

# FTS3: The Monitoring Zoo

XRootD and FTS Workshop 2023 at JSI

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Tuesday 28th March 2023

# Introduction



## What is FTS?

- Open source software for large scale queuing and reliable execution of file transfers
  - Users of FTS need tools to monitor file transfers executed by FTS on their behalf
  - Statistical information about transfer efficiency between sites
- FTS is also a service run @CERN and various other sites in WLCG
  - FTS service managers need tools to monitor the service

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- FTS is also a service run @CERN and various other sites in WLCG
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## What is this presentation about?

- User tools for file transfer monitoring in FTS

# Outline

- I. Introduction**
- II. FTS Web Monitoring**
- III. Monitoring FTS transfers via CLI**
- IV. FTS & CERN Monitoring services**
  - A. FTS Monitoring Messages & ActiveMQ
  - B. Grafana
- V. FTS Service Health Monitoring**

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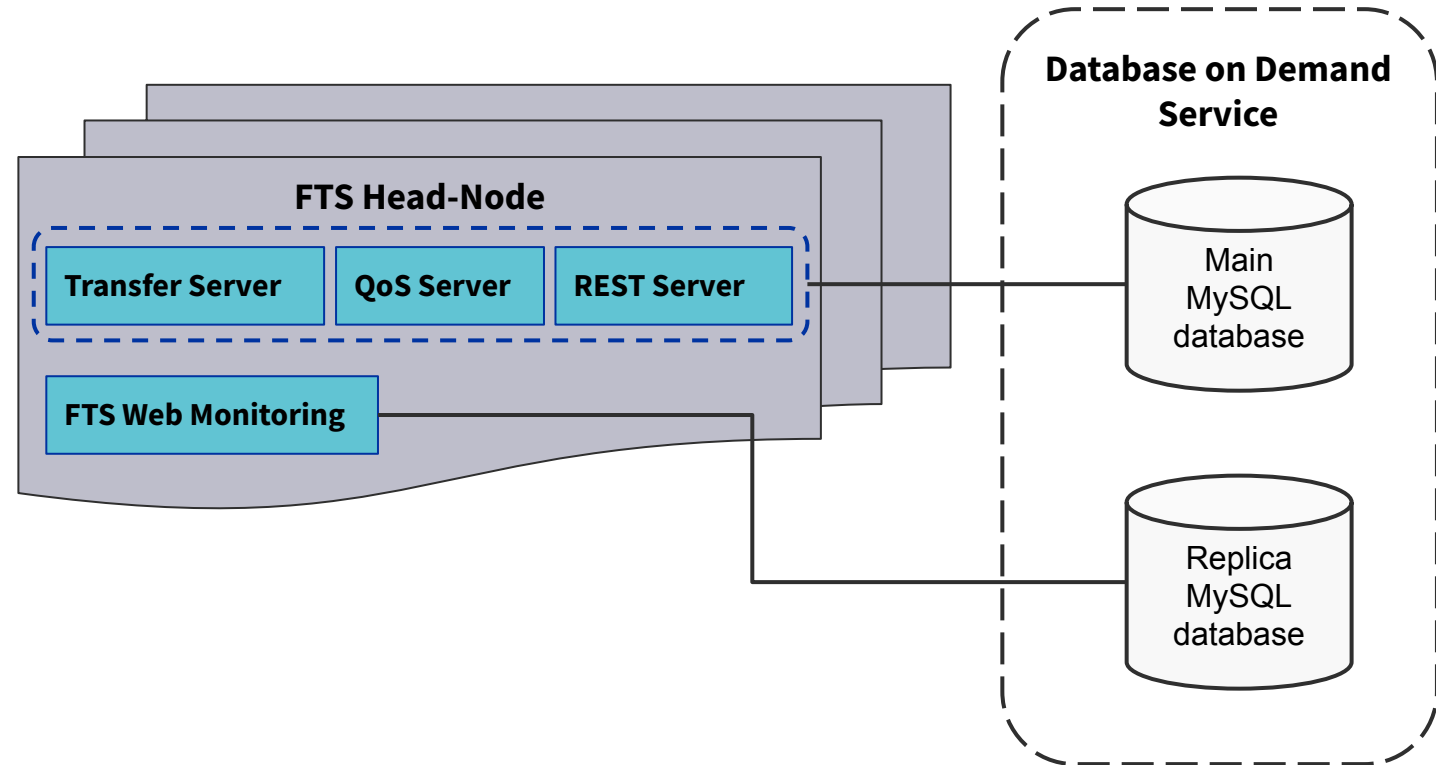
# I. FTS Web Monitoring

- Web Application for interactive users
- Fully developed and maintained by the FTS team
- Developed in Python3 using the Django framework
- Used to visualize **from a web browser**:
  - Status of individual transfer jobs
    - Does not keep long term historical information
  - Statistical information about the queues and finished transfers
  - Link utilization & transfer performance
  - Storage/link configuration

# I. FTS Web Monitoring

## CERN Deployment

- Runs in the same hosts as the FTS transfer daemons
  - Application needs access to transfer logs
- Only connects to the database replica
  - It's a read-only application on the database
  - Its different database access patterns benefit from separated caching
  - Replication delays have no impact on critical operations



# I. FTS Web Monitoring - Overview



Generated at 11:38:24 PM (fts-oms-009.cern.ch)

Overview ▾ Jobs ▾ Optimizer ▾ Error reasons ▾ Statistics ▾ Configuration ▾

Job id

## Overview

Showing 1 to 50 out of 1318 from the last 1 hour

First Previous 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 ... Next Last

Source	Destination	VO	Submitted	Active	Staging	S.Active	Archiving	Finished	Failed	Cancel	Rate (last 1h)	Thr.
+ davs://ccdavcms.in2p3.fr	davs://webdav.echo.stfc.ac.uk	cms	43491	201	-	-	-	830	6	-	99.28 %	1144.21 MiB/s
Most frequent error Q												
Monitoring Link Q												
+ root://cmscdisk.fnal.gov	root://dtn20.nese.rc.fas.harvard.edu	cms	36797	112	-	-	-	-	726	-	0.00 %	-
+ davs://ccdavcms.in2p3.fr	srm://storm-fe-cms.cr.cnaf.infn.it	cms	30007	21	-	-	6892	-	-	-	1078.44 MiB/s	
+ davs://ccdavcms.in2p3.fr	srm://cmssrm-kit.gridka.de	cms	19174	47	-	-	18	1430	5	-	99.65 %	1471.39 MiB/s
+ davs://ccdavcms.in2p3.fr	srm://ccsrm.in2p3.fr	cms	16774	34	-	-	30	2268	2	-	99.91 %	2250.53 MiB/s
+ root://eoscms.cern.ch	root://dtn20.nese.rc.fas.harvard.edu	cms	9306	15	-	-	-	12	241	-	4.74 %	1.26 MiB/s
+ davs://eoscms.cern.ch	davs://grse001.inr.troitsk.ru	cms	2498	93	-	-	-	113	14	-	88.98 %	145.59 MiB/s
+ davs://eoscms.cern.ch	davs://sbgse1.in2p3.fr	cms	2463	121	-	-	-	888	765	-	53.72 %	0.89 MiB/s
+ root://xrootd.ba.infn.it	root://dtn20.nese.rc.fas.harvard.edu	cms	1220	6	-	-	-	-	45	-	0.00 %	-
+ root://xrootd-local.unl.edu	root://dtn20.nese.rc.fas.harvard.edu	cms	871	84	-	-	-	-	627	-	0.00 %	-

