Belle II data management (and plans to use Rucio)

Paul Laycock for the Belle II team

BROOKHAVEN NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

Belle II Distributed Computing

Definition
- **MC prod / data process**
- **Type (BB, τ τ, ccbar..)**
- **# of events**
- **software version**
- **etc..**

PS

-Production
-Distribution
-Merge

Production manager (human)
- Define "Production"

Production Management

Belle DIRAC

Distributed data management
- Gather outputs to major storage (and distribute over the world)
- Check status of storages
- Define "Transfers"

output info

Fabrication Transformation
- Define jobs
- Re-define failed job
- Verify output files

B2Monitoring

DIRAC

Request management

Data management

Workload Management
- Submit job on site
- Record job status etc

Resource

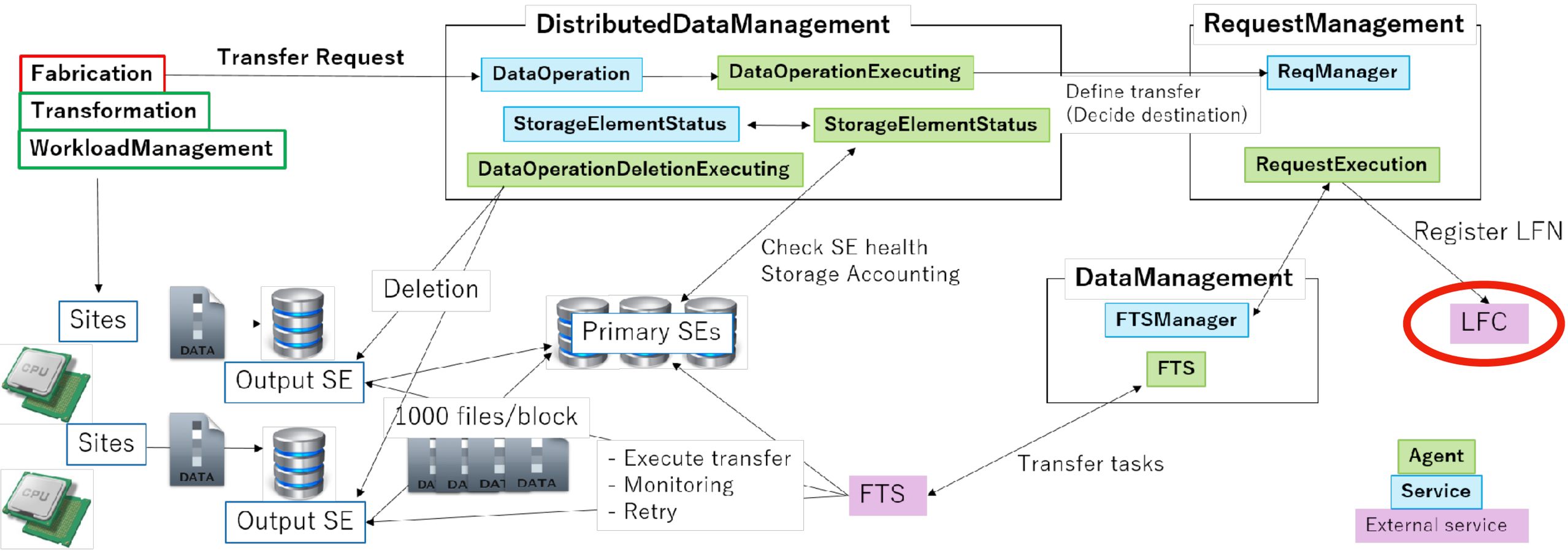
Primary SE

Output SE

Computing site

More on Belle II in Miyake-san's talk tomorrow

Belle II Distributed Data Management



- Designed as a key component of **BelleDIRAC**, the current **DDM** is well integrated into the **(Belle)Dirac** ecosystem (production system, monitoring, et al)

