

22nd International Conference on Computing in High Energy and Nuclear Physics, Hosted by SLAC and LBNL, Fall 2016

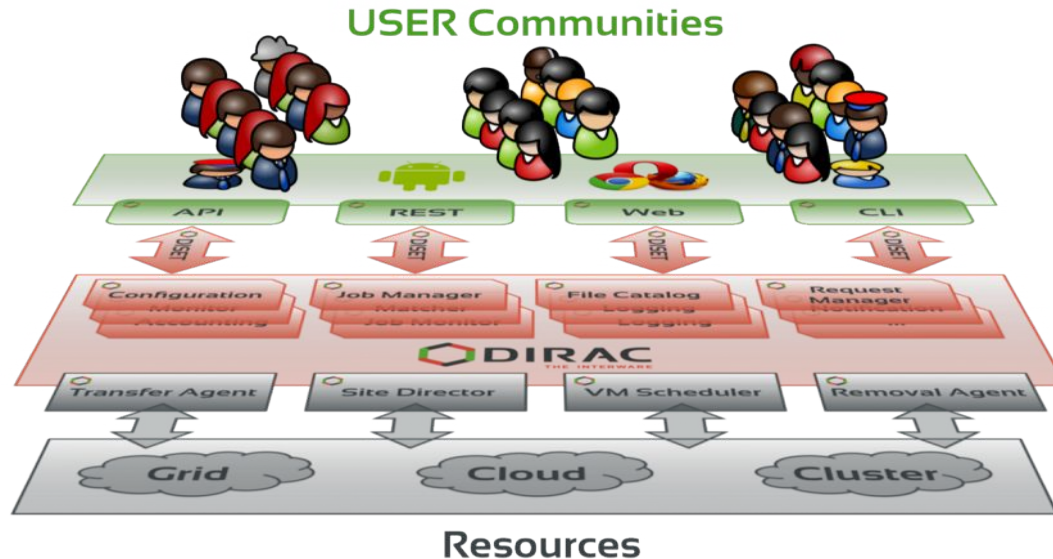
DIRAC in Large Particle Physics Experiments



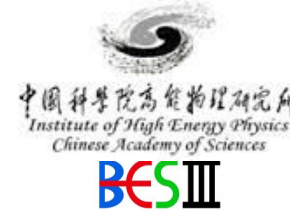
Federico Stagni

Andrei Tsaregorodtsev, André Sailer
Luisa Arrabito, Xiaomei Zhang,
Takanori Hara

- A software framework for distributed computing
- A complete solution to one (or more) user community
- Builds a layer between users and resources

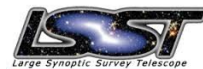


Covered in this presentation:



And many others

just some examples:



An open source project

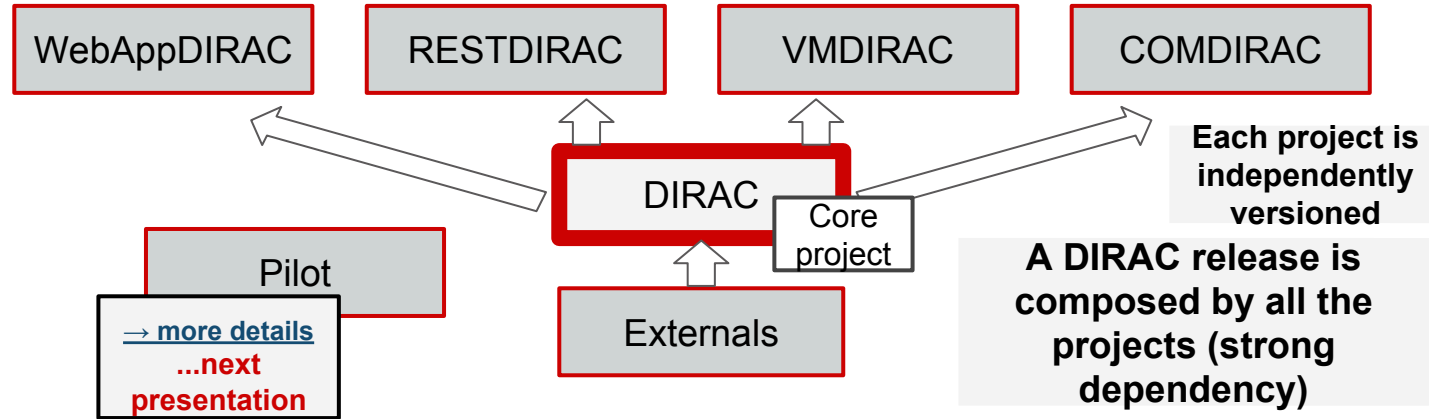
- Developed by communities, for communities
 - Open source (GPL3), [GitHub](#) hosted, python 2.7
 - Publicly [documented](#), active [assistance forum](#), yearly [users workshops](#), open [developers meetings](#)
 - 5 FTE as core developers, a dozen contributing developers
- The DIRAC [consortium](#) as representing body
 - CERN, CNRS (Marseille, Montpellier), UB, KEK, IHEP as members

