Choosing Distributed Computing Tools is much easier than choosing MC generators
Fewer products available

- Basic considerations in ATLAS
  - Systems are designed by and serves physics community
  - New features are driven by the experiment operational needs
  - Errors handling, monitoring and accounting are key components of distributed SW stack
  - There are several systems with very well defined roles which are integrated for distributed computing.
    - Combine all functionalities in one system or have several systems is an experiment choice
  - Edge service (is a relatively new layer)
  - Technology evolution should be addressed
  - Functionality is important as scalability
- New physics workflows (ML,…), new strategies ("provisioning for peak"), computing model evolution….

Courtesy: Z. Marshall

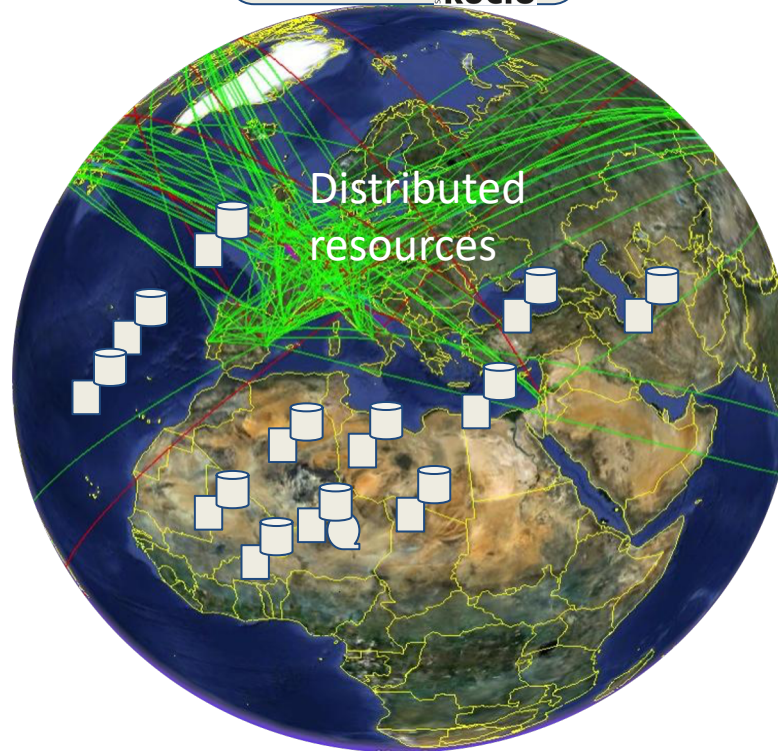# ATLAS distributed computing software stack

Workflow Management:
"translates" physicist requests into production tasks – ProdSys2

Workload Management:
submission and scheduling of tasks & jobs -**PanDA**

Monitoring production jobs & tasks, shares, users - **BigPanDA**

Dirac EGI, Dirac LHCb, Dirac Belle II, Dirac v
AliEn
CRAB
Pegasus

Distributed resources

Data Management:
bookkeeping and distribution of files & datasets - **Rucio**

Information System
PanDA Queues and resources/sites description - CRIC

Databases: Conditions and data processing (ORACLE, mySQL, PostgresSQL)