  + It's native, e.g. controlled the same way as any other Dirac components

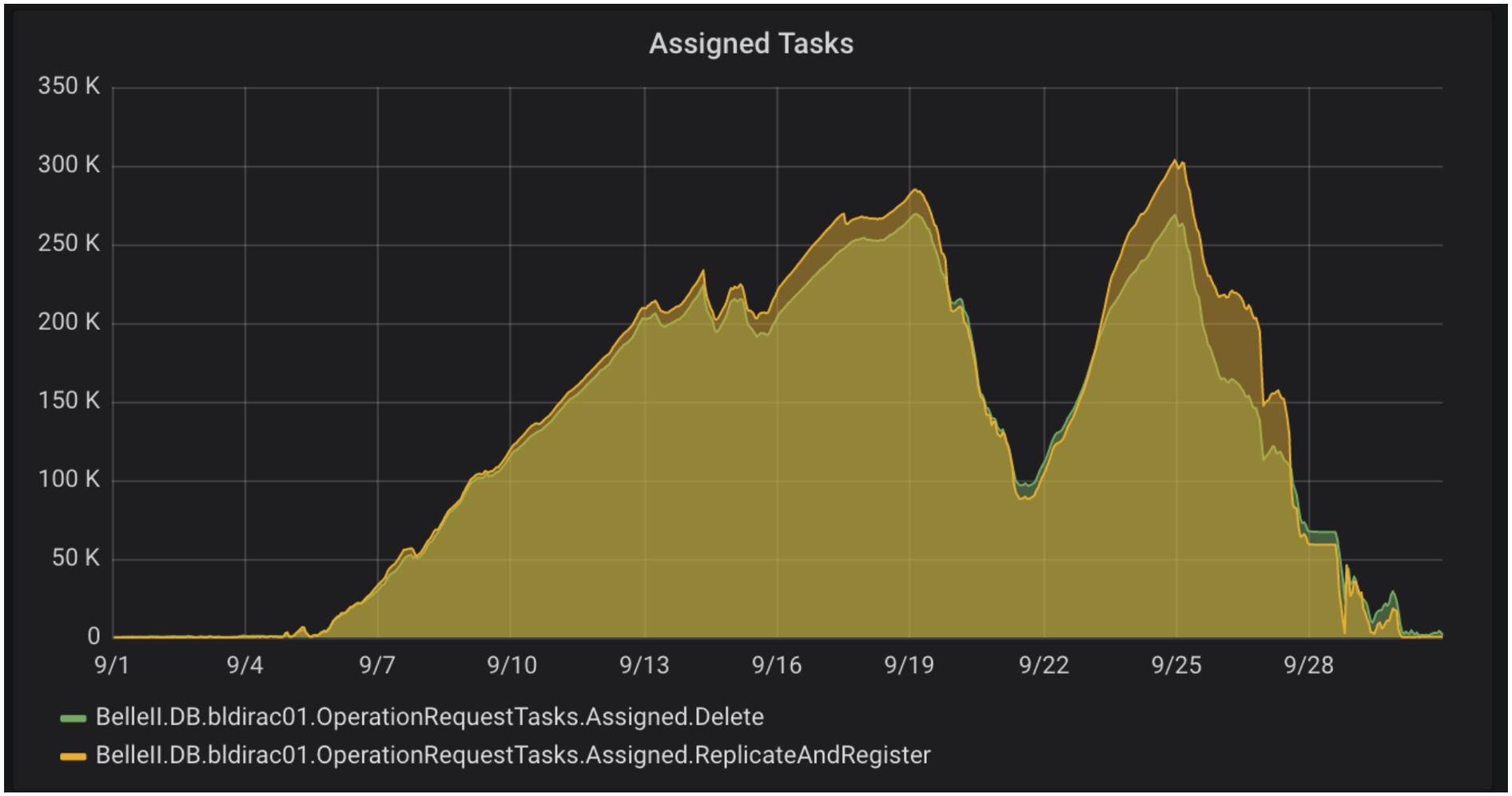
  - Only basic functionality, lots of effort needed to fix implementation, key features either untested or missing, it ignores the Transformation System and the LFC file catalogue may soon be extinct

