



# CMS Computing Software and Analysis Challenge 2006



# CSA06 Goals

The CSA06 Challenge is designed to exercise the CMS Computing and Software systems at roughly 25% of the expected scale in 2008

- ➔ Perform event reconstruction at the Tier-0 center on a mix of samples at ~40Hz for the period of a month
- ➔ Distributed the data to Tier-I centers for archiving and data serving purposes
  - Rate from Tier-0 to Tier-I based on MOU pledges
    - Custodial archiving to tape where possible, and disk based archives for 30 days otherwise
- ➔ Serve the data to Tier-2 computing centers (Bursts of 20MB/s-100MB/s)
- ➔ Create selections of data storage at Tier-I centers
  - Defined by physics groups
- ➔ Execute re-reconstruction jobs at Tier-I centers
- ➔ Submit analysis jobs to Tier-2 centers
  - 30k-50k jobs per day integrated over centers



# Successful Demonstration of Services

CMS is successfully using both the OSG and EGEE infrastructure to complete the computing software and analysis service challenge

- ➔ All Tier-1 centers contributed
- ➔ CMS has approximately 19 EGEE Tier-2 sites and 8 OSG Tier-2 sites
  - Roughly what is anticipated by the fraction of the collaboration

Infrastructure for data selection, event simulation, user analysis submission, and load testing is designed to submit to both grids

- ➔ The 60M simulated events produced over the summer for the challenge were balanced over sites from both grids
- ➔ The load generators for simulated analysis access to Tier-2 sites perform direct Condor-G submission to OSG resources and use the gLite RB in bulk submission for EGEE resources
- ➔ The user analysis submission infrastructure can use the LCG-RB to submit to either grid transparently



# Tier-0 Reconstruction

During the first four weeks of the challenge over 200M have been reconstructed at the Tier-0 center

- ➔ Averaged better than 50Hz for the first three weeks and increased to more than 100Hz for the final week
- ➔ The Tier-0 work flow beat the target rate each day with 100% up time
- ➔ New CMS Software framework has good performance and memory requirement properties
  - Rate of application failures is extremely low
- ➔ Reconstruction, Calibration, and Analysis objects are produced and registered in the data management system
- ➔ Calibration information was accessed by the LCG-3D Frontier distribution system



# Data Transfer

CMS is using a combination of WLCG services to successfully complete the service challenge transfers

- ➔ FTS transfers are driven from PhEDEx from servers both at the Tier-0 and Tier-I computing centers
  - All Tier-I centers are operating channels for transfers from EGEE sites
  - Overall service reliability has been good with a few known issues requiring intervention
    - Support response has been excellent with operational problems addressed promptly and upgrades provided when needed.
- ➔ The underlying storage interface between OSG and EGEE is SRM
  - SRM performance and stability especially at CERN and the Tier-I centers has been good
  - The one compatibility issue for large files was solved with a new release almost immediately



