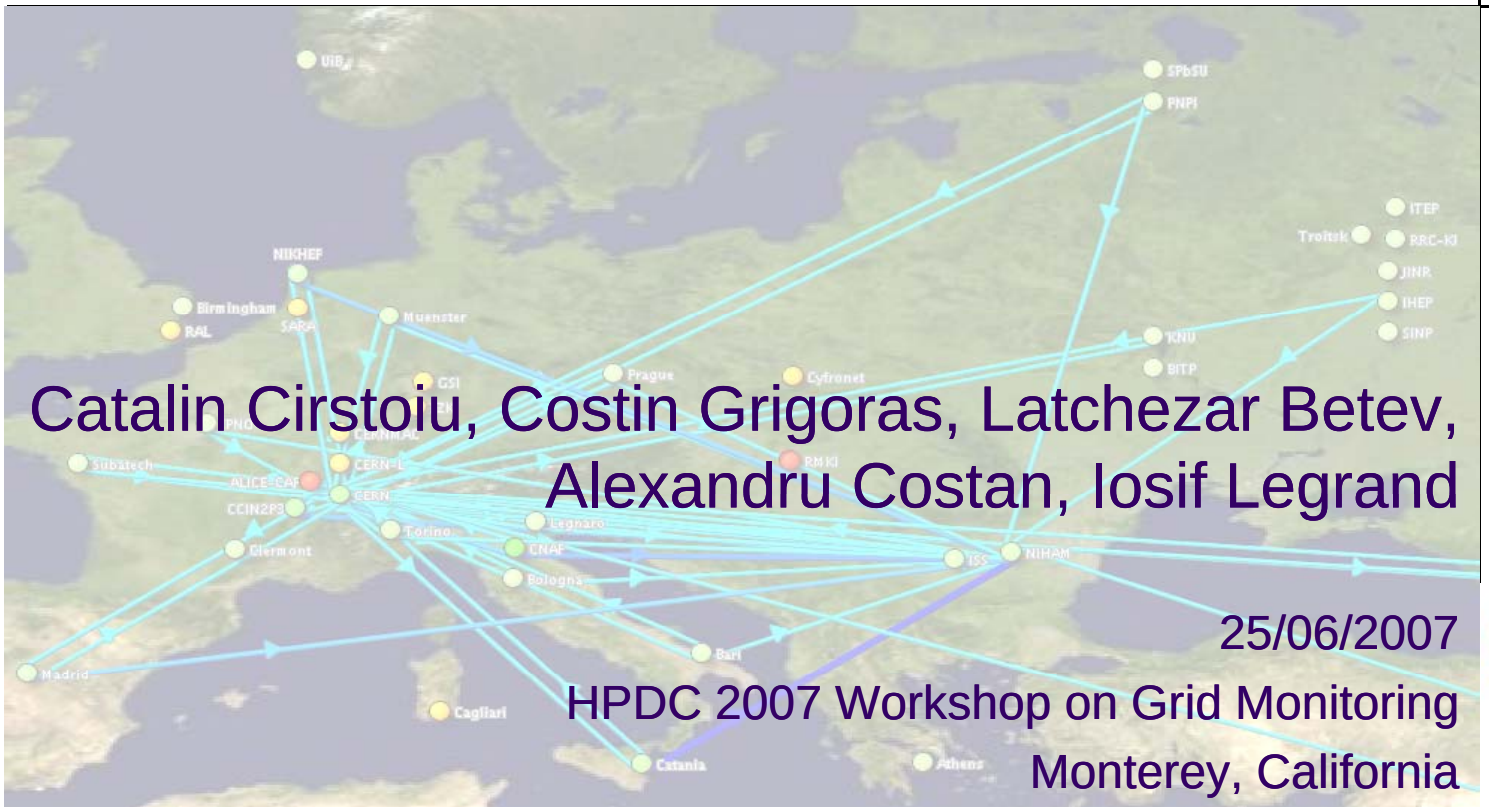
Monitoring, Accounting and Automated Decision Support for the ALICE Experiment Based on the MonALISA Framework

http://monalisa.caltech.edu



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HPDC 2007 Workshop on Grid Monitoring