The Far Side by Gary Larson

PULL

MIDVALE
SCHOOL FOR
THE GIFTED

Picture in 2018



- DDM frequently got stuck
  - Several implementation issues including, SE health assessment, lack of concurrency, easily blocked by one problematic SE
- Lacking in automation and advanced features, not commissioned or non-existent
- ***Question - Would it be possible to use Rucio instead?***

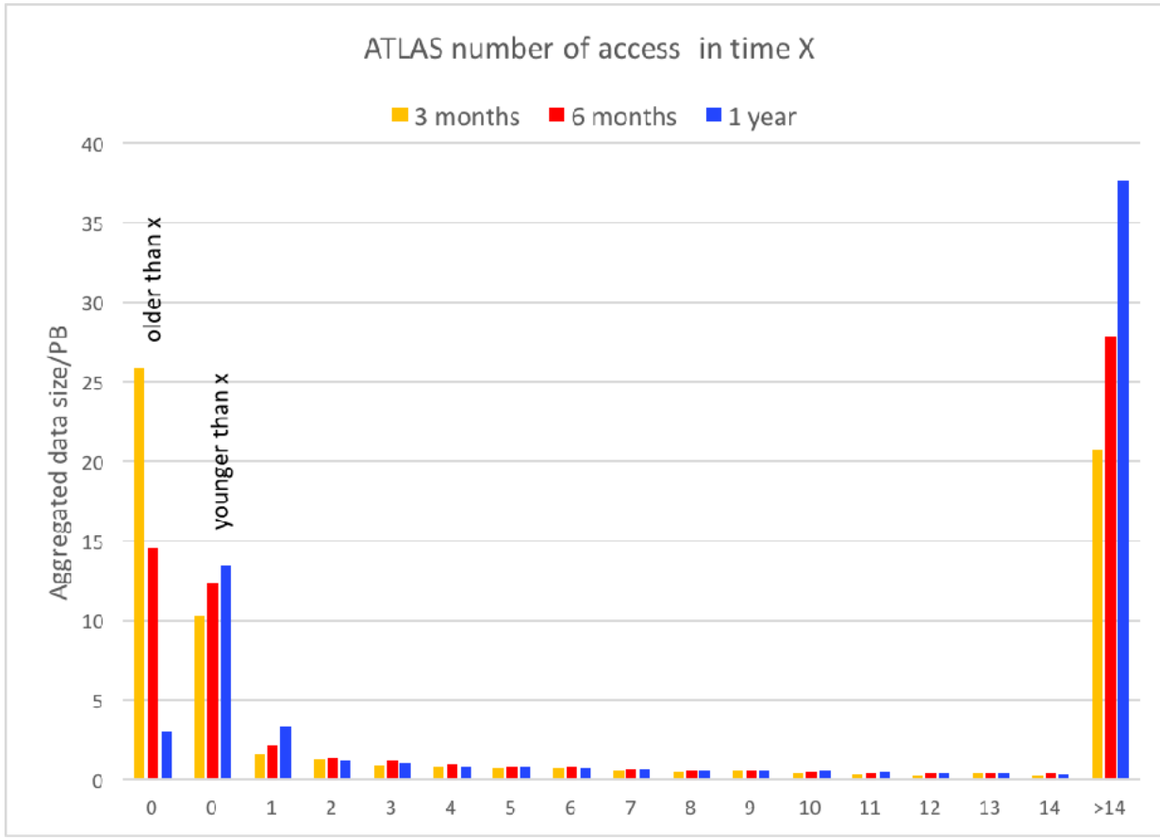
Rucio functionality

- **Rucio** has the advanced ***functionality and scalability*** that **Belle II DDM** needs, and it's open source
  - https://rucio.cern.ch/

