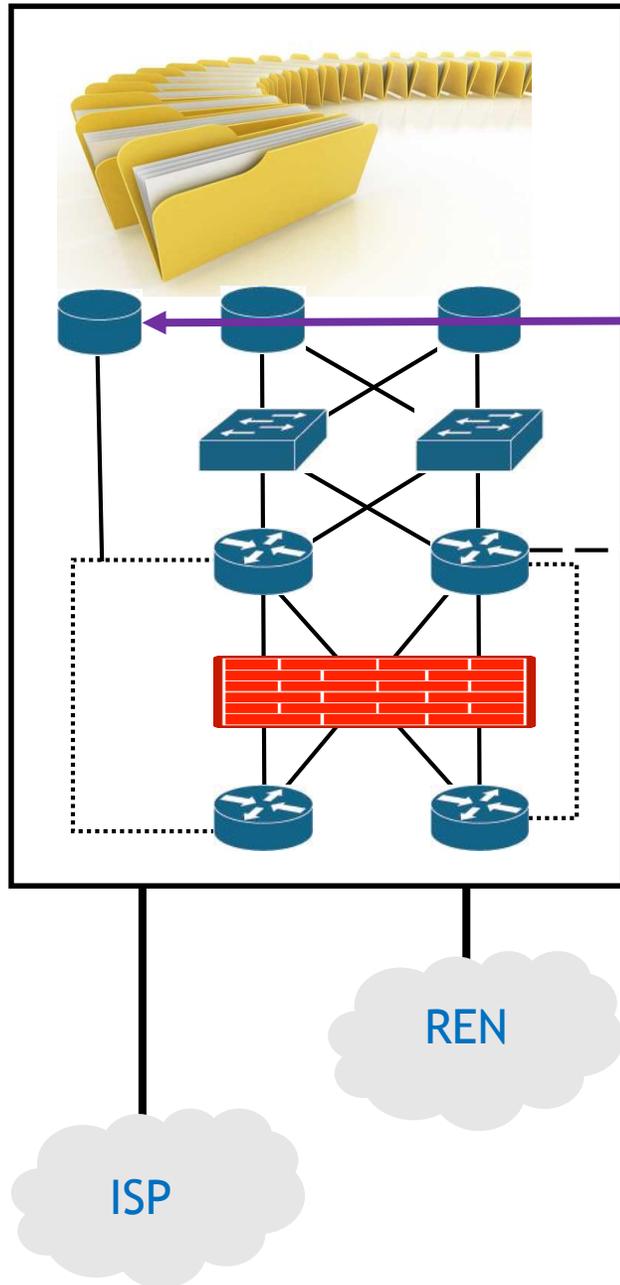# Establishing a common Data Transfer picture

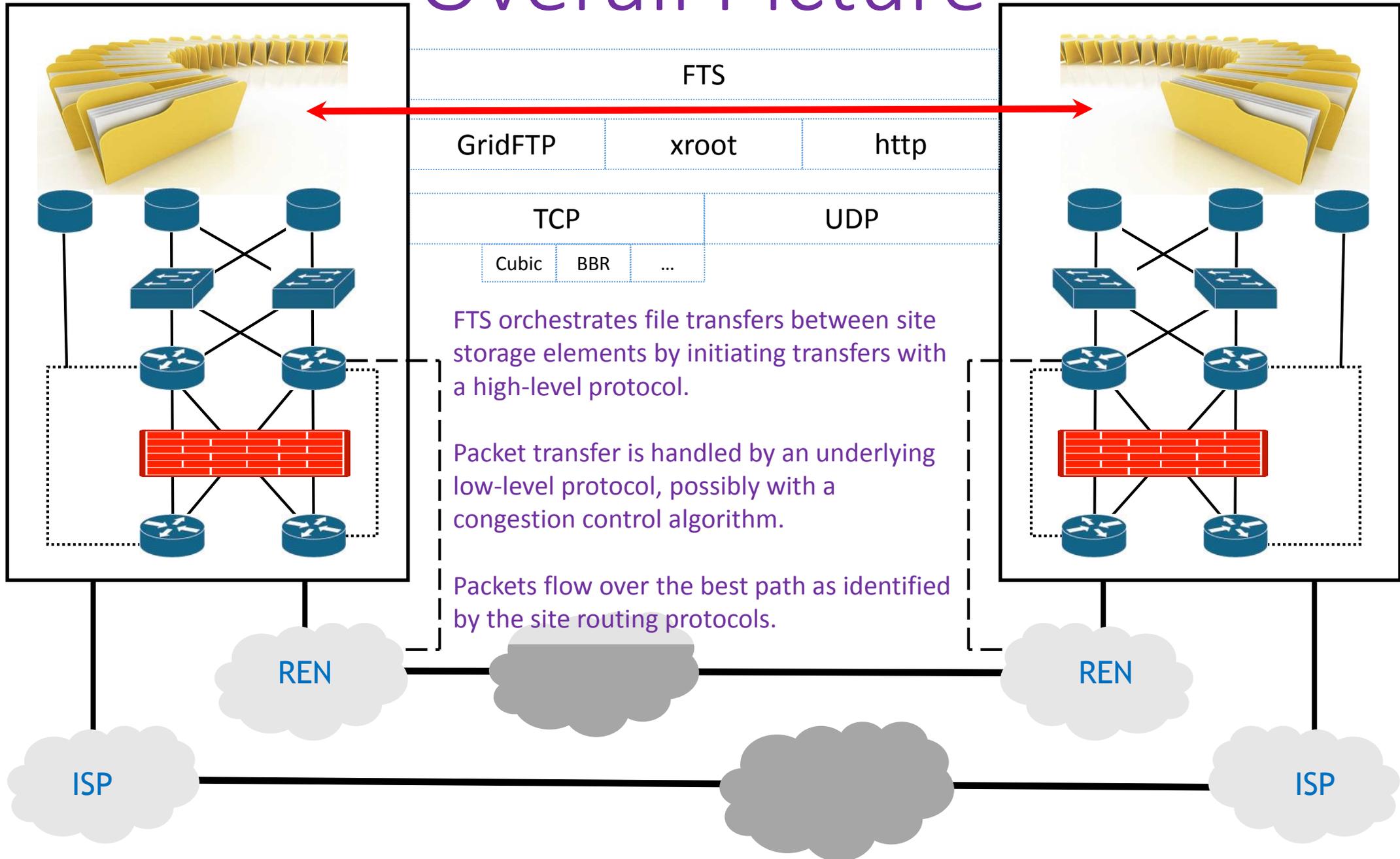Tony Cass, Richard Hughes-Jones, Edoardo Martelli

