



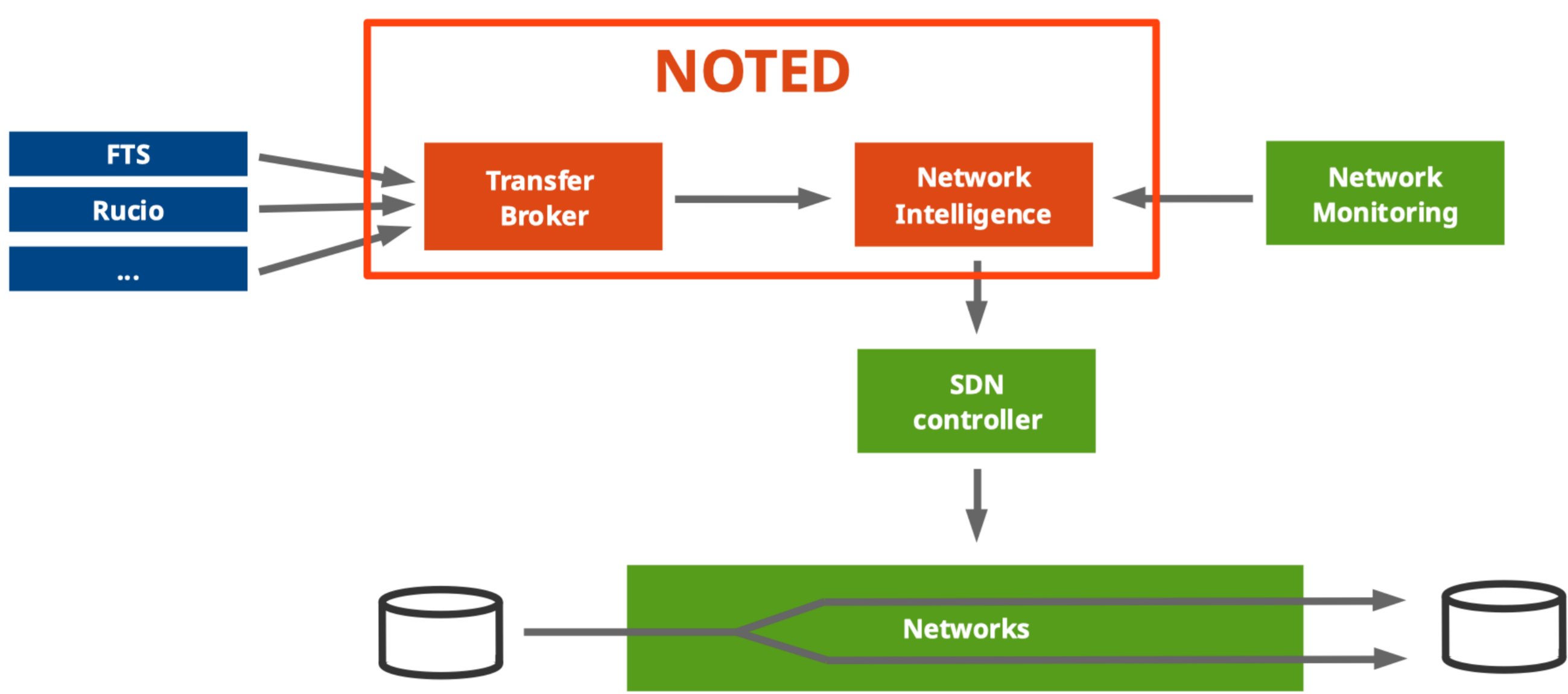
# NOTED: AN INTELLIGENT NETWORK CONTROLLER TO IMPROVE THE THROUGHPUT OF LARGE DATA TRANSFERS IN FILE TRANSFER SERVICES BY HANDLING DYNAMIC CIRCUITS

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## SKELETON AND ELEMENTS OF NOTED



FTS (File Transfer Service):