- Key features *missing* from current DDM include
  - ***Authentication, accounts, quotas***
  - ***Data discovery, monitoring, analytics***
  - ***Data lifetime***
    - crucial for managing data is being able to ***delete*** it, rucio also tracks data popularity, identify write-once-read-never data
  - ***Data integrity, dark data, dataset containers***
  - ***Replication by Policy (very basic implementation exists)***

- Stable rucio operation for **ATLAS** beyond the scale needed for **Belle II**

Rucio, funding bodies and



- The number of accesses plot features heavily for LHC experiment reports to funding bodies
- In my view, this is ***one of the main*** reasons that drives Rucio's popularity
  - Well, that and the awesome team ;)
- Funding agencies will expect to see this plot - don't ask for more !

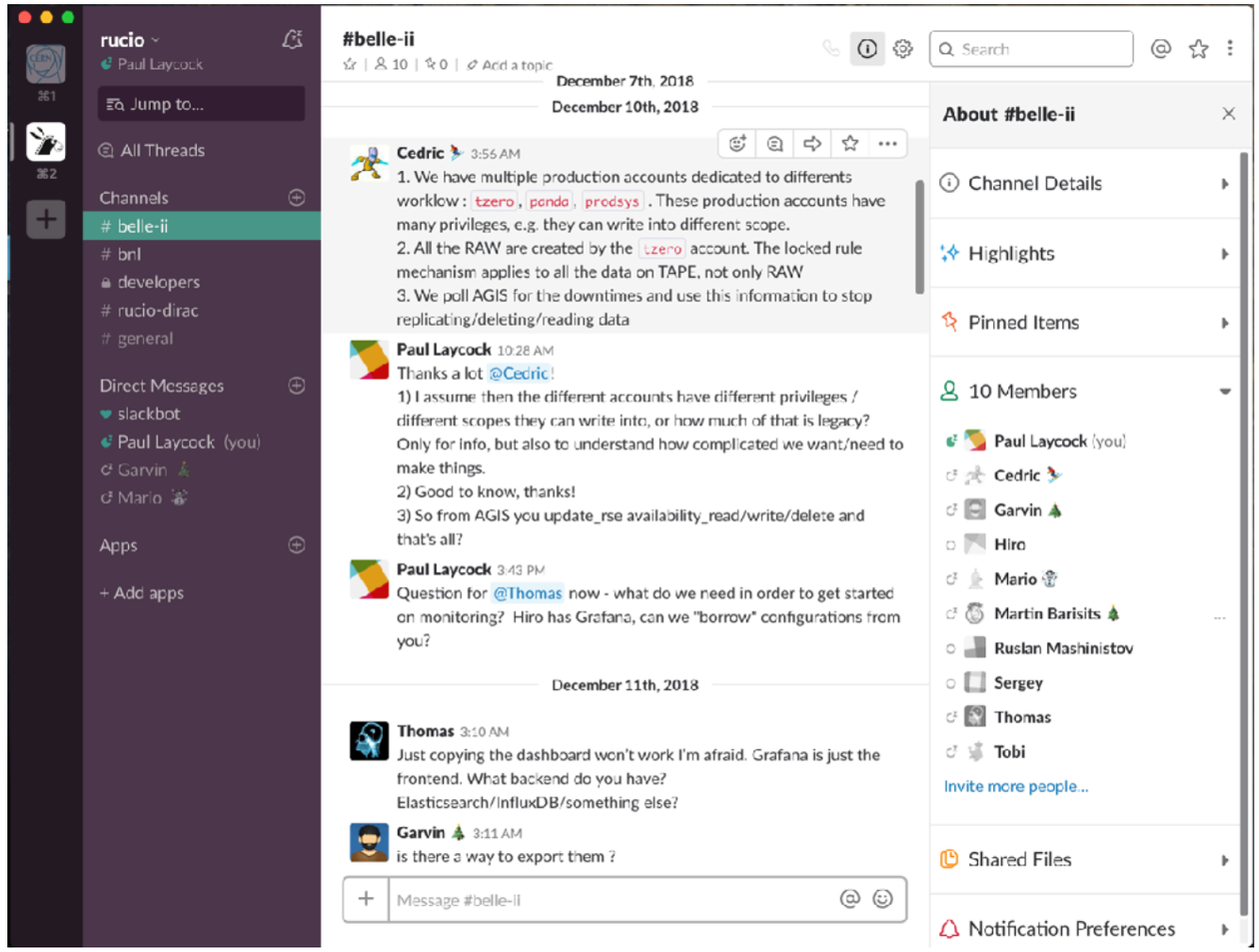
- *(The image is taken from Charles Dickens' "Oliver Twist", a classic London childcare fairytale)*