Monitor the optimizer decisions

Find link and storages configurations



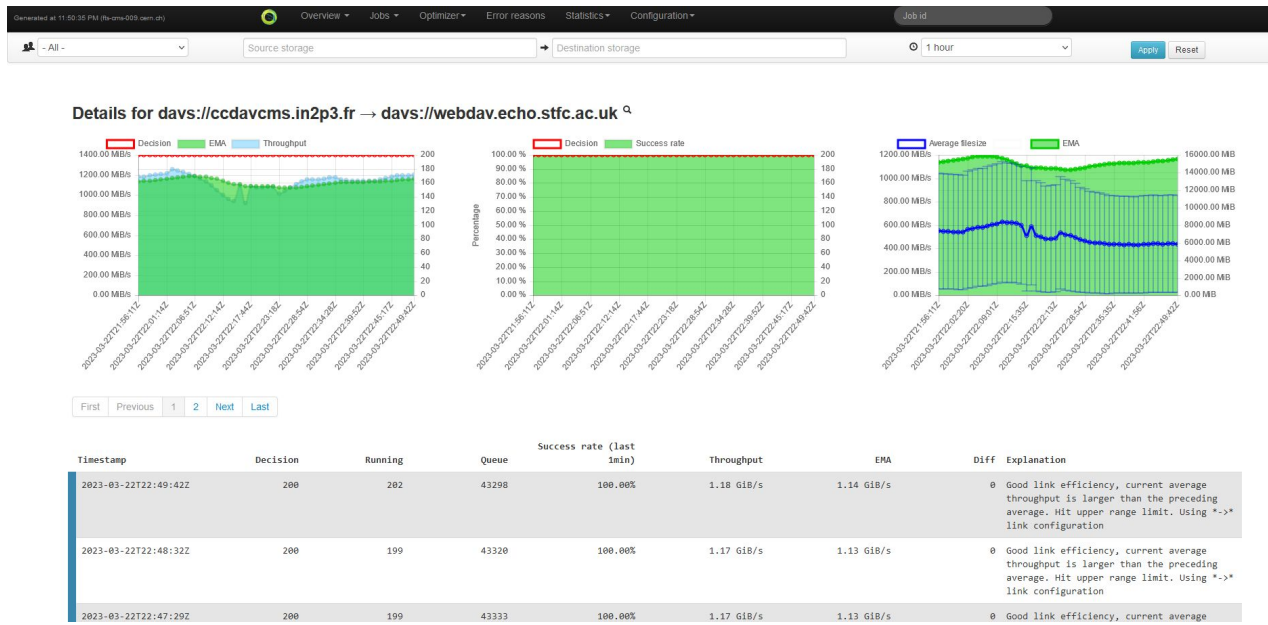
# I. FTS Web Monitoring - Overview



Source	Destination	VO	Submitted	Active	Staging	S.Active	Archiving	Finished	Failed	Cancel	Rate (last 1h)	Thr.
+ davs://ccdavcms.in2p3.fr	davs://webdav.echo.stfc.ac.uk	cms	43491	201	-	-	-	830	6	-	99.28 %	1144.21 MiB/s
Most frequent error <a href="#">Q</a>												
Monitoring Link <a href="#">Q</a>												

Optimizer

Link and storage configurations



Source:	Destination:	Link
davs://ccdavcms.in2p3.fr	davs://webdav.echo.stfc.ac.uk	
Active transfers: 300 Outbound limit: 300 Config type: Generic	Active transfers: 293 Inbound limit: 300 Config type: Generic	Active transfers: 199 Min limit: 10 Max limit: 200 Config type: Generic

Optimizer

Active transfers: 199  
Decision: 200  
Description: Good Link Efficiency, Current Average Throughput Is Larger Than The Preceding Average. Hit Upper Range Limit. Using \*->\* Link Configuration

Storage Config | Link Config

Close



# I. FTS Web Monitoring - Jobs

Generated at 11:50:18 PM



Overview ▾

Jobs ▾

Optimizer ▾

Error reasons

Statistics ▾

Configuration ▾

2f2d2-c8bf-11ed-b247-fa163ebacedb

## Transfer '6742f2d2-c8bf-11ed-b247-fa163ebacedb' FINISHED

VO: cms

Delegation ID: ad89efd56a13b568  
Submitted time: 2023-03-22T14:39:52Z  
Job finished: 2023-03-22T22:24:28Z  
Priority: 3  
Bring online: -1  
Archive timeout: 605000

Received by fts-cms-005.cern.ch  
Job expires: 2023-04-01T14:39:52Z  
Overwrite flag: M  
Job type: H  
Cancel flag:  
Pin lifetime: -1  
Target QoS:

Metadata:

```
{"issuer": "rucio", "multi_sources": false, "multihop": true, "auth_method": "certificate"}
```

Files transferred	Bytes transferred	Submission time	Start time	Running time	Avg. file throughput	Current job throughput
2 out of 2	40.69 GiB	2023-03-22T14:39:52Z	2023-03-22T20:22:23Z (+20551s)	5808 s	23.77 MiB/s	-

