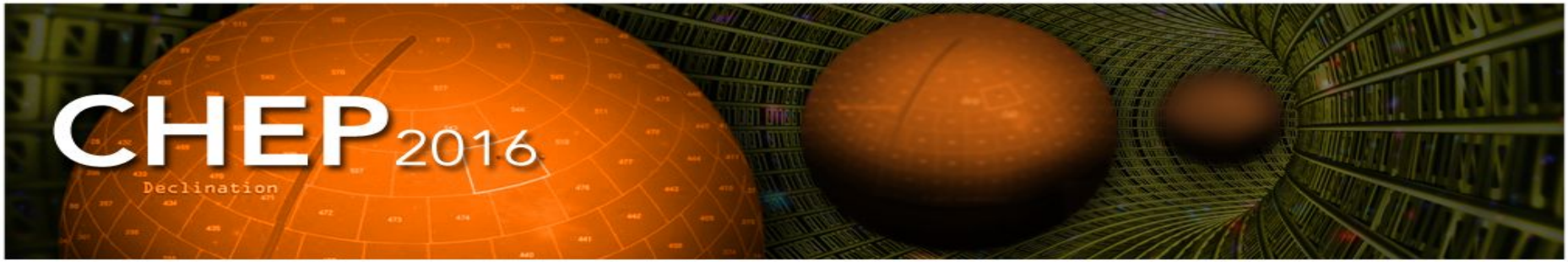

22nd International Conference on Computing in High Energy and Nuclear Physics, Hosted by SLAC and LBNL, Fall 2016

DIRAC in Large Particle Physics Experiments

(and not only)

DIRAC
THE INTERWARE

Federico Stagni

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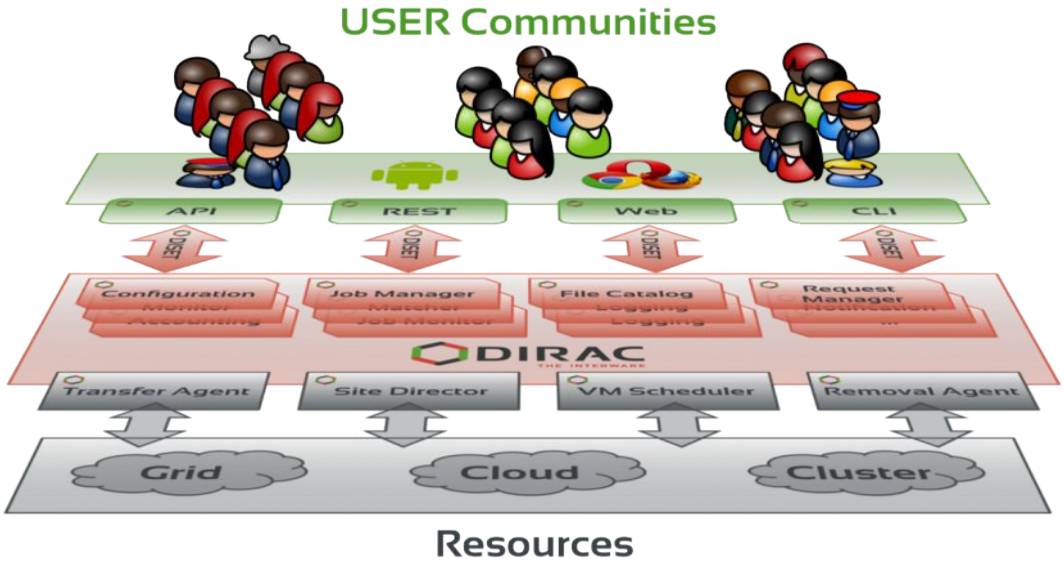
Luisa Arrabito, Xiaomei Zhang,
Takanori Hara

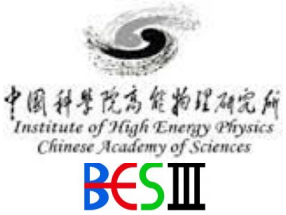
The DIRAC Interware

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



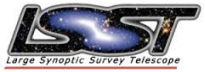
Users

Covered in this presentation:



And many others

just some examples:

→ more details
GridPP Dirac

Accommodating requirements

Each VO may have different requirements, how to accommodate all of them?

