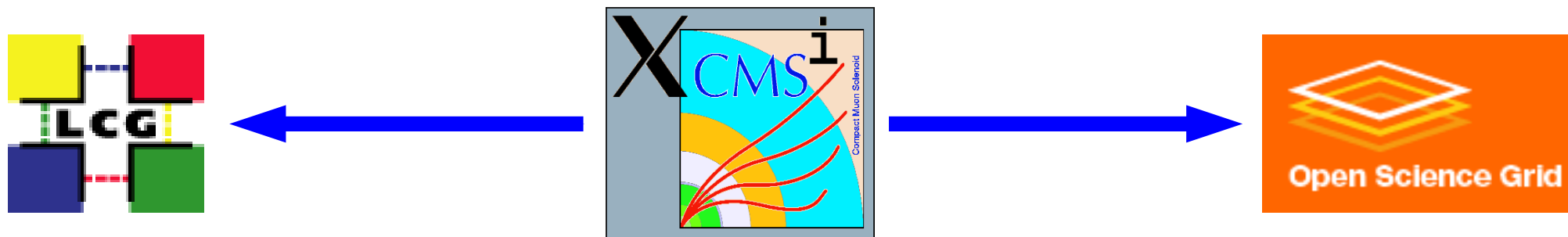
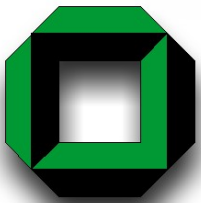


Software Deployment on Grids in High Energy Physics



Volker Büge, Klaus Rabbertz, Armin Scheurer
Institut für experimentelle Kernphysik
Universität Karlsruhe



Outline



Live Demo!

Short Intro to High Energy Physics

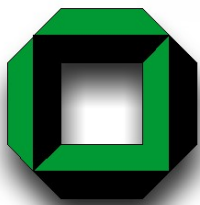
The Challenge

View on existing Implementations

Some Details on selected Components

Demo Results

Outlook



Live Demo (1) Local Installation



Configuration GUI

Choose software to install:
- Tags: Select set(s) of RPMs resolving dependencies
- Archives: Select single or multiple RPMs

Load configuration (optional)

Change configuration (if necessary)

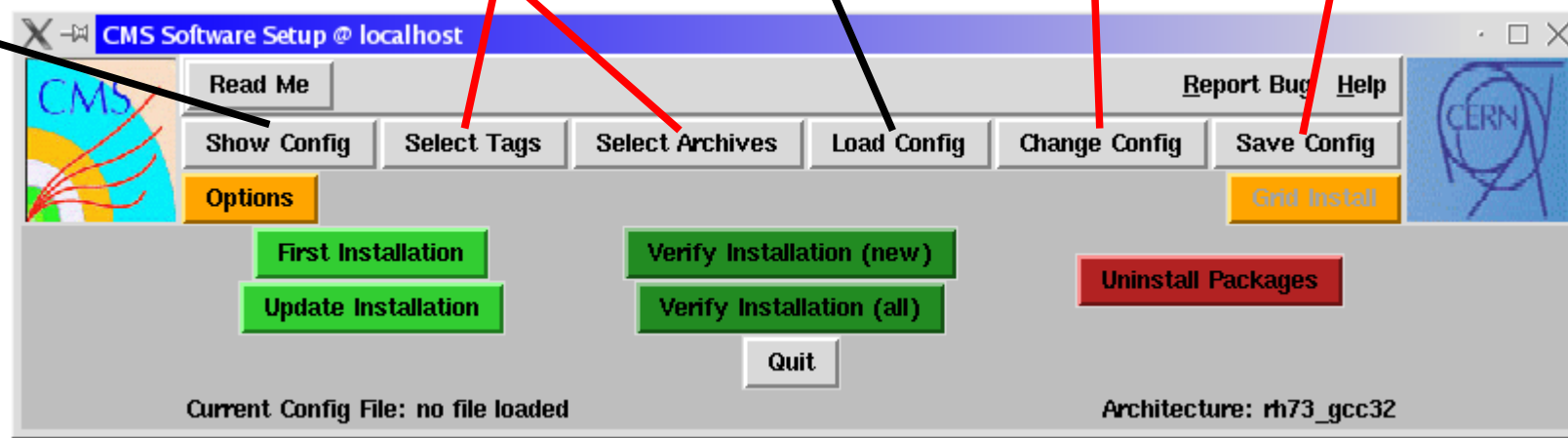
Save configuration:
- Mandatory to transfer configured settings to command-line installer

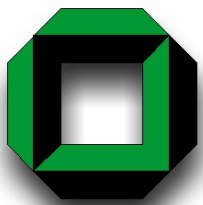
Show configuration (optional)

1.

2.

3.





Live Demo (2)

Grid Submission



If possible the following will be done in real:

(Needs to be run from a grid user interface (UI))

Get name of compute element for GridKa/FZ Karlsruhe:

```
> lcg-infosites --vo cms ce | grep gridka
```

List info on installed software, look for LinuxTag_6_5_6:

```
> lcg-ManageVOTag -vo cms -host a01-004-128.gridka.de --list
```

→ Already there, nothing to be done

List same info for EKP/University of Karlsruhe:

```
> lcg-ManageVOTag -vo cms -host ekp-lcg-ce.physik.uni-karlsruhe.de --list
```

→ Software is missing ...

Initialize grid authentication:

```
> grid-proxy-init
```

Give details on certificate:

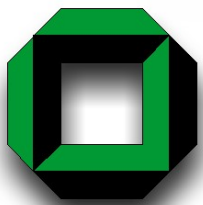
```
> grid-proxy-info
```

Submit grid install job in debug mode, nothing gets sent:

```
> ./cmsg.pl -t rpm -s ekp-lcg-ce.physik.uni-karlsruhe.de -n -i LinuxTag_6_5_6
```

Really submit:

```
> ./cmsg.pl -t rpm -s ekp-lcg-ce.physik.uni-karlsruhe.de -i LinuxTag_6_5_6
```



Live Demo (3)

Automated Submission



If possible the following will be done in real:

(Again from a grid user interface (UI))

Add software install request to some grid sites, e.g. DESY:

```
> lcg-ManageVOTag -vo cms -host grid-ce0.desy.de --add  
-tag VO-cms-LinuxTag_6_5_6-request-install
```

→ Software will be submitted for installation during next monitoring period

Finished ...

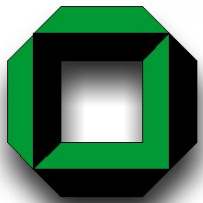
For the demonstration a cron job was set to start the monitoring at 17:15 today

```
> crontab -l
```

Keep your fingers crossed ...

