Machine Learning for ATLAS Data Management

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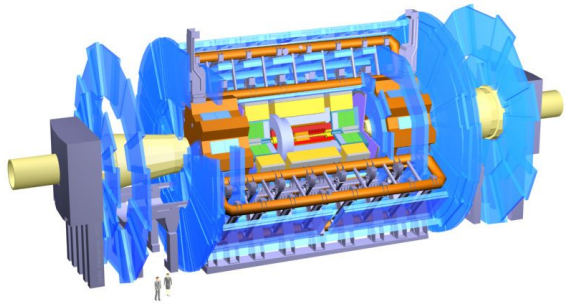
Data management responsibilities



Organise all of the experiment's data
Make data available to experiment's workflows

The software stack that implements ATLAS DDM is called *Rucio*

- Built upon the experiences from LHC Run-1 DDM system *Don Quijote 2* (DQ2)
- Modularized – extensible and open architecture
- Scalable by design – beyond LHC Run-2

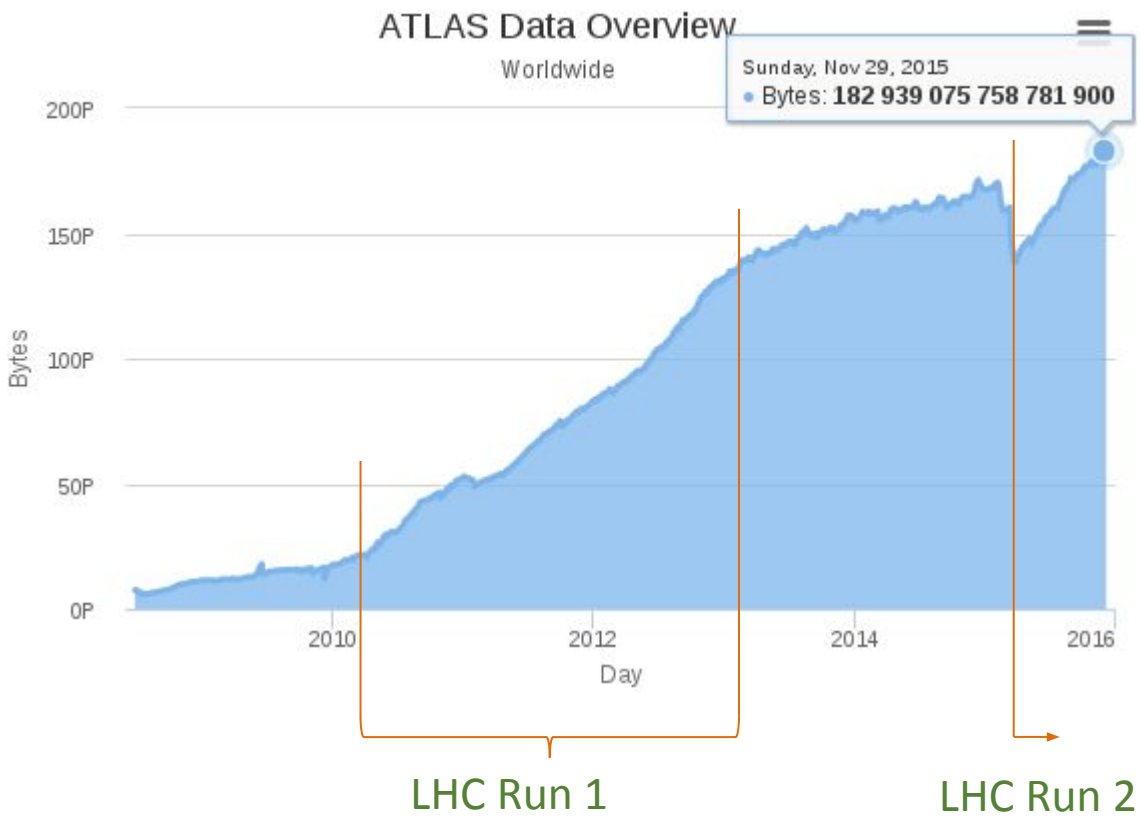
Generic and adaptive system – Also in use by Alpha Magnetic Spectrometer experiment