Showing 1 to 2 out of 2

SUBMITTED DELETE READY STAGING ARCHIVING ACTIVE STARTED CANCELED FAILED 2 FINISHED NOT\_USED

First Previous 1 Next Last

File ID	File State	File Size	Throughput	Remaining	Start Time	Finish Time	Staging Start	Staging End	Archiving Start	Archiving End	
+ 3671020737	FINISHED	20.35 GiB	3.76 MiB/s	-	2023-03-22T20:22:23Z	2023-03-22T21:59:11Z	-	-	-	-	Log
davs://ccdavcms.in2p3.fr:2880/disk/data/store/mc/Run3Summer19DRPremix/DoublePion_E-50/GEN-SIM-RECO/2023ScenarioRECO_106X_mcRun3_2023_realistic_v3-v2/20000/80B10B2D-92DA-9B44-8DB4-AE4BF0DAF316.root											
davs://webdav.echo.stfc.ac.uk:1094/store/mc/Run3Summer19DRPremix/DoublePion_E-50/GEN-SIM-RECO/2023ScenarioRECO_106X_mcRun3_2023_realistic_v3-v2/20000/80B10B2D-92DA-9B44-8DB4-AE4BF0DAF316.root											
+ 3671020738	FINISHED	20.35 GiB	43.79 MiB/s	-	2023-03-22T21:59:15Z	2023-03-22T22:07:15Z	-	-	2023-03-22T22:07:24Z	2023-03-22T22:24:28Z	Log
root://xrootd.echo.stfc.ac.uk:1094//store/mc/Run3Summer19DRPremix/DoublePion_E-50/GEN-SIM-RECO/2023ScenarioRECO_106X_mcRun3_2023_realistic_v3-v2/20000/80B10B2D-92DA-9B44-8DB4-AE4BF0DAF316.root											
root://antares.stfc.ac.uk:1094//eos/antares/prod/cms//store/mc/Run3Summer19DRPremix/DoublePion_E-50/GEN-SIM-RECO/2023ScenarioRECO_106X_mcRun3_2023_realistic_v3-v2/20000/80B10B2D-92DA-9B44-8DB4-AE4BF0DAF316.root											

Access `fts\_url\_copy` process logs

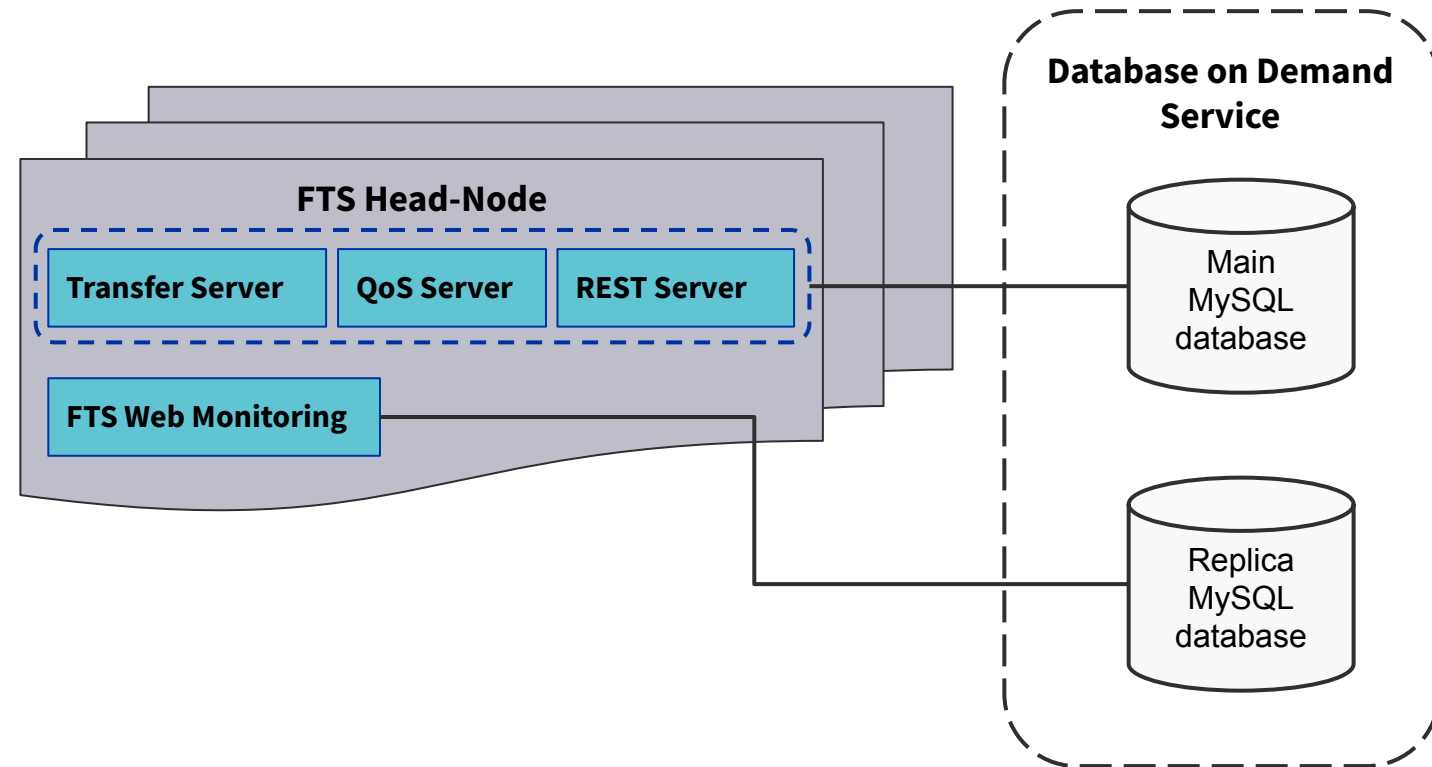
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## II. Monitoring FTS transfers via CLI

- FTS provides a command line interface (CLI)
  - ``$ yum install fts-rest-client``
- Can be used to monitor the status of individual file transfers via the command line.
- Performs HTTP requests to the **FTS-REST API**
  - Same used for job submission
  - `https://fts3-<experiment>.cern.ch:8446`
- It serves the requests directly from the main database



## II. Monitoring FTS transfers via CLI

```
$ fts-rest-transfer-submit -s <fts-server> <src> <dst>
```

*Job successfully submitted.*

*Job id: <job-id>*

```
$ fts-rest-transfer-status -s <fts-server> <job-id> --json
```

*Also available via Python Bindings*

## II. Monitoring FTS transfers via CLI

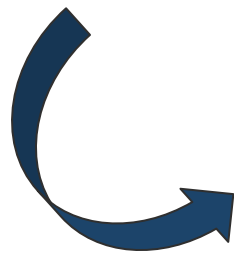
```
$ fts-rest-transfer-submit -s <fts-server> <src> <dst>
```

*Job successfully submitted.*

*Job id: <job-id>*

```
$ fts-rest-transfer-status -s <fts-server> <job-id> --json
```

*Also available via Python Bindings*



**> GET /jobs/<job\_id> HTTP/1.1**

**> Host: <fts-server>**

•  
•

All the other API resources at:

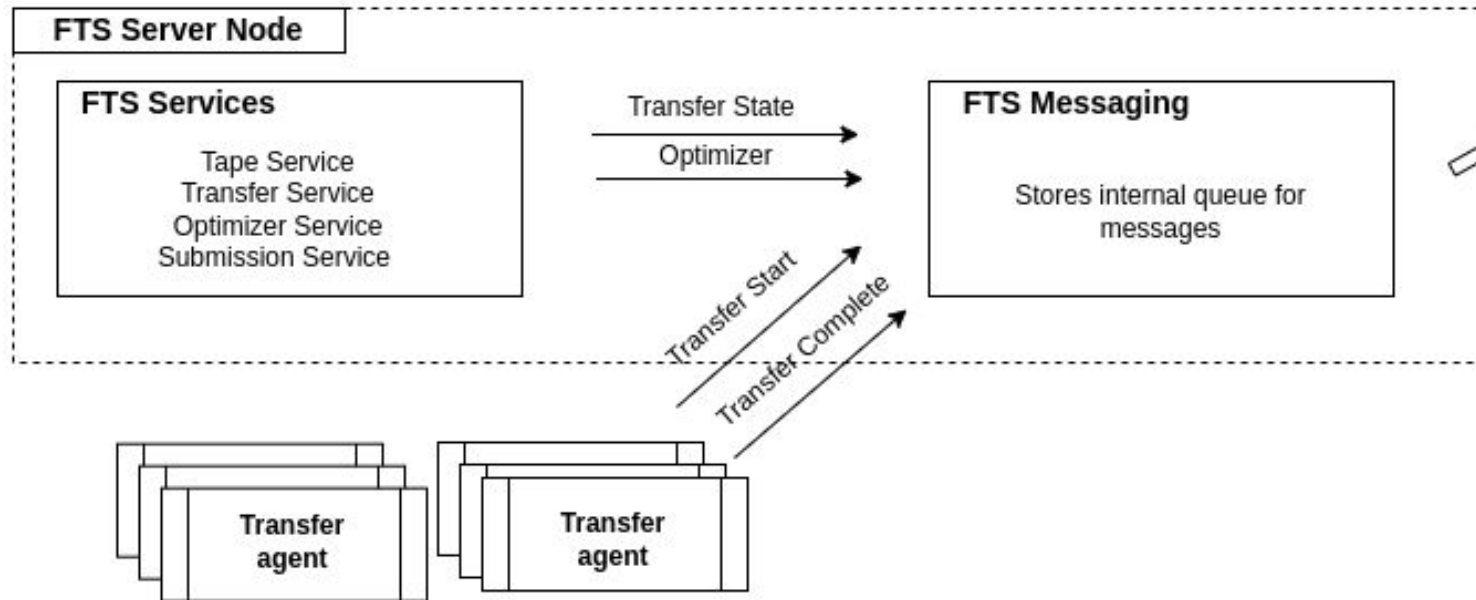
- <https://fts3-docs.web.cern.ch/fts3-docs/fts-rest/docs/api.html>

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# III. FTS Monitoring Messages & ActiveMQ

- FTS sends monitoring messages at key moments in transfer lifecycle
- A dedicated FTS component sends messages to CERN ActiveMQ



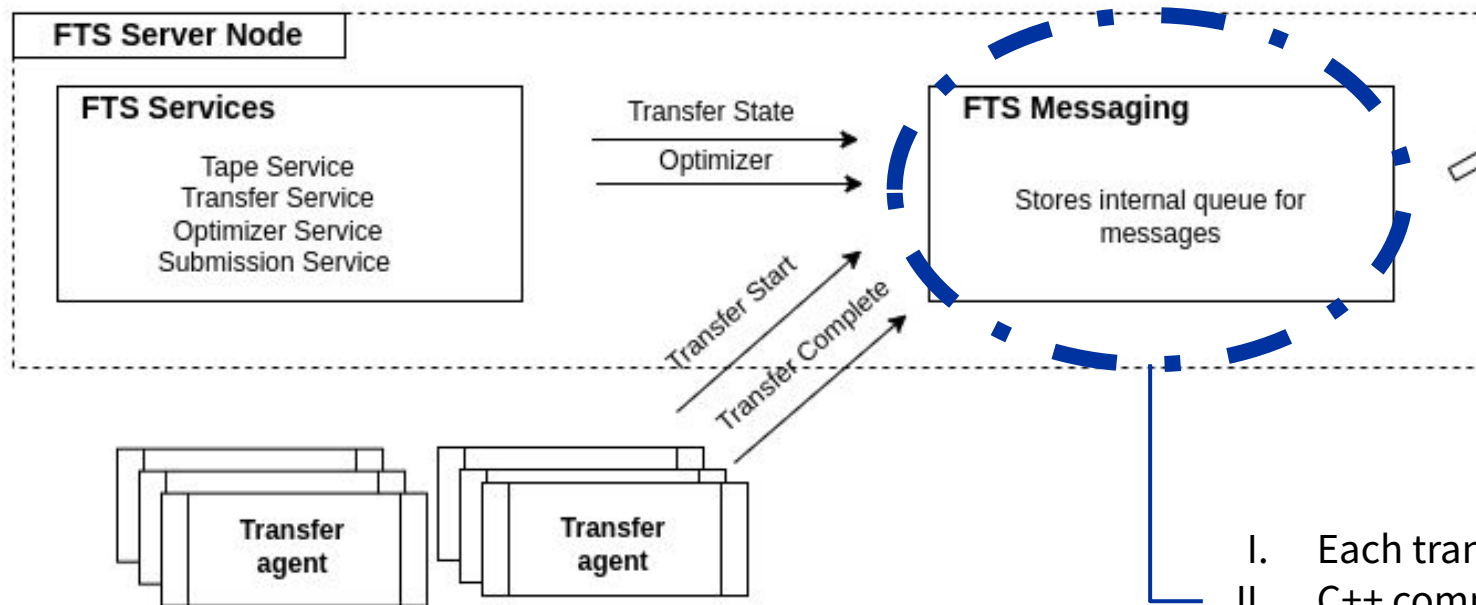
Provided by IT-DA group at CERN

- <https://monit-docs.web.cern.ch/metrics/amq/>



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Provided by IT-DA group at CERN

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- I. Each transfer host runs a `fts\_msg\_bulk` daemon
- II. C++ component that uses DirQ to relay messages produced by the FTS services to the CERN hosted ActiveMQ instance

# III. FTS Monitoring Messages & ActiveMQ

- **There are 4 types of messages sent:**

- Transfer Start (transfer.fts\_monitornig\_start)
- Transfer Complete (transfer.fts\_monitornig\_complete)
- Transfer State (transfer.fts\_monitornig\_state)
- Optimizer State (transfer.fts\_monitornig\_queue\_state)