A Generic Site

Files are hosted by storage servers, some or all of which may be in a
"Science DMZ"
with privileged access to the external network.

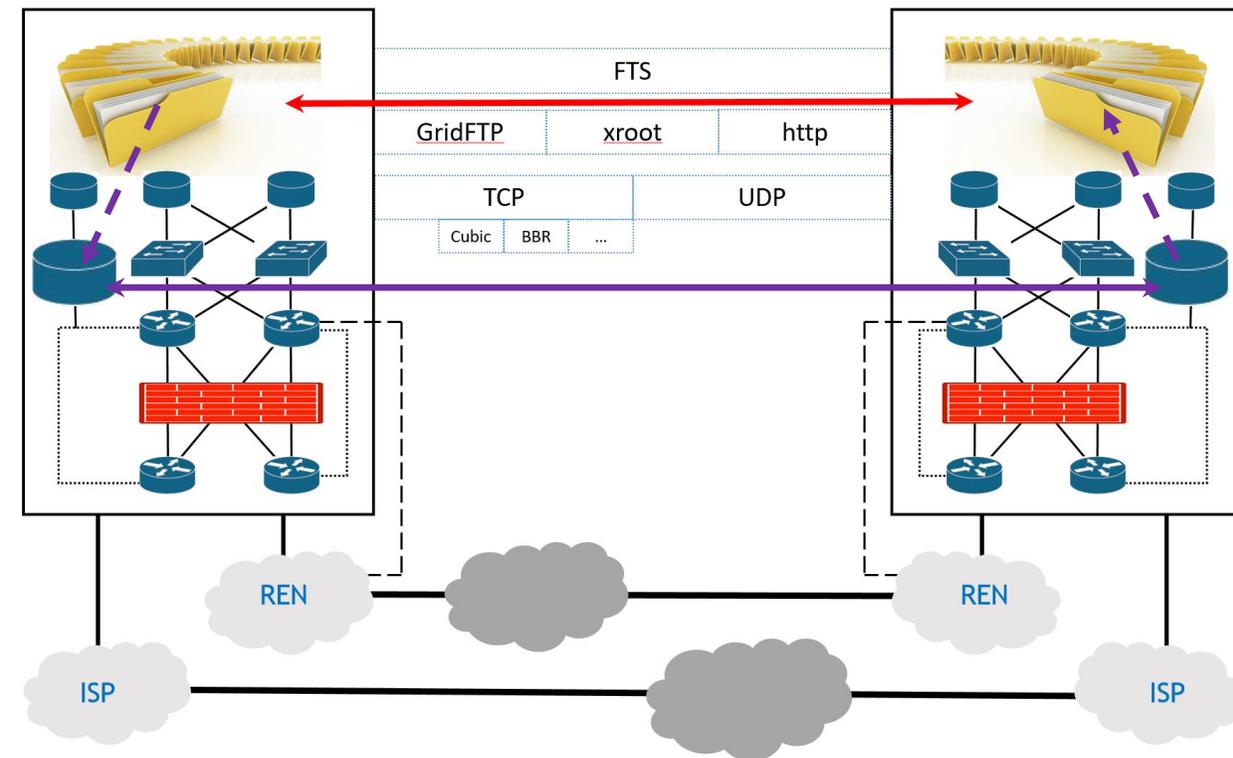The site has one or more connections to the outside world via commercial or research network providers.