Data volume

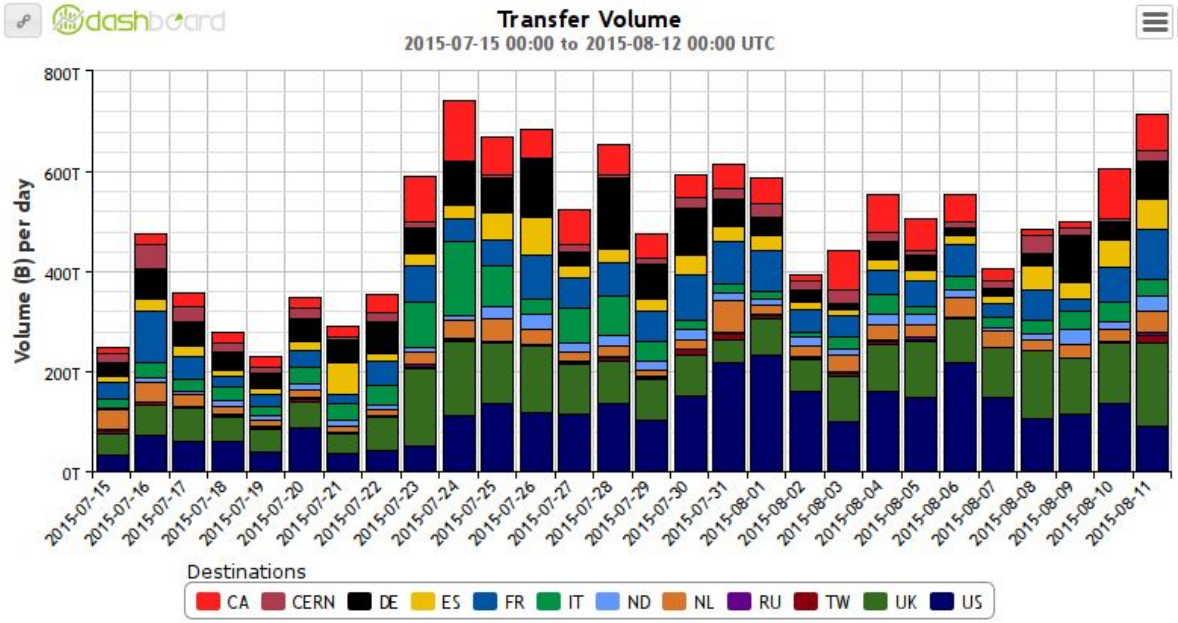
Files organised in datasets and containers
- 600 million files
- 20 million datasets & containers
- 40 million archived datasets

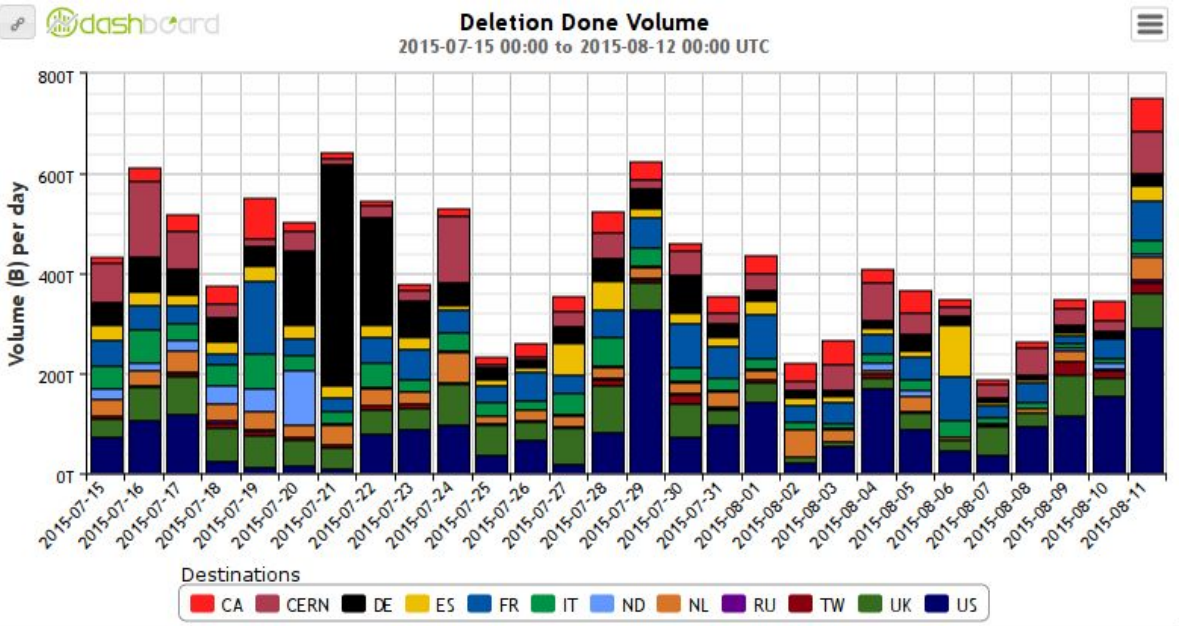
File replicas on storage
- 650 million replicas
- 720 storage endpoints
- 145 data centres