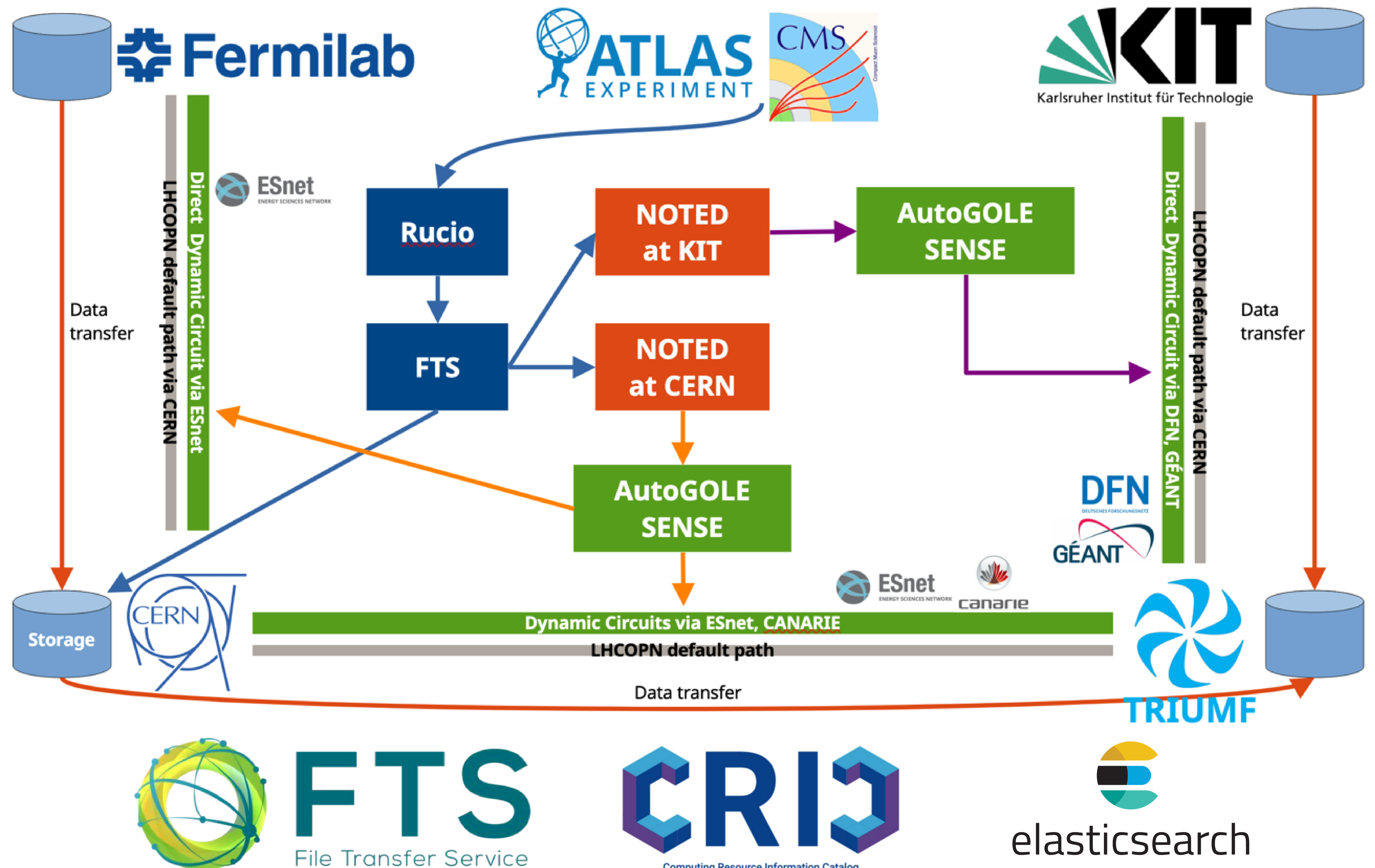
- Inspect and analyse data transfers to estimate if an action can be applied to optimise the network utilization → **get on-going** and **queued** transfers.

CRIC (Computing Resource Information Catalog):

- Enrichment to **get an overview** and knowledge of the **network topology** → get IPv4/IPv6 addresses, endpoints, rcsite and federation.

## FLOWCHART AND DATASET STRUCTURE

- Input parameters:** configuration given by the user  
In noted/config/config.yaml → define a list of {src\_rcsite, dst\_rcsite}, maximum and minimum throughput threshold, SENSE/AutoGOLE VLANs UUID and user-defined email notification among others.
- Enrich NOTED** with the topology of the network:  
Query CRIC database → **get endpoints** that could be involved in the data transfers for the given {src\_rcsite, dst\_rcsite} pairs.
- Analyse on-going and upcoming** data transfers:  
Query FTS recursively → **get on-going** data transfers for each set of source and destination endpoints.  
The total utilization of the network is the **sum** of on-going and upcoming **individual data transfers** for each source and destination endpoints for the given {src\_rcsite, dst\_rcsite} pairs.
- Network decision:**  
If NOTED interprets that the link will be **congested** → provides a **dynamic circuit** via SENSE/AutoGOLE.  
If NOTED interprets that the link will **not be congested** anymore → **cancel the dynamic circuit** and the traffic is routed back.