- Open source (real!)
- Extensibility
- Flexibility

An open source project

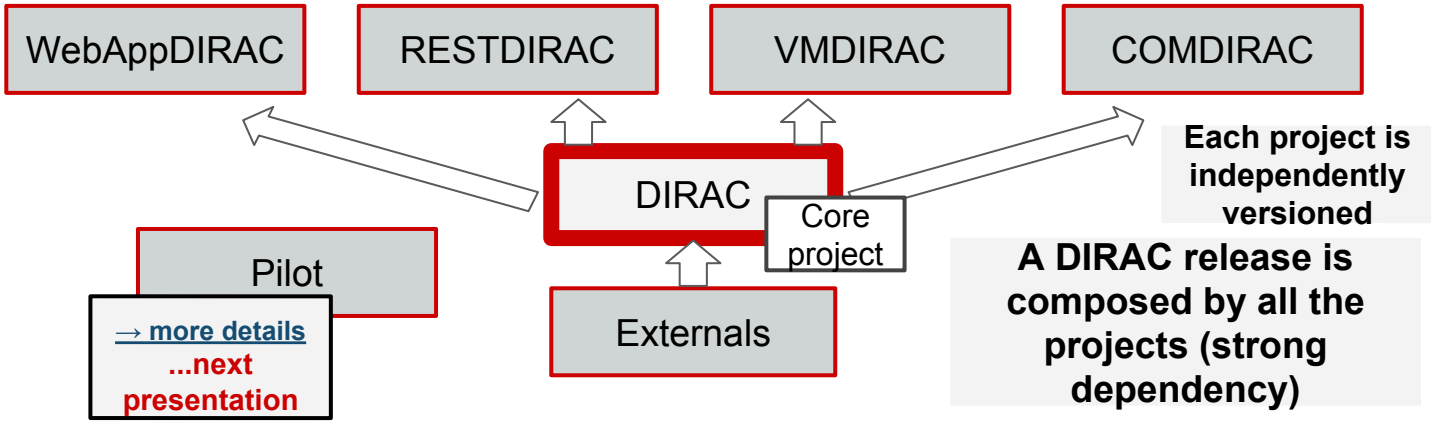
- Developed by communities, for communities
  - Open source (GPL3), GitHub hosted, python 2.7
  - No dedicated funding for the development of the “Vanilla” project
  - Publicly documented, active assistance forum, yearly users workshops, open developers meetings
  - 5 FTE as core developers, a dozen contributing developers
- The DIRAC consortium as representing body
  - CERN, CNRS (Marseille, Montpellier), UB, KEK, IHEP as members
  - First users (after LHCb) in 2009

