PNNL-SA-127779

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Belle II Distributed Data Management and Networking

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Belle II Collaboration

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c.f. CERN Greybook July 2017
ATLAS: 39 countries, 217 inst., 7783 members
CMS: 49 countries, 208 inst., 6217 members
ALICE: 41 countries, 167 inst., 2799 members
LHCb: 17 countries, 74 inst., 1494 members

Computing requirement on par with LHC Run I

- The Belle II experiment is for Super B factory at KEK in Japan
- Complementary physics to the LHC based on precision measurements from high-intensity beams
- Total integrated luminosity : 50 ab^{-1}
- Collisions start in Early 2018
- Similar data rate as from LHC Run I

Raw Data : 100 KB / event
Detector mDST : 5 KB / event
MC mDST : 6 KB / event
Reconstruction : 20 HEPSPEC *s / event
MC : 60 HEPSPEC *s / event

	2017	2018	2019
Disk [TB]	3000	4500	11000
Tape [TB]	2000	2200	6500
CPU [KHEPSPEC06]	210	400	480

Belle II computing sites across the globe

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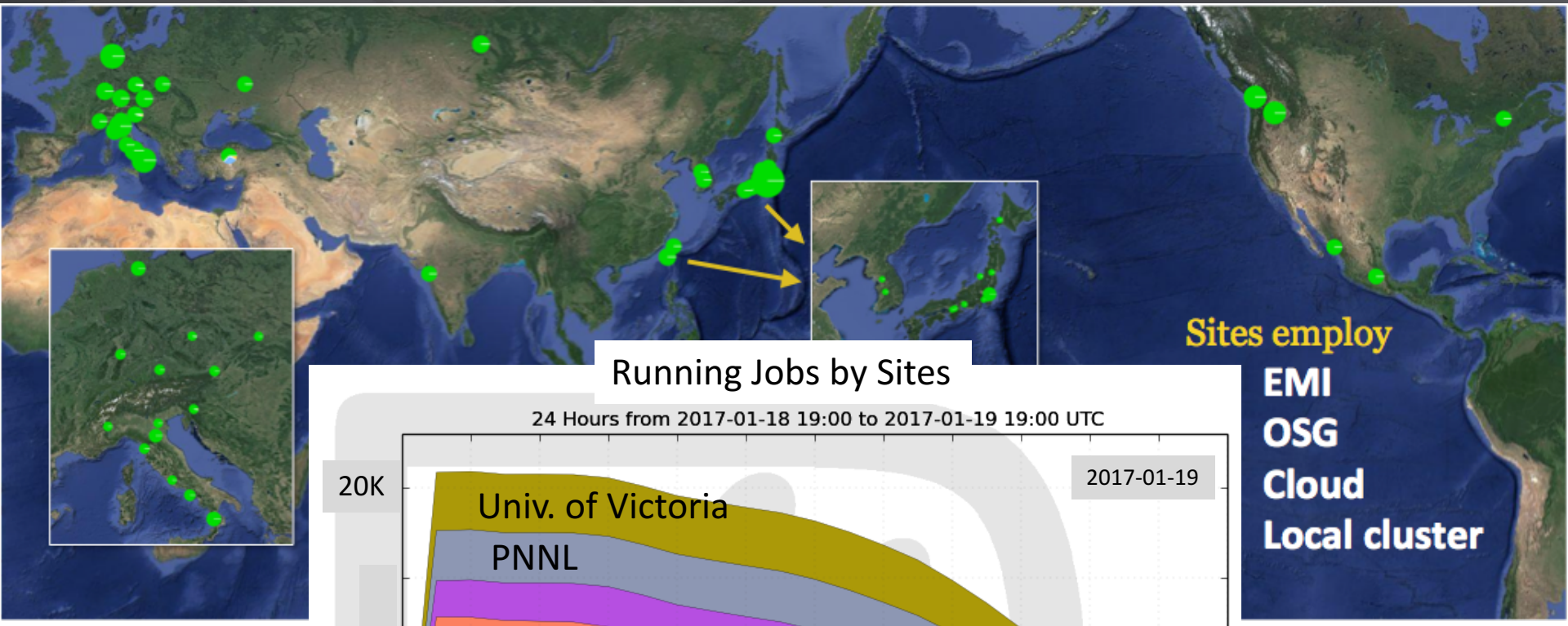

