The Advanced Resource Connector for Distributed LHC Computing

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NorduGrid and ARC

- The Advanced Resource Connector (ARC) is Grid middleware connecting distributed resources
- NorduGrid is a collaboration of many institutes and projects involved in developing/maintaining ARC and it's applications

NORDUGRID
Grid Solution for Wide Area
Computing and Data Handling

NorduGrid Projects

Several projects operate under the NorduGrid umbrella

- NDGF manages the WLCG Tier 1 site (including distributed storage) and production ARC release

- KnowARC is creating the next-generation ARC middleware

- NGiN does research into leading-edge grid technologies

ARC Design Principles

- Simple Scandinavian design
  - start with something simple that works for users and add functionality gradually
  - non-intrusive on the server side
  - Flexible & powerful on the client side

- User- and performance-driven development
- Strong connection to system administrators and users

Illustrations:"Scandinavian Design beyond the Myth"

www.scandesign.org

ARC Design
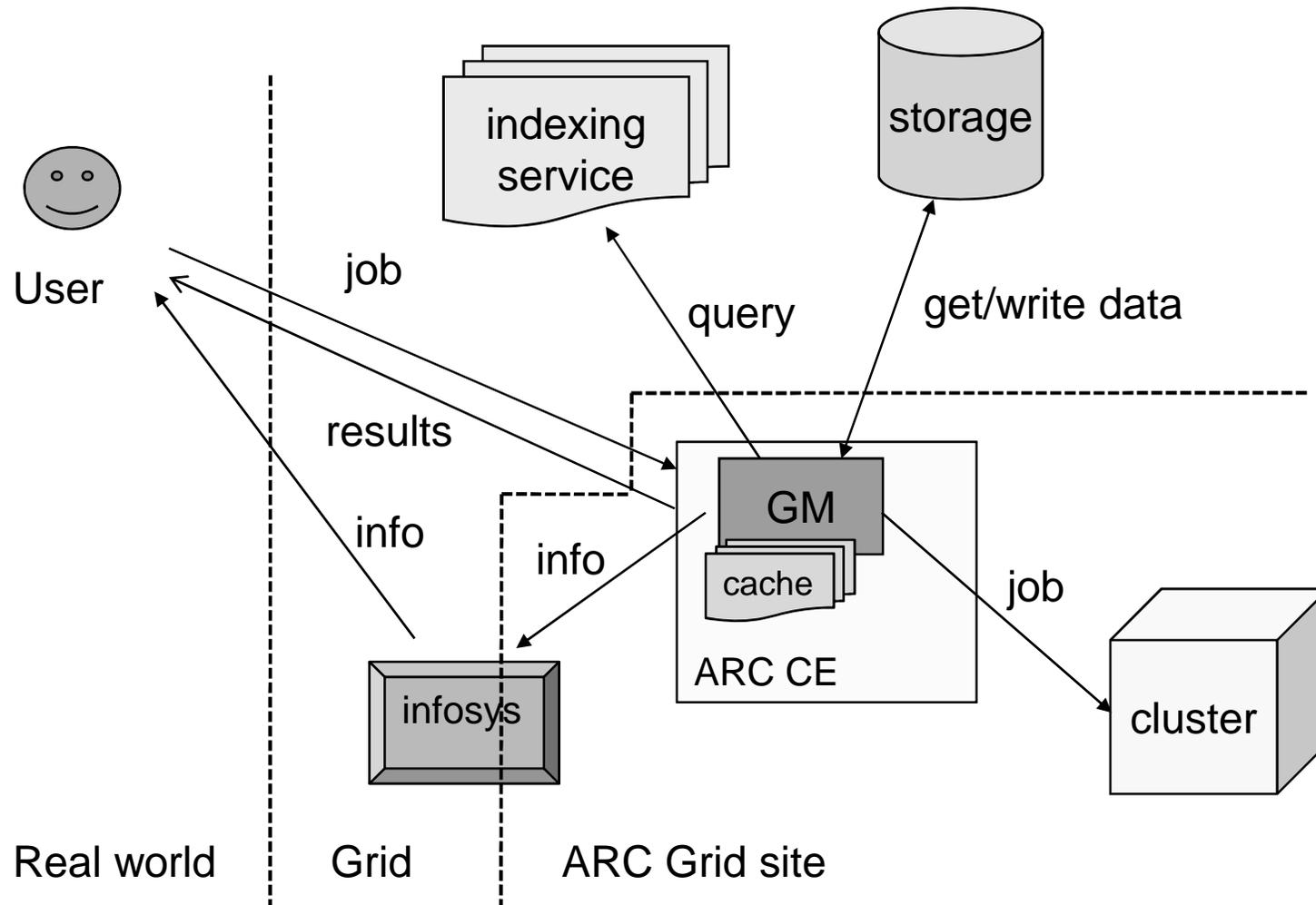
Summary of ARC Components

- Simple and lightweight
  - no middleware on the worker node!
  - no centralised resource broker
- Computing Element based on GridFTP server
- Information system based on Globus MDS (soon BDII)
- User client tools
- Interfaces to local batch systems and external data services

- Top 10 things about arc
  - http://www.nordugrid.org/slides/sc2005-top10.pdf
  - Available for 16 Linux OS (32 and 64-bit)
  - An extremely easy to install and use user client
  - …

http://download.nordugrid.org/builds

User Client

- Grid should be simple to use!