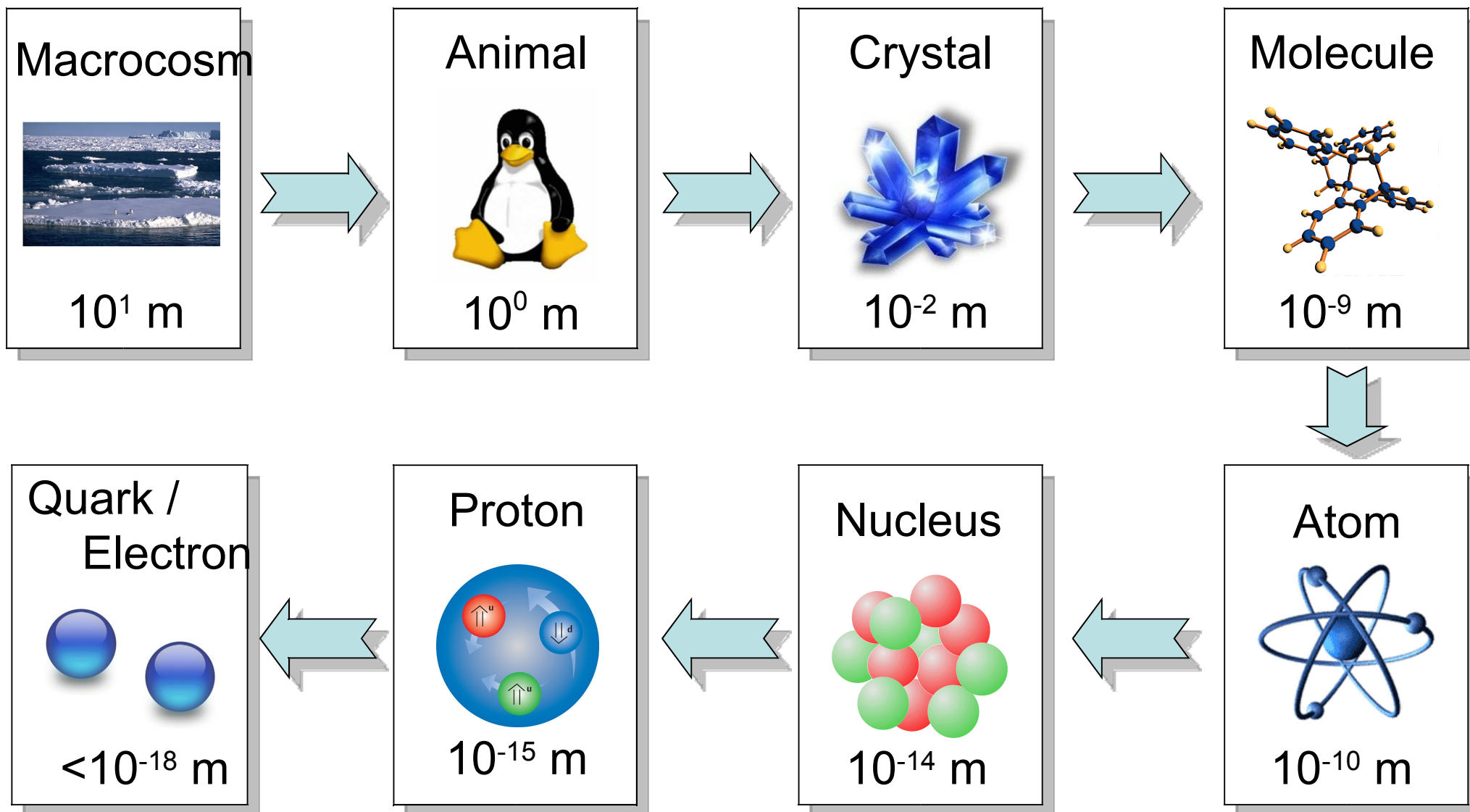
Time for a quick look on the current status:

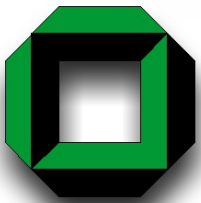
<http://www-ekp.physik.uni-karlsruhe.de/~rabbertz/xcmsi/cmsmon.html>



High Energy Physics (1)

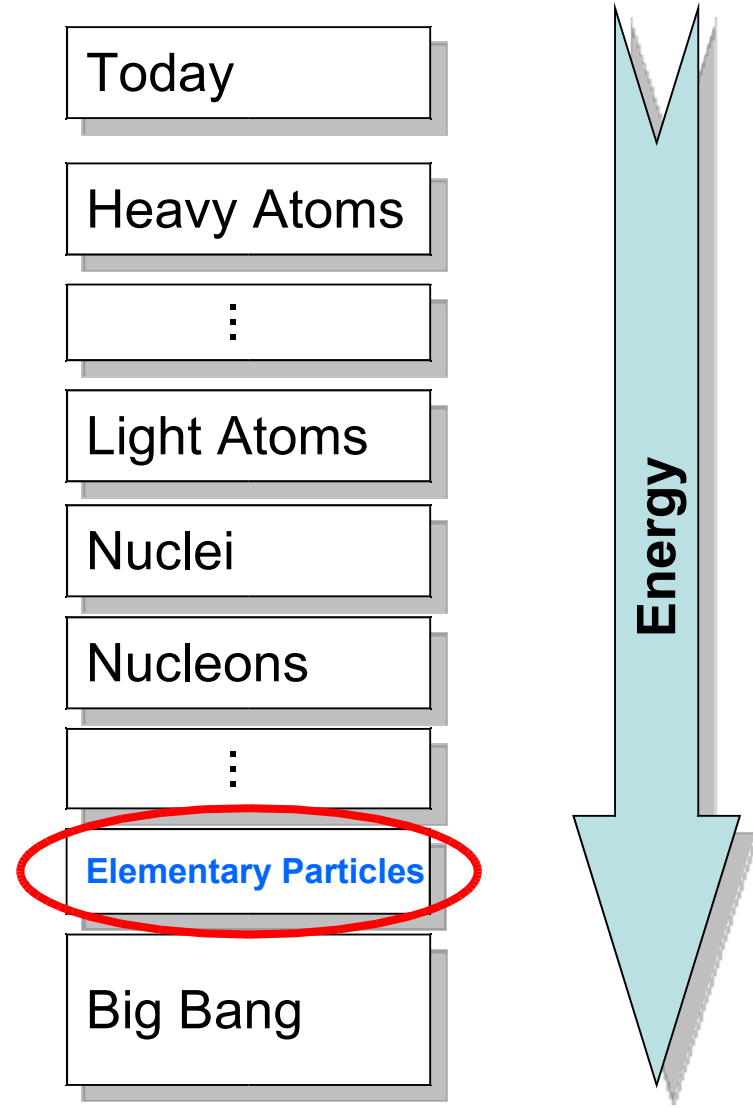
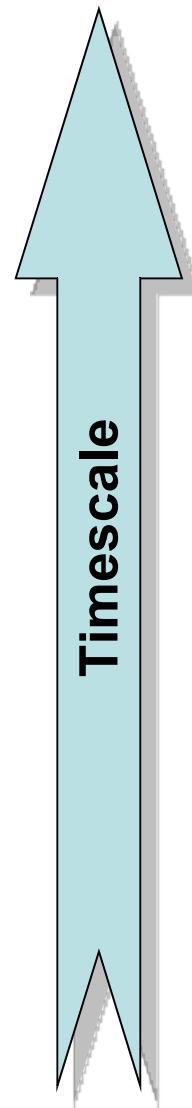
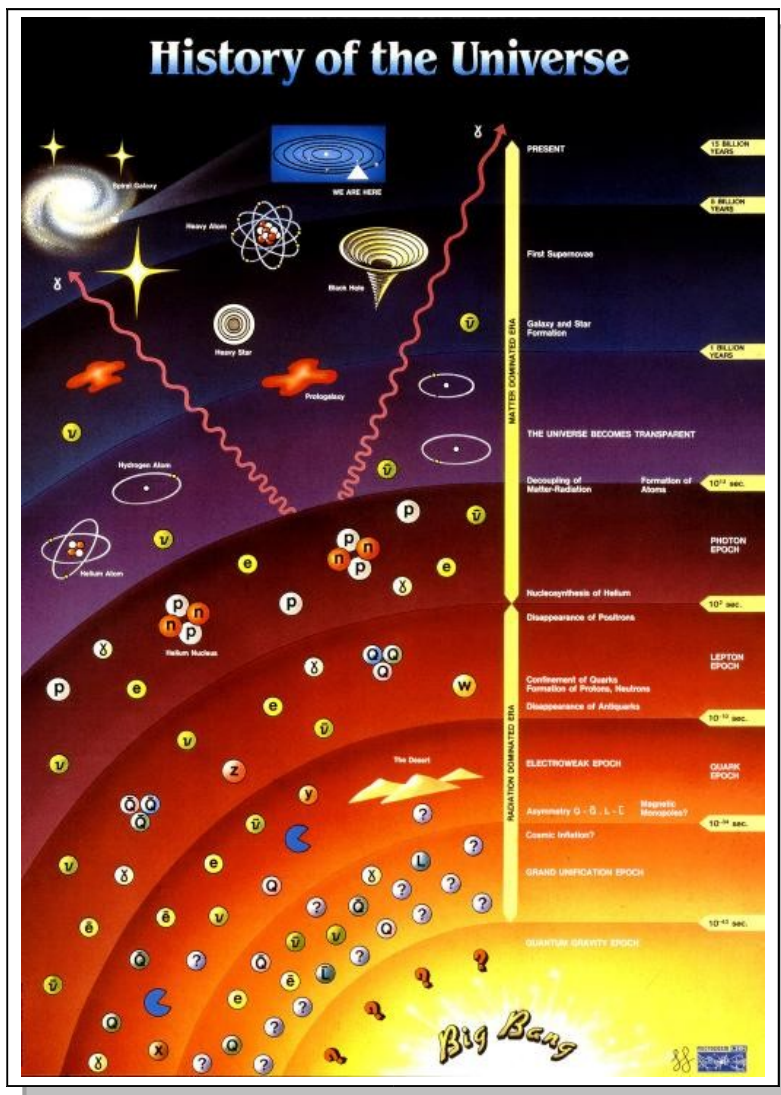
Spatial Dimensions

