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File Transfer Service

FTS news and plans

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on behalf of the FTS team

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File Transfer Service

Overview

- FTS intro
- FTS architecture & components
- Multiprotocol support: gfal2
- 2018 outcomes
- 2019 plans

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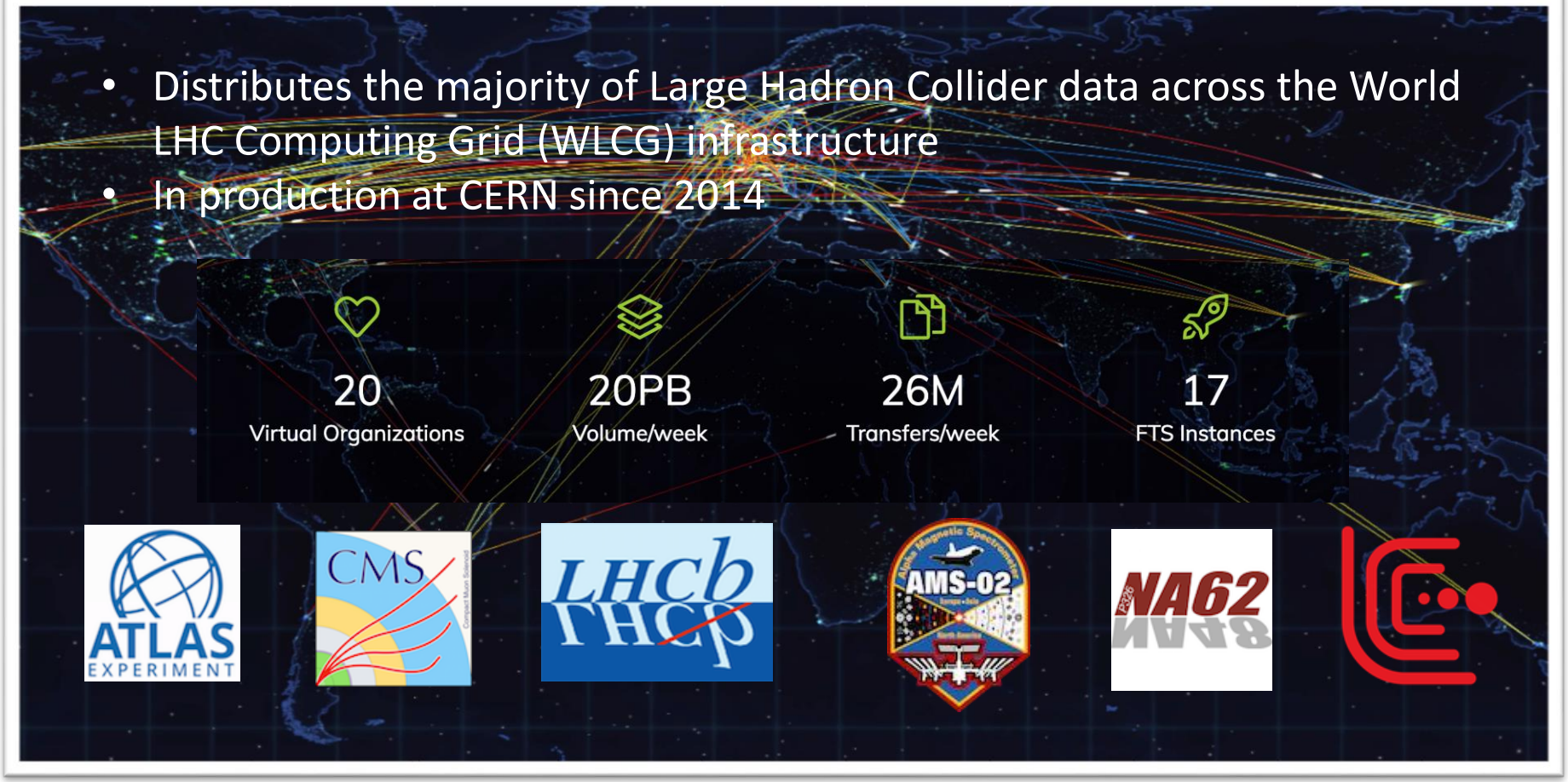
File Transfer Service

- Distributes the majority of Large Hadron Collider data across the World LHC Computing Grid (WLCG) infrastructure
- In production at CERN since 2014