Access control
- 9400 identities
- 5300 user accounts



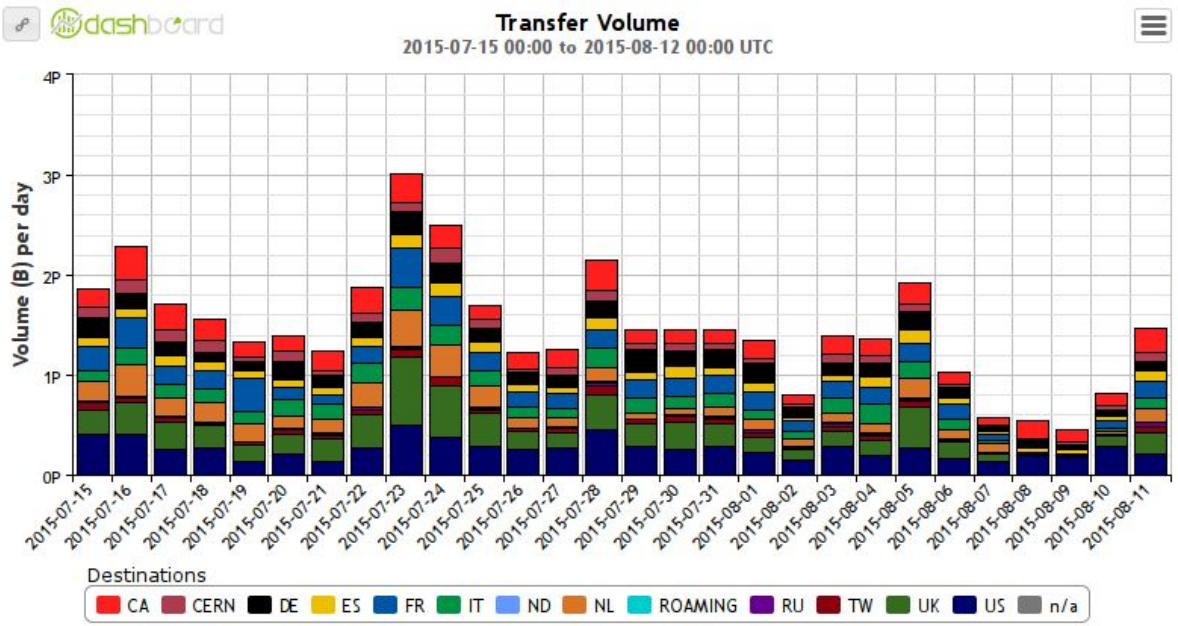
Scheduled throughput

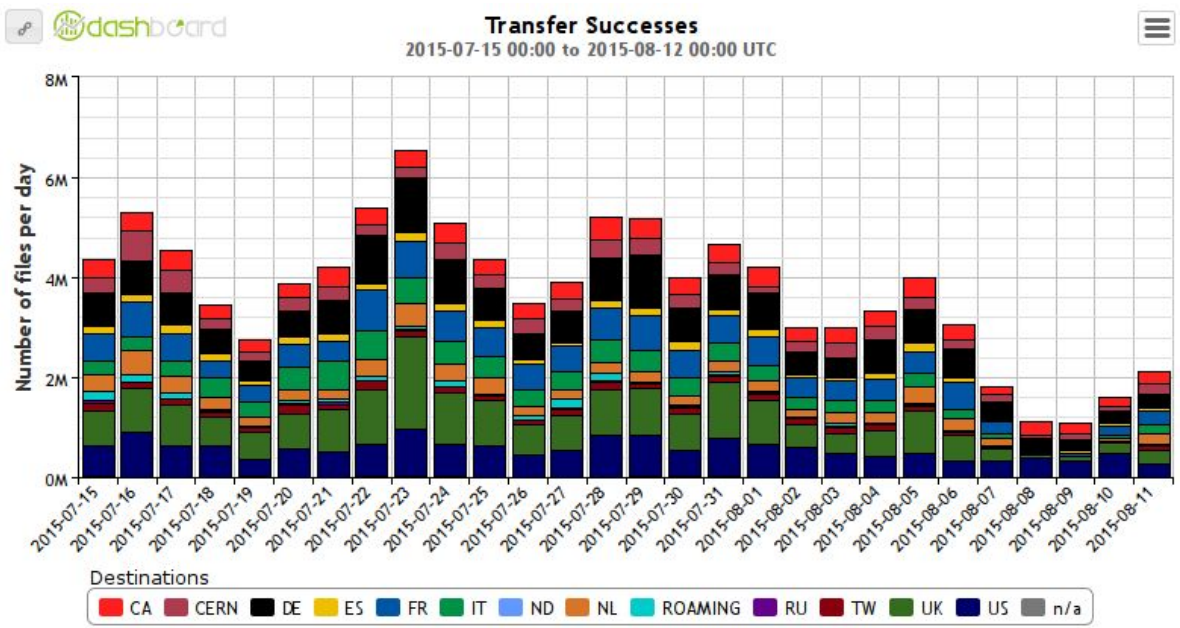




Throughput throttled on ISO/OSI Layer 7 (Application)
Limited storage capacity leads to dynamic data management
Constraint logic engine evaluates and processes data placement rules