Analytics
ElasticSearch/Kibana – for PanDA and Rucio

2

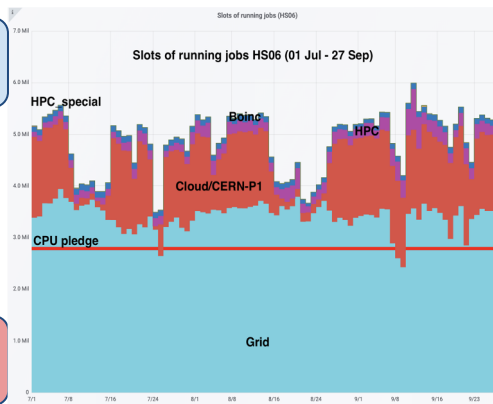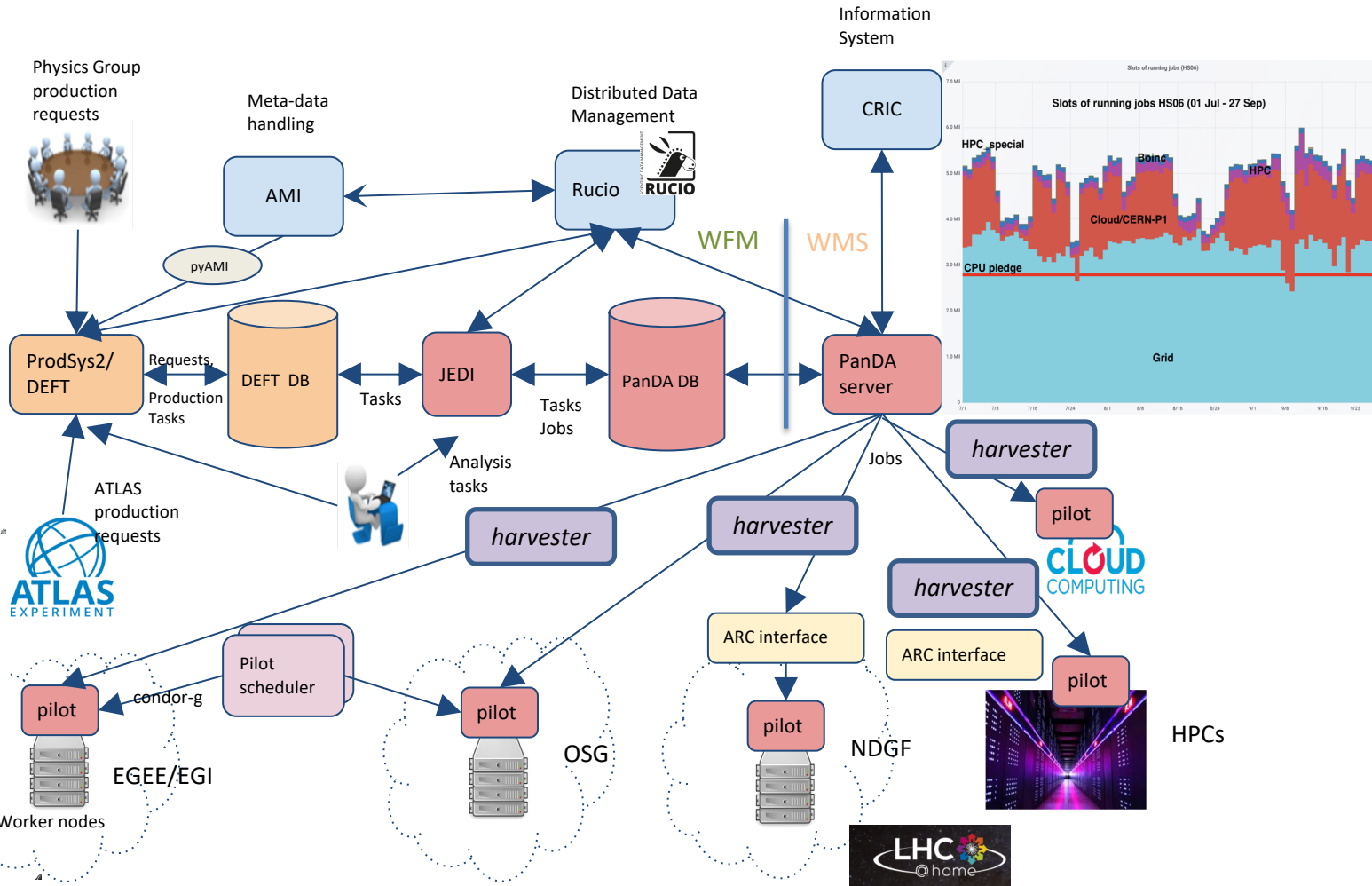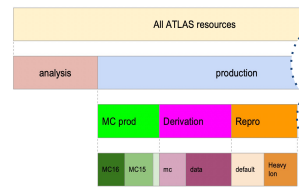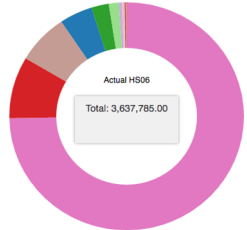# Workflow and Workload Management. ProdSys2/PanDA

Global ATLAS operations
Up to ~1.2M concurrent jobs
25-30M jobs/month at
>250 sites
~1400 ATLAS users

Orchestrate all ATLAS Workflows :
- *MC Production*
- *Physics Groups WF*
- *Data reprocessing*
- *T0 spill-over*
- *HLT processing*
- *SW validation*
- *User's analysis*
- *ART*