Rucio support

- Developed by **ATLAS**
  adopted by **CMS** and **DUNE**
    - and a growing community

- **Rucio** is ***open source***:
    - https://github.com/rucio/rucio

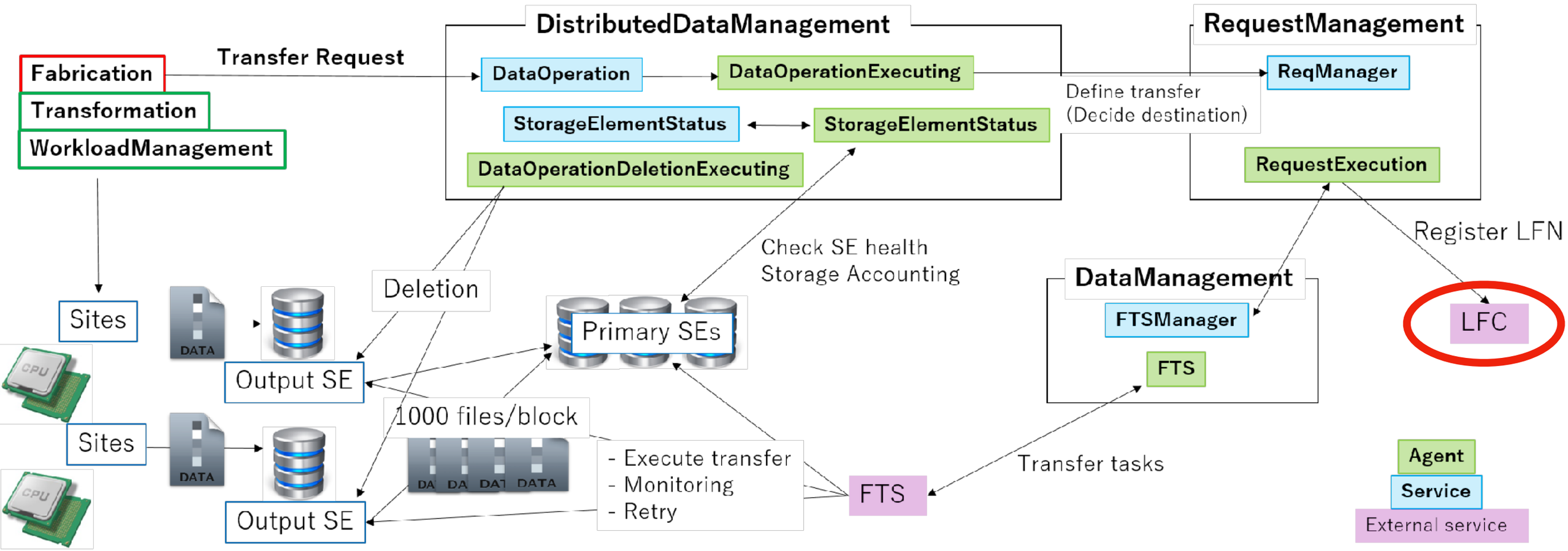
- Weekly dev meetings to set priorities



- Use **slack** for ***fast feedback*** with the core development team, with the pool of expertise growing all the time
    - Currently very dependent on core CERN team, working to ensure their availability will not be an issue in the future (participate in the ***second Rucio community workshop***)