Accommodating different requirements: Developed with extensibility in mind

“Horizontal”
extensibility

-

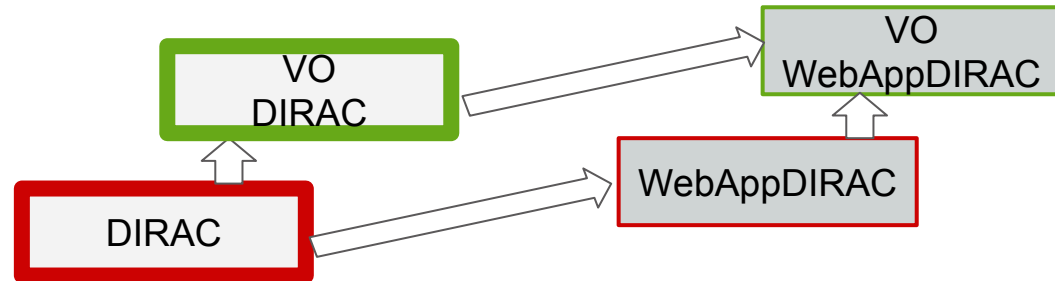
For specific requirements



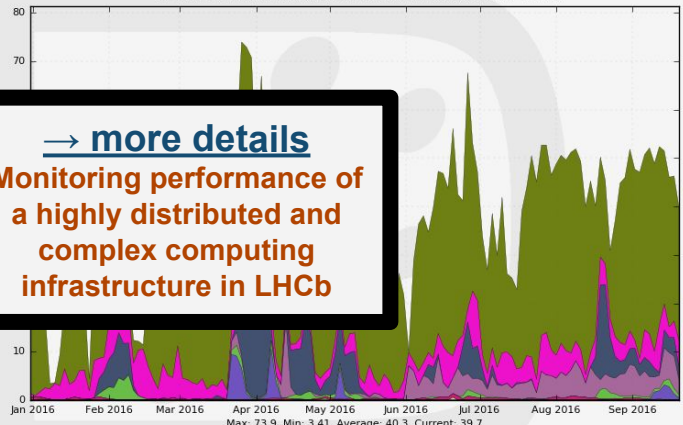
“Vertical”
extensibility

-

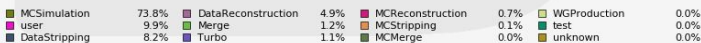
Community driven



37 Weeks from Week 52 of 2015 to Week 38 of 2016

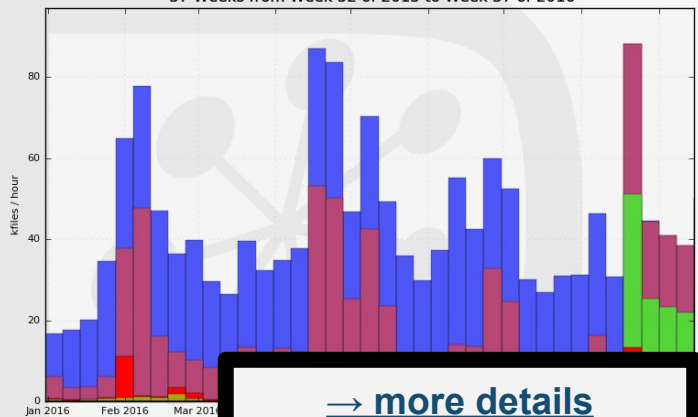
→ [more details](#)