Produced by the transfer agents: `fts\_url\_copy`

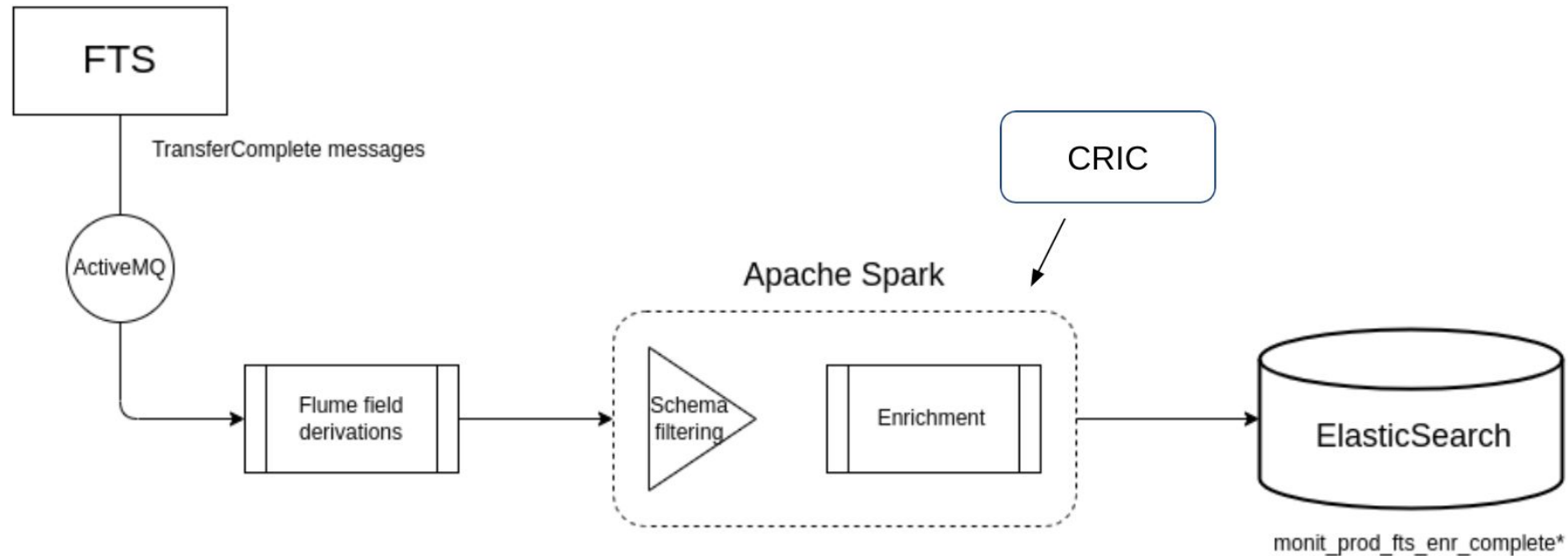
Produced by the FTS daemons: `fts\_server`, `fts\_qos` and `fts3rest`

- **Complete format in FTS Messaging documentation**

- <https://fts3-docs.web.cern.ch/fts3-docs/docs/messaging/format.html>

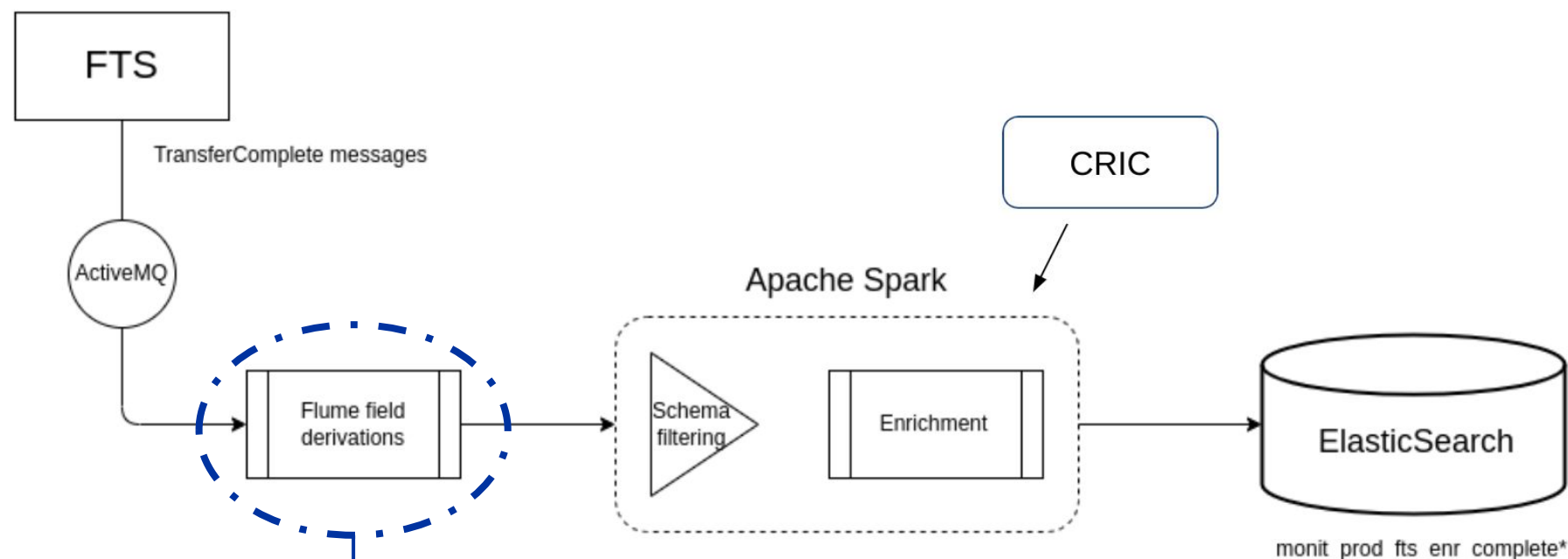
# III. FTS Monitoring Messages & ActiveMQ

