End User Analysis
Model @ CMS

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Outline

- Introduction to CMS computing model
- Find Data to Analyze
  - Data Bookkeeping System (DBS)
- Move Data to Sites
  - PhEDEx
- Access remote Data
  - CMS Remote Analysis Builder (CRAB)
Introduction

CMS has adopted a distributed computing model motivated by:

- The large amount of data to access
- The large quantity of computing required
- Benefits of providing local control of some services

~20% of the resources are located at CERN, ~40% at T1s and ~40% at T2s. CMS relies on grid services developing “ad hoc” tools, making data transfers and submission easy for users.
Data Flows

- Tier-0 is only used for organized processing
  - Prompt reconstruction, Partial Reprocessing, First archive copy of the raw data.
- Tier-1 centers perform reprocessing and skimming, mainly organized task
  - Data reprocessing, Data Serving to Tier-2 for analysis, Archive Simulation from Tier-2, Custodial storage of a fraction of RAW data.
- Tier-2 centers support more chaotic analysis activities
  - Are roughly half simulation and half analysis.
- CERN Analysis Facility for CMS (CAF) support for “latency critical”
Tier-2 computing centers are the place where more flexible, user driven activities can occur. They represent the bulk of the analysis computing resources for the experiments.

- Data distribution to Tier-2s:
  - Since each Tier-1 center only serves a portion of the RAW data, a Tier-2 can download data from any Tier-1
  - Full mesh of Tier-1 to Tier-2 connectivity is needed

- Tier-2 centers are associated with one or more analysis groups:
  - analysis group's activities have access to storage and CPU resources
Data Driven Analysis

Model

While data are moved to available resources, jobs are submitted to remote analysis resources.

- Users develop and test analysis code interactively using CMS Framework (CMSSW) running over few events.
- Find needed data through Data Bookkeeping system (DBS)
- Submit jobs through the grid interface to sites hosting data

CMS has developed a service to provide transparency to the structure of the computing system
Data Discovery

The Dataset Bookkeeping System (DBS) has been developed by CMS to record and track the history of all event data providing the following functionalities:

- **Data definition**: dataset definition, runs, etc., and tracking of data parentage
- **Data discovery**: what data exists and how are organized in term of files/fileblocks

DBS supports the existence of local and global instances (for private and public data).
Various Data Discovery interfaces:

- Advanced search interface
- Navigator (menu-driven interface)
Data Transfers

- CMS has developed a dedicated tool (PhEDEx) for data movement:
  - PhEDEx replicates individual files and updates the data management system when complete blocks have been transferred
  - Uses grid services and interfaces to replicate data
- While data movements at Tier-1 are centrally managed by CMS, those at Tier-2 are intended to be driven by needs of users
- User/Analysis group can make requests to transfers data at Tier-2 centers
Any user can make a transfer request through the PhEDEx web interface.

Only a site data manager can approve a request avoiding the site is over subscribed.
CRAB has been developed by CMS with the aim to provide users with a simple interface to:

- Data Management (data discovery)
- Application Framework (pack the user local code)
- Batch farm/Grid infrastructure

CRAB try also to automatize the analysis workflow:

- can delegate the user task to a server performing action for him
Data Access

- configure a simple file filling the relevant infos:

```
[1xplus226] ~/scratch0/WorkOK > crab -create -submit

`crab` crab (version 2.4.0) running on Sun Sep 28 22:57:11 2008

`crab`. Working options:
- scheduler: `glite`
- job type: `CMSSW`
- working directory: `/afs/cern.ch/user/s/spiga/scratch0/WorkOK/crab_0_080928_225711/`

`crab`. Contacting Data Discovery Services ...`
`crab`. Requested dataset: `/Zmumu/CSA08/CSA08_S156_v1/GEN-SIM-RECO` has 16862 events in 1 blocks.

`crab`. 2 job(s) can run on 30 events.
`crab`. List of jobs and available destination sites:
- Block 1: jobs 1-2: sites: t2-srm-02.lnl.infn.it

`crab`. Downloading config files for `https://cmsweb.cern.ch/crabconf/files/server_1nl2.conf`
`crab`. Creating 2 jobs, please wait...

`crab`. Total of 2 jobs created.

`crab`. Registering a valid proxy to the server:
`crab`. Proxy successfully delegated to the server.

`crab`. Starting sending the project to the storage crabas2.lnl.infn.it...
`crab`. Task `crab_0_080928_225711` successfully submitted to server crabas2.lnl.infn.it

`crab`. Total of 2 jobs submitted
`crab`. Log-file is `/afs/cern.ch/user/s/spiga/scratch0/WorkOK/crab_0_080928_225711/log/crab.log`

- Run a simple command line to submit jobs:
User Produced Data

User data can follow exactly the same workflow...

- Users run over public data, then:
  a) Retrieve result to submission machine
  or
  b) Store the results on a Tier-2 Storage Element
- Publish produced data in a DBS local instance
  a) Access again those data through the Grid, using the same interface (CRAB)
  and/or
  b) Retrieve locally produced results
User Community

~800 distinct users
Jan2008-today

Distinct users per day
CMS Jobs....

- From May up to now 3.4Milion jobs
Outlook

- The main functionality for analysis workflow is in place

- Working on:
  - improving scaling
  - improving reliability
  - improving automation

- Waiting for data :)