Shares/priorities

Support rich harvest of heterogeneous resources. Integrate WF and data flow

Workflows in ATLAS beyond PanDA : prompt data processing (T0), HLT, local physics analysis
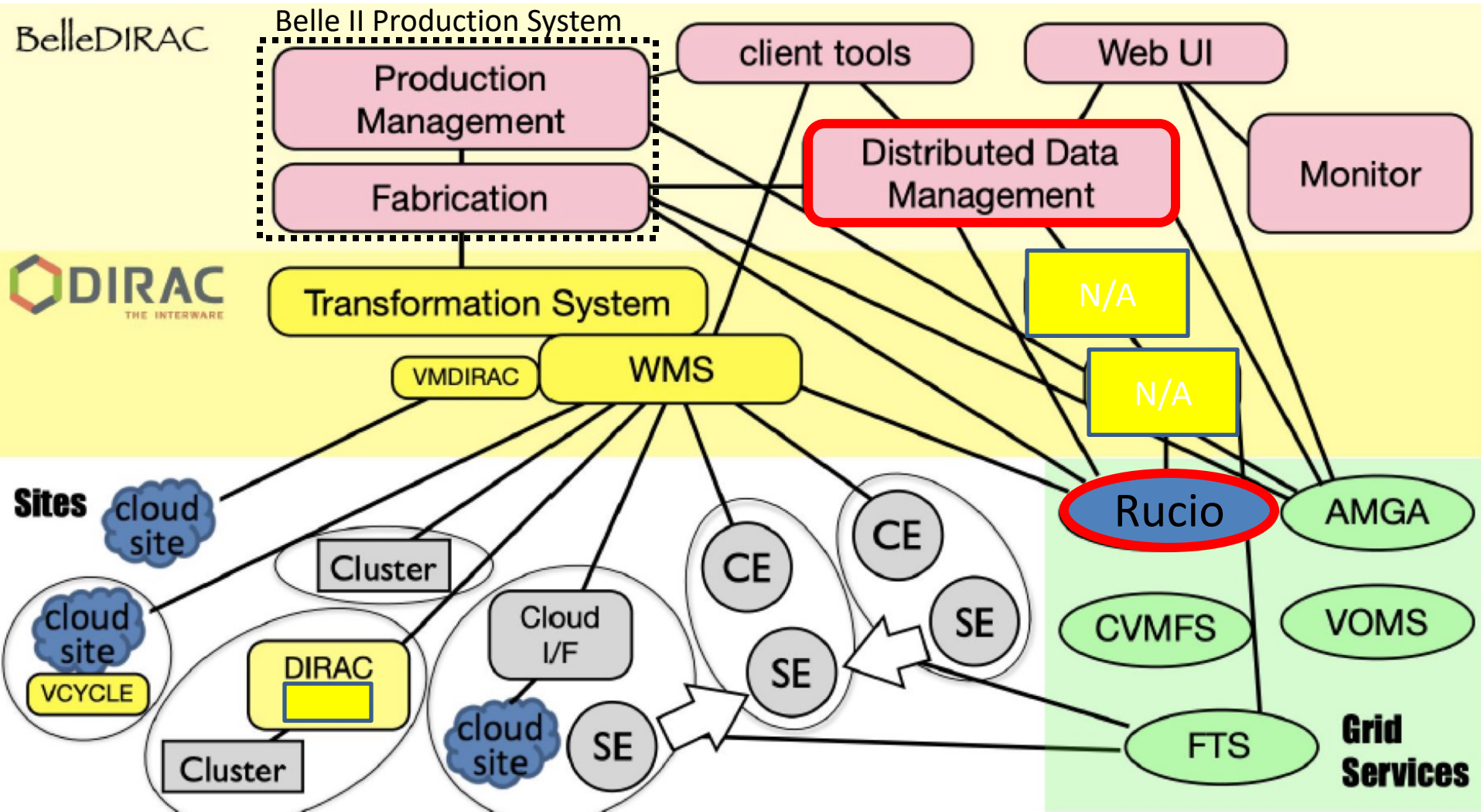
	CRIC	PanDA	Rucio	BigPanDA Monitoring
ATLAS	X	X	X	X
Belle II			X	
CMS	X		X	
COMPASS		X		X
DUNE	X		X	
NICA	X	X	X	X
SKA	X		X	
Vera Rubin		X	X	X

- X - in production
- X - selected
- X - evaluation is in progress
- X - ongoing discussion

PanDA, CRIC and BigPanDA monitoring in 2014-18
- *nEDM*
- *BlueBrain*
- *USQCD*
- *BioEngineering*
- *Molecular Dynamic*

Belle II Distributed Software at BNL

- DIRAC is a distributed service, BNL owns and runs DDM, most BelleDIRAC expertise and the main BelleDIRAC services are at KEK

Belle II Distributed Software at BNL

- DIRAC != BelleDIRAC
  - DIRAC is a toolkit to cover the basics, the KEK team wrote the BelleDIRAC extension to implement Belle II specific workflows for data and MC sim/reco/skimming + analysis tools
  - DDM is owned and run by BNL, moving to Rucio worked out well
  - Focus of BNL-Belle II effort is BelleDIRAC-DDM, not on vanilla DIRAC, though positive side-effects will come for both communities

- Our expertise is in Rucio and BelleDIRAC-DDM, not core DIRAC!

- Other thoughts and experience on DIRAC:
  - DIRAC has good community support, documentation and mailing lists, but remember DIRAC != BelleDIRAC
  - DIRAC configuration has a nice GUI, in practice getting an instance of BelleDIRAC up and running from scratch took weeks as dependencies are not well (at all) handled, configuration is complicated
    - *In-house support is really critical here !!*