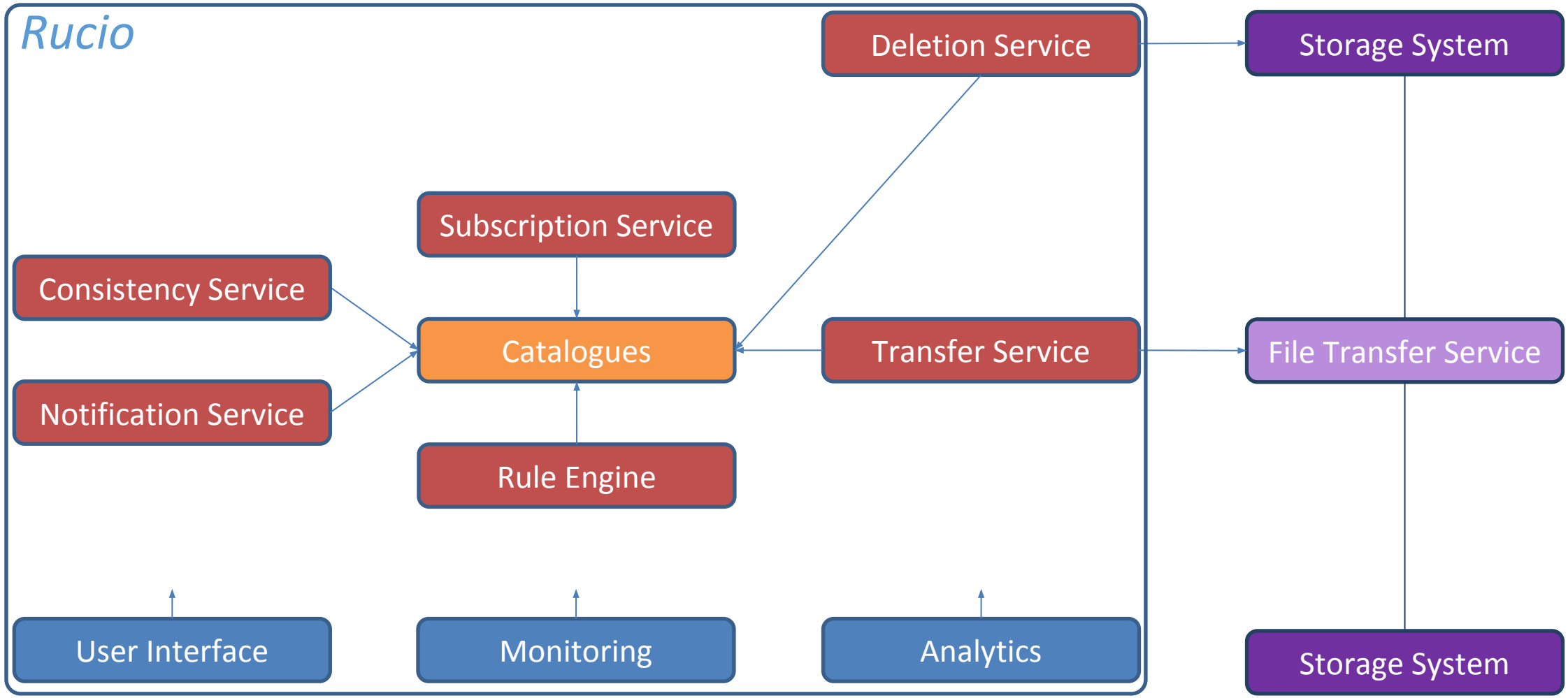
Unscheduled throughput



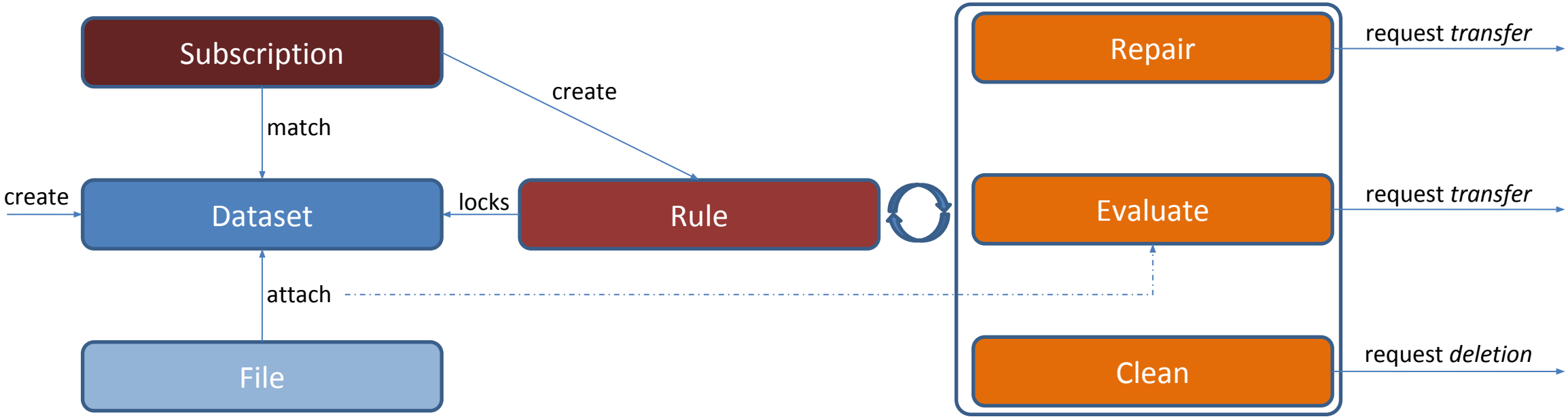


Jobs, CLIs, … also access data – requires interaction with Rucio
Unpredictable interaction rate – potentially disruptive