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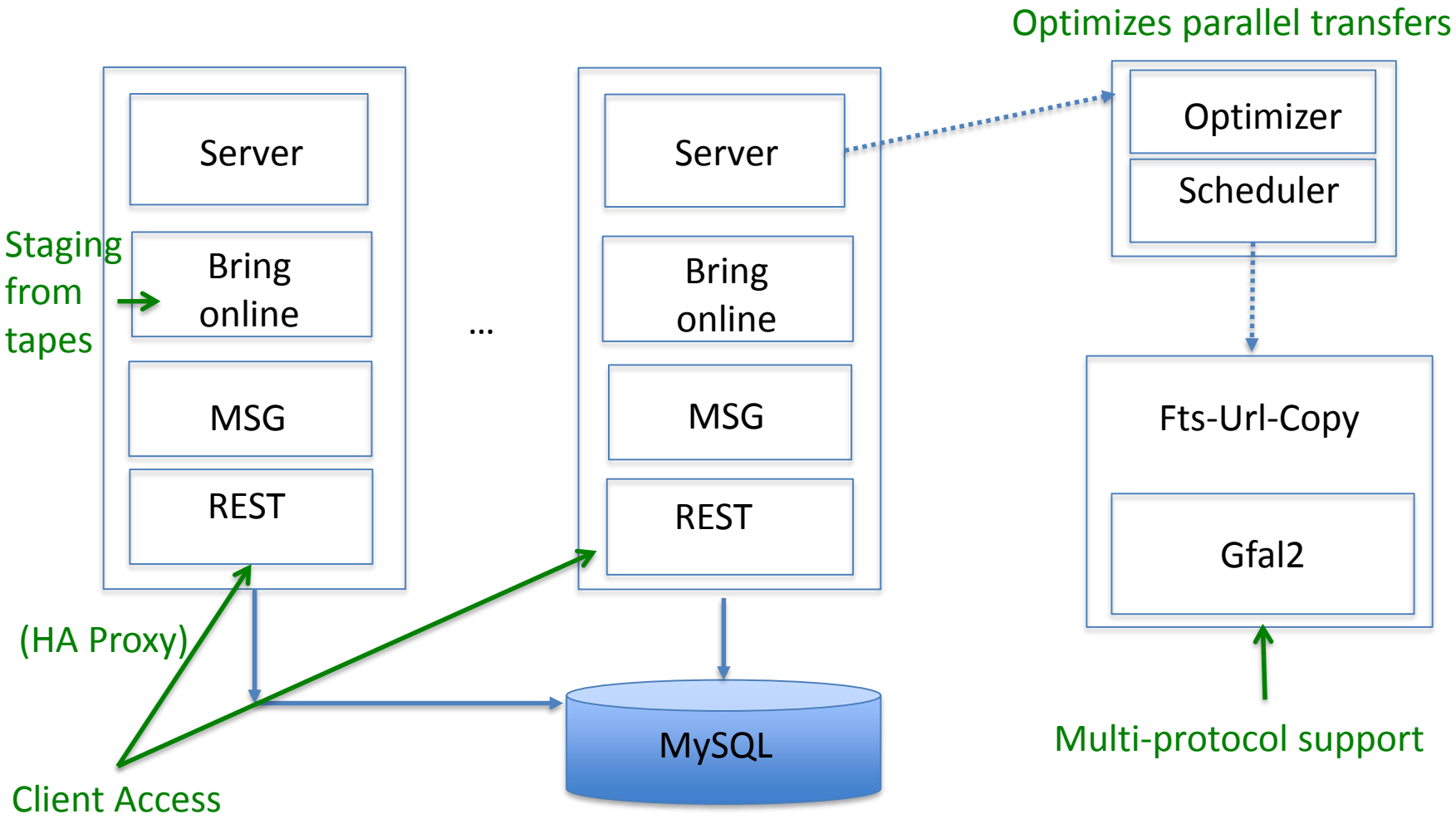
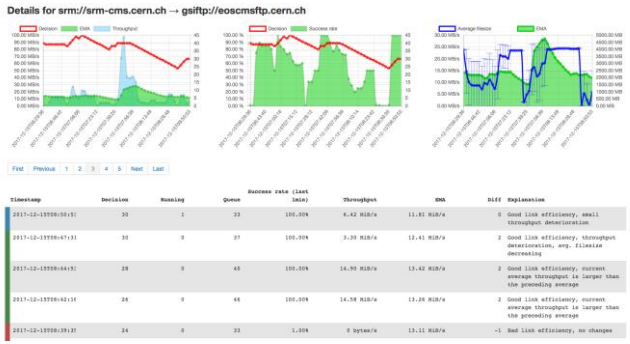