Monitoring performance of
a highly distributed and
complex computing
infrastructure in LHCb

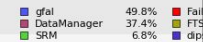


Succeeded Transfers by Protocol

37 Weeks from Week 52 of 2015 to Week 37 of 2016

→ [more details](#)

LHCbDIRAC as Apache Mesos
microservices



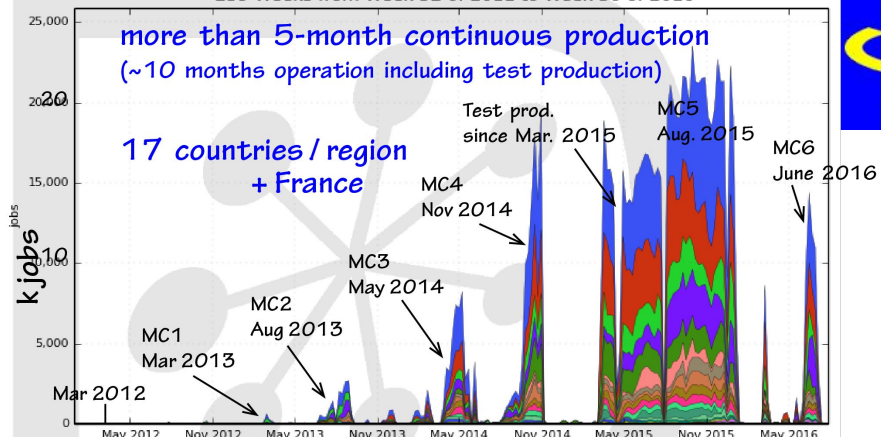
- DIRAC first developers, main maintainers
- Uses DIRAC for all distributed computing needs
- Computing resources:
 - Grid: CREAM, ARC, HTCondorCE
 - Private Clusters: SSH/GSISsh tunnels
 - Batch: LSF, SGE, Condor, Torque
 - Clouds: LHCbDIRAC pilots spawned by vcycle
 - Vac, opportunistic (BOINC, HLT, HPC) with LHCbDIRAC pilots
 - Req: CVMFS
- Storage, DataManagement:
 - SRM (gfal, gfal2), DIP, FTS3
- Catalogs:
 - DFC (DIRAC File Catalog)
 - Bookkeeping (data provenance)
- Extended:
 - LHCbDIRAC - most of systems
 - Massive data production and manipulation with chained “transformations”
 - LHCbPilot
 - LHCbWebAppDIRAC
- End Users interface with LHCbDIRAC client or with Ganga

239 Weeks from Week 52 of 2011 to Week 30 of 2016



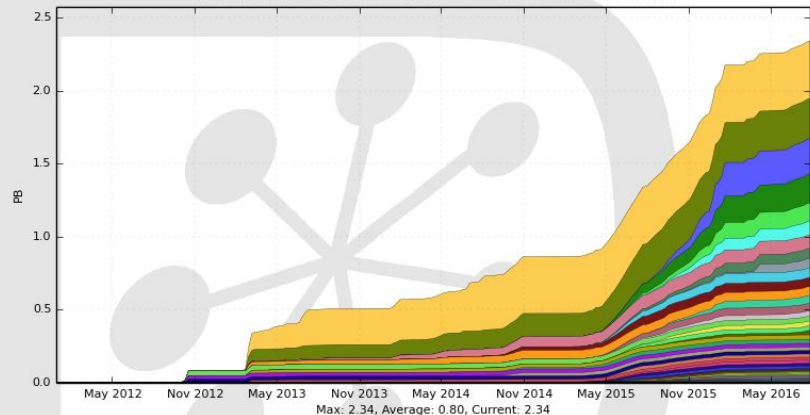
more than 5-month continuous production
(~10 months operation including test production)