Belle II computing model until Year 3

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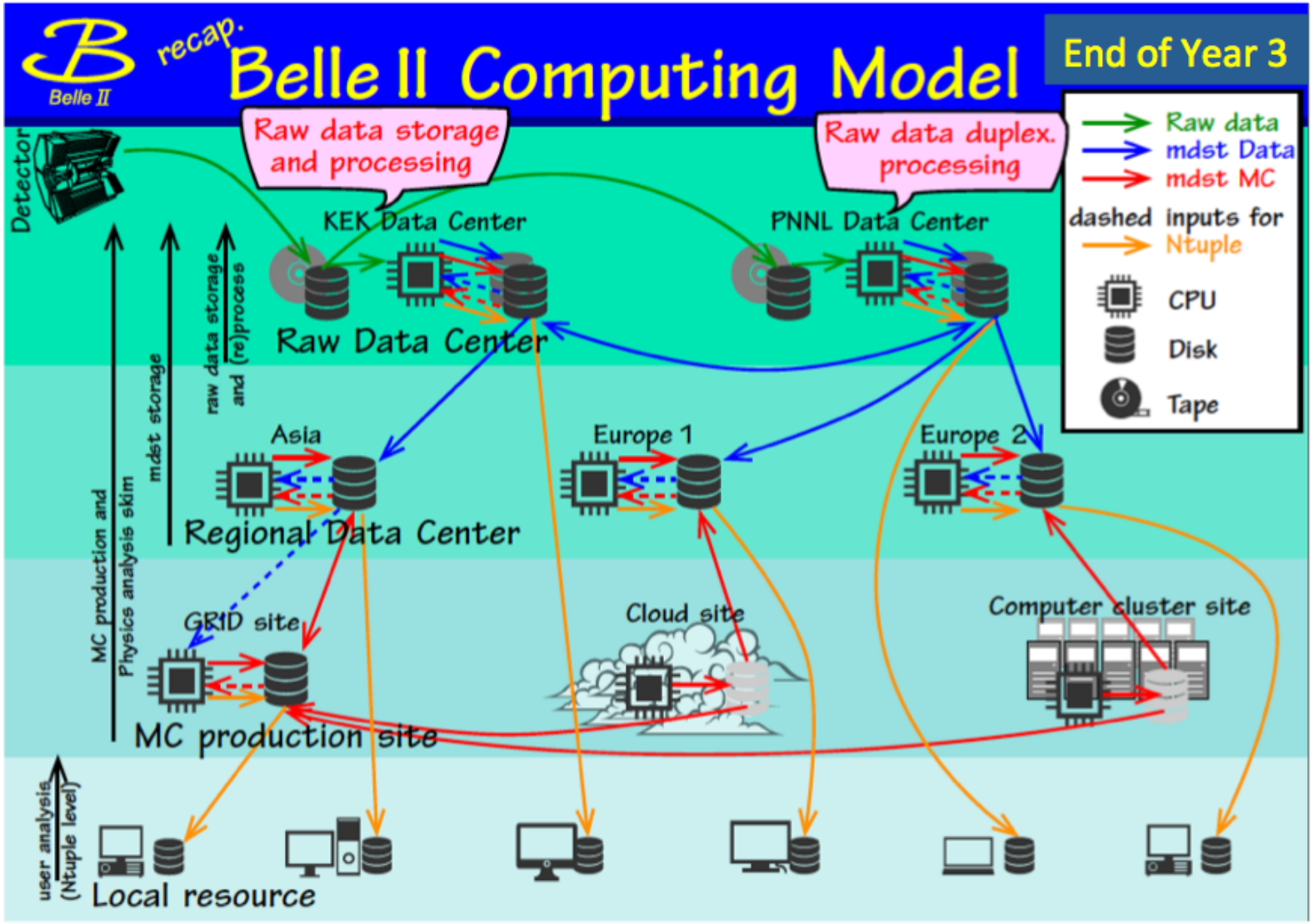
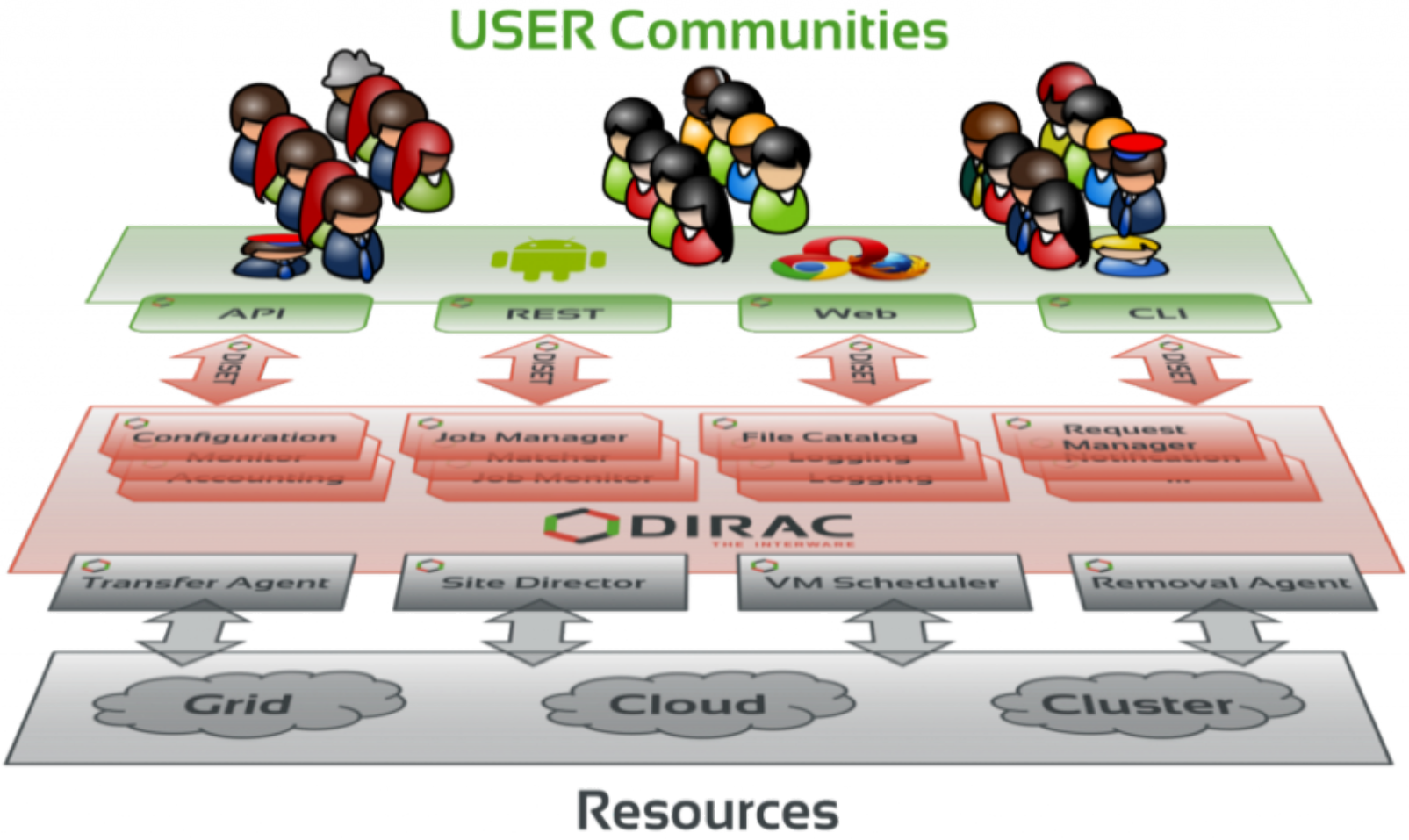


Belle II distributed computing software

- DIRAC (Distributed Infrastructure with Remote Agent Control) as the solution of choice
- Successfully used by LHCb. Extended for Belle II.