Transfer Scheduler and Optimizer

- The **Scheduler** prioritizes transfers within a link according to:
  - Transfer Priority
  - Activities shares -> Weights associated to transfers activities (labels assigned to transfers)
  - VO shares -> Weights associated to VOs
- The **Optimizer** assigns slot to links according to throughout and success rate
  - Number of Streams per transfer are also optimized
    - based on the file size and the transfer queue
    - (if enough transfers on a link -> 1 stream per file)



Other Main Features

- Tape Archives integration
  - FTS can request to ”bring-online” files to disk from storages supporting Tapes
- Multi-hop transfers support
  - Transfers from A->C, but also A->B->C
- Source replica selection
  - Selection of the best source replica using different algorithms
- Session Reuse transfers
  - For small files it makes sense to serialize the transfers on a link and run them using a single process to reduce overheads

User Tools and APIs

- Data Management frameworks integrated
  - **Rucio**, **Phedex**, **DIRAC**, etc.
- RESTFul APIs
  - http://fts3-docs.web.cern.ch/fts3-docs/fts-rest/docs/api.html
- Python “easy” bindings and CLI
  - http://fts3-docs.web.cern.ch/fts3-docs/fts-rest/docs/easy/index.html
  - http://fts3-docs.web.cern.ch/fts3-docs/fts-rest/docs/cli.html
- C++ CLI
  - http://fts3-docs.web.cern.ch/fts3-docs/docs/cli/cli.html

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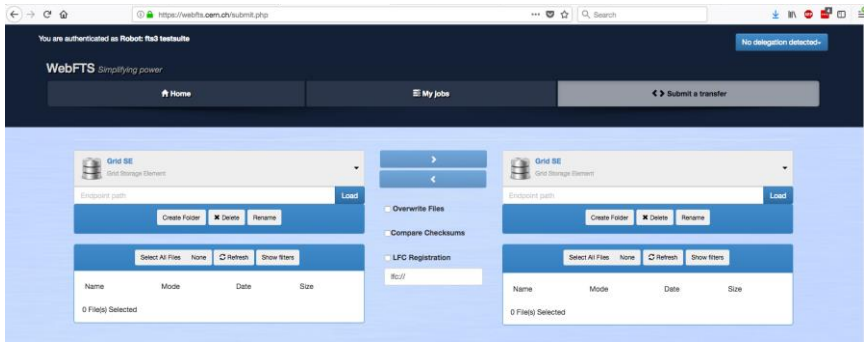
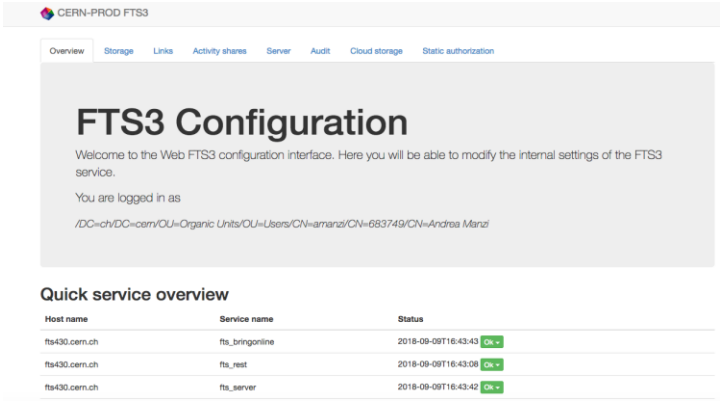
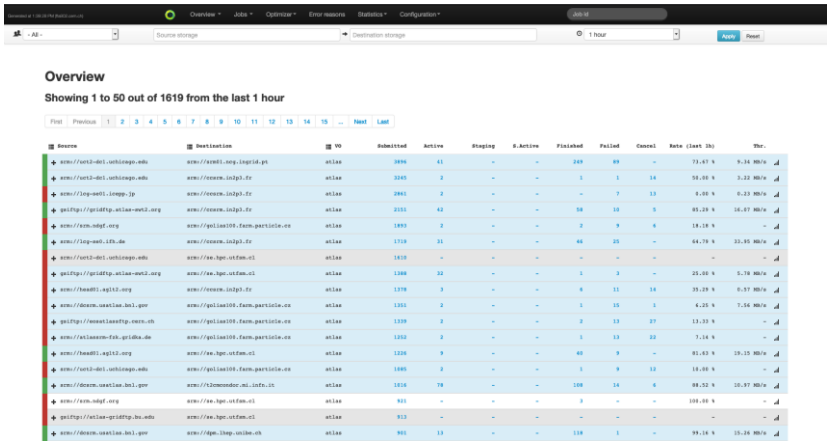
Web Access and Monitoring