Where there is a research network link, there may be a privileged LHCONE or LHCOPN path.

REN

ISP

Overall Picture

FTS

GridFTP | xroot | http

TCP | UDP

Cubic | BBR | ...

FTS orchestrates file transfers between site storage elements by initiating transfers with a high-level protocol.

Packet transfer is handled by an underlying low-level protocol, possibly with a congestion control algorithm.

Packets flow over the best path as identified by the site routing protocols.

REN   REN

ISP   ISP

What is a DTN?

DTN — Data Transfer Node (ESNET)

- For ESNET, a Data Transfer Node is a "purpose built [server] dedicated to the function of wide area data transfer"
  - https://fasterdata.es.net/science-dmz/DTN/

- For most WLCG sites, storage nodes will meet the ESNET DTN definition so having a dedicated DTN will be an overhead as data must be copied to/from this node before the wide area transfer.
  - Having a DTN does, though, offer an advantage if point-to-point circuits are used as there is a clearly defined end-point within the site. Without the DTN, it may be hard to establish the relevant server for a given transfer.
  - And a DTN is appropriate, of course, in other contexts, for example an HPC installation where large scale external transfers are not a major activity.

DTN — Data Transfer Node (GÉANT)
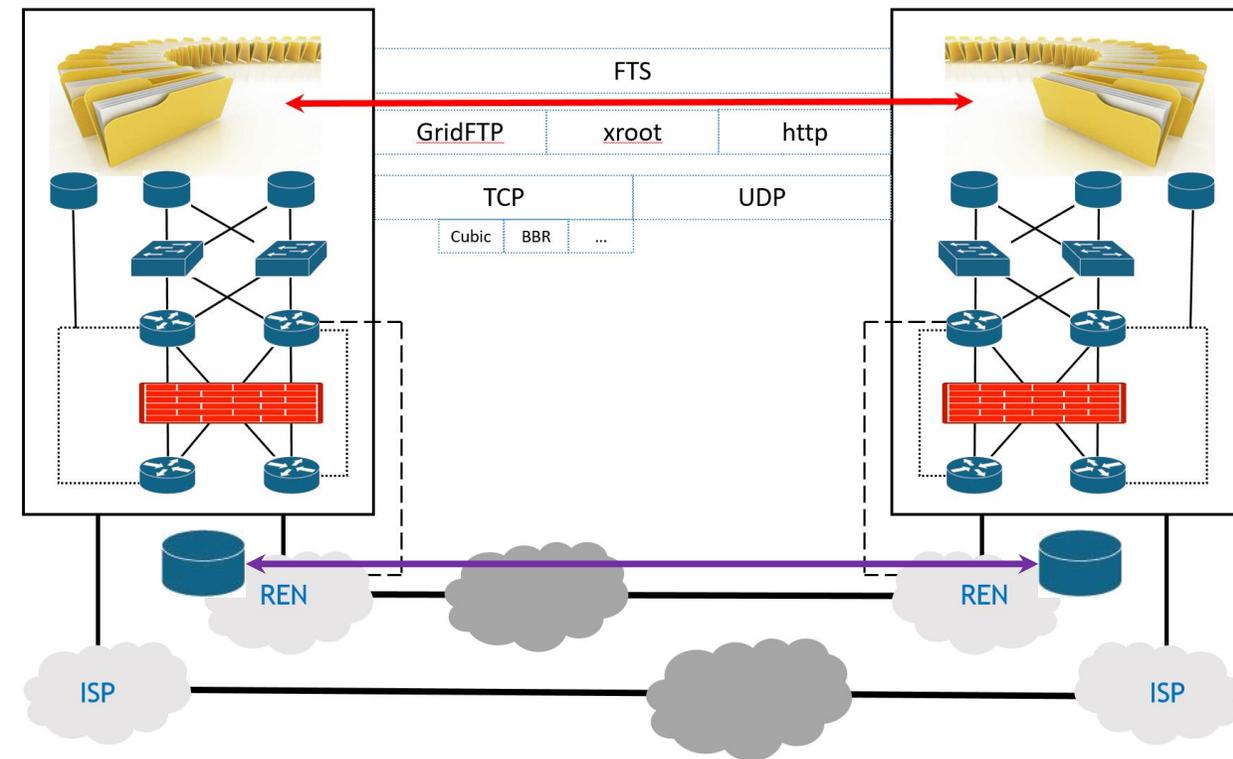
- For GÉANT, a DTN is a server in their network but as close to a site as possible.

- The aim is to have a node that can be used both to set a performance baseline against which transfers between site storage nodes can be compared and to allow users to test file transfer application behaviour.

  - Perfsonar is for regular and long-term monitoring, taking into account intra-site networking issues.