Belle II distributed computing layers

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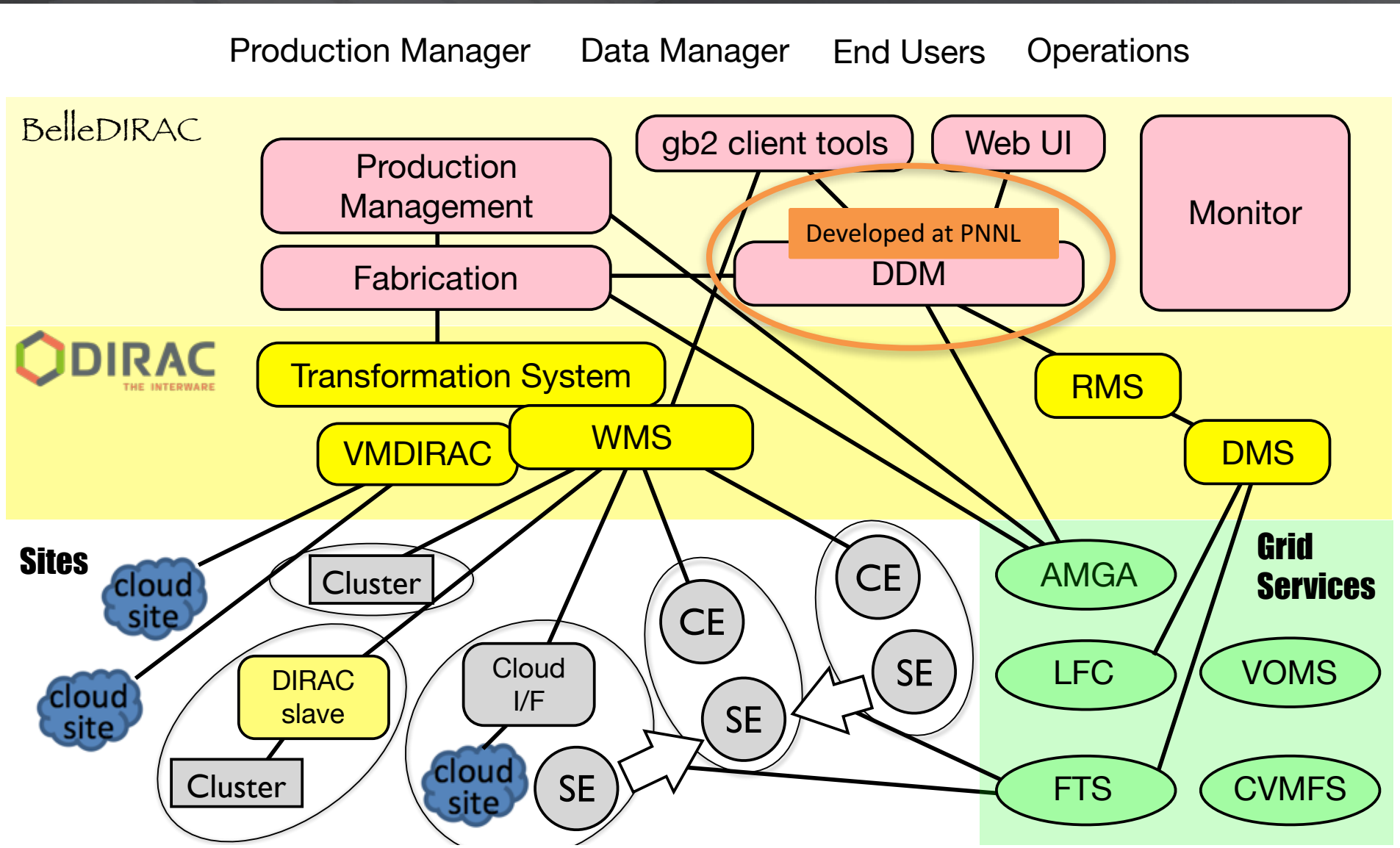