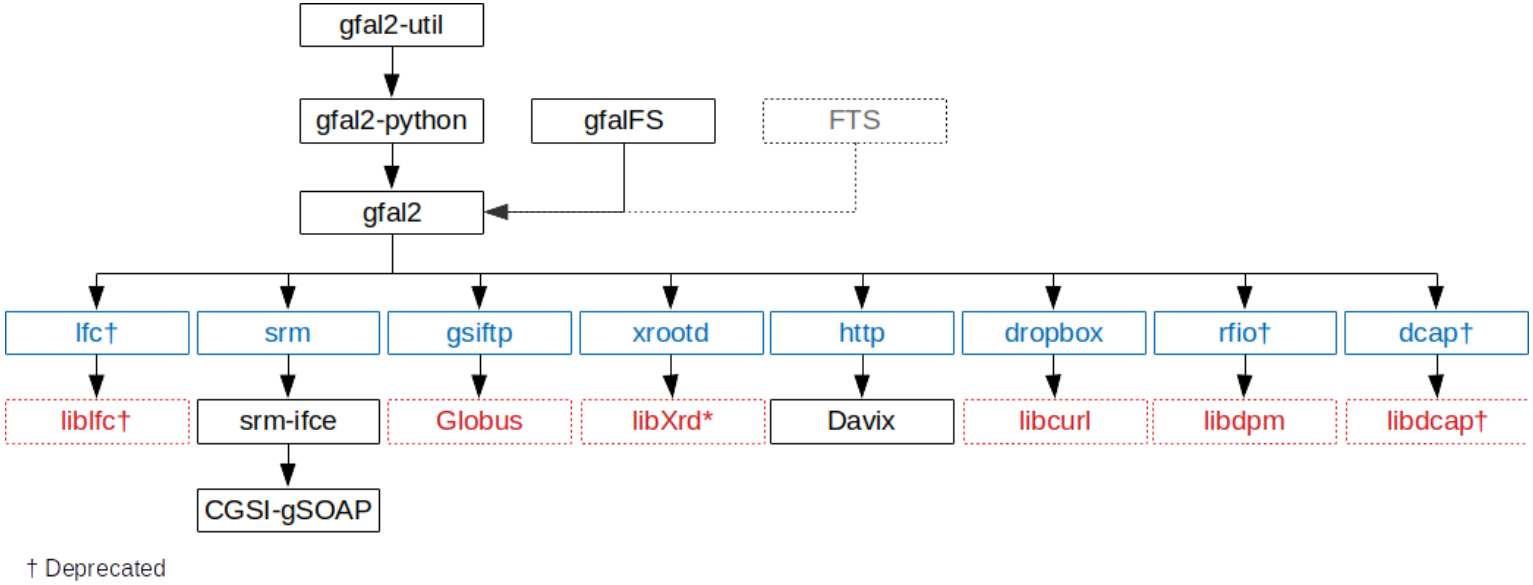






Multiprotocol support: gfal2

- FTP/GSIFTP, HTTP, XROOTD, SRM, S3, GCLOUD, ..
- TPC (3rdParty copy) or protocol translation (streaming)



FTS/DMC 2018 releases overview

- FTS 3.8 (Oct) + 5 patch releases
  - FTS nagios probes for C7
- Gfal2 2.16 (Sept) + 7 patch releases
  - Gfal2 bindings for python3 released to EPEL7 (Nov)
    - Needed packaging boost-python3 in EPEL7
- Davix 0.7 (Oct) + 3 patch releases
- Srm-ifce 1.24.4 (July)
- CGSI-GSOAP 1.3.11 (June)

2018 Activities

- **EOS-CTA integration**
  - New Tape Solution @CERN
    - SRM-less
  - Staging via Xrootd implemented in gfal2-xrootd plugin
  - see Julien's presentation in the afternoon

- **Xrootd and HTTP TPC enhancements**
  - Support for Bearer tokens (Macaroons/Scitokens)
    - Many contributions from B. Bockelman integrated and released (Thanks!)
  - Enabled X509 Delegation for XrootD TPC (XrootD 4.9)
  - Many enhancements to HTTP PUSH/PULL TPC
  - Driven by WLCG DOMA TPC -> alternative to gridftp
    - https://twiki.cern.ch/twiki/bin/view/LCG/ThirdPartyCopy

2018 Activities[2]

- **Scheduler performance improvements (ongoing)**
  - Improve the DB schema, indexes and add queries optimization
- **Automatic Session Reuse**
  - FTS Server automatic enables session reuse based on the Job parameters (number of files, size of the files, etc)
- **Cloud Support**
  - Support for Google Cloud implemented in davix/gfal2
    - ATLAS Data Ocean project
  - Support for S3 Multipart upload in davix