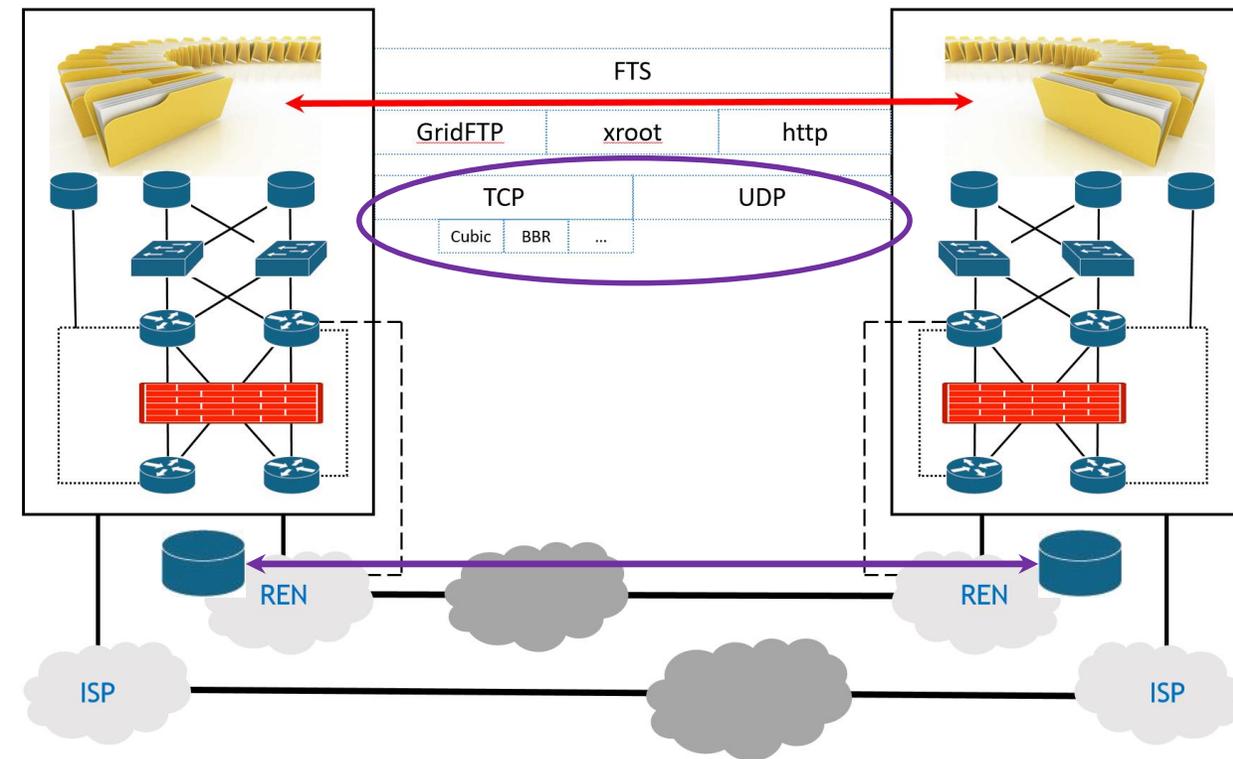 - A GÉANT DTN is more for punctual tests and to enable tests with larger data volumes.

Transfer Optimisation Projects

TPC — Third Party Copy
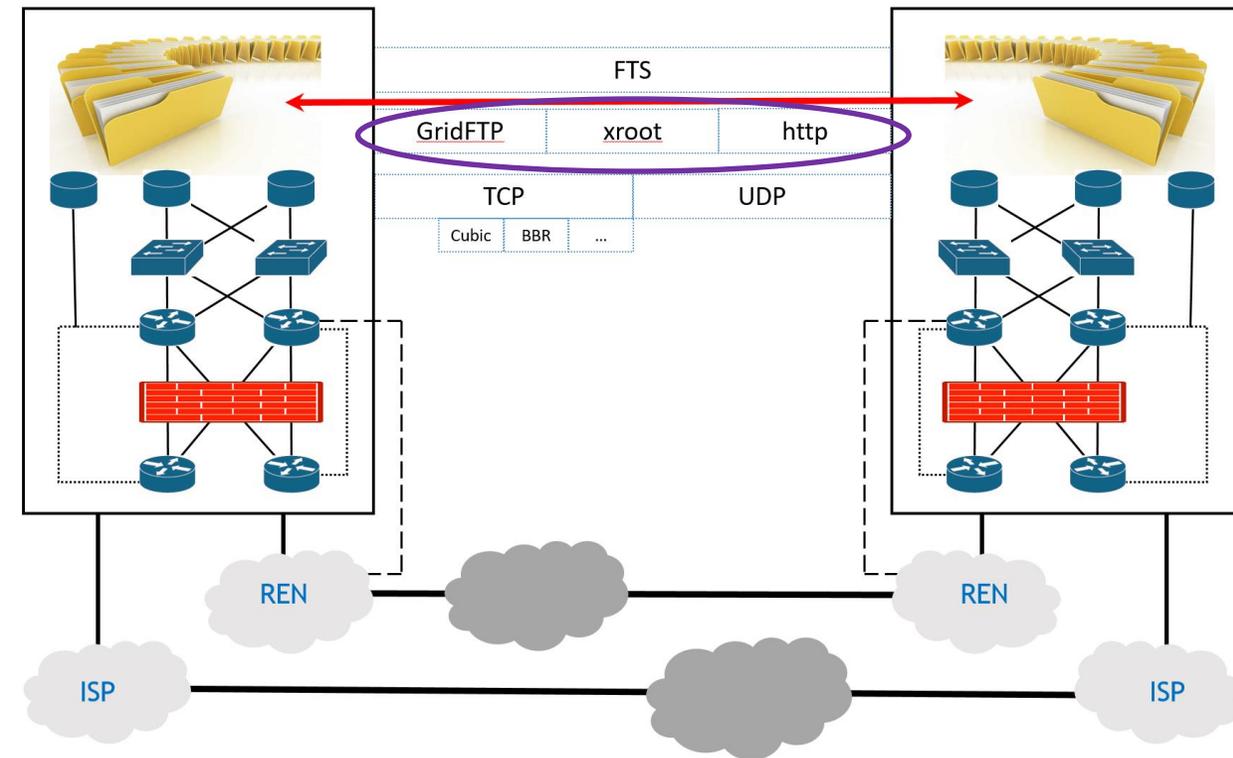
- Investigating high-level protocol alternatives.