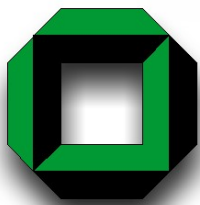




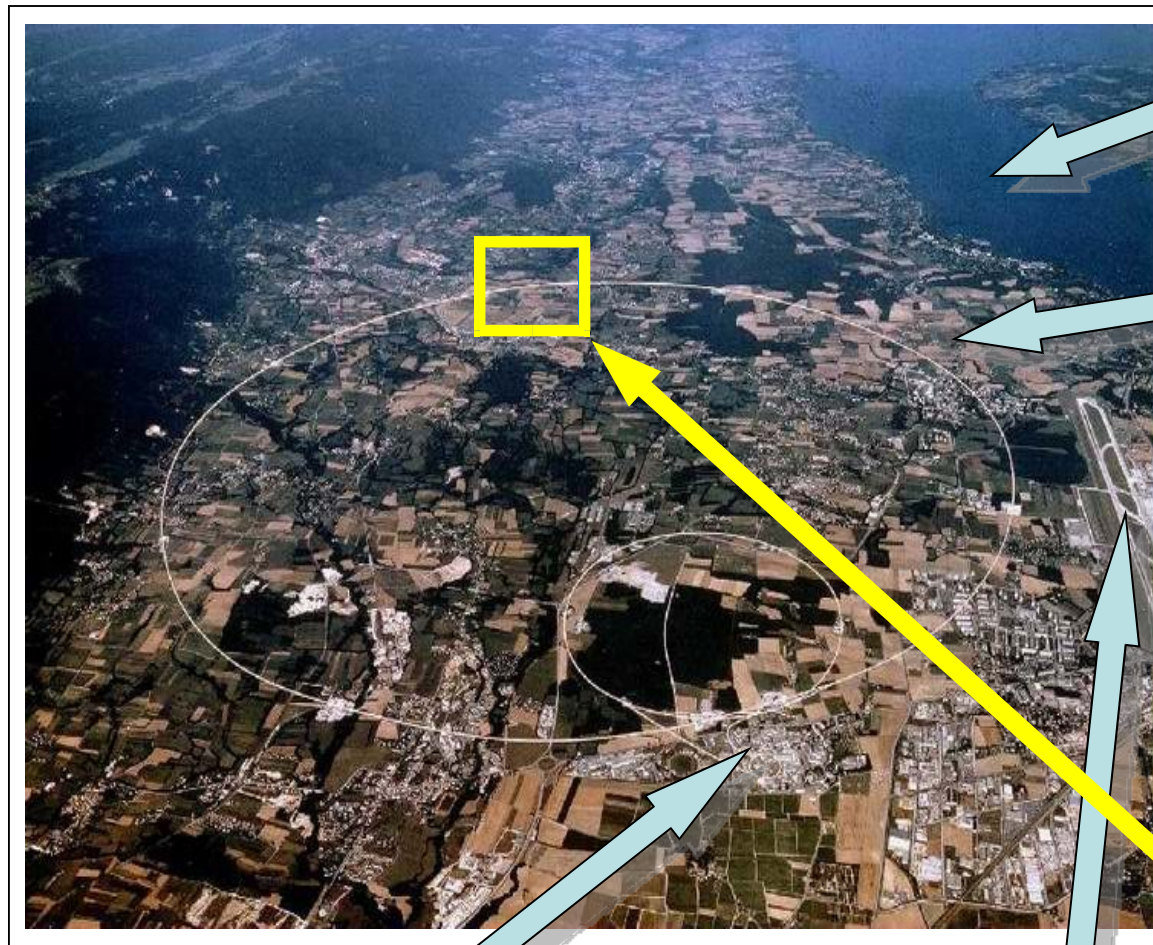
High Energy Physics (2)

Temporal Dimensions





The Large Hadron Collider



Lake Geneva

Large Hadron Collider

Length: 27 km
Beam energy: 7 TeV
Below surface: 100 m
Temperature: -271 °C
Energy use: 1 TWh/a

Best vacuum between earth and andromeda galaxy

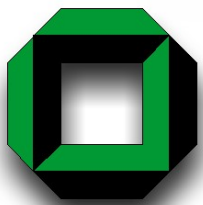
4 large experiments:

CMS
LHCb

ATLAS
ALICE

CERN

Airport



The Challenge (1)

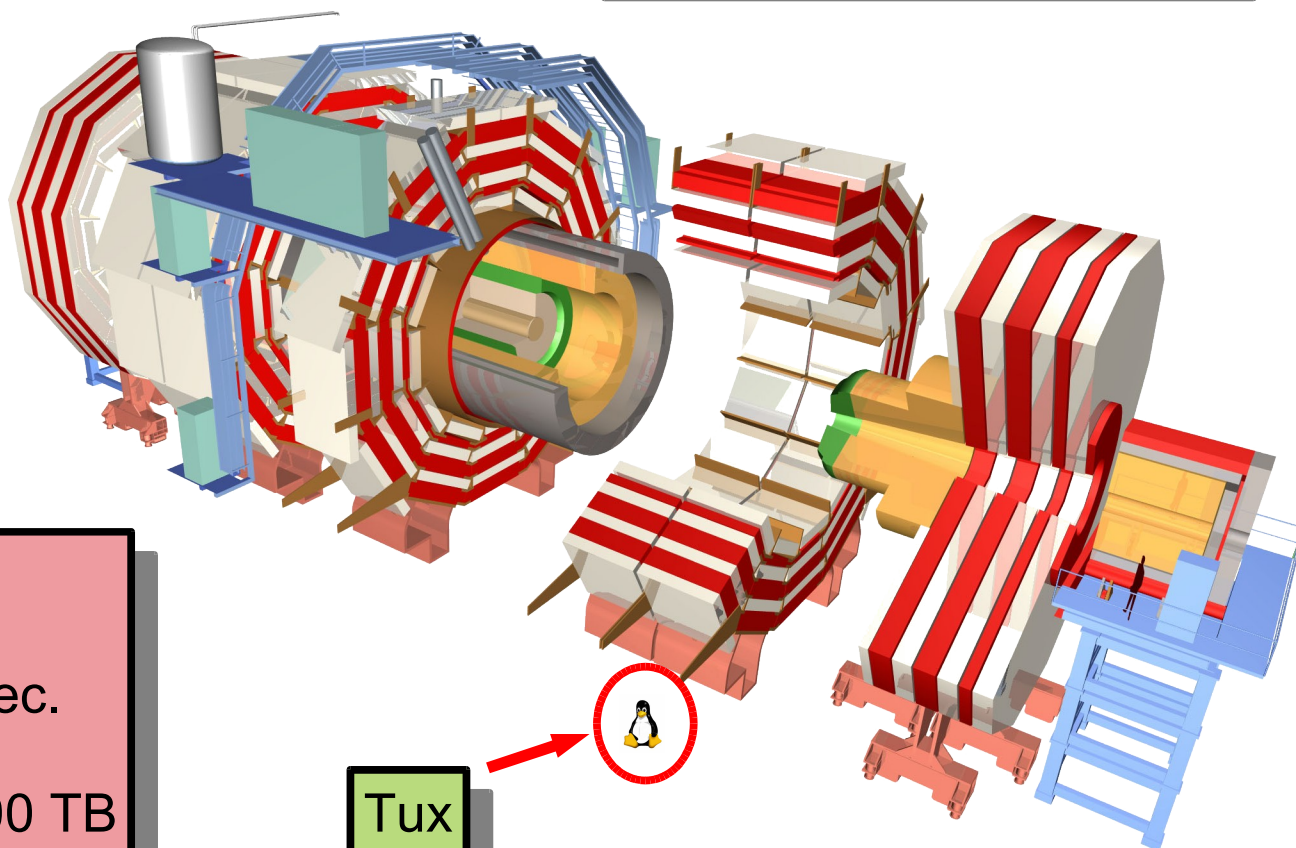
Huge Amounts of Data



Technical Data:

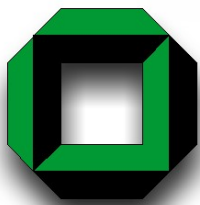
CMS: Length: 21.5 m
Diameter: 15.0 m
Weight: 12500 t
Magnetic field: 4 T
(200000 x terr. magn. field)

The CMS Detector (Compact Muon Solenoid)



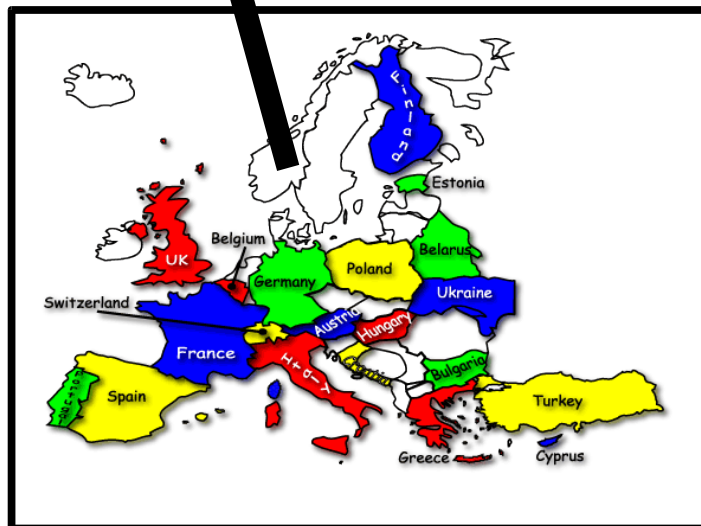
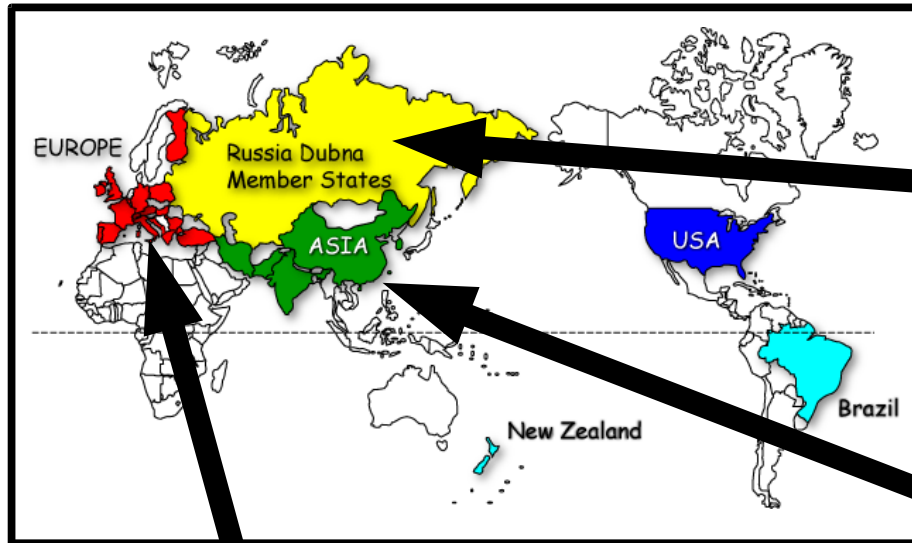
Huge Amounts of Data:

CMS: Event size: 1.5 MB
Event rate: 150 events/sec.
Events/year: 1 billion
Total raw data/year: 1,500 TB

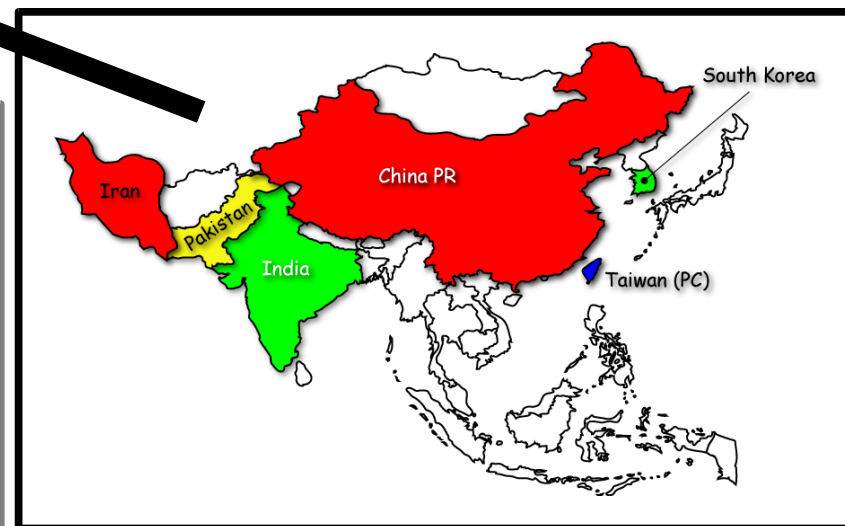


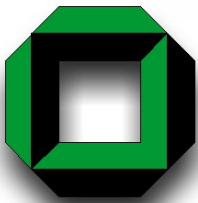
The Challenge (2)

Many People Worldwide

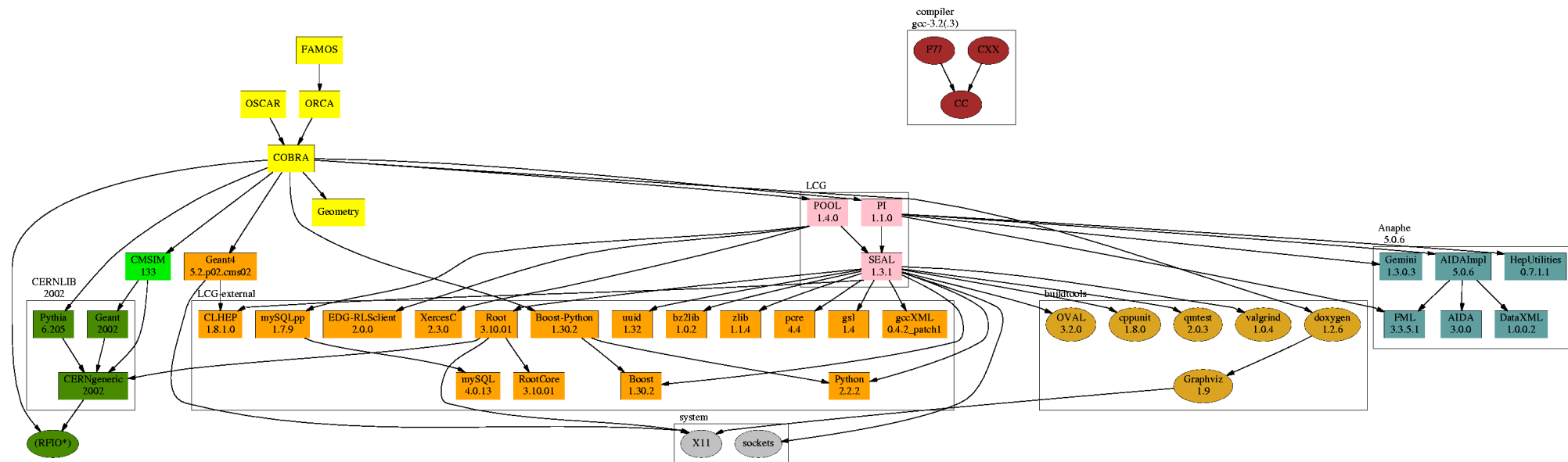


Big International Collaborations:
CMS
38 Countries
182 Institutes
2000 Scientists & Engineers



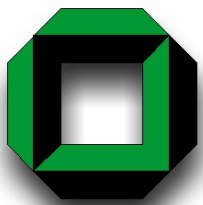


The Challenge (3) Complex Software



Typical Experiment Software Installation:
CMS Detector Simulation and Reconstruction

- > 200000 lines of code
- > 200000 files
- ≈ 100 RPM packages of 2 GB in total
- ≈ 6 GB of disk space unpacked



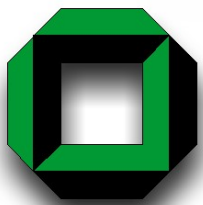
The Challenge (4) Numerous Grid Projects



Many Grid Projects:

- LHC Computing Grid (LCG)
- OpenScienceGrid (OSG)
- D-Grid
- NorduGrid
- BalticGrid, ...