Monterey, California

AliEn 2 @GRID

http://alien.cern.ch

ALICE

Contents

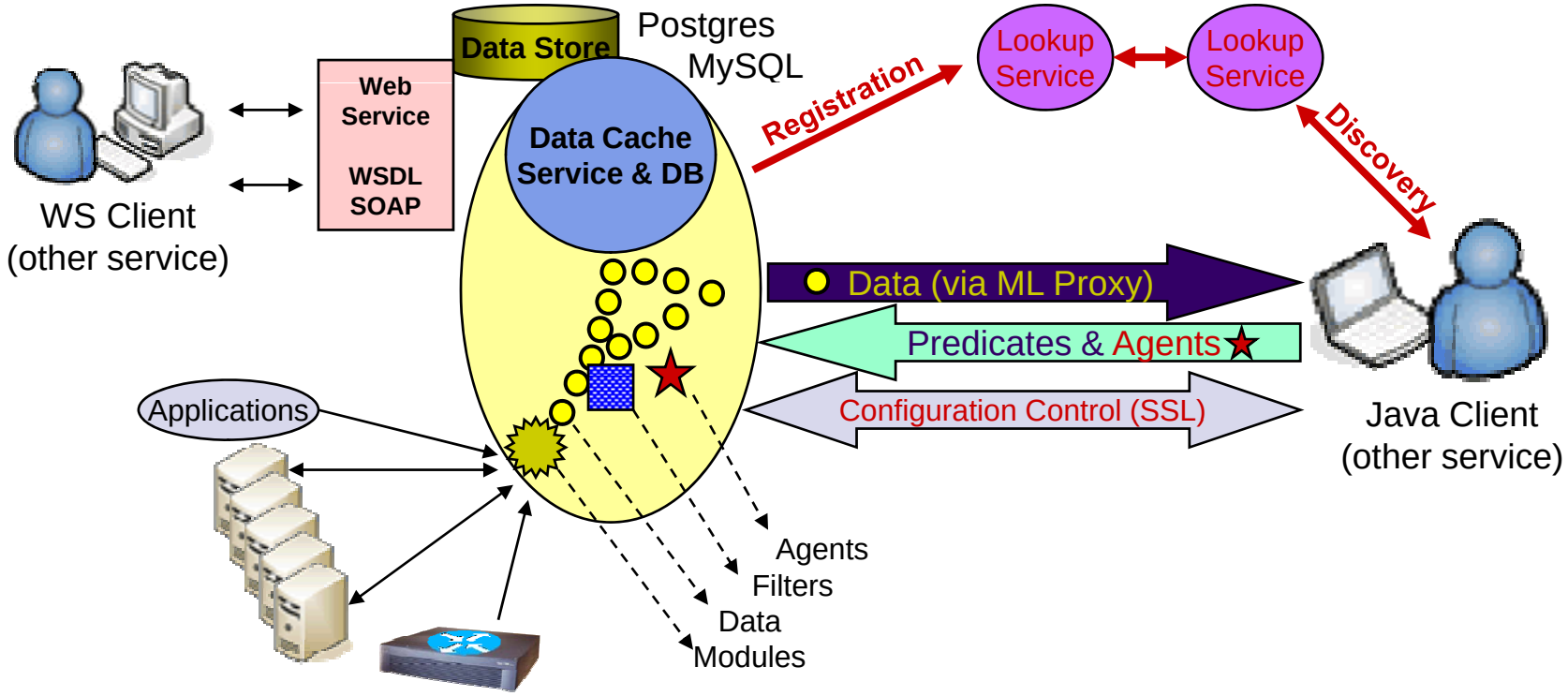
- Monitoring requirements
- MonALISA overview
- Application monitoring
- Monitoring architecture in AliEn
  - Jobs monitoring
  - Traffic monitoring
  - Services monitoring
  - Nodes monitoring
- Actions framework
- Feature snapshots

Monitoring Requirements

- Global view of the entire distributed system
  - Least-intrusive
  - As accurate as possible
  - Best-effort data transport
  - Minimizing the requirements for open ports
- Providing
  - Near real-time information
  - Long-term history of aggregated data
- On key parameters like
  - System status
  - Resource usage
- Helping with
  - Correlating events
  - System debugging
  - Generating reports
- Taking automated actions based on the monitored data