Accommodating different requirements: Developed with extensibility in mind

"Horizontal" extensibility

-

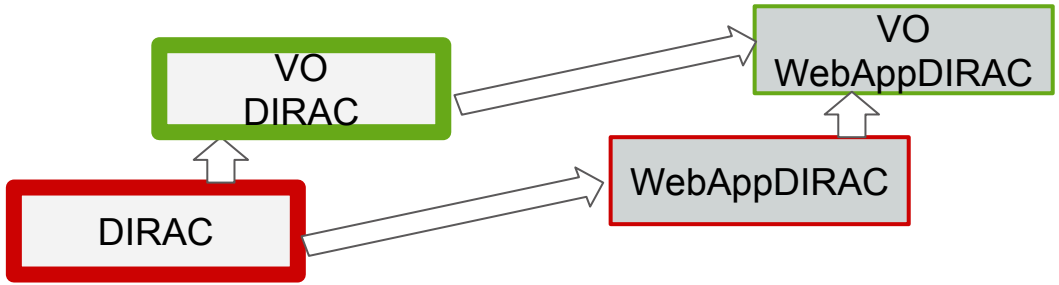
For specific requirements



"Vertical" extensibility

-

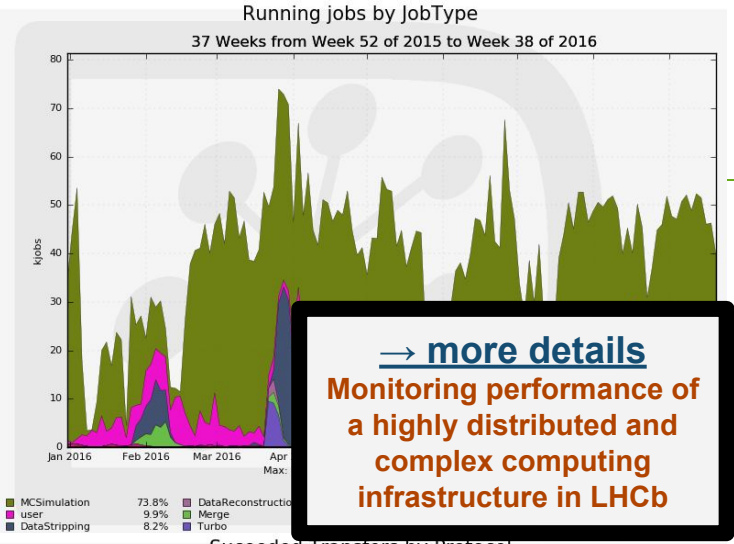
Community driven

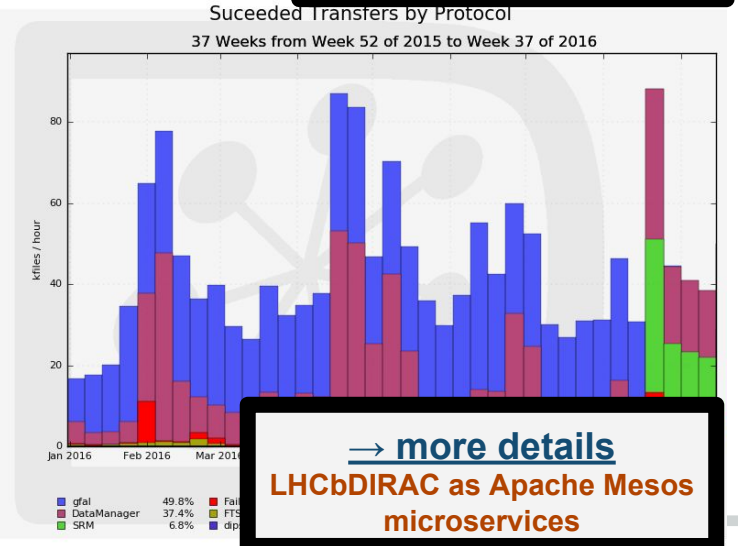


Flexibility: just 1 example

- DIRAC does not impose you any computing model
- Tiers level may not mean anything to certain VOs
- The (fixed) computing model is dead

- Example: full mesh computing model
  - Every job can run everywhere
- A real world computing model is a full mesh with limits
- All configurable in few clicks