# Tier-I Transfers

All 7 Tier-I centers participated in the challenge activities

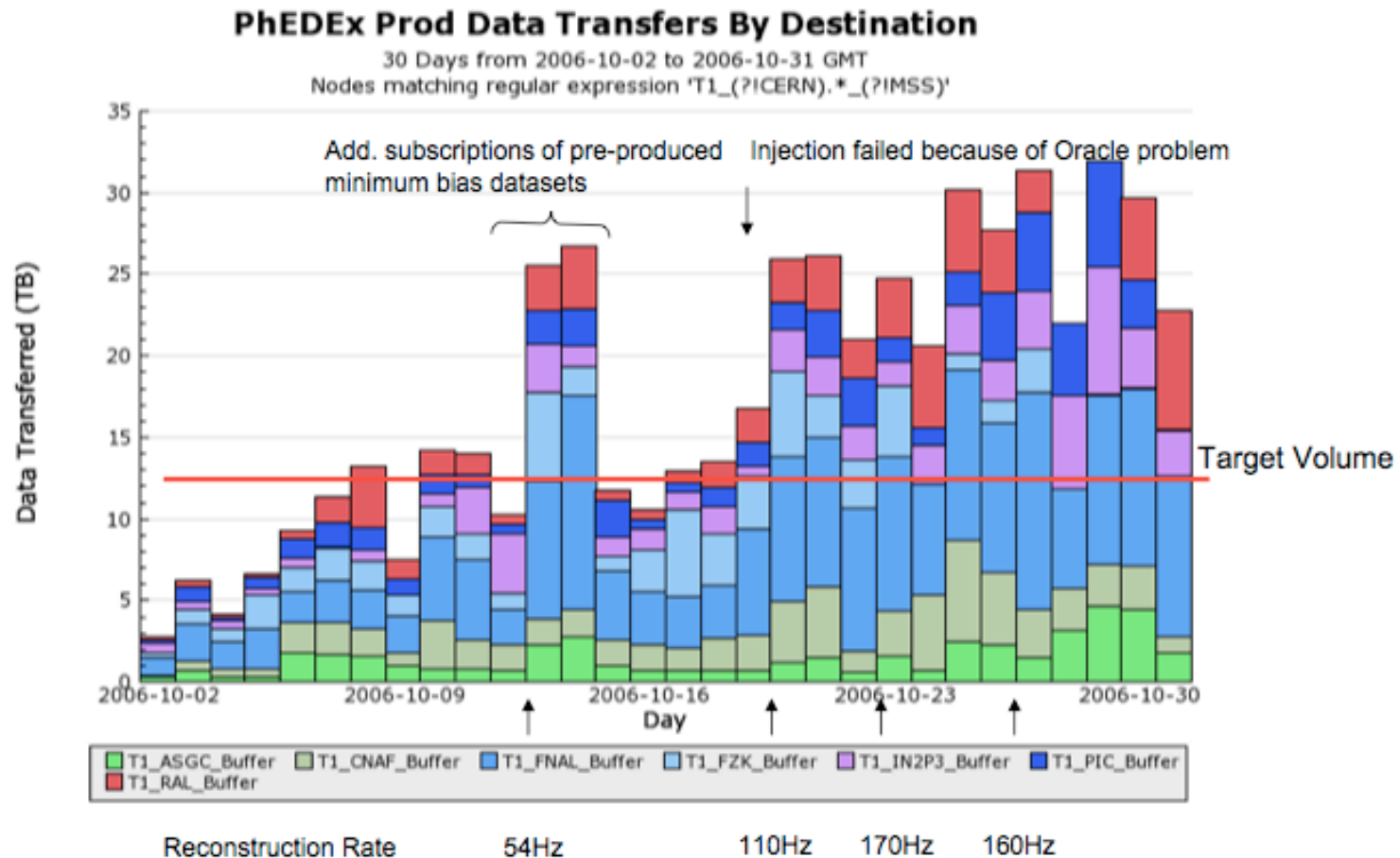
Site	Nominal (CSA) Rate	Last 30 Day average	Last 15 Day average	Outage (Days)	MSS used
ASGC	15 MB/s	17 MB/s	23 MB/s	0	(YES)
CNAF	25 MB/s	26 MB/s	37 MB/s	0	(YES)
FNAL	50 MB/s	68 MB/s	98 MB/s	0	YES
FZK	25 MB/s	23 MB/s	28 MB/s	3	NO
IN2P3	25 MB/s	23 MB/s	34 MB/s	1	YES
PIC	10 MB/s	22 MB/s	33 MB/s	0	NO
RAL	10 MB/s	23 MB/s	33 MB/s	2	YES



# Tier-I Performance

The Tier-0 to Tier-I Transfer performance during event reconstruction

- ➔ More than doubled the initial challenge goals
- ➔ Performance and stability of Castor at CERN has been excellent