- http://www.nordugrid.org/documents/ng-client-install.html

  – Get a grid certificate

  – Go to http://download.nordugrid.org

  – Download the standalone client tarball (~4MB) for your architecture

  – tar xfz nordugrid-standalone….

  – cd nordugrid-standalone…

  – source setup.sh

  – Go and use the grid!

  – (this might help http://www.nordugrid.org/documents/ui.pdf)

CLI and API

- The ARC client provides a set of command line tools for
  - Job management: ngacl, ngclean, ngget, ngkill, ngrenew, ngresub, ngresume, ngstat, ngsub, ngsync
  - Data mangement: ngcp, ngls, ngrm, ngstage, ngtransfer
- And corresponding API in C++ and python
- Supported data access protocols
  - file, ftp, http, https, gsiftp, srm (v1 and 2.2)
  - rls, lfc

```
$ ngls -lL
lfc://atlaslfc.nordugrid.org//grid/atlas/dq2/user/user.alexread.production/NGExecWrapper9
/grid/atlas/dq2/user/user.alexread.production/NGExecWrapper9 file 13048 "Tue Jun 17 16:05:19
2008" * AD:87a74e01
        srm://srm.ndgf.org/atlas/disk/users/AlexRead/NGExecWrapper9
```

ATLAS and ARC

- The ATLAS MC production system in NorduGrid (Dulcinea) uses the ARC python API to manage jobs

```
from arclib import *  # import ARC API

clusters = GetClusterResources() # get list of clusters from infosys
queuelist = GetQueueInfo(clusters,…) # get queues on each cluster

xrsl = '&(executable="/bin/sh")…' # construct job description
X = Xrsl (xrsl)
targetlist = ConstructTargets (queuelist, X) # job submission targets
targetlist = PerformStandardBrokering (targetlist) # do brokering

submitter = JobSubmission (X, targetlist) # job submitter object
jobid = submitter.Submit() # submit job

jobinfos =  GetJobInfo(jobids,…) # check status
```
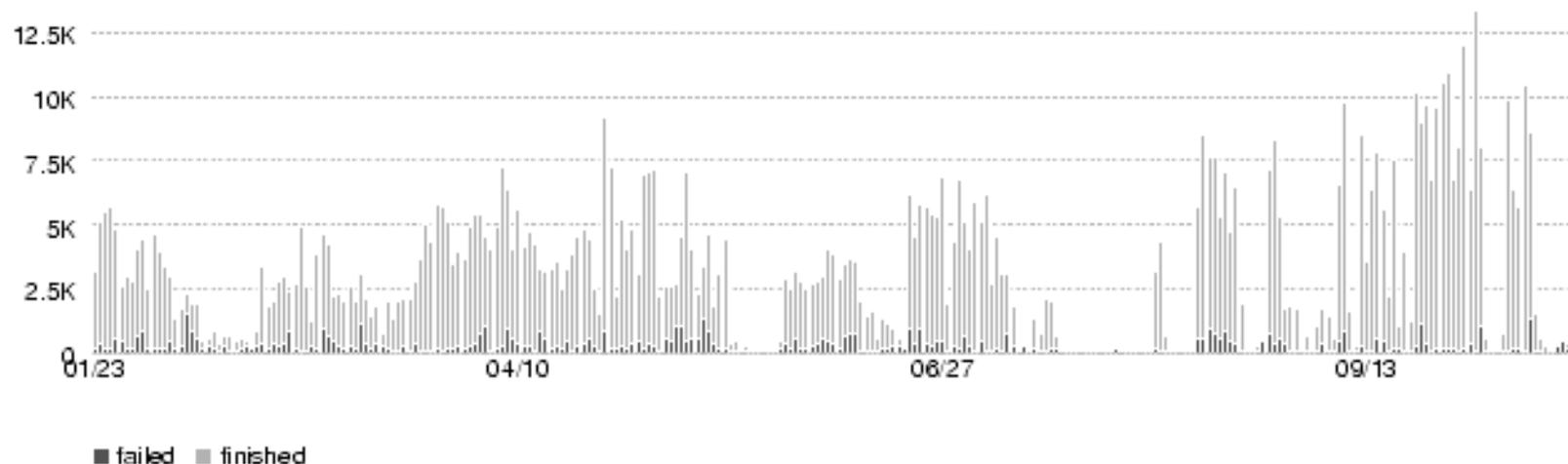
ATLAS ARC Usage