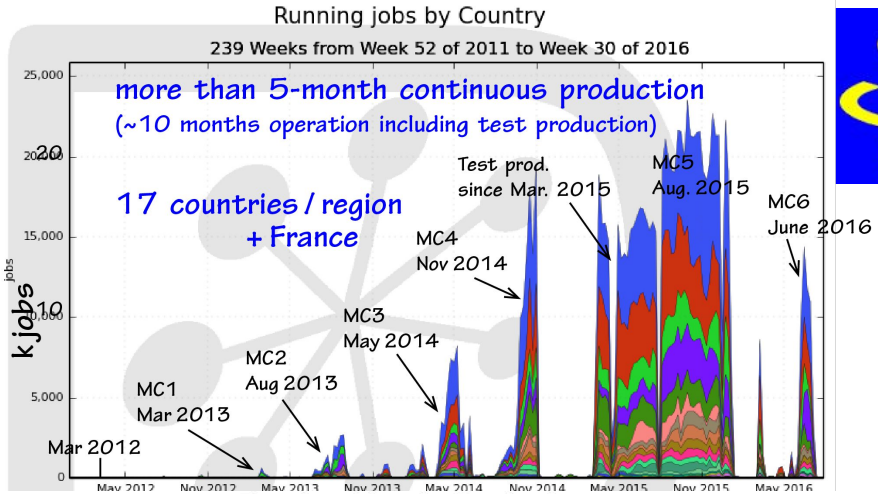
→ more details

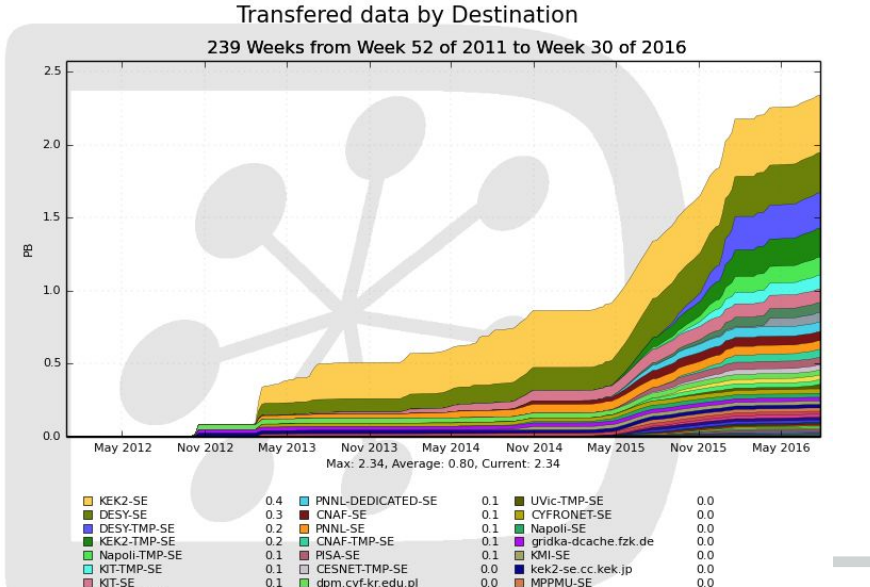
Monitoring performance of a highly distributed and complex computing infrastructure in LHCb

→ more details

LHCbDIRAC as Apache Mesos microservices

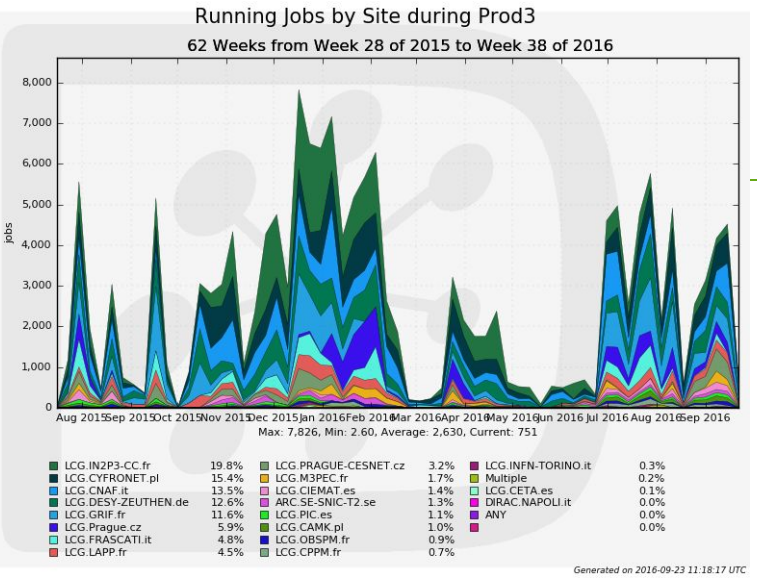
- DIRAC first developers, main maintainers
- Uses DIRAC for all distributed computing needs (almost)
- Computing resources:
  - Grid: CREAM, ARC, HTCondorCE
  - Private Clusters: SSH/GSISSH tunnels
  - Batch: LSF, SGE, Condor, Torque
  - Clouds: LHCbDIRAC pilots spawned by vcycle
  - Vac, opportunistic (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