17 countries / region
+ France



Transferred data by Destination

239 Weeks from Week 52 of 2011 to Week 30 of 2016



Max: 2.34, Average: 0.80, Current: 2.34

| | | | | | |
|---------------|-----|-------------------|-----|----------------------|-----|
| KEK2-SE | 0.4 | PNNL-DEDICATED-SE | 0.1 | UVic-TMP-SE | 0.0 |
| DESY-SE | 0.3 | CNAF-SE | 0.1 | CYFRONET-SE | 0.0 |
| DESY-TMP-SE | 0.2 | PNNL-SE | 0.1 | Napoli-SE | 0.0 |
| KEK2-TMP-SE | 0.2 | CNAF-TMP-SE | 0.1 | gridka-dcache.fzk.de | 0.0 |
| Napoli-TMP-SE | 0.1 | RISA-SE | 0.1 | KMI-SE | 0.0 |
| KIT-TMP-SE | 0.1 | CESNET-TMP-SE | 0.0 | kek2-se.cc.kek.jp | 0.0 |
| KIT-SE | 0.1 | dqm.cvf-kr.edu.pl | 0.0 | MPPMU-SE | 0.0 |

- Computing resources:

- Grid: CREAM, ARC, HTCondorCE
- Private Clusters: SSH/GSISsh tunnels
- Clouds: VMDIRAC, CloudScheduler, Dynamic Torque
- opportunistic (e.g. BOINC) with DIRAC pilots

- Storage, DataManagement:

- SRM (gfal, gfal2), XRootD, DIP, FTS3

- Catalogs:

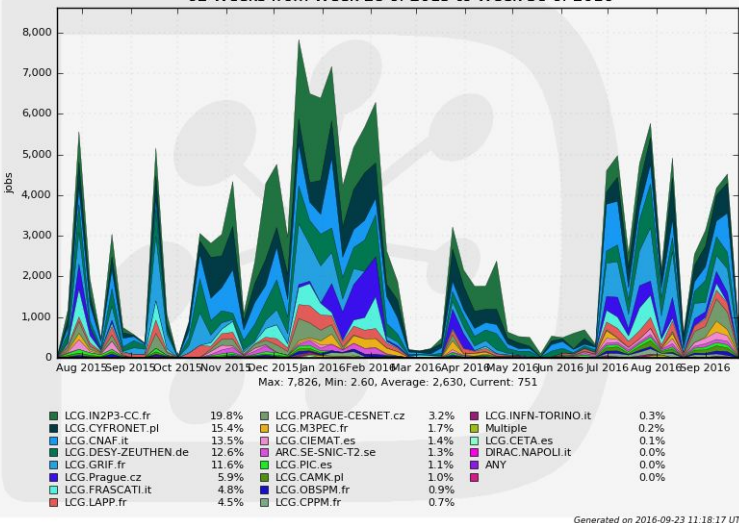
- LFC (Replica) + AMGA (Metadata)
- DFC (in development instance)

- Extended:

- Automated "Production system" based on Transformation System

→ [more details](#)

Highlights of Belle2
Computing

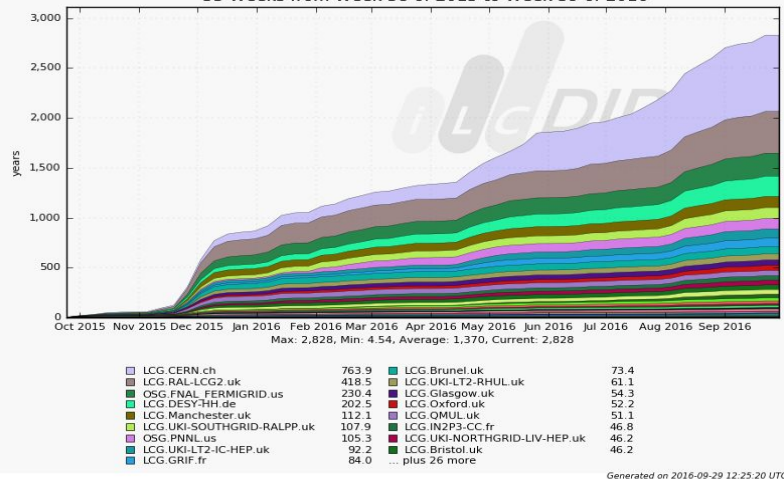


- Computing resources
 - Grid: CREAM, ARC
 - Private Clusters: SSH tunnels
- DFC as catalog
 - 25M replicas
- Storage, DM
 - SRM (gfal), DIP