- ATLAS has been using ARC for MC production since 2002
- ATLAS is now running up to 3000 concurrent jobs on ARC resources

ATLAS ARC Usage

- ARC resources ran 10% of ATLAS MC jobs in the last year, with very high efficiency

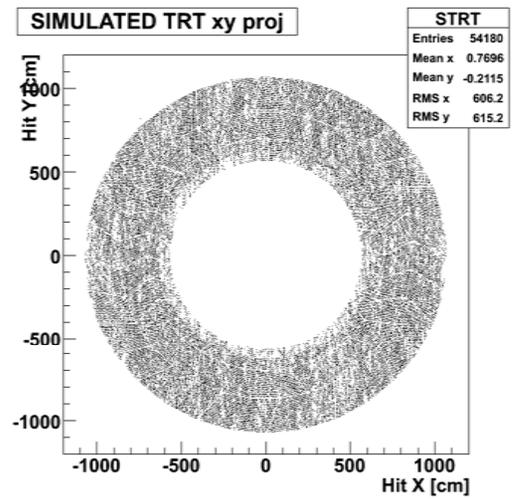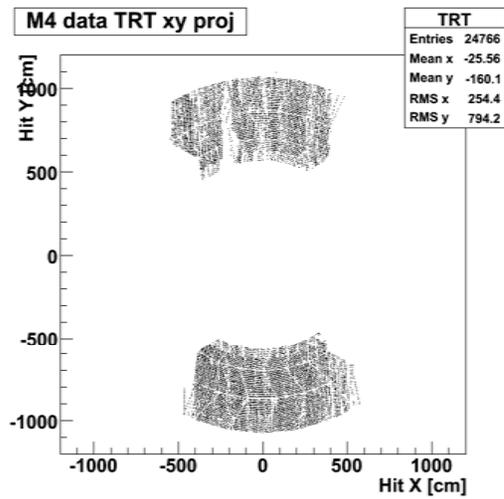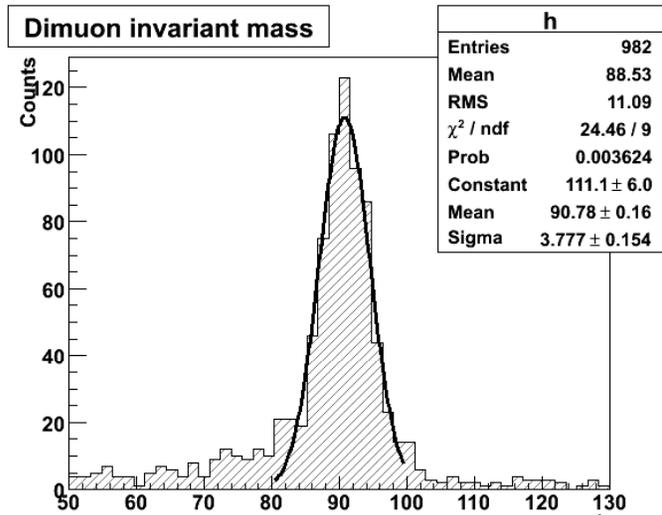| grid	success	failure	efficiency	efficiency (walltime)
LCG	6365116	2407485	72.6%	80%
OSG	3210720	724210	81.6%	84%
Nordugrid	986766	81644	92.4%	96.9%
None	446568	528022	45.8%	83.6%
total	11009170	3741361	74.6%	82.4%