## Enriched TransferComplete messages:



# III. FTS Monitoring Messages & ActiveMQ

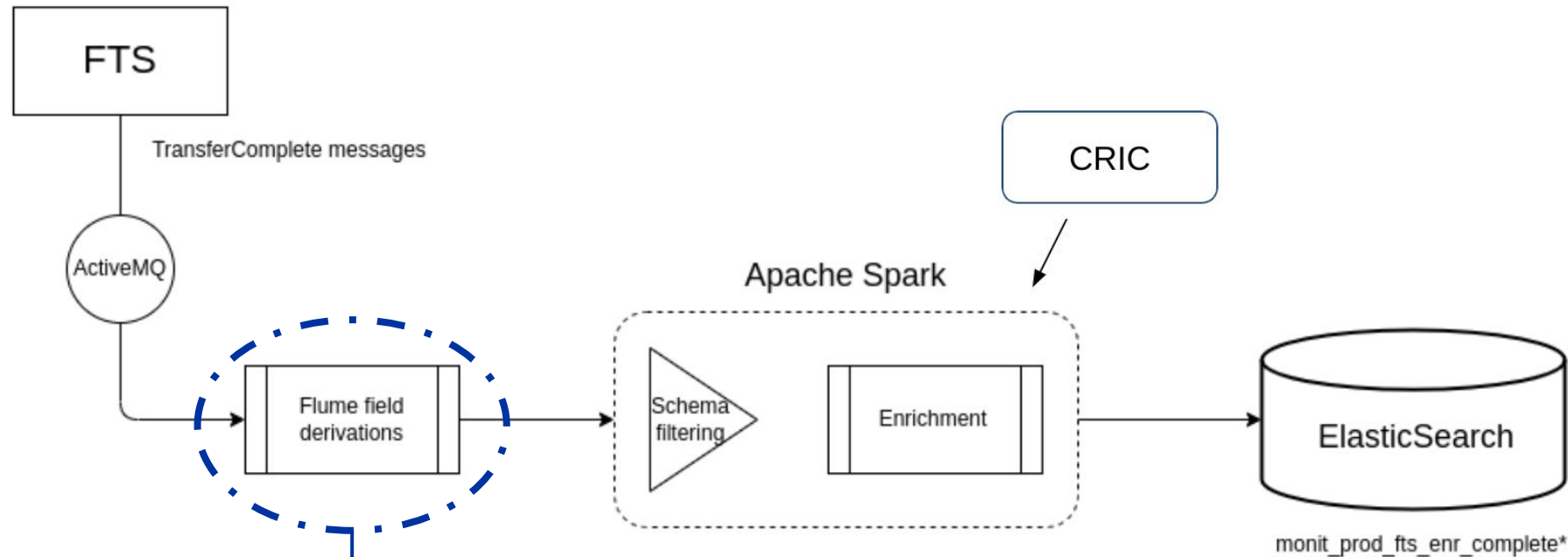
## Enriched TransferComplete messages:



- **Field derivation step: existing FTS fields are used to compute new fields**
  - (e.g.:  $\text{transfer\_duration} = \text{finish\_timestamp} - \text{start\_timestamp}$ )

# III. FTS Monitoring Messages & ActiveMQ

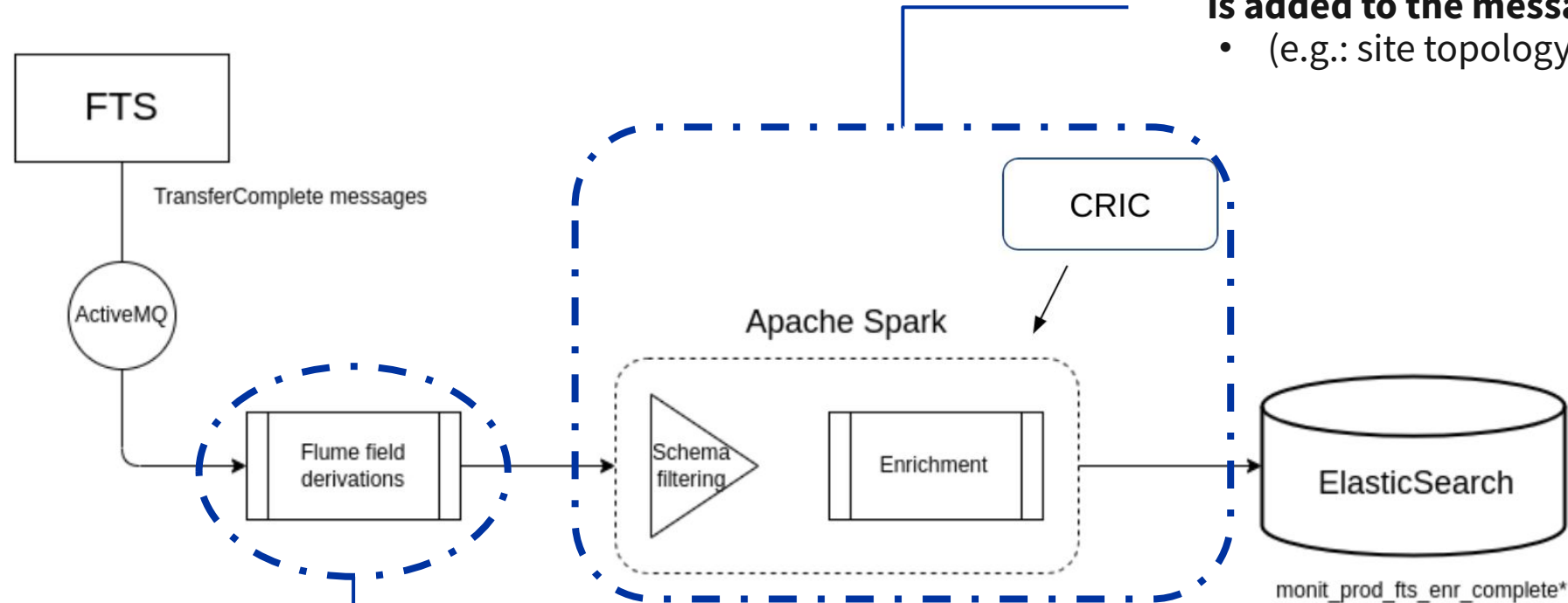
## Enriched TransferComplete messages:



- **Field derivation step: existing FTS fields are used to compute new fields**
  - (e.g.: transfer\_duration = end\_timestamp - start\_timestamp)

# III. FTS Monitoring Messages & ActiveMQ

## Enriched TransferComplete messages:



- **Field enrichment step: information from outside is added to the message**
  - (e.g.: site topology via CRIC)

- **Field derivation step: existing FTS fields are used to compute new fields**
  - (e.g.: transfer\_duration = end\_timestamp - start\_timestamp)

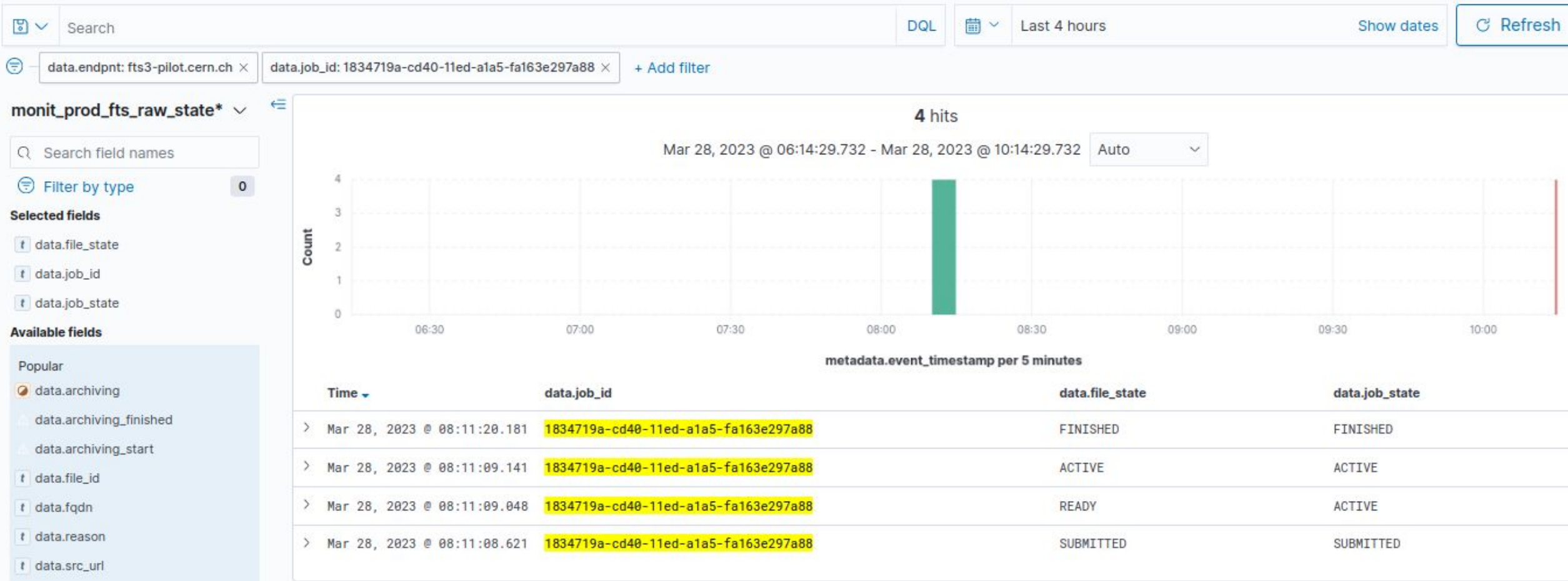
# III. FTS Monitoring Messages & ActiveMQ