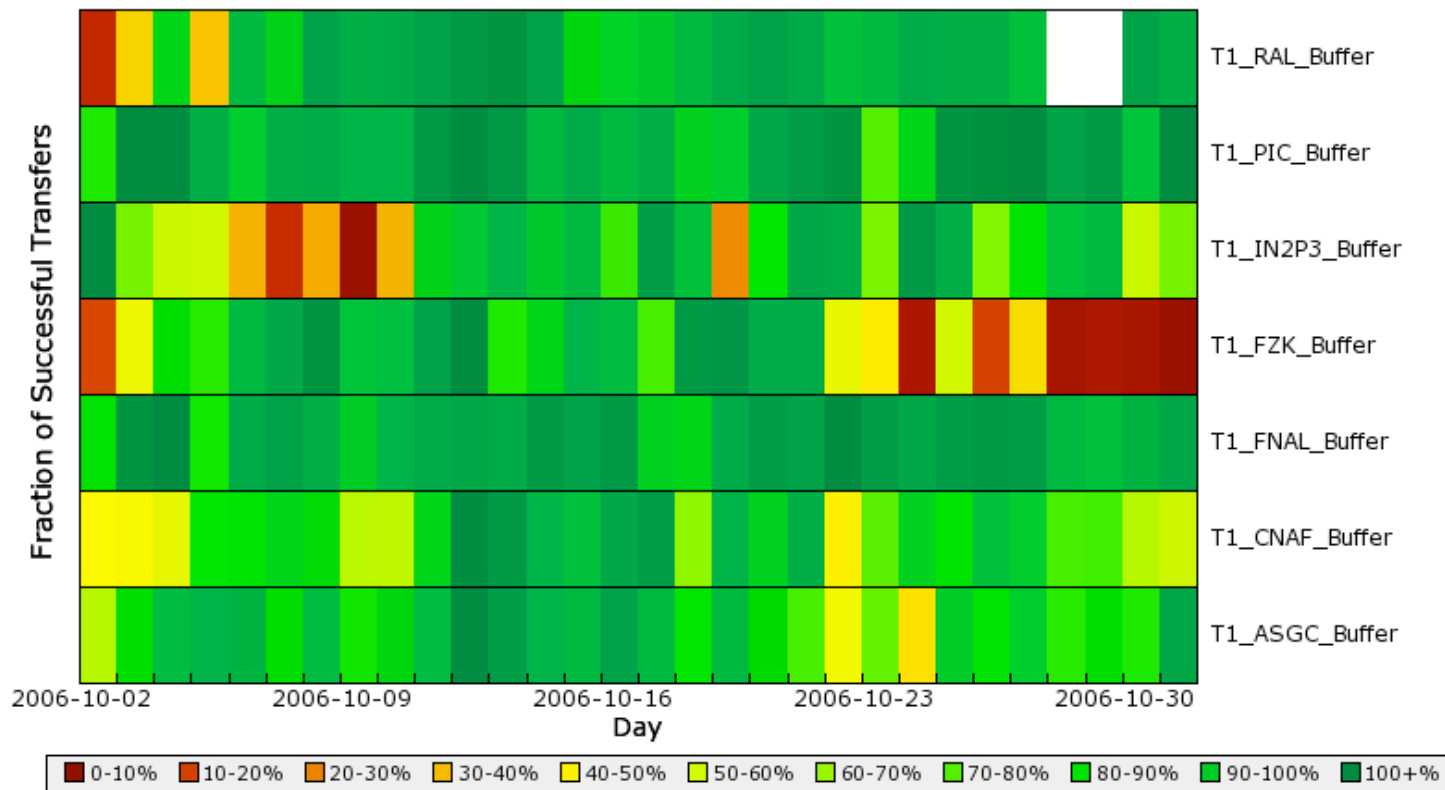
# Tier-I Transfer Quality

## Stable performance from Tier-I's

- ➔ A couple of sites have had specific problems or downtimes
- This compares very favorably to the results at the beginning of SC4