ATLAS Usage

- Ganga is the main end user analysis tool for ATLAS
  - Jobs can be submitted to ARC through a back-end ARC plugin
  - The ARC stand-alone client is packaged with Ganga
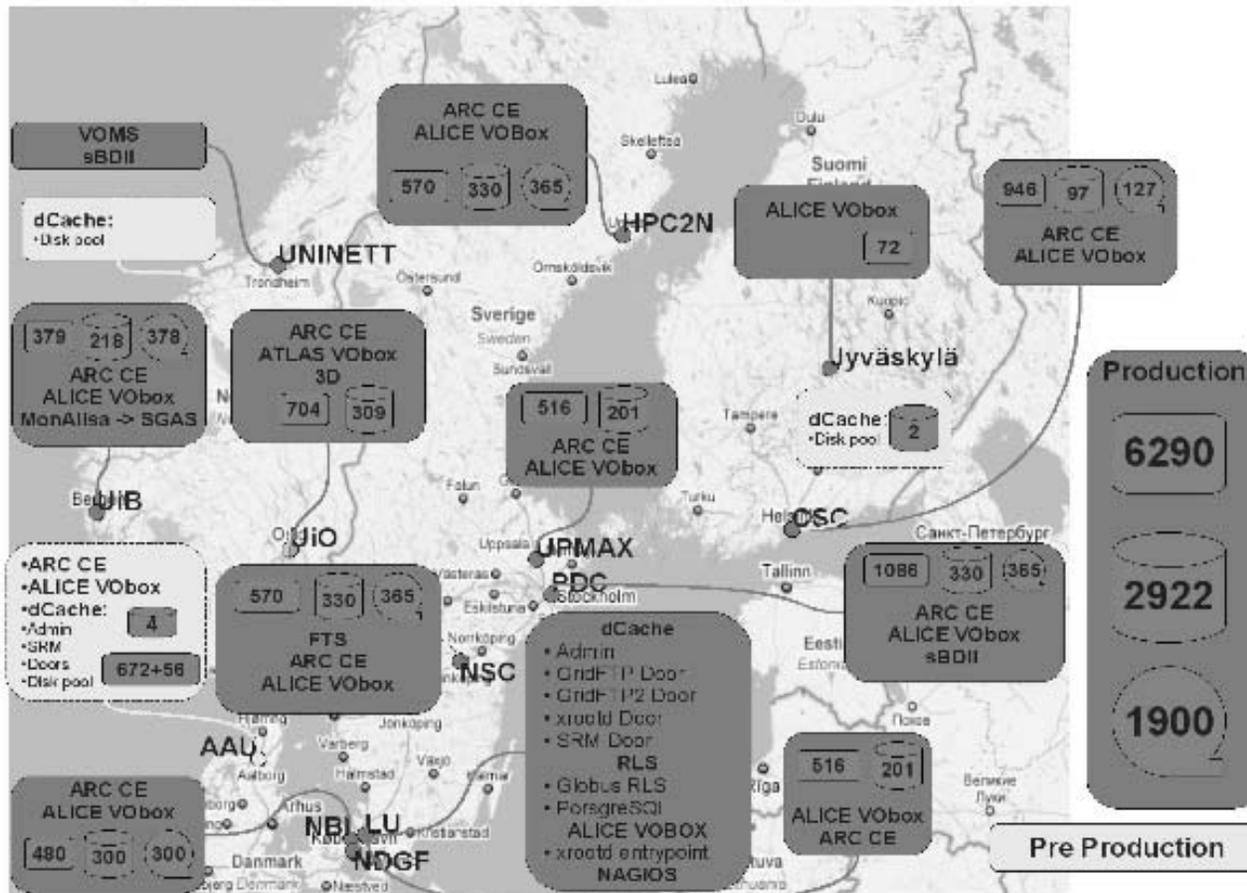- The user only needs to change one parameter to change grids
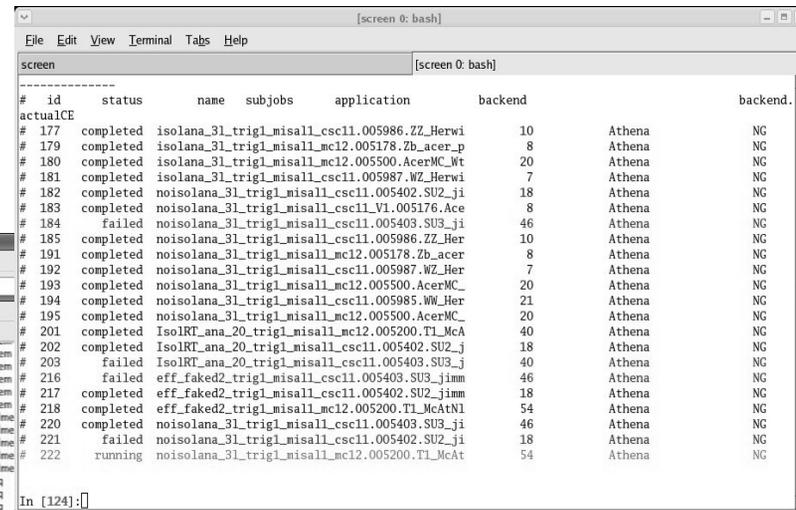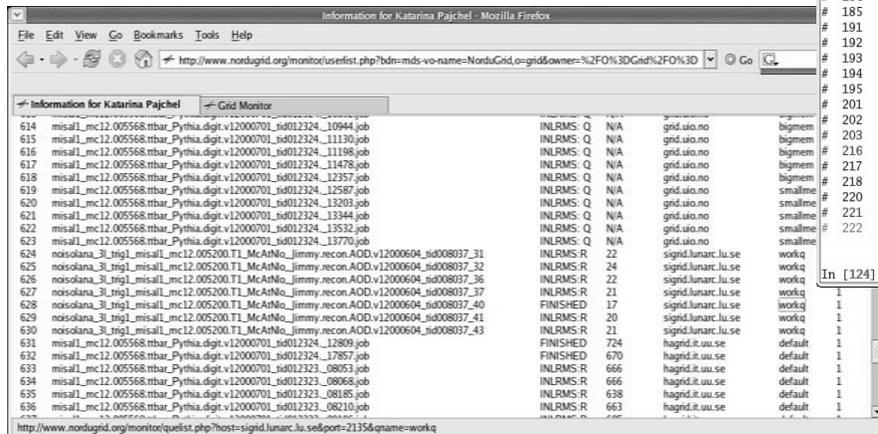