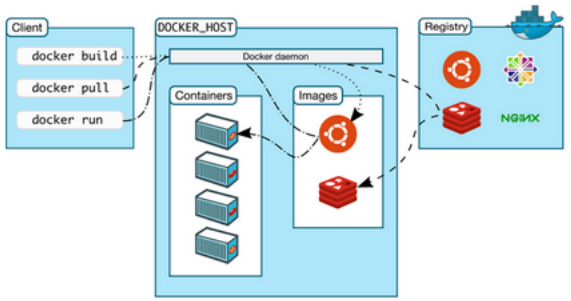

Figure 1.1 Docker architecture [from https://docs.docker.com/get-started/overview/]

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DTN Tests over GTS

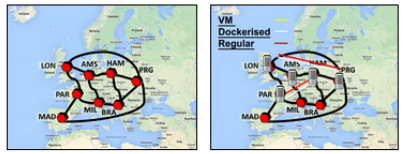
Creado por Susanne Naegele-Jackson, modificado por última vez hace 2 horas

The DTN (Data Transfer Node) Focus Group has performed several tests on GTS (GÉANT 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 set-up or 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 "GÉANT Testbeds Service" (GTS) provides the user with definite experimental networks 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 SDN-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 rationally isolated from the production GÉANT 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 testbed were:

1. Virtual Machines, short distance (AMS-AMS):
   a. 1 CPU
   b. 2 CPU
   c. 4 CPU
2. Virtual machines, long distance (AMS-LON):
   a. 1 CPU
   b. 2 CPU
   c. 4 CPU
3. Bare metal servers, short distance (HAM-PAR).
4. Bare metal servers, long distance (LON-PRA):
   a. R430
   b. R520
5. Dockerised environment on bare metal servers, short distance (HAM-PAR).
6. Dockerised environment on bare metal servers, long distance (LON-PRA).

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 virtualised environments using both VMs (provided as setup from the GTS testbed administration page) and Dockers.

Simplified tables:

Virtual machine	1 CPU		2 CPU		4 CPU	
Nodes/Tools	**AMS-AMS**	**AMS-LON**	**AMS-AMS**	**AMS-LON**	**AMS-AMS**	**AMS-LON**
iPerf	9.90 Gb/s	9.90 Gb/s	9.90 Gb/s	9.90 Gb/s	9.90 Gb/s	9.90 Gb/s
gridFTP	8.30 Gb/s	8.36 Gb/s	8.86 Gb/s	8.47 Gb/s	8.50 Gb/s	7.51 Gb/s
FDT	9.32	7.90	9.19	8.49	8.98	7.77

Hardware testing	Docker	
	R430	**R430**
Nodes/Tools	**HAMB-PAR**	**LON-PRA**
iPerf	9.2 Gb/s	9.0 Gb/s
gridFTP	8.53 Gb/s	8.50 Gb/s
FDT	8.87 Gb/s	8.70 Gb/s
Xrootd	8.00 Gb/s	8.00 Gb/s

Hardware testing	Bare Metal Servers (BMSs)		
	R430	**R520**	**R430**
Nodes/Tools	**HAMB-PAR**	**LON-PRA**	**LON-PRA**
iPerf	9.41 Gb/s	9.32 Gb/s	9.43 Gb/s
gridFTP	8.58 Gb/s	3.30 Gb/s	8.52 Gb/s
FDT	9.39 Gb/s	4.12 Gb/s	9.39 Gb/s
Xrootd	8.00 Gb/s	3.13 Gb/s	7.99 Gb/s

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

The research leading to these results has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 856726 (GN4-3).

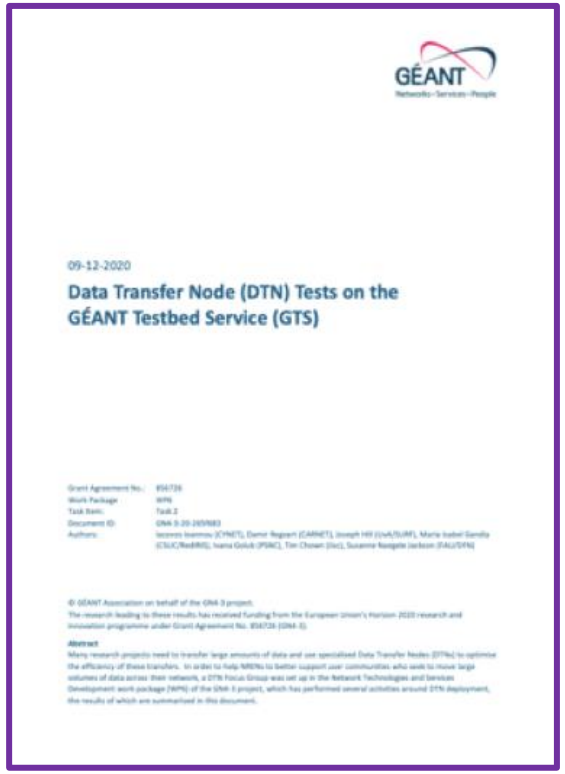
More information is available in the GÉANT White Paper:

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

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

or

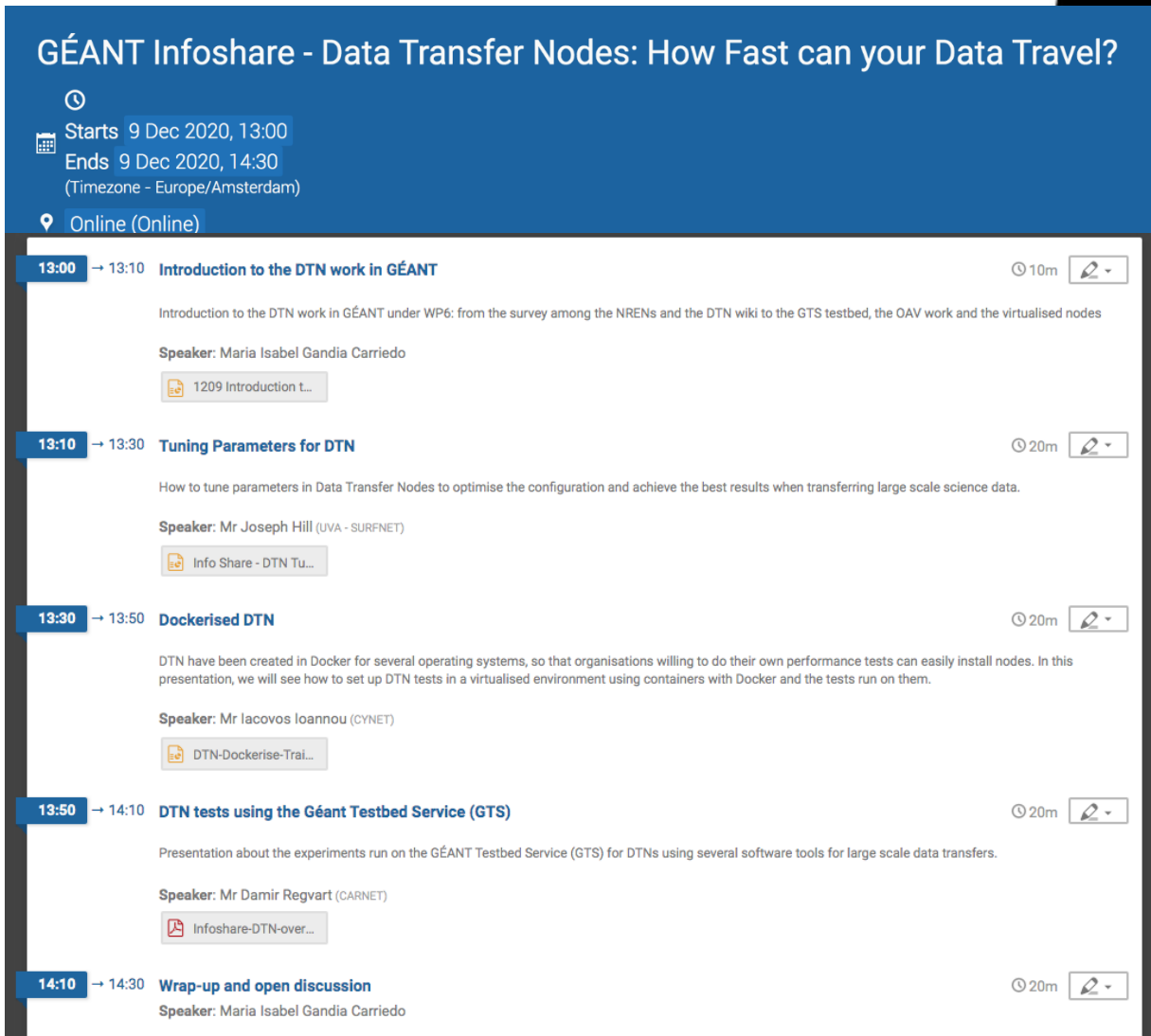
https://www.geant.org/Resources/#white



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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