High Level Architecture



Rule engine



Implicit data management – specify what, not how – use subscriptions & replication rules

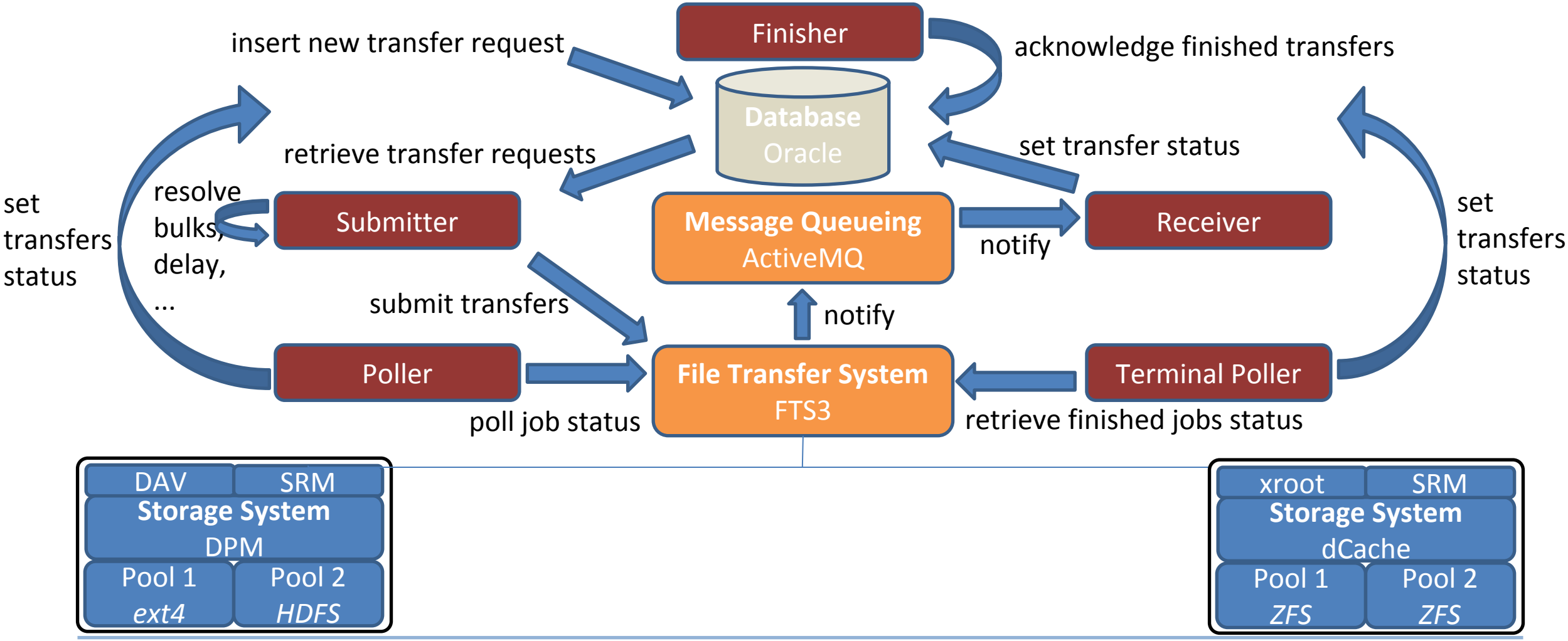
e.g., `{mc15_13TeV*, copies: 2, type=tape}` or `{user.mlassnig.01, copies: 1, country=at}`

Replication rules express interest in data – protect replicas from deletion

Smart potential destination selection – volume, distance, quota, grouping

Files without rules are eligible for deletion – kept as cache until space is needed