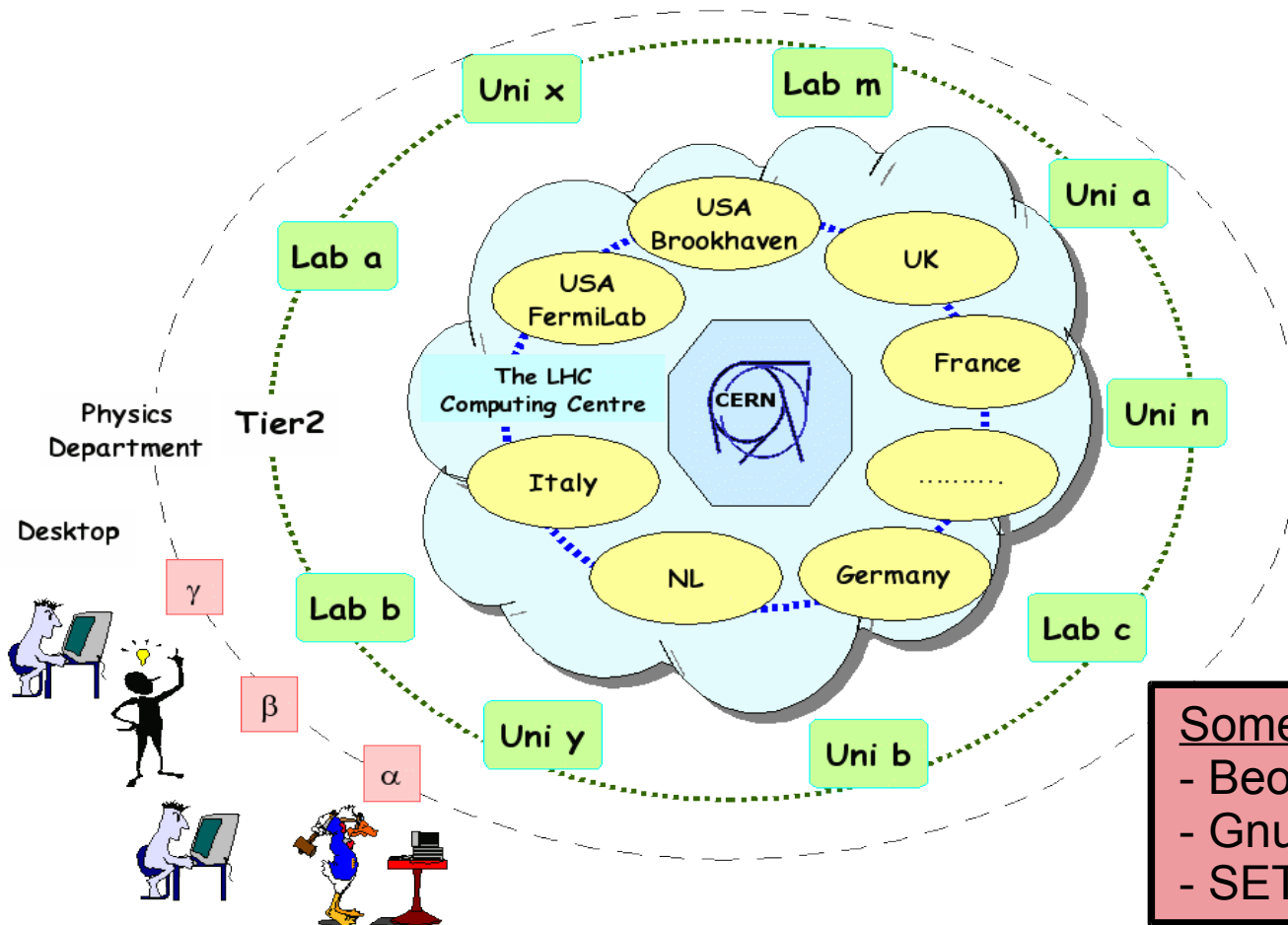




Some Remarks on Grids



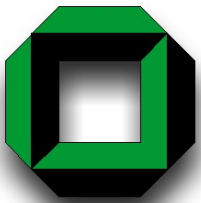
Tiered Architecture of the Worldwide LHC Computing Grid



I. Foster on Grid Computing:
... coordinated resource sharing and problem solving in dynamic, multi-institutional virtual organizations ...

Some Projects which are NOT Grids:

- Beowulf: Cluster Computing
- Gnutella: Peer-to-Peer
- SETI @ home: Distributed Computing



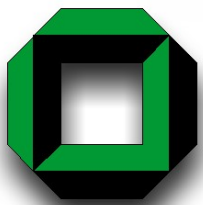
The Task



Grids-wide Deployment of Experiment Software for Simulation, Data Analysis and Development

Desirable properties of experiment software installations:

- Relocatable packages
- No root privileges required
- Optional network download
- Batch mode installable
- Save-able and reusable set-up
- Included validation procedure
- Concise configuration also for less experienced users
- Multi-platform support
- Multiple installations possible