Distributed data management system overview

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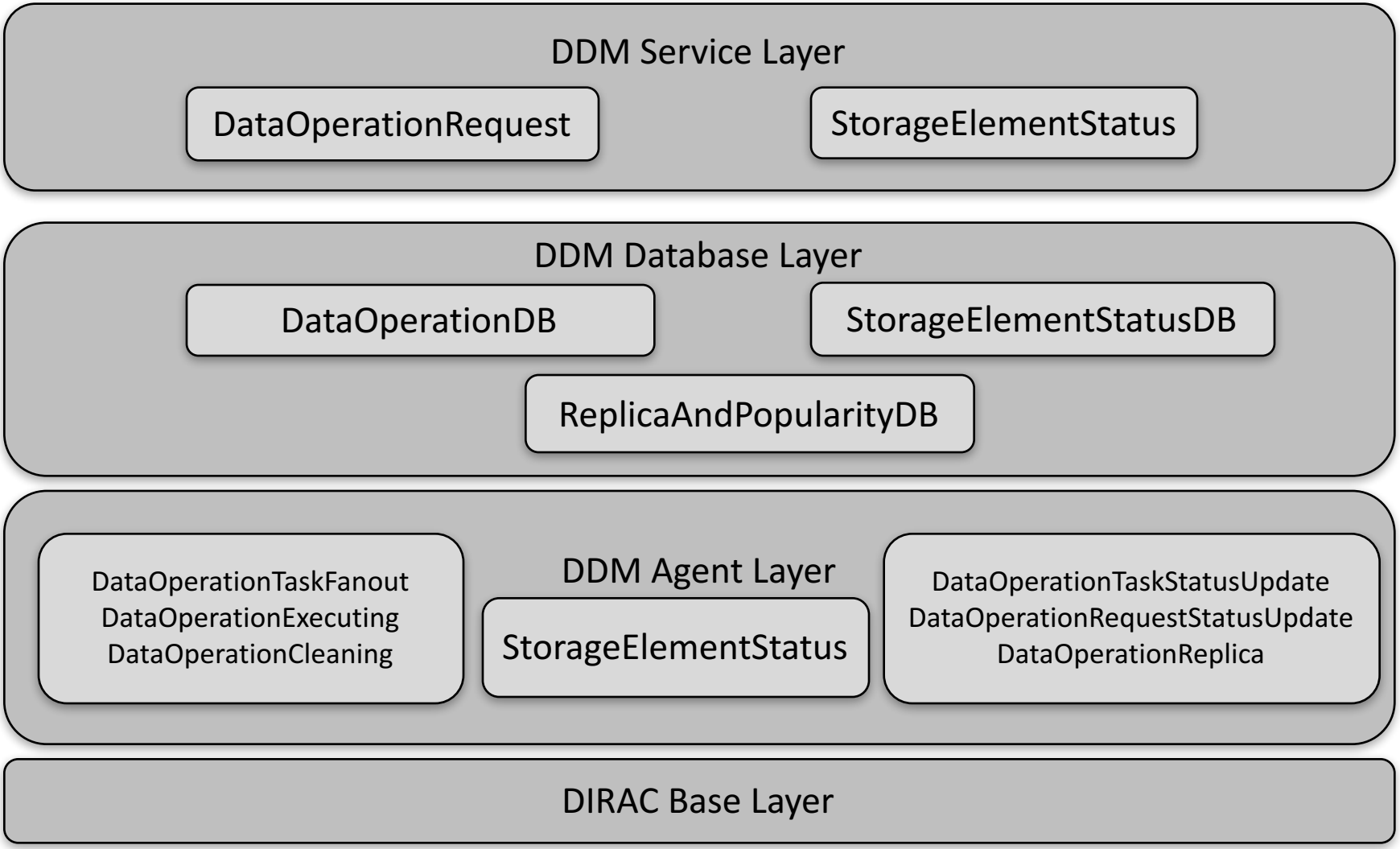
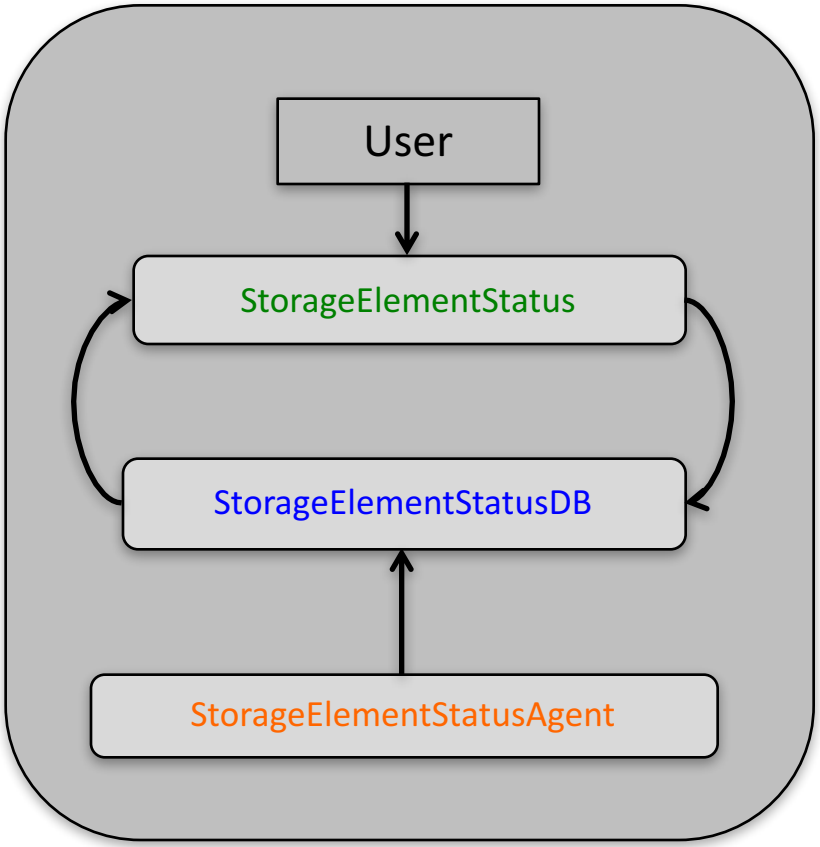


StorageElement Status Workflow



Purpose:

- Provide near real time storage elements information

Current implementations:

① StorageElementStatus provide API layer for internal and external users.

② StorageElementStatusAgentDB provide persistified information

③ StorageElementStatusAgent :

- Available space
- Access rights (w/r) at file and director level
- ADLER32 Checksum

Extra features:

- Include full ACL

DataOperation : Workflow Overview

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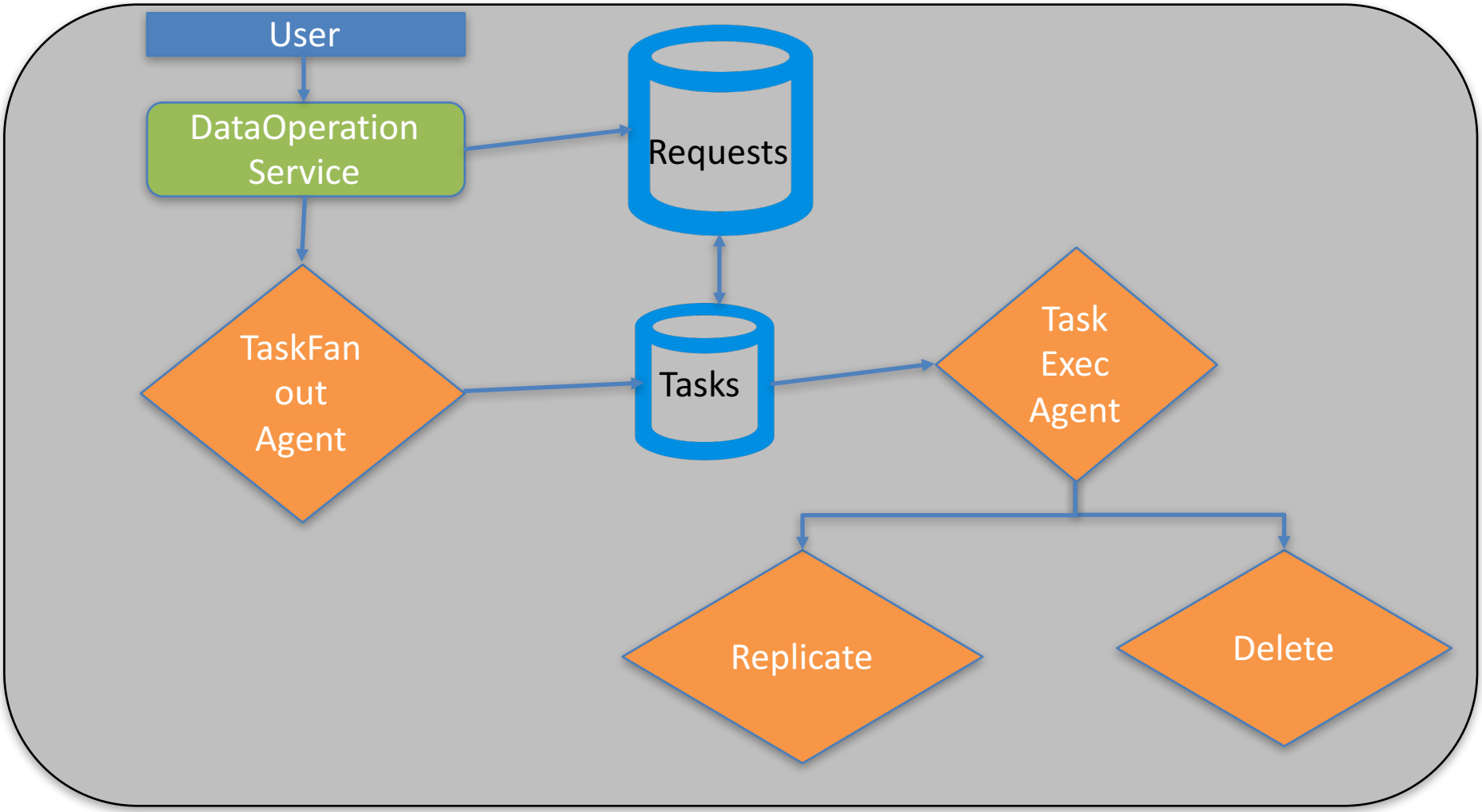