## NETWORK MONITORING: NOTED ALARMS IN CERN MONIT GRAFANA

The NOTED alarms are exported to a MySQL database and summarized in CERN Monit Grafana for LHCONE/LHCOPN network controllers. The NOTED status column specifies the current state: running, decision-making, monitoring, action or stopped depending on whether there is on-going FTS data transfers and whether the SDN controller provides a dynamic circuit.

ID	Alarm name	Version	NOTED status	NOTED action	SDN status	Max FTS Throughput [Gb/s]	Interface
287	CH-CERN to DE-KIT	LHCOPN	Decision-making	An action on the link may be required: number of events: 1. Throughput [Gb/s]: 0.94	Not provided		1513-e-rjup1-1_irb.3530
286	CH-CERN to CA-TRIUMF	LHCOPN	Running	Spectrum generated an alarm: NOTED is inspecting FTS.	Not provided		1513-e-rjup1-1_irb.2126
285	CH-CERN to UK-T1-RAL	LHCONE	Stopped	The large data transfer is finished.	Released	2.15	1513-e-rjup1-1_irb.111
284	CH-CERN to IT-INFN-T2	LHCONE	Action	On-going SDN. FTS throughput [Gb/s]: 0.06	Provided	4.73	1513-e-rjup1-1_irb.111
283	CH-CERN to FR-CCIN2...	LHCONE	Stopped	The large data transfer is finished.	Released	11	1513-e-rjup1-1_irb.111
282	CA-TRIUMF to CH-CERN	CUSTOM	Stopped	The large data transfer is finished.	Released	1.77	
281	TR-Tier2-federation to ...	LHCONE	Stopped	No transfers found in FTS. Spectrum alarm is cleared	Not provided		1513-e-rjup1-1_irb.111
280	IT-INFN-T2 to CH-CERN	LHCONE	Stopped	No transfers found in FTS. Spectrum alarm is cleared	Not provided		1513-e-rjup1-1_irb.111
279	CH-CERN to DE-KIT	LHCOPN	Stopped	No transfers found in FTS. Spectrum alarm is cleared	Released	5.37	1513-e-rjup1-1_irb.3530
278	CH-CERN to DE-KIT	LHCOPN	Stopped	No transfers found in FTS. Spectrum alarm is cleared	Released	5.88	1513-e-rjup1-1_irb.3530
277	CH-CERN to DE-KIT	CUSTOM	Stopped	The large data transfer is finished.	Released	18.5	
276	DE-KIT to CH-CERN	CUSTOM	Action	On-going SDN. FTS throughput [Gb/s]: 25.39	Provided	28.8	
275	CA-TRIUMF to CH-CERN	LHCOPN	Running	Spectrum generated an alarm: NOTED is inspecting FTS.	Not provided		1513-e-rjup1-1_irb.2126
274	CH-CERN to DE-KIT	LHCOPN	Stopped	No transfers found in FTS. Spectrum alarm is cleared	Not provided		1513-e-rjup1-1_irb.3530
273	UK-T1-RAL to CH-CERN	LHCONE	Stopped	No transfers found in FTS. Spectrum alarm is cleared	Not provided		1513-e-rjup1-1_irb.111
272	CH-CERN to DE-KIT	LHCOPN	Monitoring	No transfers found in FTS. NOTED is still running until Spectrum clears the alarm.	Not provided		1513-e-rjup1-1_irb.3530
271	CH-CERN to UK-T1-RAL	LHCONE	Stopped	The large data transfer is finished.	Released	0.450	1513-e-rjup1-1_irb.111

## SC22 DEMO RESULTS: FTS LARGE DATA TRANSFERS BETWEEN CA-TRIUMF AND CERN

Outcomes from SC22 NOTED demonstration: once an on-going FTS large data transfer was detected by NOTED, it called the SDN controller that provided 2 dynamic circuits (VLANs 2024 and 2025) via ESnet and SURF to Canarie + 1 dynamic circuit (VLAN 2027) that was routed through SC22 booth.