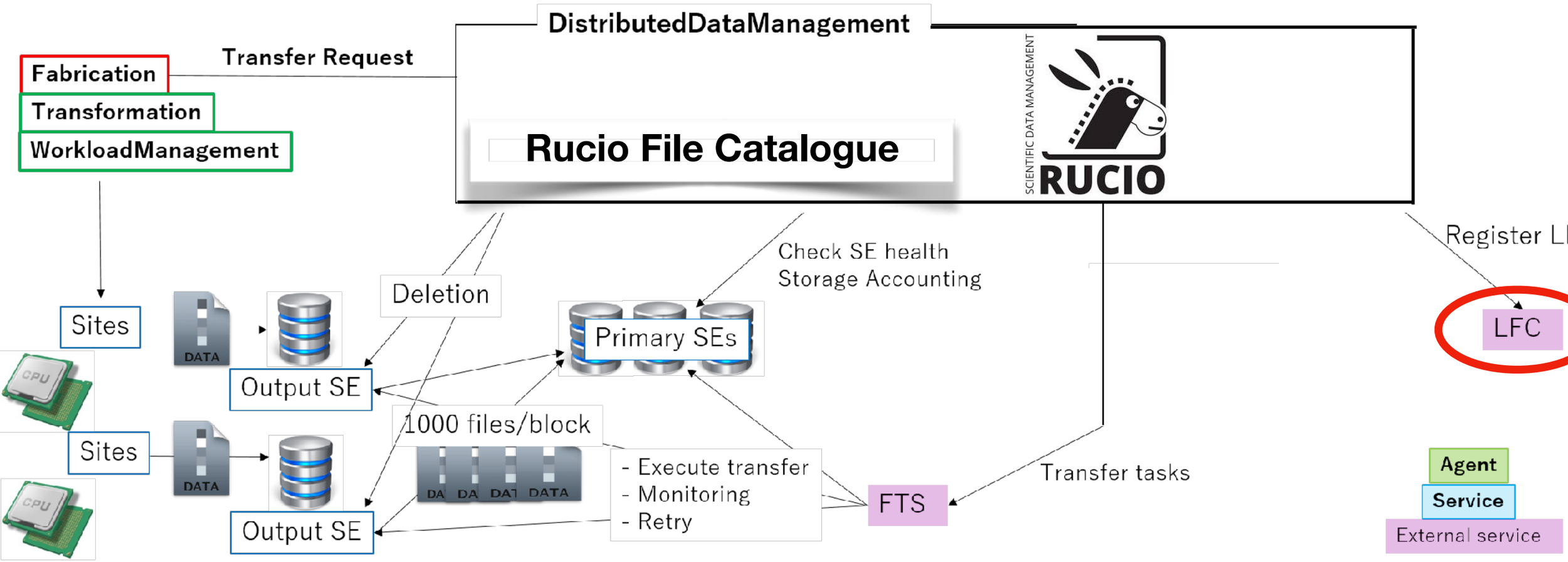
- Experience of other experiments moving to rucio was persuasive