DataOperation : Replication Workflow

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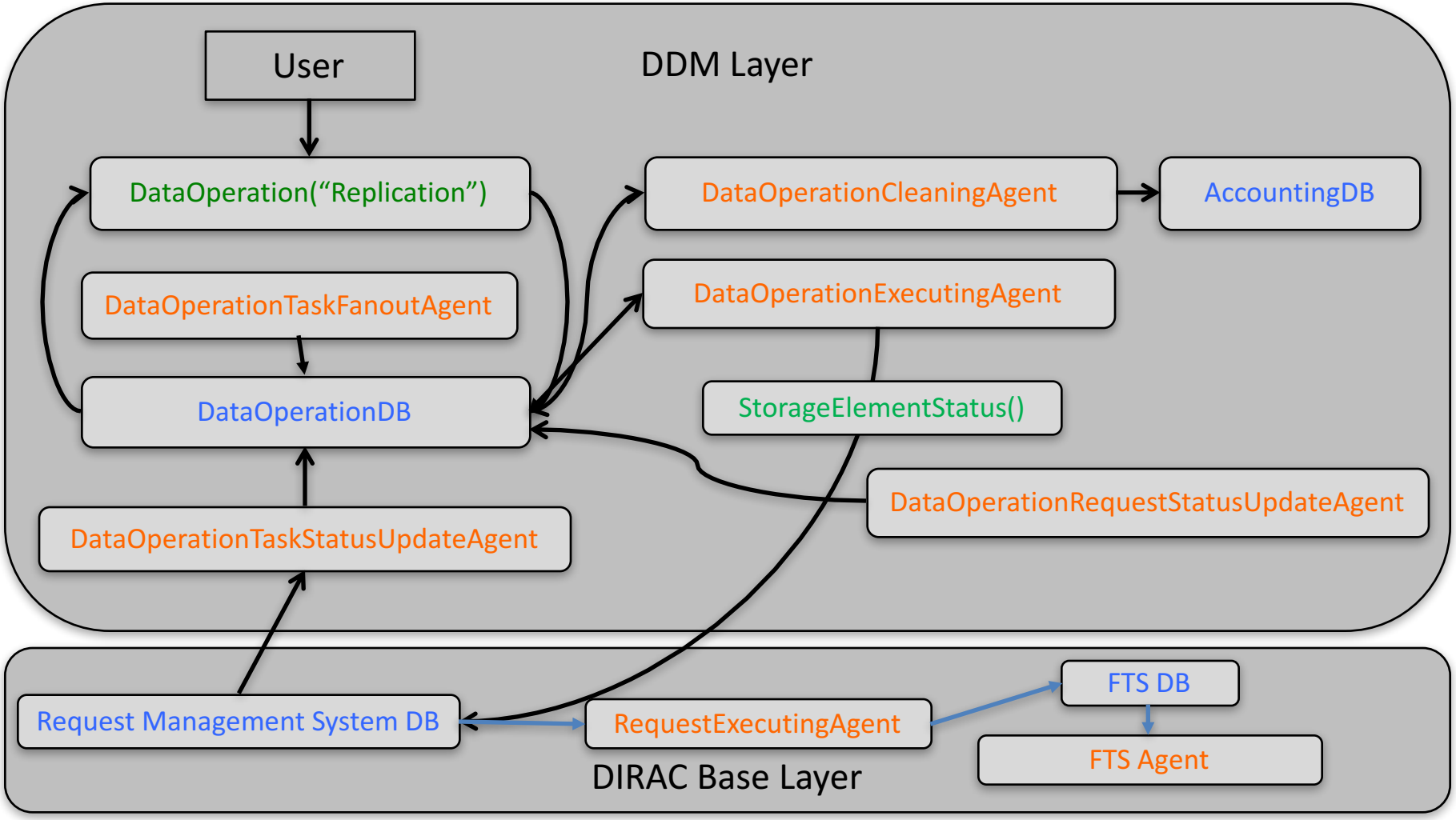
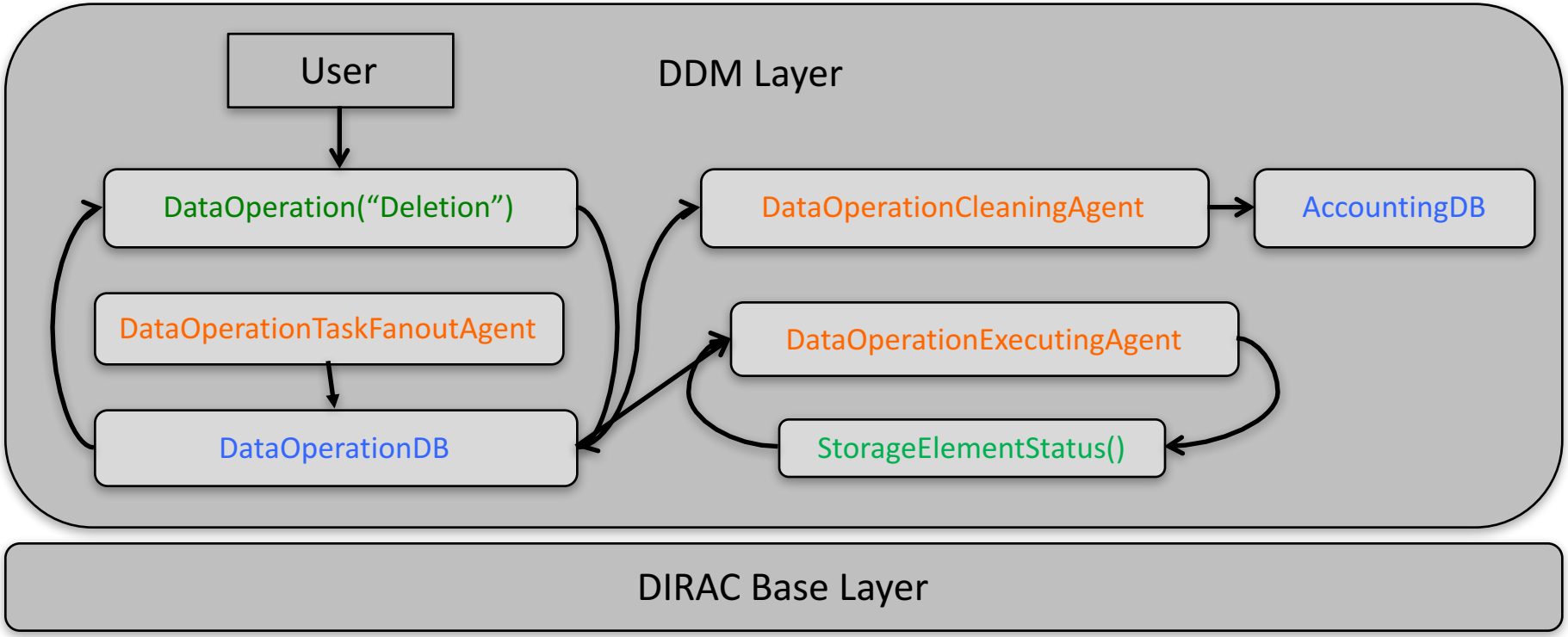


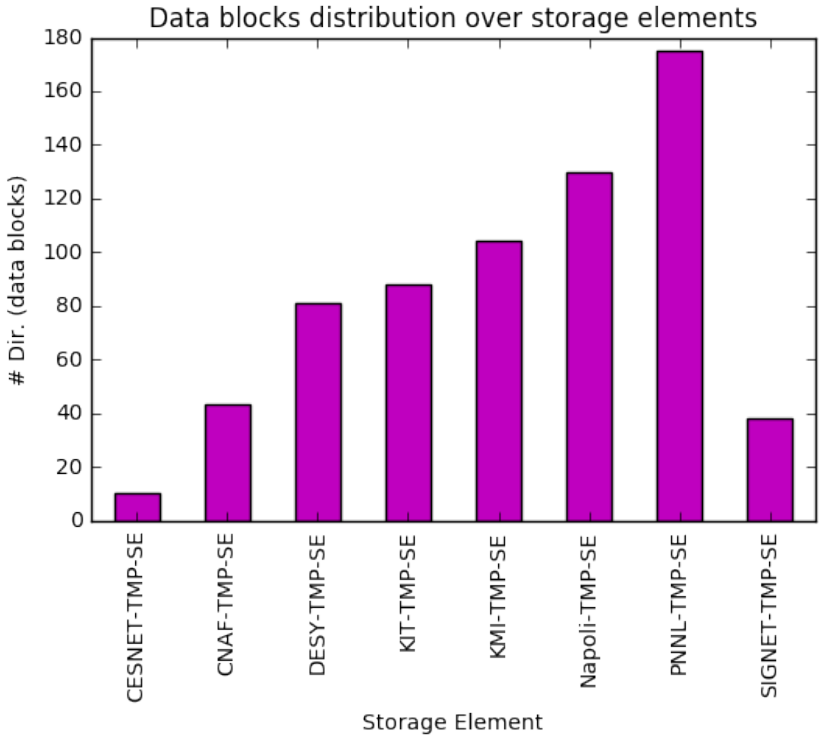
DataOperation : Deletion Workflow



- DDM by design does not delegate deletion of files to base DIRAC to avoid race conditions on data files
  - In addition Belle II utilizes AMGA (metadata service) that is not available in base DIRAC
- Data operation executing agent only acts on one operation on physical file at any given time