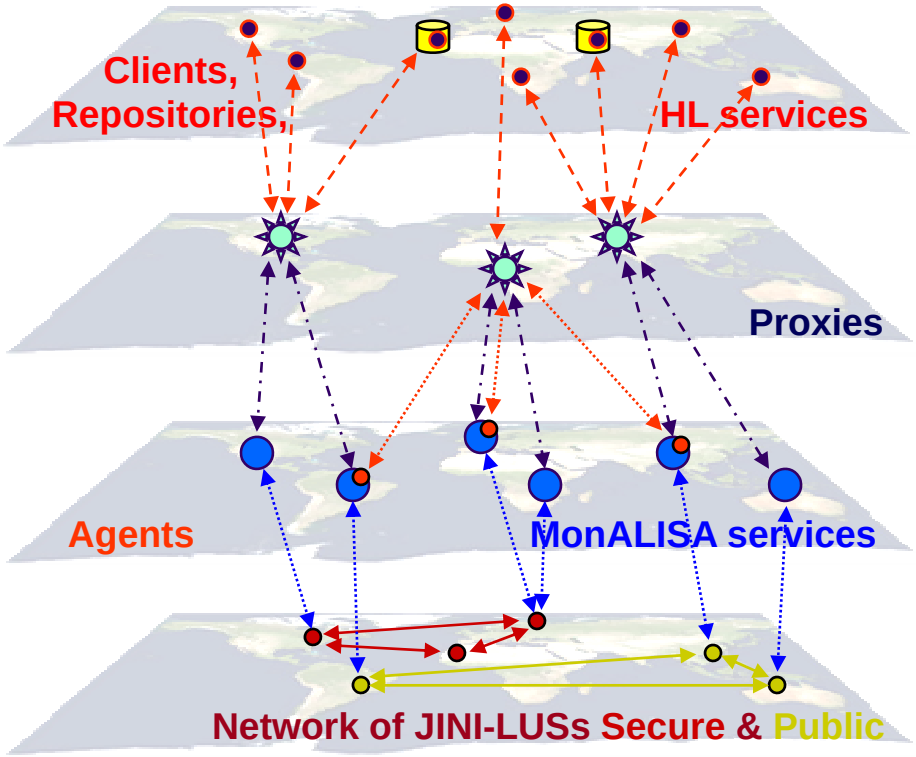
MonALISA Overview

- MonALISA is a dynamic distributed framework
- Collects any type of information from different systems
- Aggregates and analyzes it in near-real time
- Provides support for automated control decisions and global optimization of workflows in complex distributed systems.



ML Discovery System & Services

- Hierarchical structure of loosely coupled services
- Independent & autonomous entities able to
  - Publish their existence
  - Discover other available Jini-enabled services
  - Use a dynamic set of proxies to cooperate with them



Global Services or Clients

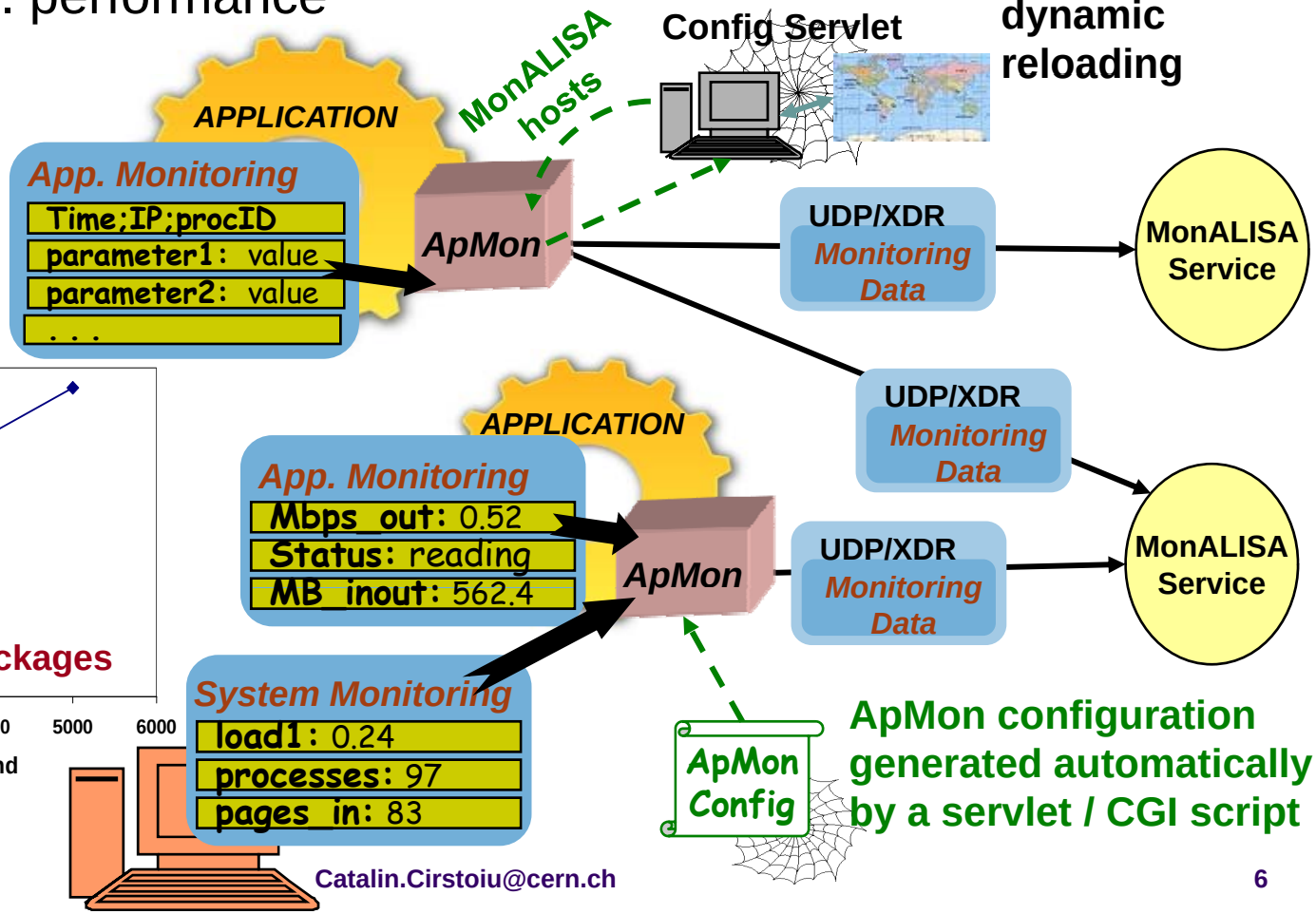
Dynamic load balancing
Scalability & Replication
Security AAA for Clients