- Also much involved in investigation of authentication issues (macaroons et al…)

SKA AENEAS project

- Investigating low-level protocol performance and alternatives, in particular for long haul transfers. To do this, use is being made of GÉANT DTNs at ??? and ???.

- Also studying performance of GridFTP and other high level protocols, including CalTech's Fast Data Transfer (FDT).
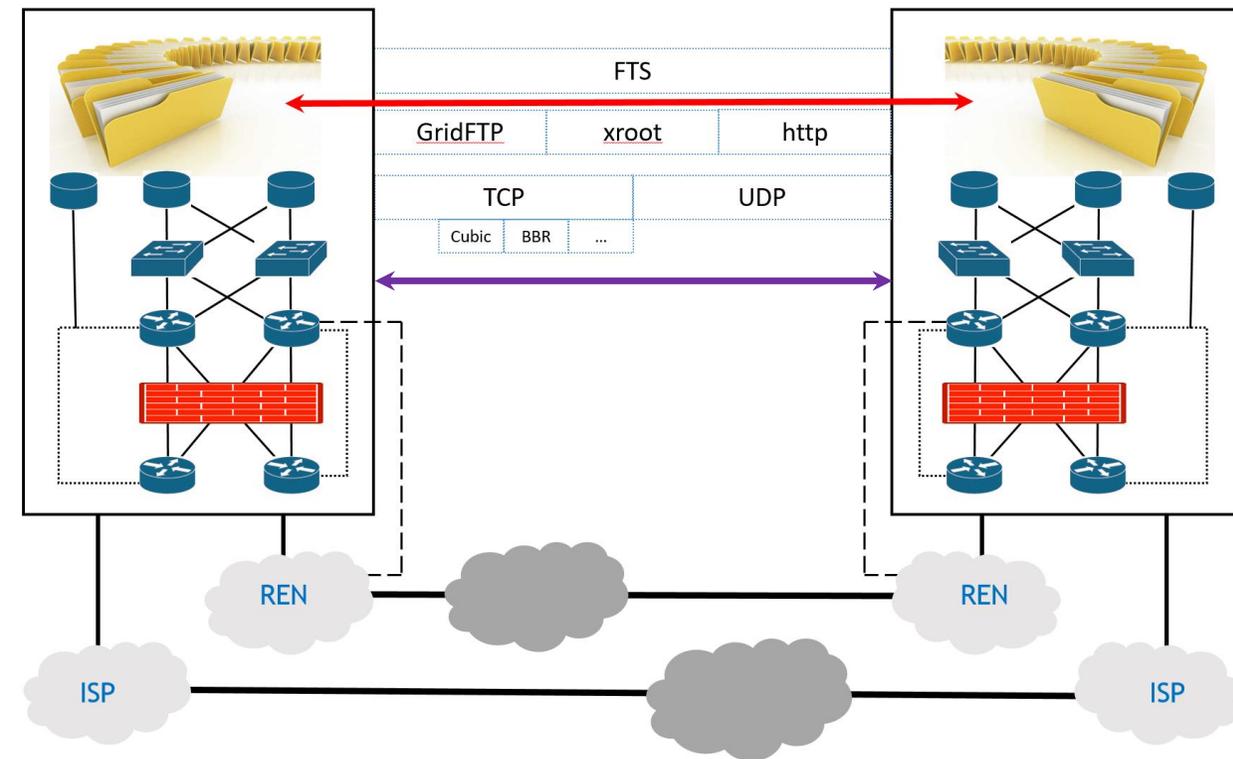
NOTED