- 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



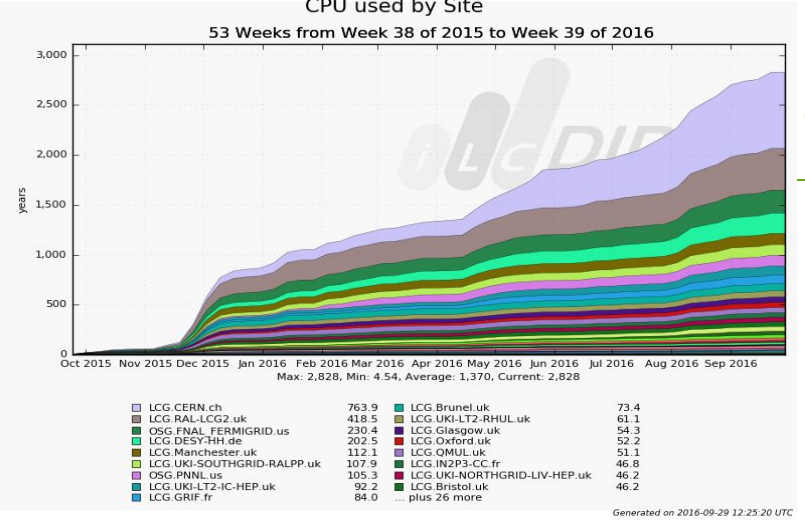
- Computing resources
  - Grid: CREAM, ARC
  - Private Clusters: SSH tunnels
- DFC as catalog
  - 25M replicas
- Storage, DM
  - SRM (gfal), DIP

cherenkov telescope array

- 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

→ more details
The CTA production system for Monte Carlo simulations and analysis

- 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

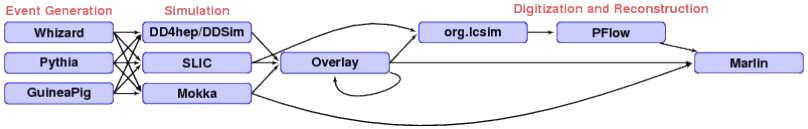


Shared DIRAC instance for Linear Collider detector studies; CLICdp, ILD, SiD collaborations

- 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

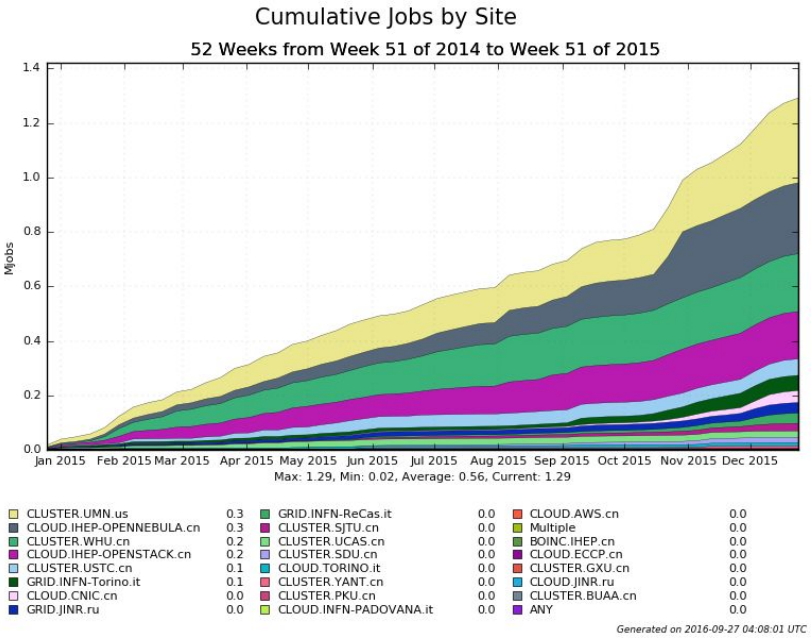
- Extended: Job Submission and Workflow Modules for Linear Collider Software
  - Easy chaining of applications



  - 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)
```

- Very happy users running lots of jobs



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

- Distributed computing system needed for peek needs of BESIII
  - Set-up should 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)

→ more details
A lightweight task submission and management infrastructure

Summary

- Actively used and developed
- Satisfies the requirements and use cases of several communities
  - Extensibility at several levels, plugging resources, flexibility
  - Not everything is singing&dancing, especially for multi-VO support
- Can be extended to accommodate experiment-specific use cases
  - Common use cases:
    - Interfacing to experiment software
    - Productions handling

Come on board!

DIRAC
THE INTERWARE

Questions/comments

?