Distributed System for gathering and Analyzing Information

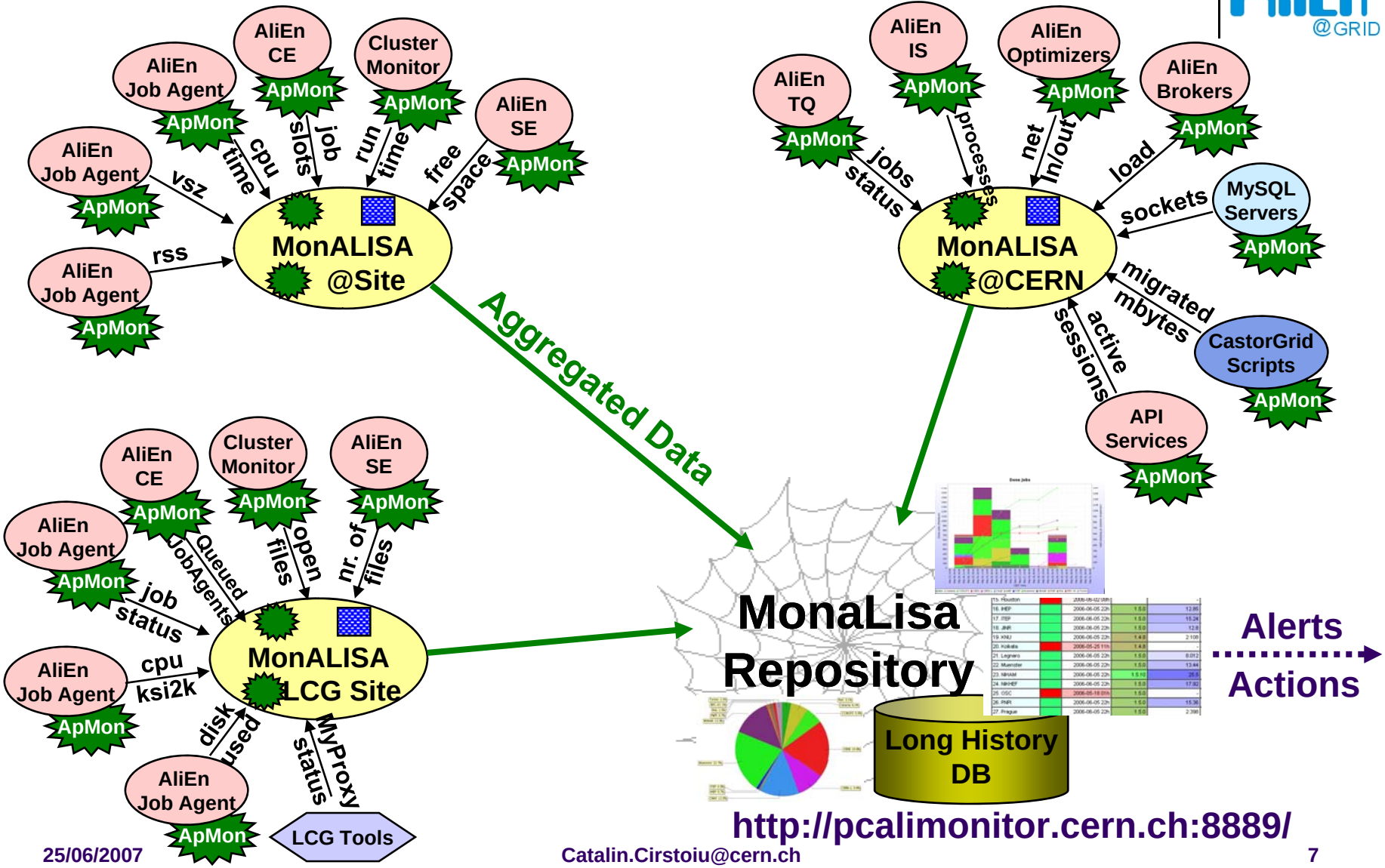
Distributed Dynamic Discovery-based on a lease Mechanism and REN