### PhEDEx Prod Transfer Quality By Destination

30 Days from 2006-10-02 to 2006-10-31 GMT  
Nodes matching regular expression 'T1\_(?!CERN).\*(?!MSS)'





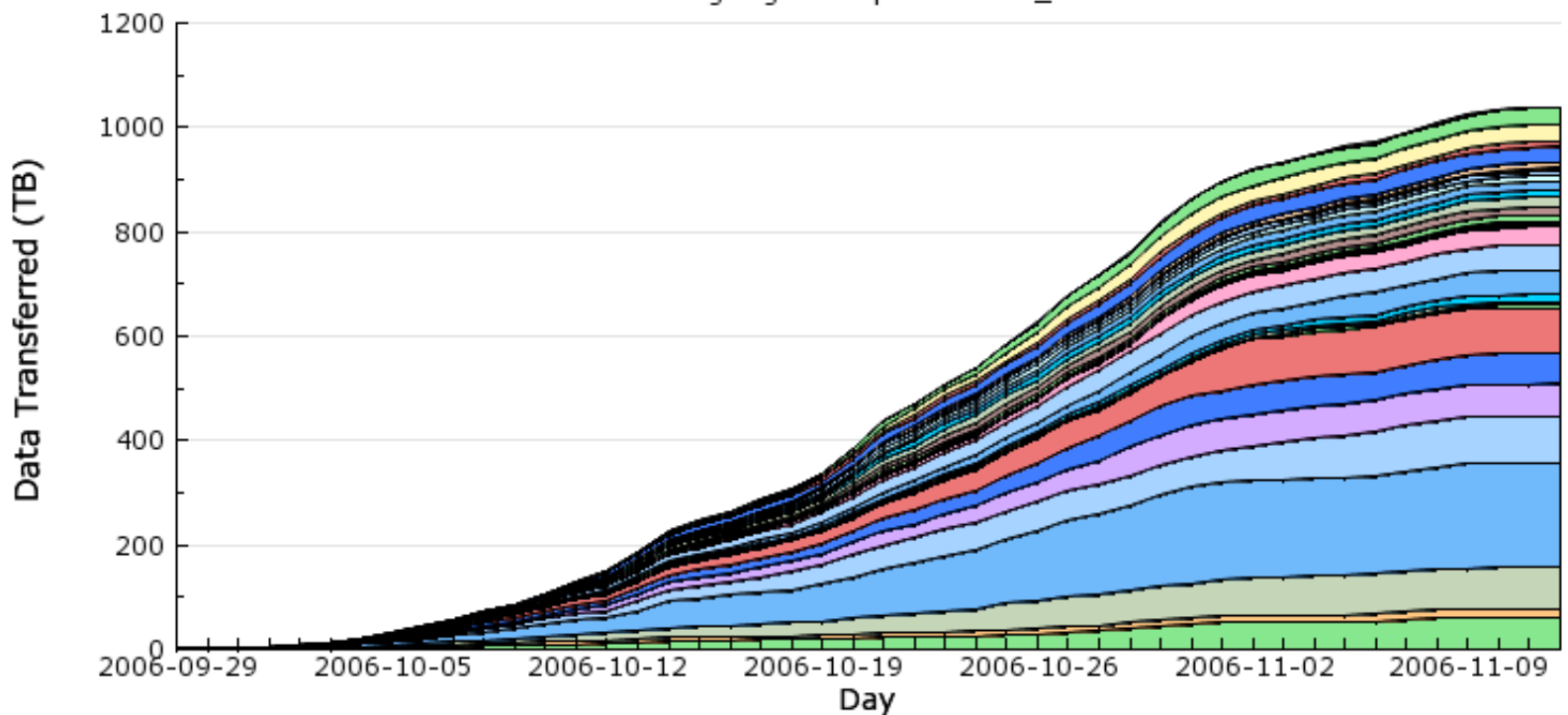


# Cumulative Data Transferred over CSA06

Over the challenge more than 1PB was moved between centers

## PhEDEx Prod Data Transfers By Destination

45 Days from 2006-09-29 to 2006-11-12 GMT  
Nodes matching regular expression '.\*\_Buffer'



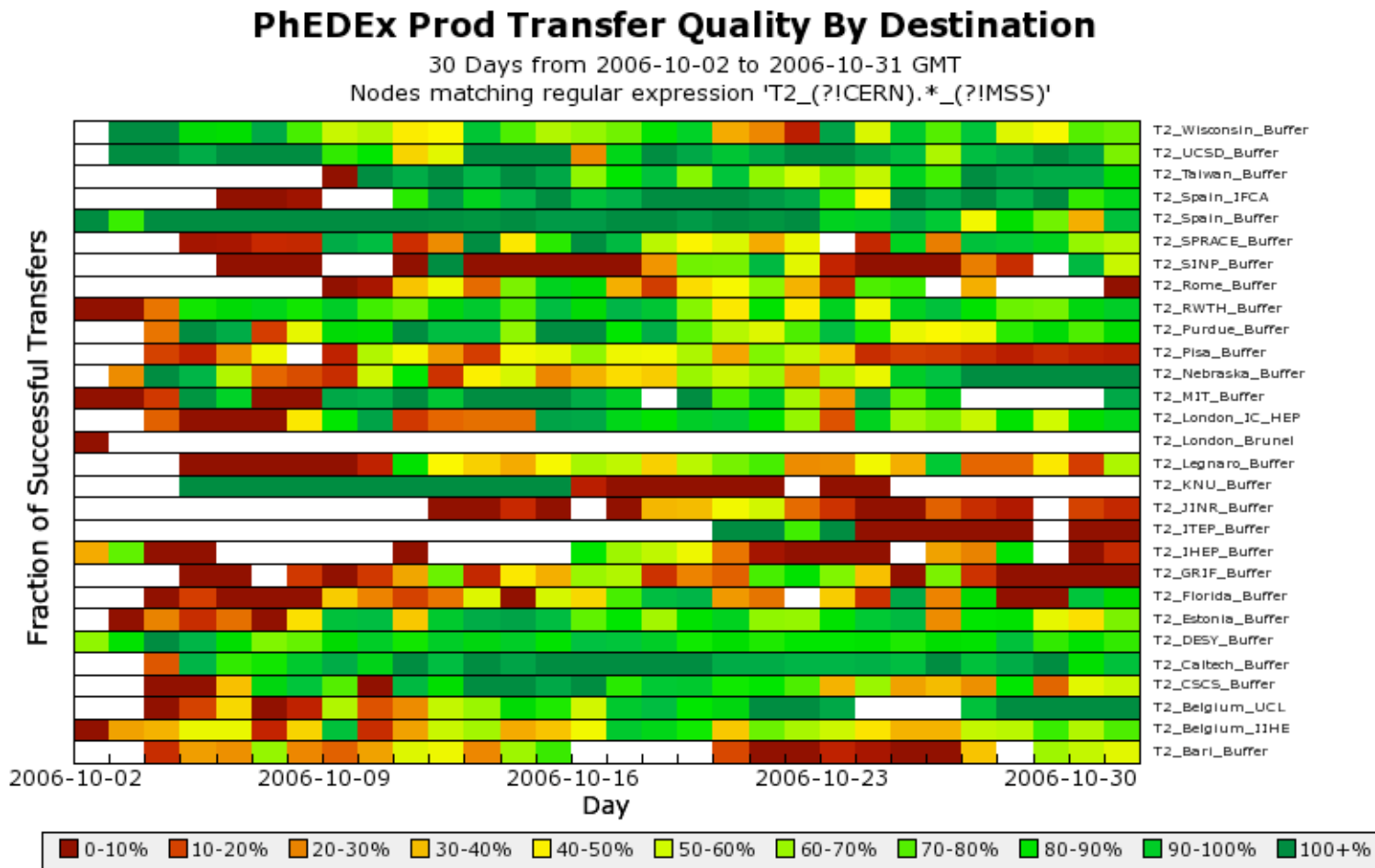
T1_ASGC_Buffer	T1_CERN_Buffer	T1_CNAF_Buffer	T1_FNAL_Buffer	T1_FZK_Buffer	T1_IN2P3_Buffer
T1_PIC_Buffer	T1_RAL_Buffer	T2_Bari_Buffer	T2_CSCS_Buffer	T2_Caltech_Buffer	T2_DESY_Buffer
T2_Estonia_Buffer	T2_Florida_Buffer	T2_GRIF_Buffer	T2_IHEP_Buffer	T2_IITP_Buffer	T2_JINR_Buffer
T2_KNU_Buffer	T2_Legnaro_Buffer	T2_MIT_Buffer	T2_Nebraska_Buffer	T2_Pisa_Buffer	T2_Purdue_Buffer
T2_RWTH_Buffer	T2_Rome_Buffer	T2_SINP_Buffer	T2_SPRACE_Buffer	T2_Spain_Buffer	T2_Taiwan_Buffer
T2_UCSD_Buffer	T2_Wisconsin_Buffer	T3_Minnesota_Buffer			



# Tier-2 Transfers

We have hit 26 Tier-2 sites have successfully received data

- ➔ The target goal was 20
- More structure in Tier-2 quality, which we are working with sites to improve





# Processing in CSA06

Aside from the Tier-0 prompt reconstruction, analysis and calibration object generation, CMS had three processing activities in CSA06