Network Optimised Transfer of Experimental Data
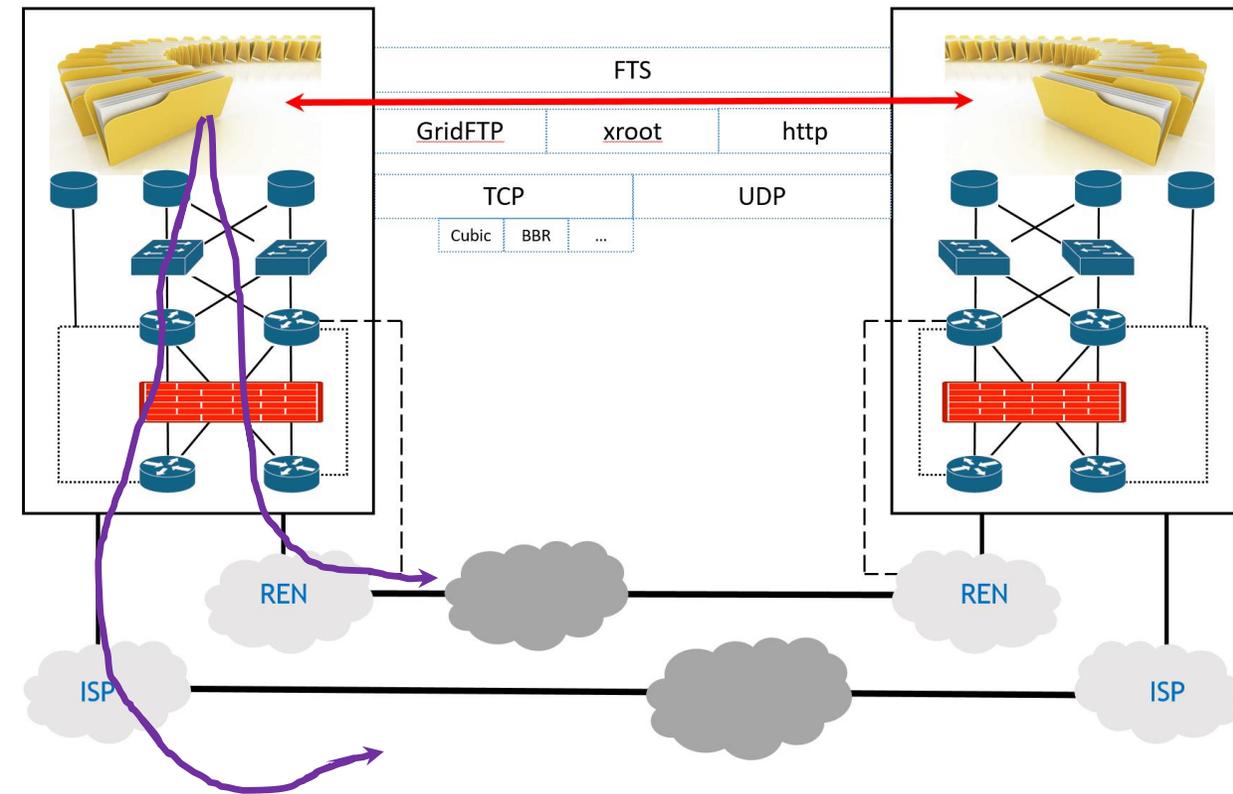
- Exploring options to select outgoing network path from a site to load balance traffic across links
  - smooth peaks
  - increase usable bandwidth
- Uses information from FTS to identify "significant" data transfers

Bandwidth on Demand

- Bandwidth on Demand is a proposal from GÉANT (Mian Usman) which enables adding additional temporary bandwidth.

- CERN/Surfnet evaluating this using information from FTS about significant data transfers to trigger the request.