- **Mapping between FTS ActiveMQ ↔ Monit Elasticsearch:**
  - transfer\_complete → monit\_prod\_fts\_enr\_complete\*
  - transfer\_start → monit\_prod\_fts\_raw\_start\*
  - transfer\_state → monit\_prod\_fts\_raw\_state\*
  - optimizer\_state → monit\_prod\_fts\_raw\_queue\*
- **Above ES indexes are kept for only 30 days (monit-opensearch.cern.ch)**
- **The TransferComplete data stream is aggregated into 1h buckets**
  - monit\_prod\_fts\_agg\_complete\* (monit-kibana-acc.cern.ch\*)
  - This data is kept ad-infinitum



# III. FTS Monitoring Messages & ActiveMQ

- From *monit-opensearch.cern.ch*

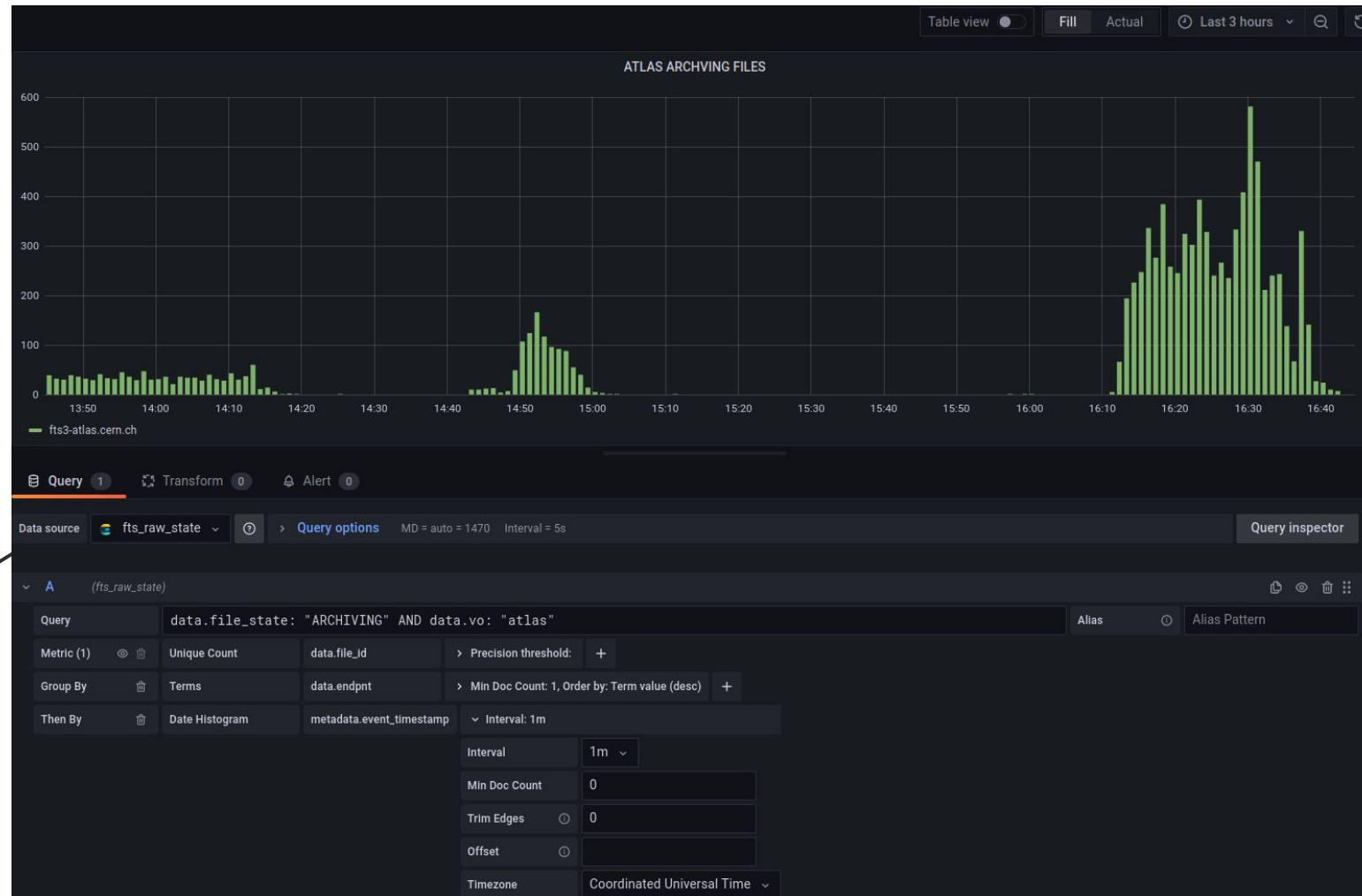




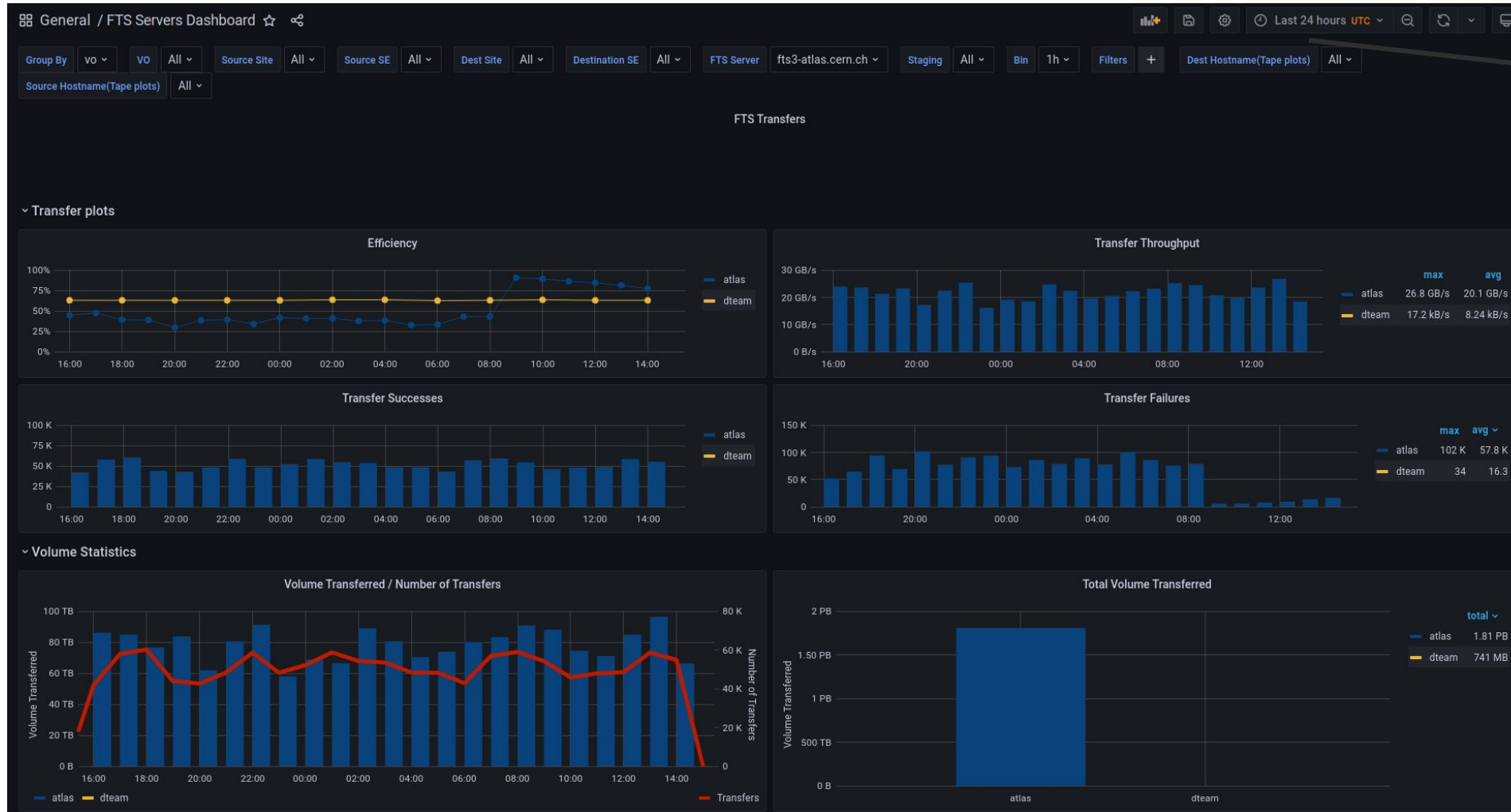
# III. Grafana monitoring

- Elasticsearch indexes can be found at <https://monit-grafana.cern.ch>
- Can be used to create graphs using the monitoring messages published by FTS