Distributed data management system in production

- Distributed Data Management System (DDMS) is successfully used in Monte Carlo (MC) samples production
- Production system hand overs data files to DDMS
  - DDMS decides to transfer the files/data to specific sites as per policy.



Distributed data management system in production

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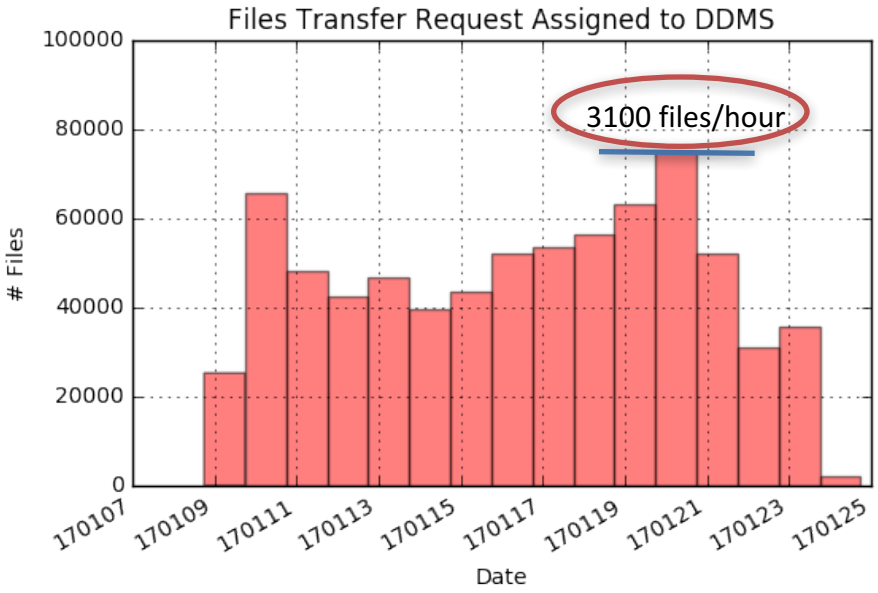
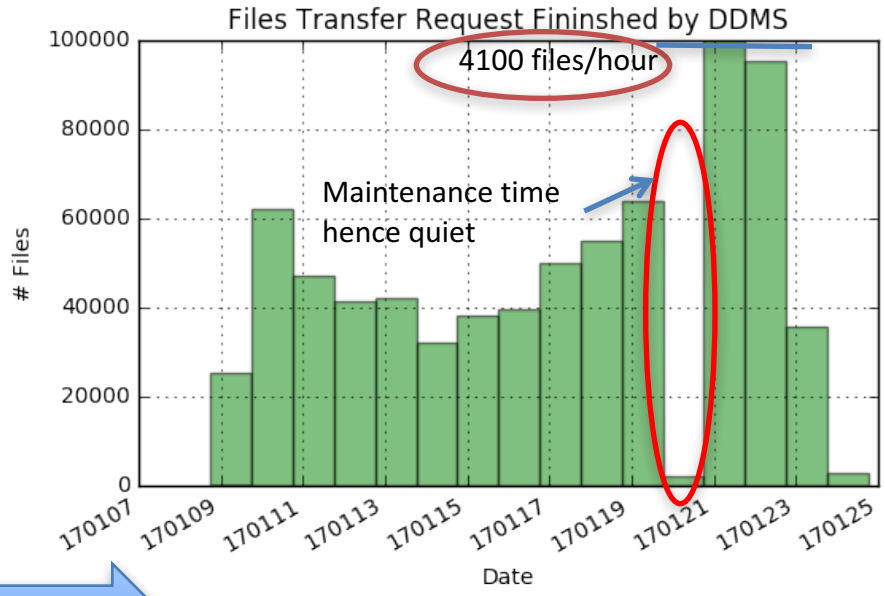
- Production system hand overs data files to DDMS
  - DDMS check for site health before starting any transfers. Replicates through DIRAC using File Transfer Server and reports back finished transfers