# Point-to-point channels
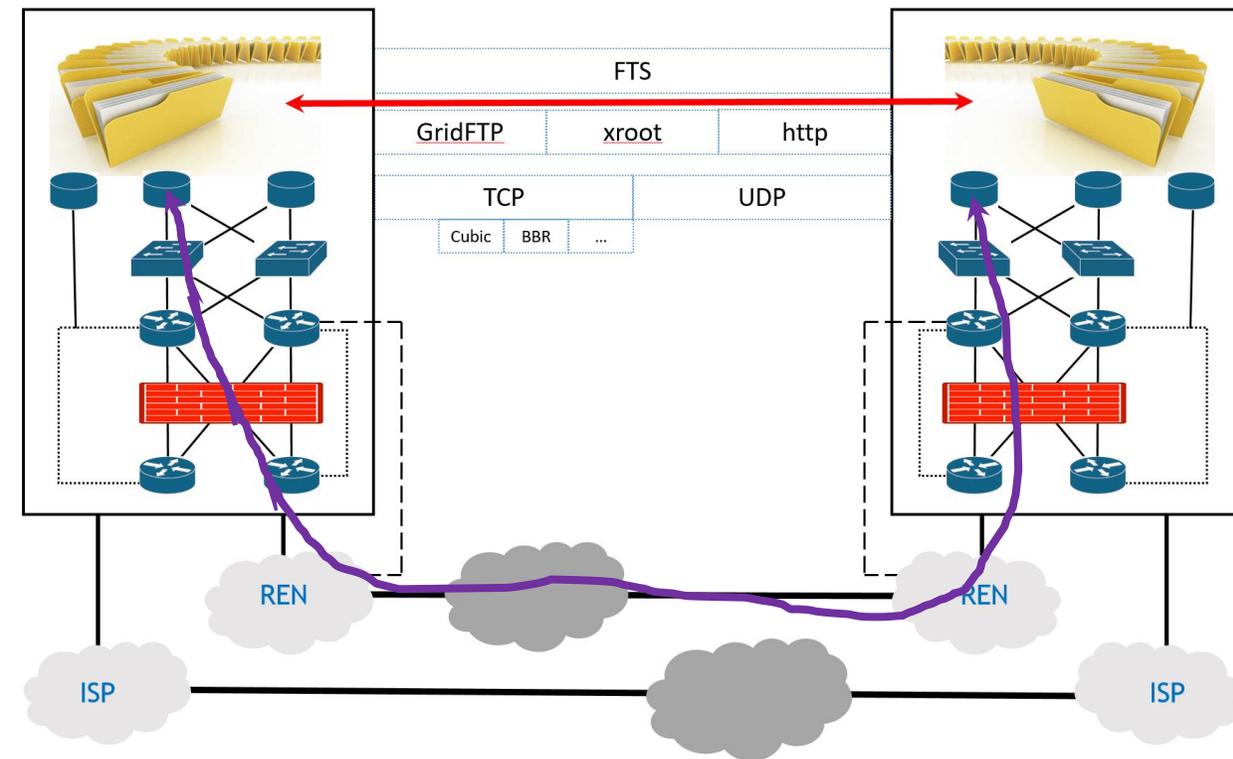
- The LHCONE Point2Point project is looking at options to dynamically create circuits for individual data flows. Two alternatives are considered:
  - SDN based (proposed by Caltech)
  - BGP based (proposed by NORDUnet)

HEPiX Network Function Virtualisation Group
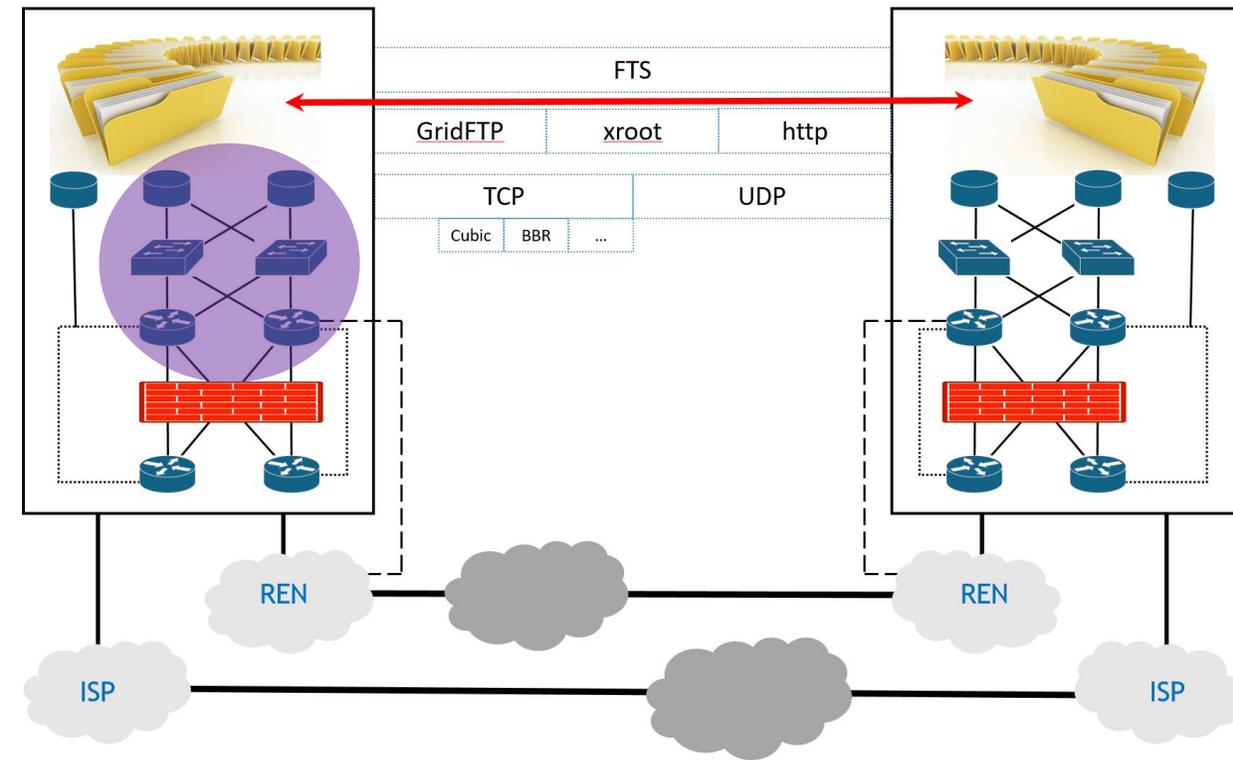
The HEPiX NFV working group is studying the use of SDN technologies to optimise network performance and enhance network flexibility within a site.
This relates more to network traffic between CPU nodes (or between a CPU node and a local storage server) than to external data transfers.