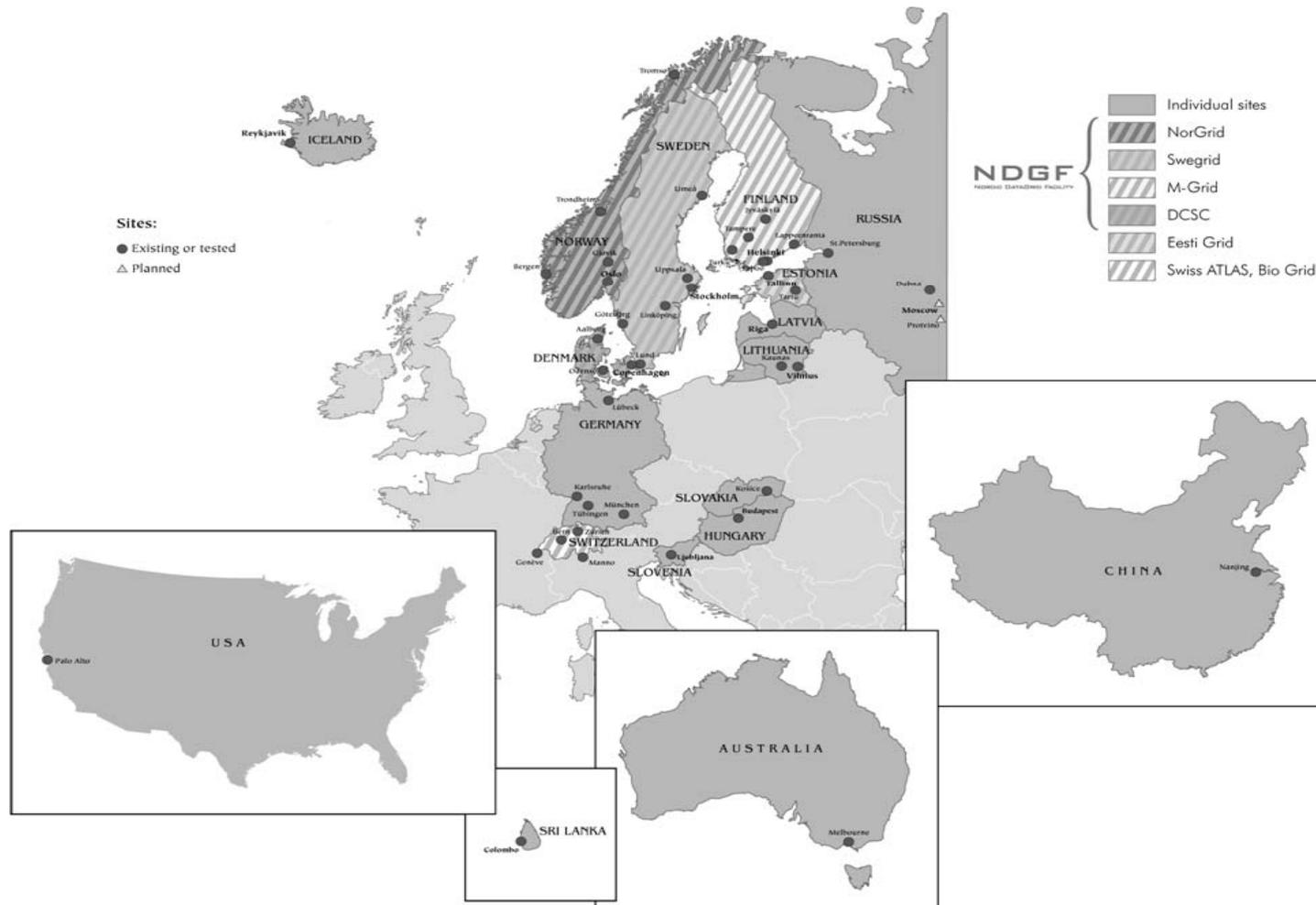
ATLAS Results
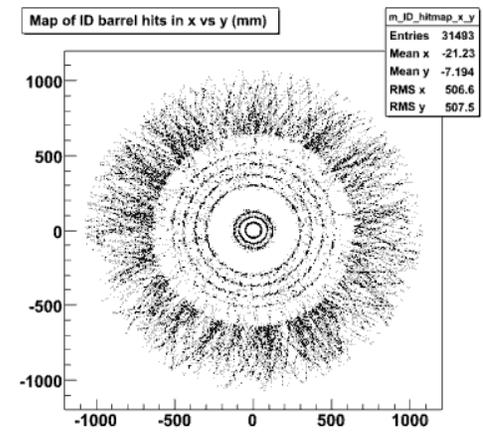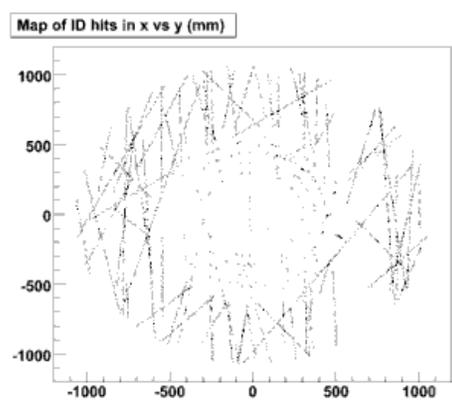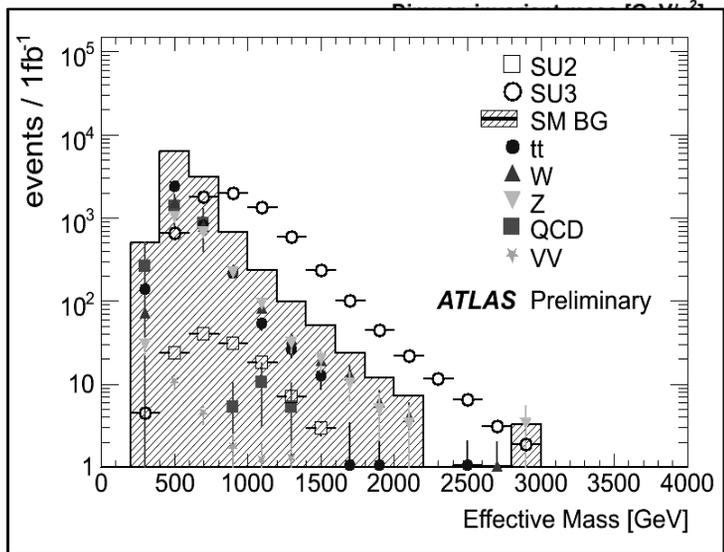
Distributed NDGF T1