Belle II wide area networking

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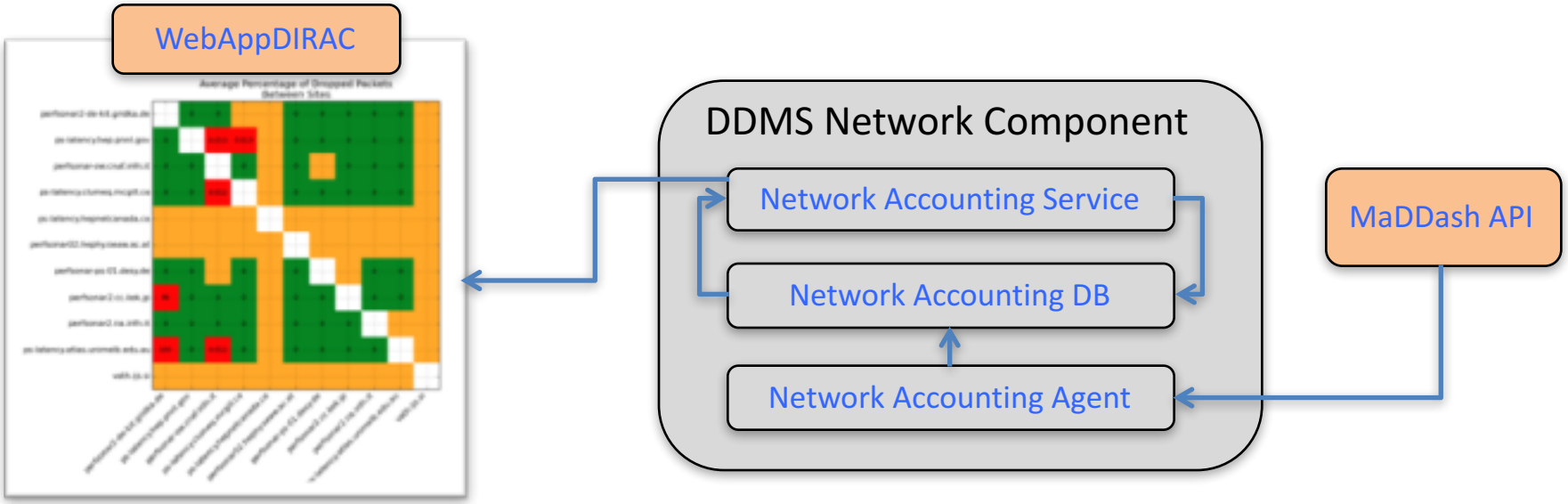
- Powered by National Research and Education Networks (NREN), e.g. ESnet
- Dedicated servers set up at Belle II sites for network monitoring
- PNNL leads the effort in setting up Belle II Monitoring Dashboard (MaDDash) mesh to measure sites-pair wise bandwidth and latency
- Network info is part of DDMS inside DIRAC
- Automate notification to sites with network problems



WAN data challenge KEK ↔ PNNL

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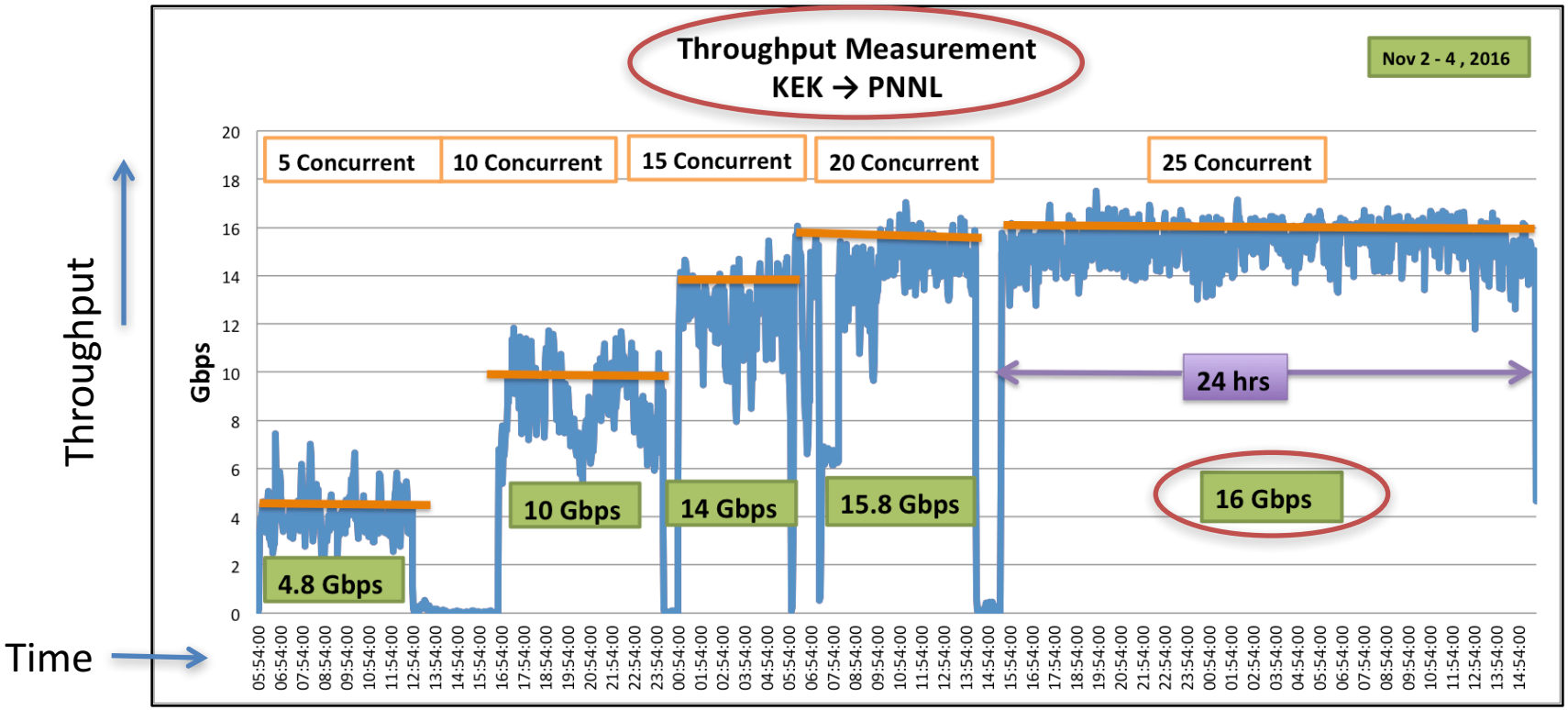
- Estimated network bandwidth for peek outgoing traffic from KEK : 9 Gbps
- KEK outgoing traffic measured at 16 Gbps
- DDM can be made to asses various network paths for optimal data transfers



Summary and Plan Moving Forward

- Belle II computing needs on par with LHC Run I
- Belle II distributed computing software is written in DIRAC framework
- Distributed data management system handles data transfers and deletion and is currently deployed in production mode
- We are actively working on next version of DDM that will directly schedule transfers to FTS to avoid DIRAC's RMS layer
- We foresee to add network health and monitoring in distributed data management system

Detailed Deletion Workflow

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