Cloud Service Provider (CSP) connection optimisation

FTS

GridFTP	xroot	http

TCP	UDP

| Cubic | BBR | ... |

REN

ISP   ISP

Cloud eXchange Point
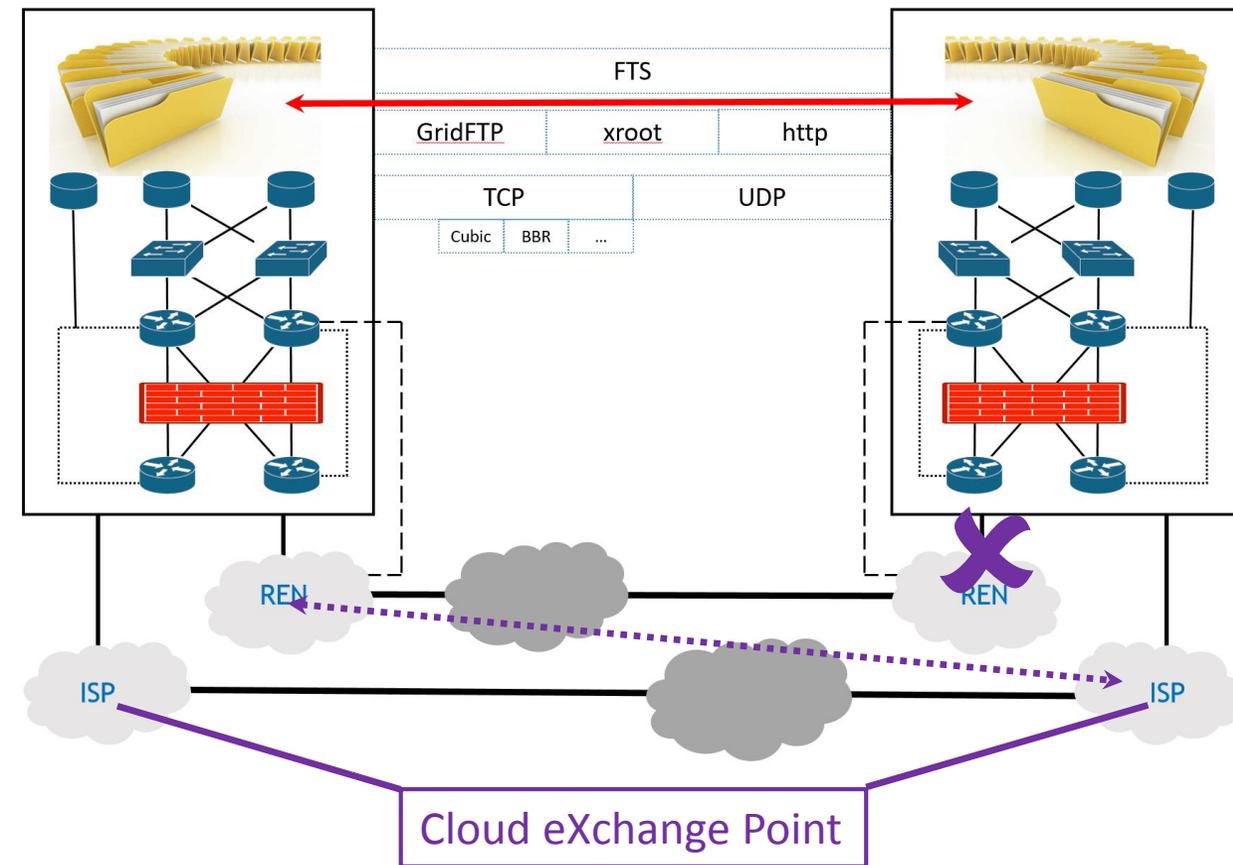
- A CSP has no direct connection to a research network. Options for optimising connections to a site include
  - Arranging privileged links to a REN[1]
  - Ensuring both site and CSP have connections to an exchange point guaranteeing high speed connections

[1] Various options have been proposed, with some under test by GÉANT and ESNet. Also, as part of the Helix Nebula project, DFN provided TSystems with a L2 circuit from one of their border routers to a router in GÉANT's German POP. Whilst an NREN normally provides L3 transit to GÉANT for a customer, in this case DFN was simply a carrier with no influence on the IP routing.