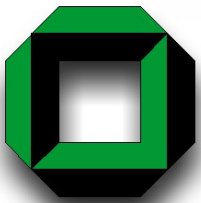


Software Preparation

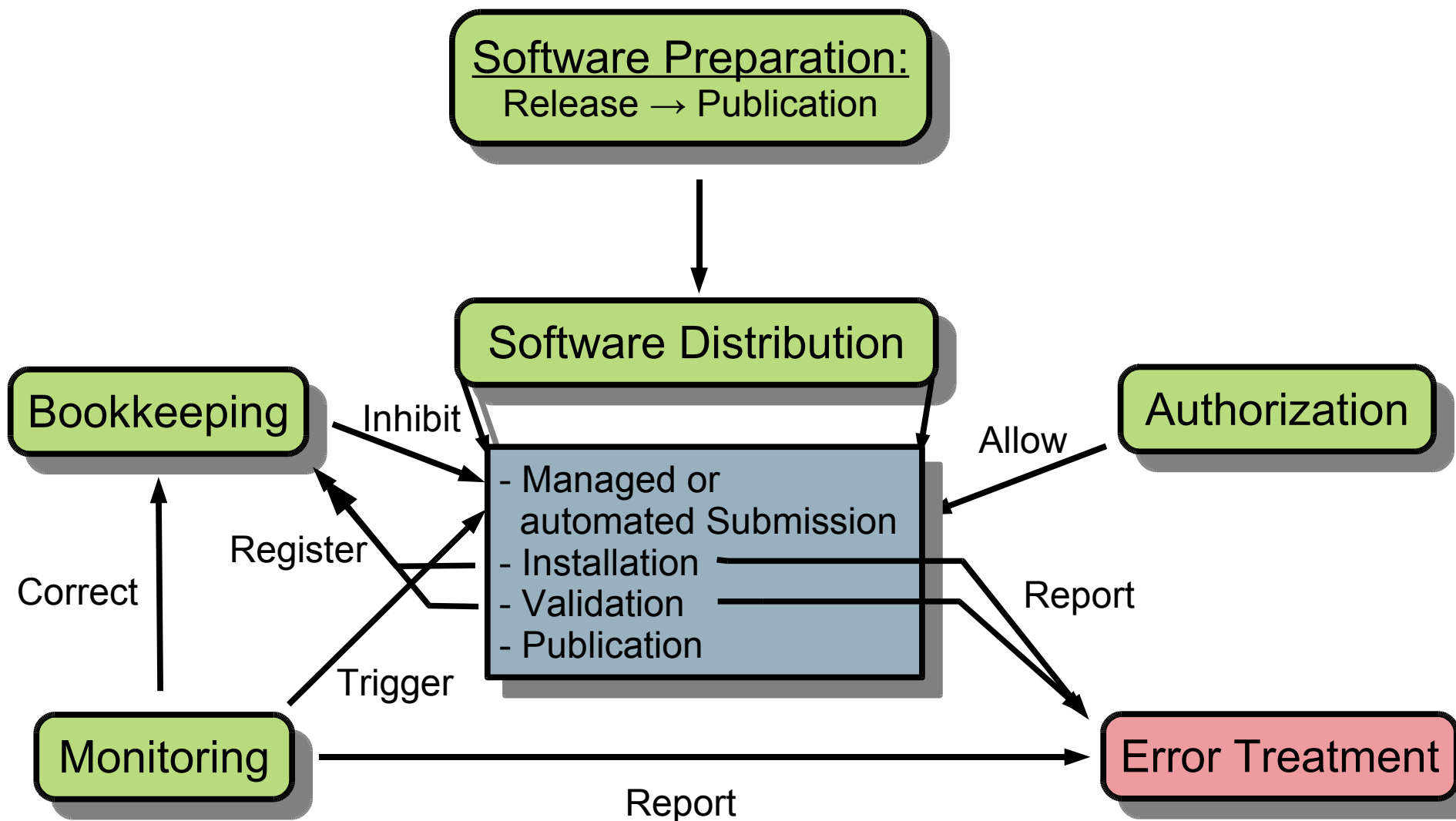


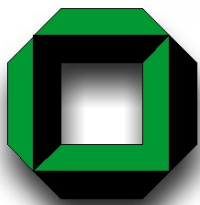
Common Tasks before Deployment on Grids:

- ➔ Release and Build
- ➔ Packaging
- ➔ Test Install and Validation
- ➔ Archiving
- ➔ Web/Grid Storage
- ➔ Publication
- ➔ Mirroring/Load Balancing