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EU Project XDC

- 2 years software development project started in Feb ‘18
- http://www.extreme-datacloud.eu/
  - *‘Developing scalable technologies for federating storage resources and managing data in highly distributed computing environments*’
- See XDC presentation from Paul Millar today
- Funded FTS activities
  - Integration with OIDC (OpenID Connect)
  - CDMI integration to support QoS transitions

OpenID Connect integration

- FTS historically supports only X509 authentication and delegation
  - Clients delegate their X509 certs in order to contact the storages

- OpenID Connect integration tasks
  - Enabled authentication via OpenID on FTS-REST
  - Implemented online/offline access token validation and token refresh (needed for transfers staying long in the queue)
- Access tokens are used both to authenticate to FTS and to the storages
  - Native Support for OpenID already available in dCache and StoRM

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Storage QoS via CDMI interface

- dCache and EOS (part of XDC as well) will expose a QoS interface compatible with CDMI
  - Possibility to change the QoS of files (e.g. replica number)
- FTS (and gfal2) has been extended in order to steer the QoS
  - Gfal2 CDMI interface implemented in the HTTP plugin
  - First QoS daemon functionality implemented
    - Able to ask for a QoS transition and monitor it
    - Will replace the bringonline daemon including its functionalities

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2019 plans

- Scalability improvements
- Migration to tape monitoring
- Scheduler improvements
  - Allow staging + transfer with different protocols
  - Avoid clients submitting multiple transfers to the same destination
- New framework for REST and Python3 support
- Complete XDC tasks

Scalability Improvements

- Big experiments (e.g. ATLAS and CMS) are now using multiple instances of FTS in the WLCG infra (3/4 of them)
  - Ideally they would like to have only one dedicated FTS instance
- Need to overcome limitations both on the number of queued transfers and number of parallel active transfers per instance
  - Distributed scheduler is creating high DB contention, increasing with the number of transfers and nodes
  - We are investigating DB partitioning or other similar improvements
- Long term (Run4) we plan to change the FTS architecture
  - e.g. Only one scheduler per instance, communicating with servers via messaging

Migrations to Tape [1]

- FTS, in case of a Tape Storage, is now unaware of file migrations to tape:
  - Transfers to a tape storage are considered completed when the file is on the disk buffer
  - Clients need an extra step in order to validate that the file is on Tape (i.e. checking the “m” bit on Castor)
- Plan to implement migrations to tape monitoring this year
  - Transfers in **final** state only when files are stored on Tape
- This will also help adding other mechanisms, like back-pressure on number of files/size of migrated data
  - FTS will stop scheduling new transfers if data under migration are over a certain threshold

Migrations to Tape [2]

- Extension of the QoS daemon (Disk->Tape is a QoS transaction) to implement a first version of the migration to tape monitoring this year
  - Targeting first EOS-CTA where disk buffer size is limited by design
  - Extension to SRM to be implemented afterwards
- We plan to involve the experiments in the design phase
  - Many details to discuss
  - N.B. CMS has already expressed high interested in this topic

Staging + transfer with different protocols

- On staging + transfer jobs possible protocol mismatch between the source and the destination
  - Staging with XrootD url and transfer to a Srm/Gridftp url destination or viceversa
- Plan to automatically adapt the source protocol to match the destination protocol when performing the transfer
- Need to (re)introduce the concept of StorageGroup to discover the endpoints associated to a storage
  - i.e. The Xrootd endpoint can be different from the Gridftp gateways endpoint

XDC plans – OIDC

- Complete extension to OIDC tokens of all FTS-REST operations now requiring X509
  - E.g. User banning
- Integration of Token translation service
  - Present a token – get an X509 certificate
  - Needed for EOS in XDC, but of course for all the other storages which do not support OIDC yet
    - Needed also to use other protocols than HTTP
- Follow closely the activity of the WLCG Authz WG

XDC plans - QoS

- Full integration of QoS logic
  - Transfer/Transition logic
    - Use existing multi-hop logic to serialise transfer-then-QoS-transition
  - Complete QoS daemon implementation
- Validate integration of all QoS methods in gfal2
- Definition of FTS QoS interface for Rucio/Orchestrator

- Support
  - fts-support@cern.ch
- Links
  - https://fts.cern.ch
  - https://fts3-docs.web.cern.ch/fts3-docs/
  - https://dmc-docs.web.cern.ch/dmc-docs/index.html
  - https://github.com/cern-fts

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