Belle II Distributed Data Management



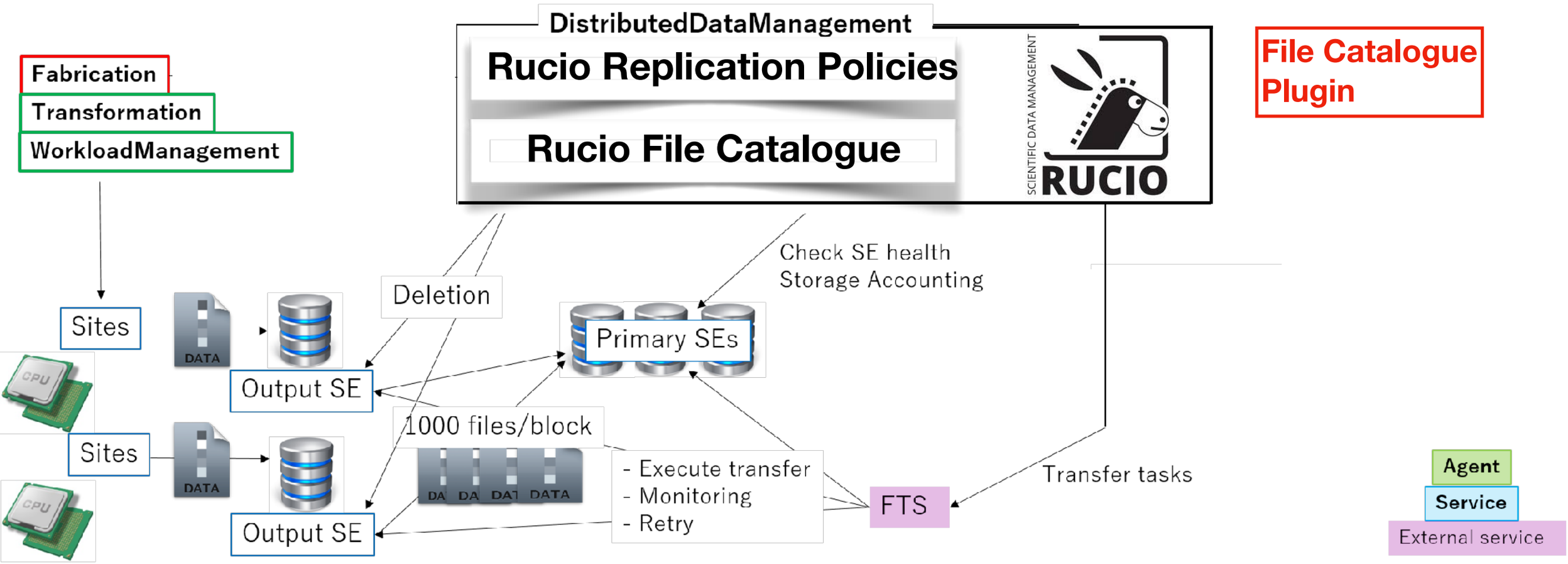
- Following approval to evaluate **Rucio**, invited **Rucio** and **BelleDIRAC** experts to **BNL**
- No blockers identified but…
- … deployment problems meant we missed ***March 2019 start date***
  - ***Prioritise fixing current DDM to be good enough, migrate to Rucio later***

Belle II Distributed Data Management - Future I



- In first stage migration, ***maintain current API*** to minimise impact
- **DDM** uses **Rucio** behind-the-scenes, but **Rucio** is not exposed to users
- **Rucio** file catalogue is also not exposed, **LFC** is still *master file catalogue*
- Fabrication system is ***DDM-type*** aware to allow ***bi-directional migration***

Belle II Distributed Data Management - Future II



- Second stage migration ***Rucio is master file catalogue*** using ***file catalogue plugin***
- ***Replication policies*** to trigger replication, ***lifetime policies*** to ***automate deletion***
- Remove explicit calls to **DDM (*no longer necessary*)**
- Instrument ***analysis s/w*** so that file access goes through **Rucio**
  - **Rucio then *tracks those files and knows they're being used - extend lifetime***

Summary

- **First stage migration** (***Rucio behind-the-scenes***)
  - Keep current DDM API, forward work to Rucio (rucio client installed on Dirac
  - Very specific to **Belle II** and a necessary first step
  - Main aim is to commission **Rucio** in full production environment without changing anything else
  - A key requirement is: ***do not break anything***
  - and in case of issues, be able to quickly revert
- **Second stage migration** (***Dirac-Rucio file catalogue plugin***)
  - File catalogue migration from LFC to Rucio FC
  - Needs a ***Dirac-Rucio file catalogue plugin - common to all Dirac-Rucio?***
  - Easier to open up the key features of **Rucio** - ***management***
  - ***Lifetime policy*** in particular is something funding agencies start to expect - prove you're managing what you have, then you can ask for more
  - Some engineering required to use all of the advanced **Rucio** features, but not reinventing the wheel