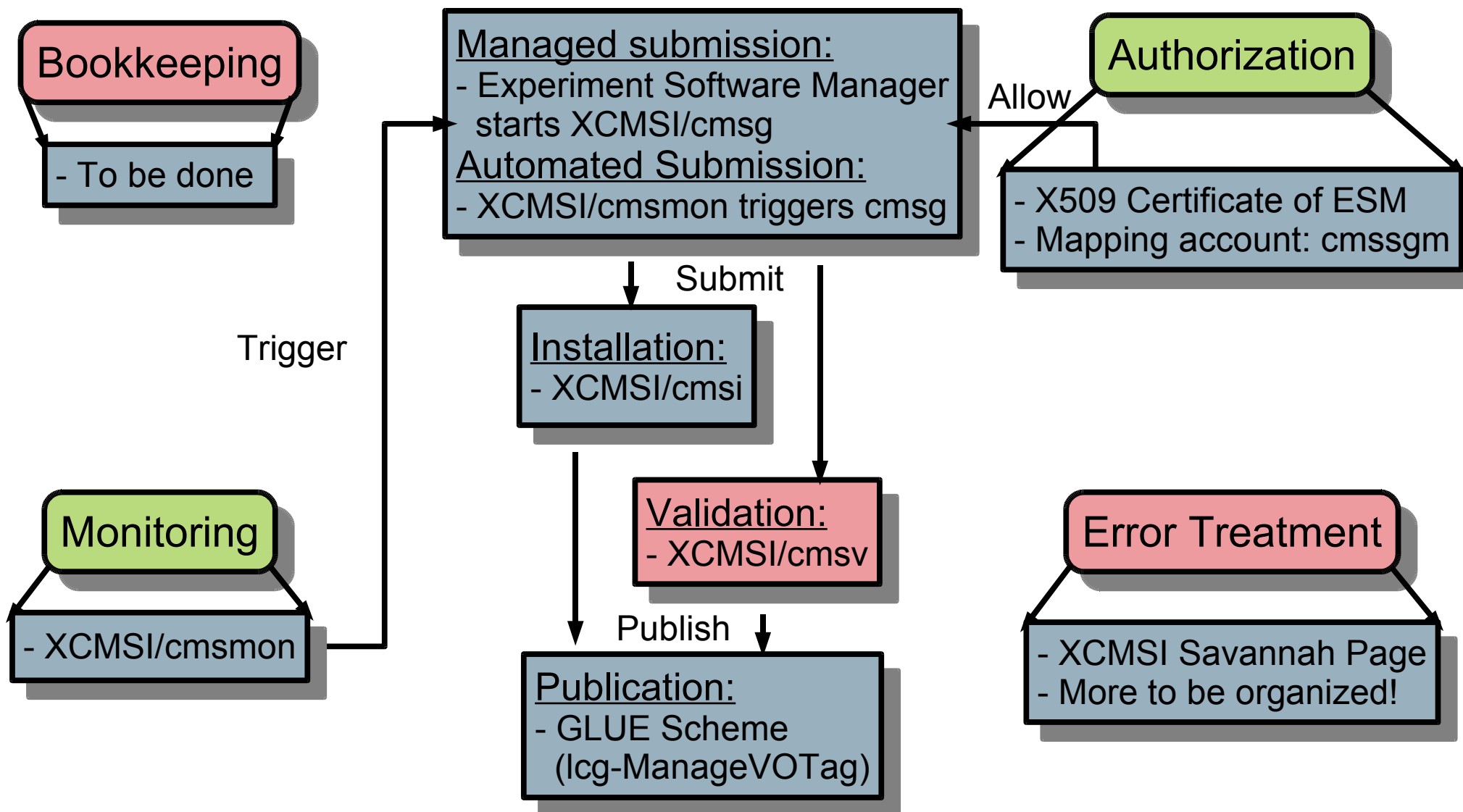


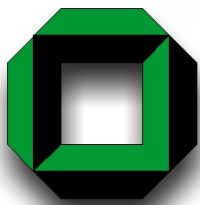
A Generic View



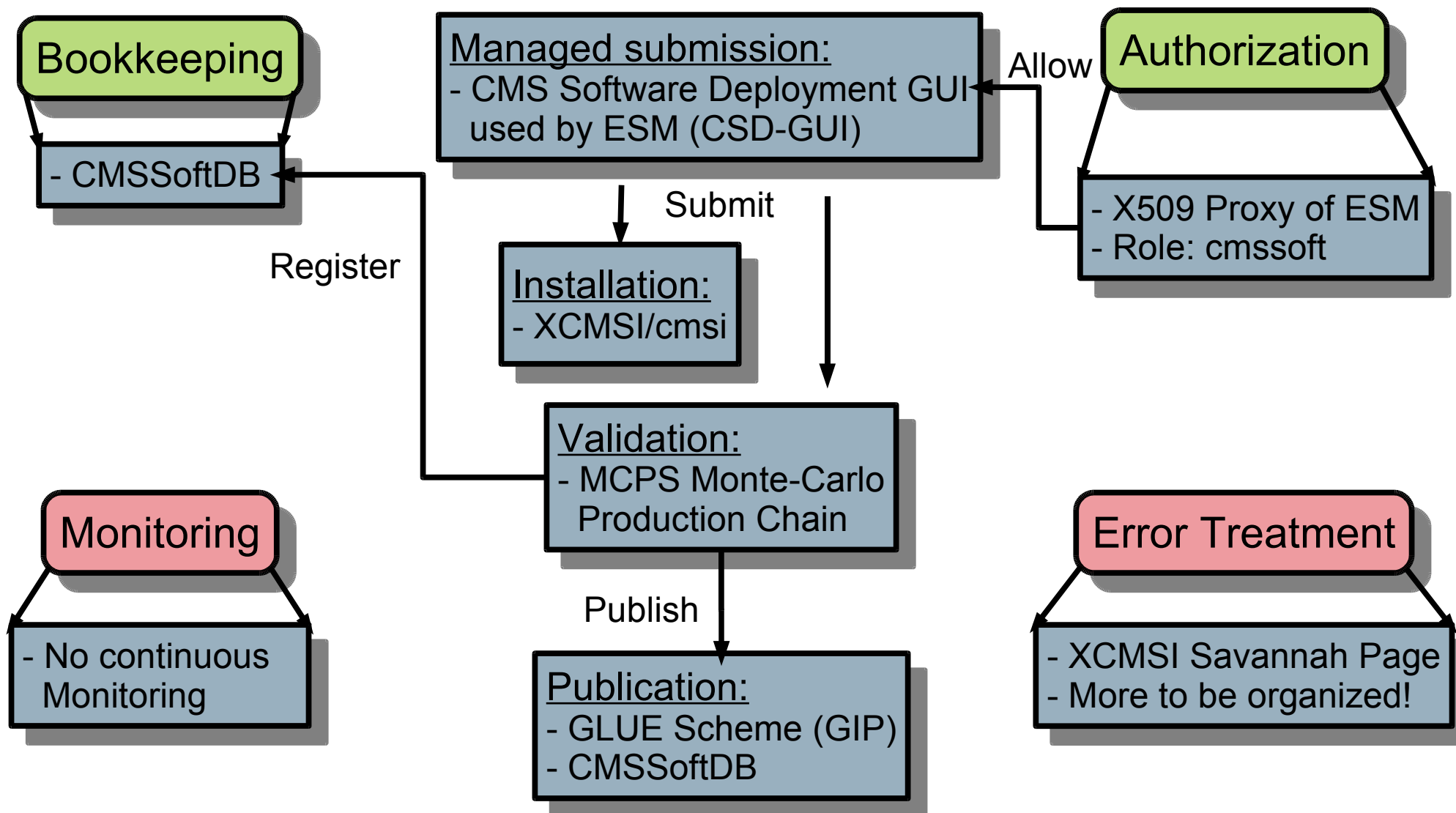


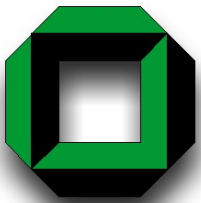
Implementation within LCG





Implementation within OSG





Bookkeeping with CMSSoftDB



Software Installation Table: Provides i.a. comprehensive overview of CMS SW Installation Status on the OSG

- ✚ Employs a MySQL Database
- ✚ No continuous Crosscheck with Monitoring

Show CMS Software Installation Table

Choose from sites... or enter a site...

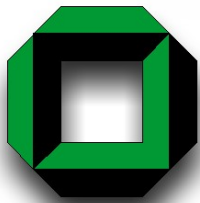
Choose from projects... or enter a project...

Show Reason Column

Show Who Column

Overview of CMS Software Installation

/home/coldfeet/services/csdogrid/data/x509_dn_unknown			
Sitename	Name	Status	Date Time
ASCC_OSG	ORCA_8_7_5	I_FORENSIC	Wed Nov 23 19:22:53 EST 2005
BNL_ATLAS_2	CMKIN_5_1_0	INSTALLED	Fri Jul 15 17:23:15 EDT 2005
BNL_OSG_Test1	ORCA_8_7_3	INSTALLED	Fri Jun 17 00:26:36 EDT 2005
CIT_CMS_PG	CMKIN_5_1_1	INSTALLED	Mon Sep 12 15:02:08 EDT 2005
CIT_CMS_PG	OSCAR_3_6_5	INSTALLED	Mon Sep 12 23:38:40 EDT 2005



CSD-GUI



Csdogrid Tasks (csdogrid) - Mozilla

Back Forward Reload Stop <https://gdsuf.phys.ufl.edu:8443/csdogrid/csdogrid/csdogrid/siteinfo> Search Print

Csdogrid OSG X509 Proxy: GSI Login

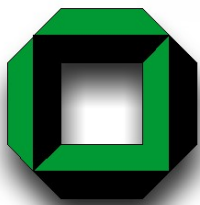
Admin Only

- **csdogrid**
 - [CMS Software Installation Analysis](#)
 - [CMS User Full Chain MC Processing](#)
- **Query Tasks**
 - [\[Grid Site Information\]](#)
 - [Create/View a Site Information](#)
 - [Check Site System/Architecture](#)
 - [Show CMS Software Installation Table](#)
- **CMS Software Installation Tasks**
 - [Upload A CMS Project](#)
 - [Install A CMS Project](#)
 - [Run Verify on an Installed CMS Project](#)
 - [Publish Installation To Discovery](#)
- **RPM Tasks**
 - [Rebuild RPM DB](#)
- **Job Management Tasks**
 - [Check Job Status](#)
 - [Execute condor rm on a job ID](#)
 - [Check Log Stdout Stderr file](#)
- **Undo Tasks**
 - [Undo Upload A CMS Project](#)
 - [Clean up an RPM or all RPMs](#)
 - [Undo Install A CMS Project](#)
 - [Undo Verification A CMS Project](#)
 - [Undo Clean up an RPM or all RPMs](#)
 - [Undo RPM Rebuild for CMS rpmdb](#)

Grid Site Information

Choose from sites... or enter a site...

Done



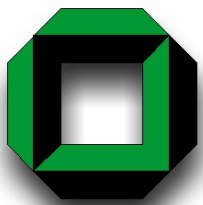
Monitoring with XCMS



CMS SW specific Monitoring: Runs short test job on compute elements

- Architecture, SW Installation Directory, RPM Database, Local Catalogs, installed Projects in comparison with published information
- Access to express queue needed (→ VOMS, Virtual Organization Membership Service)
- More elaborate Bookkeeping desirable

CE-Name	Last test	Architecture	VO_SW_DIR	rpmDB	Local Catalogue	SW OK	SW Problems	PU-Tags
CE.pakgrid.org.pk	2006/02/05_14:02 Aborted	VO-cms-slc3_ia32_gcc323	OK, read-write	-	-	0	0	-
a01-004-128.gridka.de	2006/02/05_18:10 Time out	VO-cms-slc3_ia32_gcc323	OK, read-write	OK	OK	19	5	-
a01-004-164.gridka.de	2006/02/05_18:10 Time out	VO-cms-slc3_ia32_gcc323	OK, read-write	OK	OK	0	21	-
alexander.it.uom.gr	2006/02/05_12:41 OK	VO-cms-slc3_ia32_gcc323	OK, read-write	-	-	1	2	-
antaeus.hpcc.ttu.edu	2006/02/05_18:10 Disapp. from LDAP	-	-	-	-	0	0	-
atlasce01.na.infn.it	2006/02/05_12:07 OK	VO-cms-slc3_ia32_gcc323	OK, read-write	-	-	4	0	-

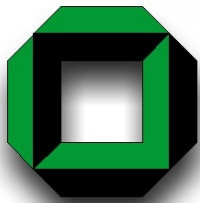


Automated Installation



XCMSI/cmsmon can be run in passive (Monitoring) and active Mode (Simple Fault Recovery, Installation Trigger)

- + E.g. Setting of Architecture Tag
- + Can trigger SW Installation or Validation
- + GLUE Tags provide simple Control (s. also: [Exp. SW Installation in LCG-2](#))
 - VO-CMS-SW_i_j_k-[request-install](#) => triggers Installation
 - VO-CMS-SW_i_j_k-[processing-install](#) => blocks concurr. Submission
 - VO-CMS-SW_i_j_k-[running-install](#) => blocks concurr. Installation
 - VO-CMS-SW_i_j_k-[to-be-validated](#) => triggers Validation
- + Time to check on the [Live Demo](#)