## ➔ Skimming

- Selection of data at Tier-1 centers based on physics filters and transferred to Tier-2 centers for further analysis

## ➔ Analysis

- Submission of analysis code to Tier-2 centers demonstrating local data access and the performance and the Tier-2 Storage Elements
- Includes the contribution of the load generating job robot

## ➔ Re-Reconstruction

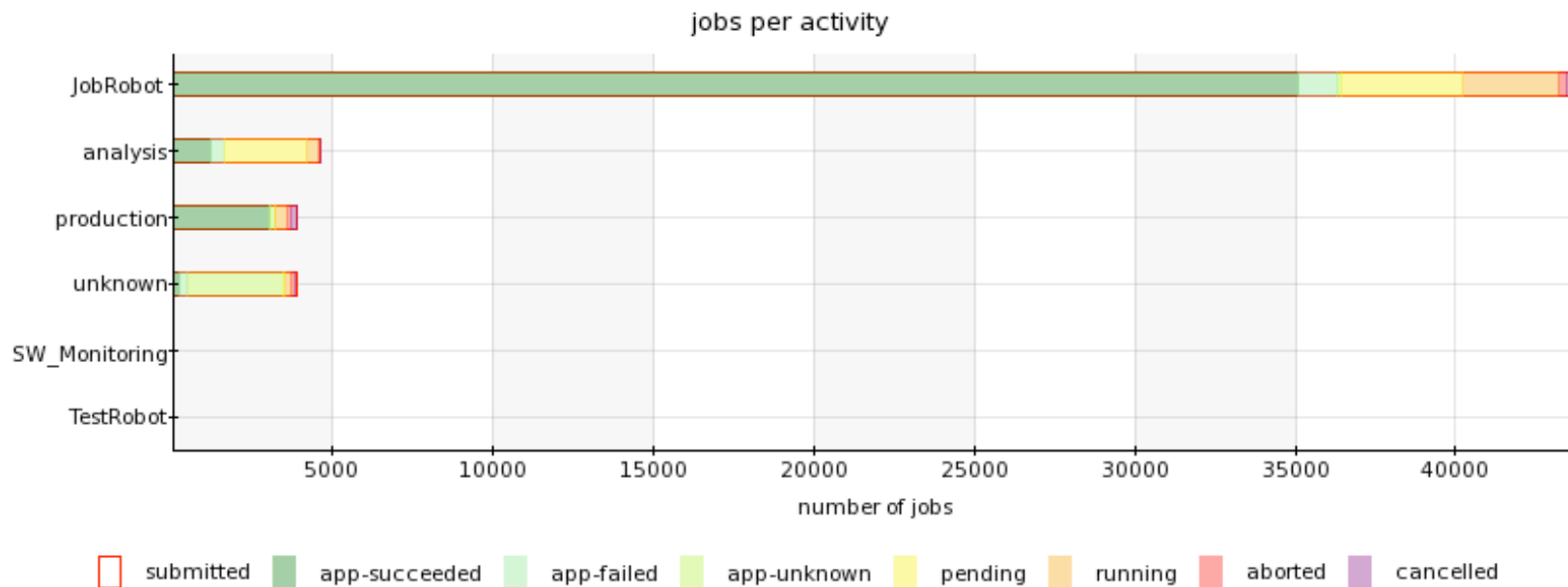
- Processing of data at Tier-1 centers with access to new calibration constants through Frontier



# Job Submission

CMS was able to meet the metric of more than 50k job submissions per day during the last week of the challenge

- ➔ User analysis was submitted by ~20 individuals
- ➔ Skimming and Re-reconstruction has been executed at all Tier-I centers
  - Successful validation of Frontier infrastructure
- ➔ The job robot introduces a load on sites that is very similar to user specified analysis applications