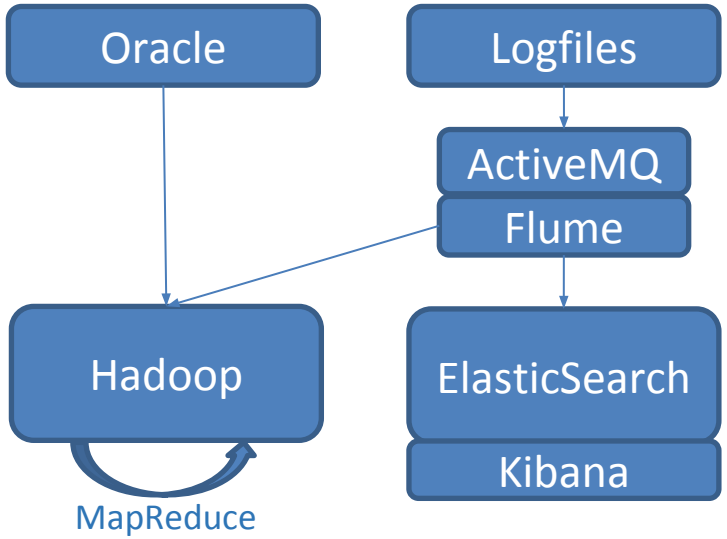
Scheduled transfers

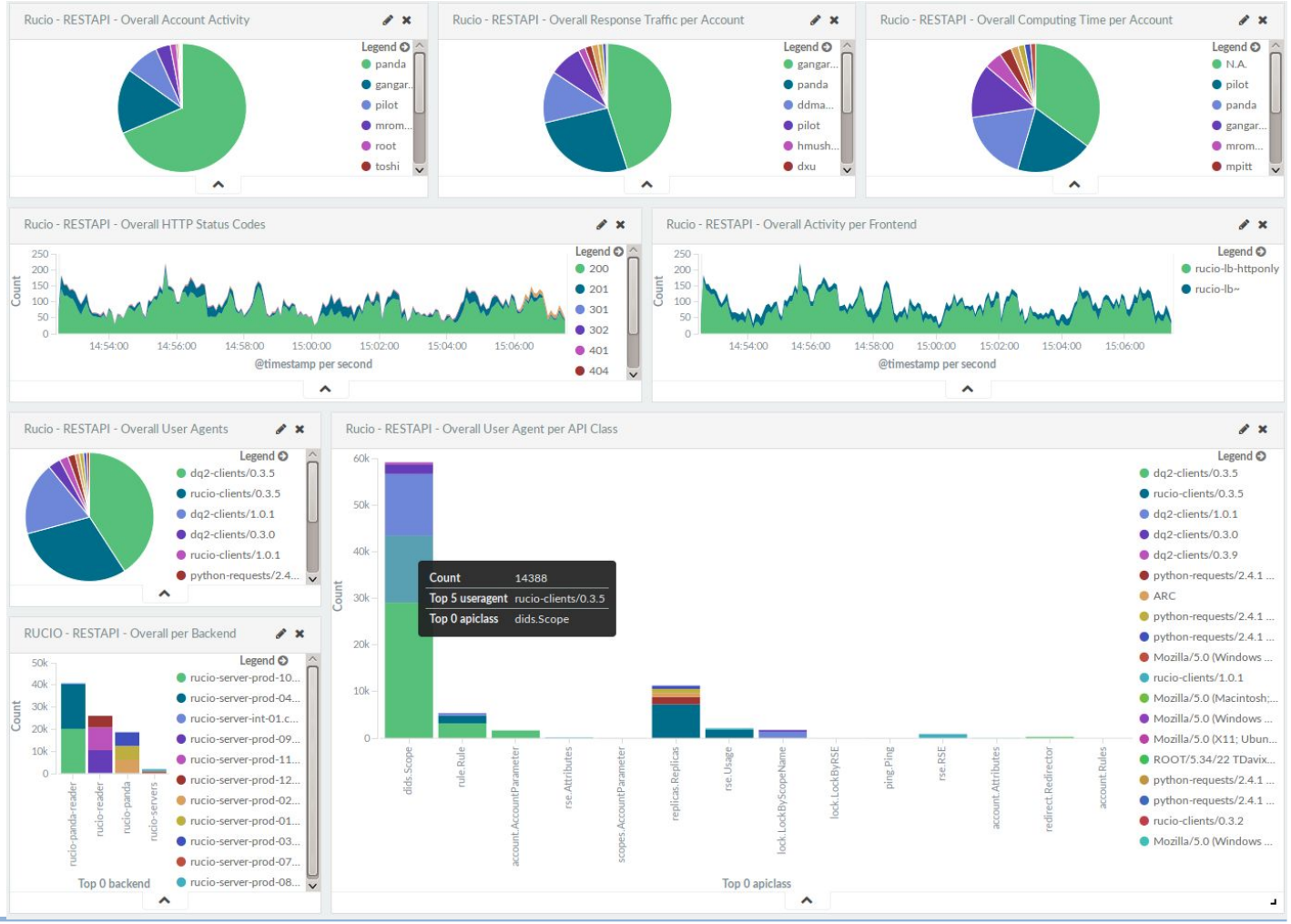


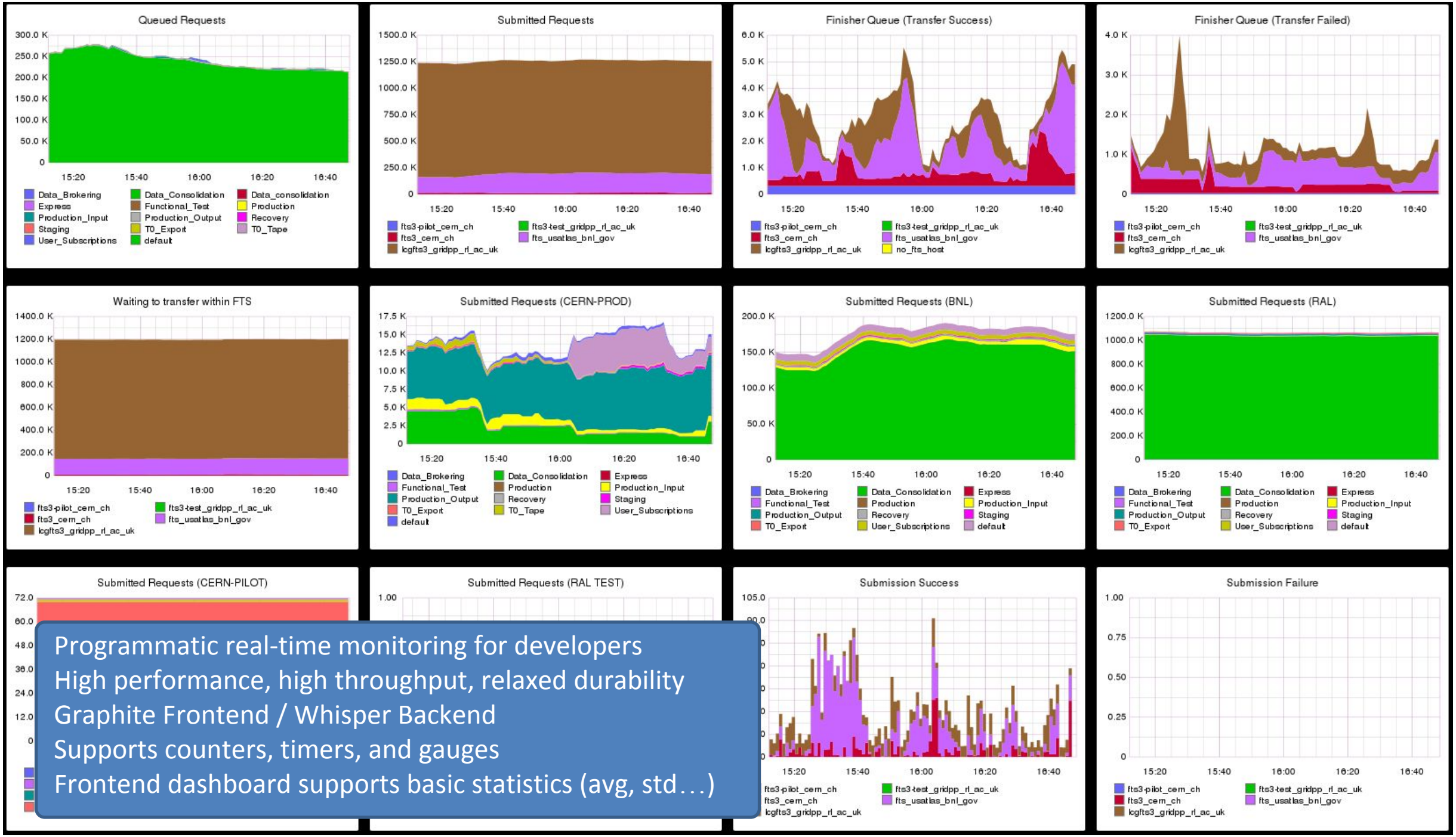
Data sources

From what can we learn?
We differentiate

offline sources
online sources

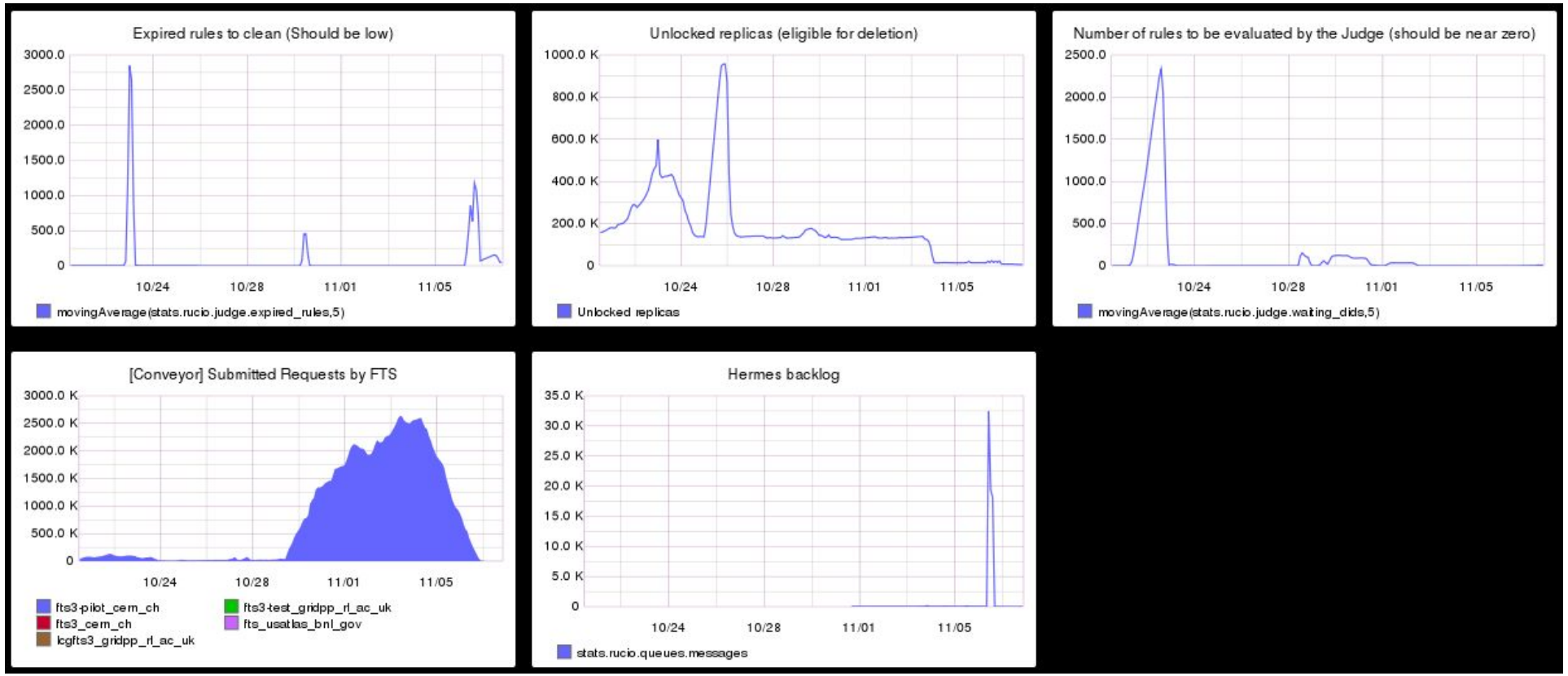






Programmatic real-time monitoring for developers