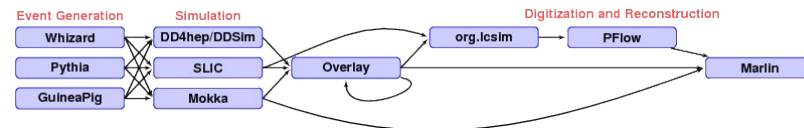


- Use cases similar to other HEP experiments
 - Massive data-production and processing
 - 360M HS06 (DB12) CPU hours
 - 2 PB produced (disk/tape)
 - Need to automatise complex workflows
- DIRAC evaluation started 5 years ago
 - DIRAC-based setup built from scratch
 - Use DFC as replica and meta-data catalog
 - Use Transformation System to manage large 'productions'
- Extended
 - Interfaces to easily configure CTA applications
- DIRAC contribution
 - Current development to achieve a fully 'data-driven' Transformation System
 - Aim to develop a 'Production System' general enough to be useful to many communities

→ [more details](#)
 The CTA production system for Monte Carlo simulations and analysis



- Extended: Job Submission and Workflow Modules for Linear Collider Software
 - Easy chaining of applications



- Simple job description via python

```

from DIRAC.Core.Base import Script
Script.parseCommandLine()
import UserJob
import Marlin
import DiracILC
d = DiracILC()
j = UserJob()
j.setOutputSandbox("recEvents.slcio")
m = Marlin()
m.setVersion("ILCSoft-01-17-09")
m.setSteeringFile("Steering.xml")
m.setInputFile("SimEvents.slcio")
j.append(m)
j.submit(d)
  
```

Shared DIRAC instance for Linear Collider detector studies; [CLICdp](#), [ILD](#), [SiD](#) collaborations

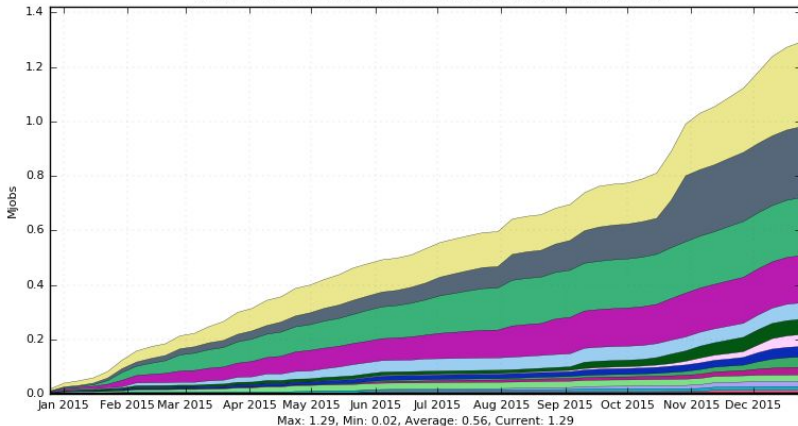
- Computing Resources
 - OSG&WLCG
- DFC (metadata too)
- Storage: SRM, XRootD
- Last 12 months: 3k CPU years, 4M Jobs, 2PB

→ [more details](#)
Using OSG Computing Resources with (iLC)DIRAC

- Very happy users running lots of jobs

Cumulative Jobs by Site

52 Weeks from Week 51 of 2014 to Week 51 of 2015



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BESIII

- Distributed computing system needed for peak needs of BESIII
 - Set-up should be easy and flexible enough with few manpower and experience
- Start since 2012 and put into production in 2014
 - Jobs reached 1.29M in 2015
- Extended:
 - Task submission and management system
 - Massive Data transfer system
 - Site Monitoring system based on DIRAC Resource Status System (RSS)

Shared DIRAC instance since 2015: other IHEP experiments, eg. JUNO, CEPC, LHAASO, etc

- Computing resources:
 - 10%Grid, 65%Batch, 25%Clouds
 - Integrate Clouds with VMDIRAC
- Catalogs:
 - Use DFC for Replica Catalog, Metadata Catalog, Dataset Catalog

→ [more details](#)

A lightweight task submission and management infrastructure

- Actively used and developed
- Satisfies the requirements and use cases of several communities
- Can be extended to accommodate experiment-specific use cases
 - Common use cases:
 - Interfacing to experiment software
 - Productions handling

Come on board!

?