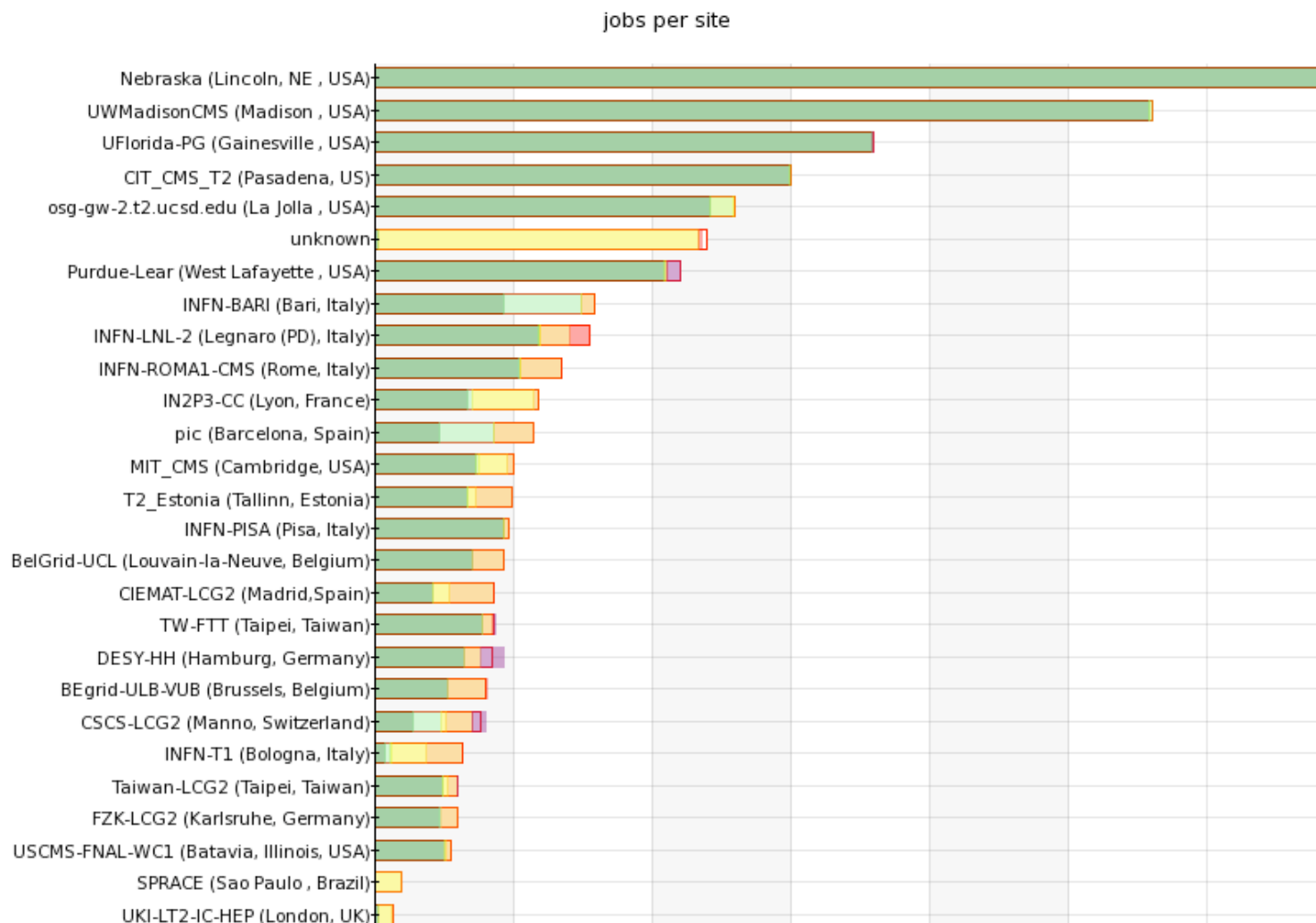




# CMS Dashboard

The CMS dashboard is a successful collaboration of ARDA and CMS

- ➔ The goal was a 90% successful completion and currently is CMS is exceeding this





# Summary

CSA06 was a successful exercise for CMS

- ➔ The metrics specified before the challenge were met

It has been a good demonstration of

- ➔ Stability and performance of the new CMS software framework
- ➔ The operability of the CMS data management and data transfer systems
- ➔ The successful integration work with the WLCG
  - Service support has been excellent
- ➔ The accessibility and usability of sites in the EGEE and OSG

We are working on improving operations

- ➔ A few items to check for improving responses to service interruptions
- ➔ Looking for any limitations to reach the next factor of two in scale
- ➔ Working with the WLCG Integration task force as items arise.