ARC Deployment

http://www.nordugrid.org/monitor

		CPUs	Load (processes: Grid+local)	Queueing
The SPbSU First Clust>		1	0+0	0+0
Slovakia	UPJS Kosice	5	5+0	1+0
	UPJS Kosice-Alice	5	2+0	0+0
	UPJS Kosice-Amos	2	1+0	0+0
	UPJS Kosice-BIO	12	7+0	0+0
	UPJS Kosice-pgs02	1	0+0	0+0
	UPJS Kosice-SUSE	1	0+0	0+0
Slovenia	SiGNET	492	150+0	61+0
Sweden	Ada (C3SE)	1004	0+938	0+257
	Grad (SweGrid, Uppmax)	512	25+64	0+0
	Green	73	0+73	83+10
	ISV	5	0+0	0+0
	Neolith	6440	96+6208	0+3116
	Ritsem (SweGrid, HPC2>	424	373+0	0+0
	Ruth (SweGrid, PDC)	93	0+0	0+0
	Siri (SweGrid, Lunarc)	504	0+0	0+0
	Smokerings (NSC)	528	263+0	0+0
	Svea (SweGrid, C3SE)	440	0+359	0+1875
Switzerland	Bern ATLAS T3 Cluster	18	22+0	3+0
	Bern UBELIX T3 Cluster	512	0+297	0+53
	Geneva ATLAS T3	148	100+0	15+0
Ukraine	BITP Cluster	116	0+55	0+0
	ICBGE Cluster	0		0+0
	ICMP Cluster	76	0+68	0+0
	ICYB SCIT-3	0		0+0
	IGTM Cluster	30	0+0	0+0
	ILTPE Cluster	7	0+6	0+0
	IMP Cluster	32	0+16	0+0
	IOP Cluster	80	0+0	0+0
	IPME Cluster	24	0+0	0+0
	ISMA Cluster	56	0+4	0+0
	KNU ARC	108	0+95	0+0
	KPI cluster	136	0+0	0+0
	MAO Cluster	32	0+28	0+0
	RI Cluster	0		0+0

ARC Grid Monitor

2008-10-30 CET 15:18:14

Processes: ■ Grid ■ Local

Country	Site	CPUs	Load (processes: Grid+local)	Queueing
Australia	Alfred (UniMelb)	126	0+74	0+0
Denmark	Benedict - Aalborg pr>	56	18+1	0+0
	Fyrkat (DCSC/AAU)	648	0+58	0+2
	LSCF (NBI)	31	0+0	0+0
	Morpheus (DCGC/NBI)	15	0+0	0+0
	Steno (DCSC/KU)	2040	202+255	154+2
Finland	Akaatti (M-grid)	200	2+84	3+3
	Ametisti (M-grid)	260	30+164	0+57
	Jaspis (M-grid, HIP)	14	2+2	1+3
	Kiniini (CSC)	72	0+0	0+0
	Kvartsi (M-grid)	192	0+160	7+77
	Murska	2176	0+2145	0+0
	Opaali (M-grid)	88	0+43	4+71
	Sepeli (M-grid)	512	0+1	0+0
	Spektroliitti (M-grid)	26	18+8	0+16
	Topaasi (M-grid)	52	0+44	7+167
Germany	Lübeck, INB	1	0+0	2+0
	Lübeck, INB (develop>	1	0+0	0+0
Hungary	NIIF cluster - SGE6.1	4	0+0	0+0
Iceland	Jotunn (UoI)	168	0+45	0+0
	RHI-CSD	1	0+0	0+0
Norway	EPF (UiO/FI)	19	0+16	0+850
	Hyperion (UiO/USIT)	205	0+163	41+10
	Norgrid@NTNU	0		0+0
	Oslo CPT Test Box	8	0+2	3926+0
	stallo (HPC/UiT)	5616	0+4155	0+82
	Tier1 (BCCS/UiB)	452	0+59	0+0
	Titan A (UiO/USIT)	3870	218+3434	166+-32
	Titan B (UiO/USIT)	3870	0+3652	0+0
Russia	Gridzone, IPHIL			
	Test, IPHIL			

RI Cluster

TOTAL	66 sites	32672	1576 + 22719

Conclusion

- ARC is a mature, reliable and efficient middleware
- It has been used in production for 6 years
- The ease of use and flexibility leads to smooth application integration