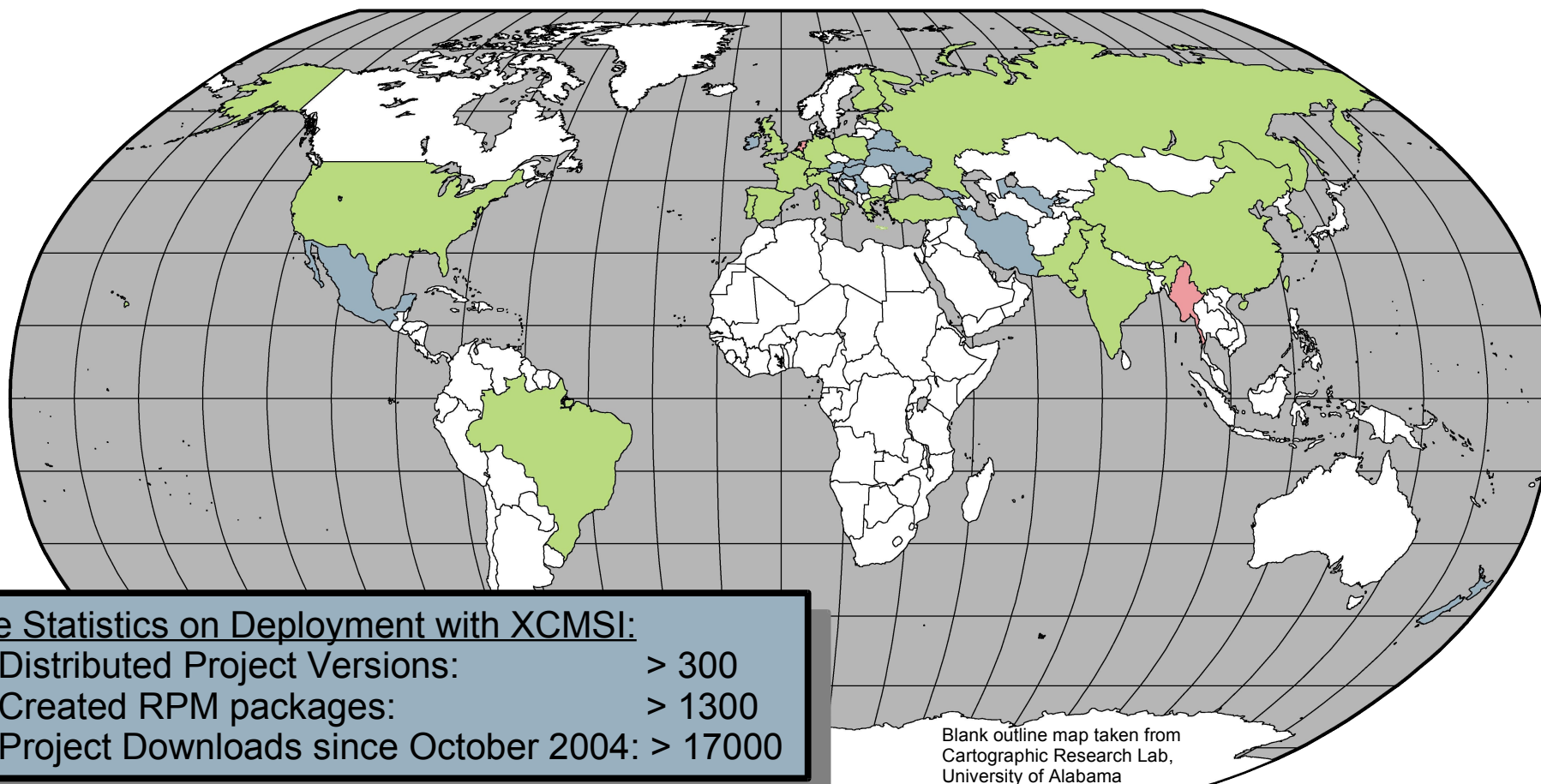
Software Distribution Map



15 Countries with CMS Institutes
and NO registered SW download

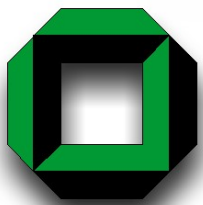
22 Countries with CMS Institutes
and registered SW downloads

2 Countries without CMS Institute
BUT registered SW download



Some Statistics on Deployment with XCMSI:
Distributed Project Versions: > 300
Created RPM packages: > 1300
Project Downloads since October 2004: > 17000

Blank outline map taken from
Cartographic Research Lab,
University of Alabama



Outlook

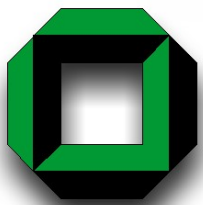


We can deploy complex software to analyze distributed data as well as monitor the activities on the Grids!

Considering 6 GB of application software (!)
versus 1 GB of Operating System ...

Future Vision:

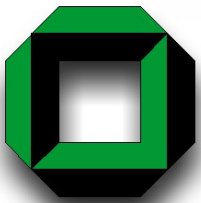
- Distribution of Virtual Machines containing already the application software



Link Collection



- ➡ CERN Home Page
- ➡ The Large Hadron Collider (LHC)
- ➡ CMS Outreach
- ➡ The LHC Computing Grid (LCG)
- ➡ The OpenScienceGrid (OSG)
- ➡ Scientific Linux (SL)
- ➡ Scientific Linux CERN (SLC)
- ➡ Grid Operations Centre (GOC)
- ➡ Grid Information Index Server (GIIS)
- ➡ Site Functional Tests (SFT)
- ➡ LCG Google Map
- ➡ Global Grid User Support (GGUS)
- ➡ CHEP06 Conference (Computing in HEP)
- ➡ EKP, University of Karlsruhe
- ➡ XCMSI Home Page
- ➡ XCMSI Monitoring Page
- ➡ XCMSI/RpmGen Savannah Page
- ➡ CMS CVS Browser
- ➡ Grid Acronym Soup (GAS)

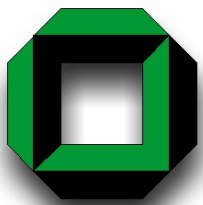


Acronymitis



CASTOR: CERN Advanced Storage Manager	GLUE: Grid Laboratory Uniform Environment
CE: Compute Element	GUI: Graphical User Interface
CMS: Compact Muon Solenoid	HEP: High Energy Physics (Particle Physics)
CSD: CMS Software Deployment	MB/GB/TB: Mega-, Giga-, TeraBytes
CVS: Concurrent Versions System	RPM: RedHat Package Manager
DB: Database	MCPS: Monte Carlo Processing Service
DC04: Data Challenge 04	SW: Software
EKP: Experimentelle Kernphysik	VO: Virtual Organization
ESM: Experiment Software Manager	VOMS: Virtual Organization Membership Service
GIP: Generic Information Provider	XCMSI: CMS Software Installation Project

➡ Grid Acronym Soup (GAS)



Acknowledgements



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Günter Quast, University of Karlsruhe

Further XCMSI authors:

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Andreas Nowack, RWTH Aachen
Joanna Weng, CERN/University of Karlsruhe

CMS colleagues at CERN:

Stefano Argiro, CERN
Shaun Ashby, CERN
Nikolay Darmenov, SOFIA-INRNE/CERN
Shahzad Muzaffar, Northeastern University
Tony Wildish, Princeton

CMS colleagues at OSG:

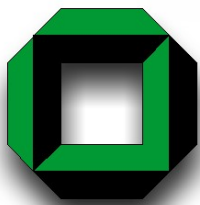
Ramzy Darwish, FERMILAB
David Evans, FERMILAB
Burt Holzman, FERMILAB
Bockjoo Kim, University of Florida
Natalia Ratnikova, FERMILAB
Michael Thomas, CALTECH

A big Thank-you also to the Organizers

There were a lot of penguins in Wiesbaden ...



But one thing we had only in Karlsruhe ...



An Installation Example (Backup)



Grid part:



```
cmsg.pl  
-t rpm -s fzk.de  
-i "ORCA_8_7_1 OSCAR_3_6_5"
```

On LCG sites the default software installation area is given by the variable `$VO_CMS_SW_DIR`

Preparations:

- Find compute element(s) (CE)
- Check against installed software
- Prepare `tar.gz` archive of `xcmsi`
- Generate executable to submit
- Prepare job description file (`jd1`)
- Submit `jd1` file (`edg-job-submit`)
- Start job monitor to fetch output after completion

Generated executable:

- Check on `$VO_CMS_SW_DIR`
- Check disk space
- Generate default configurations (first install only)
- Call installer `cmsi.pl`
- Copy configuration to default software area (first install only)
- Publish new software