High performance, high throughput, relaxed durability
Graphite Frontend / Whisper Backend
Supports counters, timers, and gauges
Frontend dashboard supports basic statistics (avg, std…)

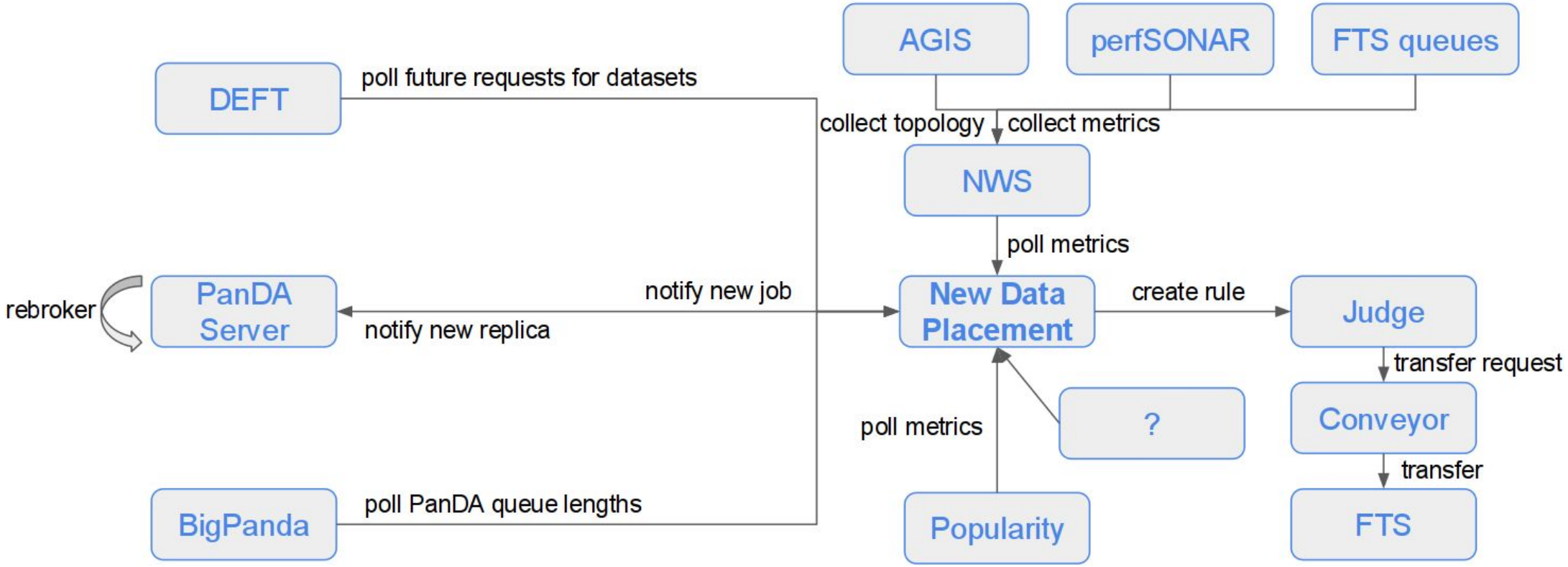
Anomaly detection



Things don't always go well — we need shifter interventions

Error-prone and costly — write up of post-mortem analysis for computing management

Dynamic data placement



Studied well in literature — Has optimal solution if full knowledge is available (topology & workload)
We have proposed a new dynamic data placement system — currently prototyping implementation

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