  - Users should contact monit team at CERN regarding access or if assistance is needed when building plots in Grafana

Select which ES index to get the data from



# III. Grafana monitoring



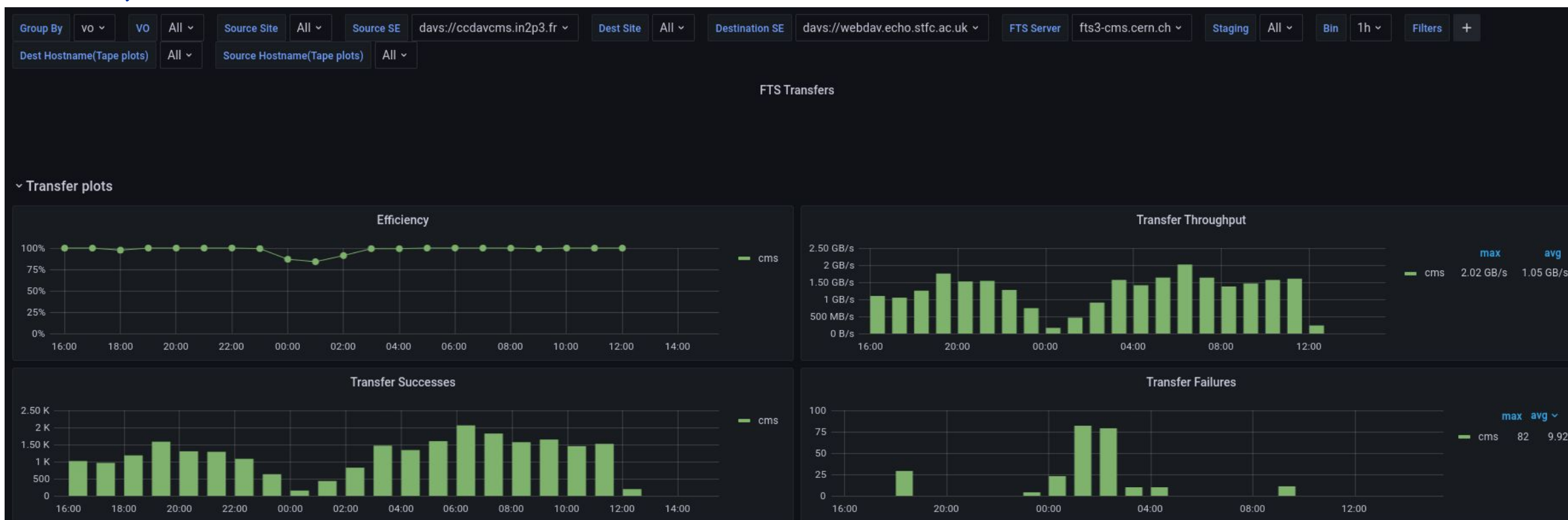
Can go back 30 days

<https://monit-grafana.cern.ch/d/veRQSWBGz/fts-servers-dashboard>

# III. Grafana monitoring

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Most frequent error 🔍												
Monitoring Link 🔍												

Redirects user to grafana.cern.ch



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# IV. FTS Service Health Monitoring

**Follow the next talk on the workshop by Mihai Patrascoiu:**

- **FTS3@CERN: Service Health Monitoring**
  - <https://indico.cern.ch/event/875381/contributions/5316269/>



[home.cern](https://home.cern)