ApMon – Application Monitoring

- Lightweight library of APIs (C, C++, Java, Perl, Python) that can be used to send any information to MonALISA Services
- High comm. performance
- Flexible
- Accounting
- Sys Mon

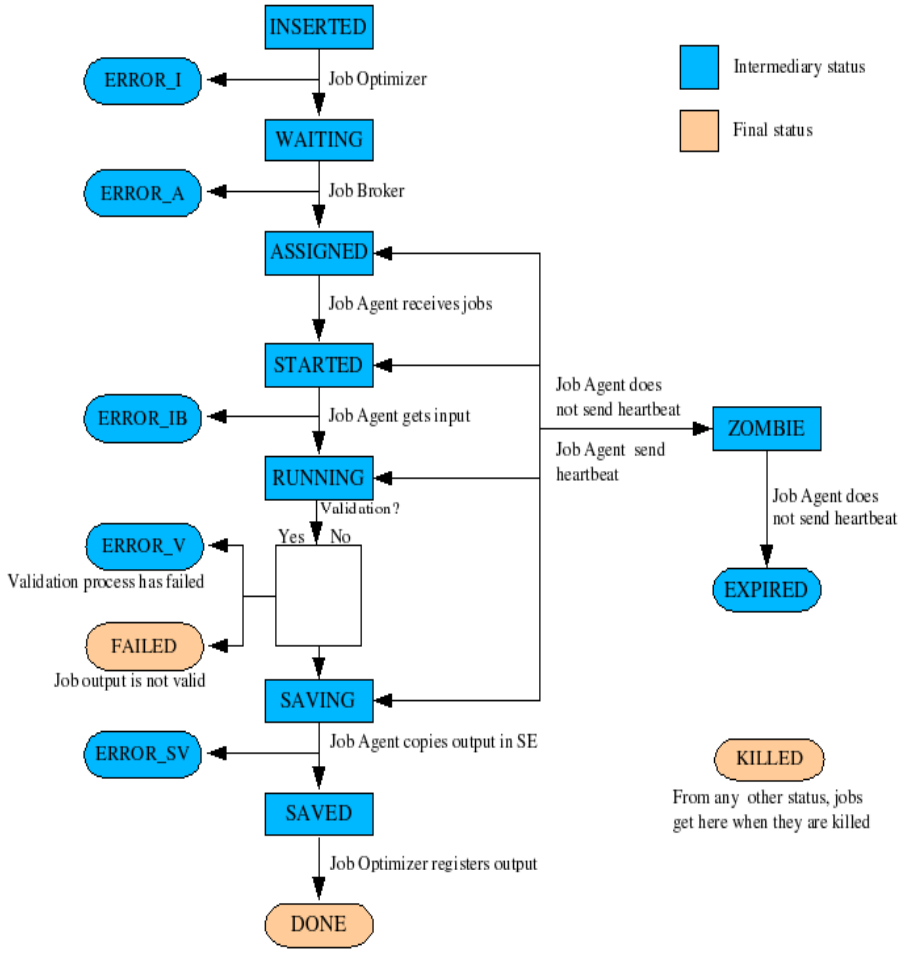


Monitoring architecture in AliEn

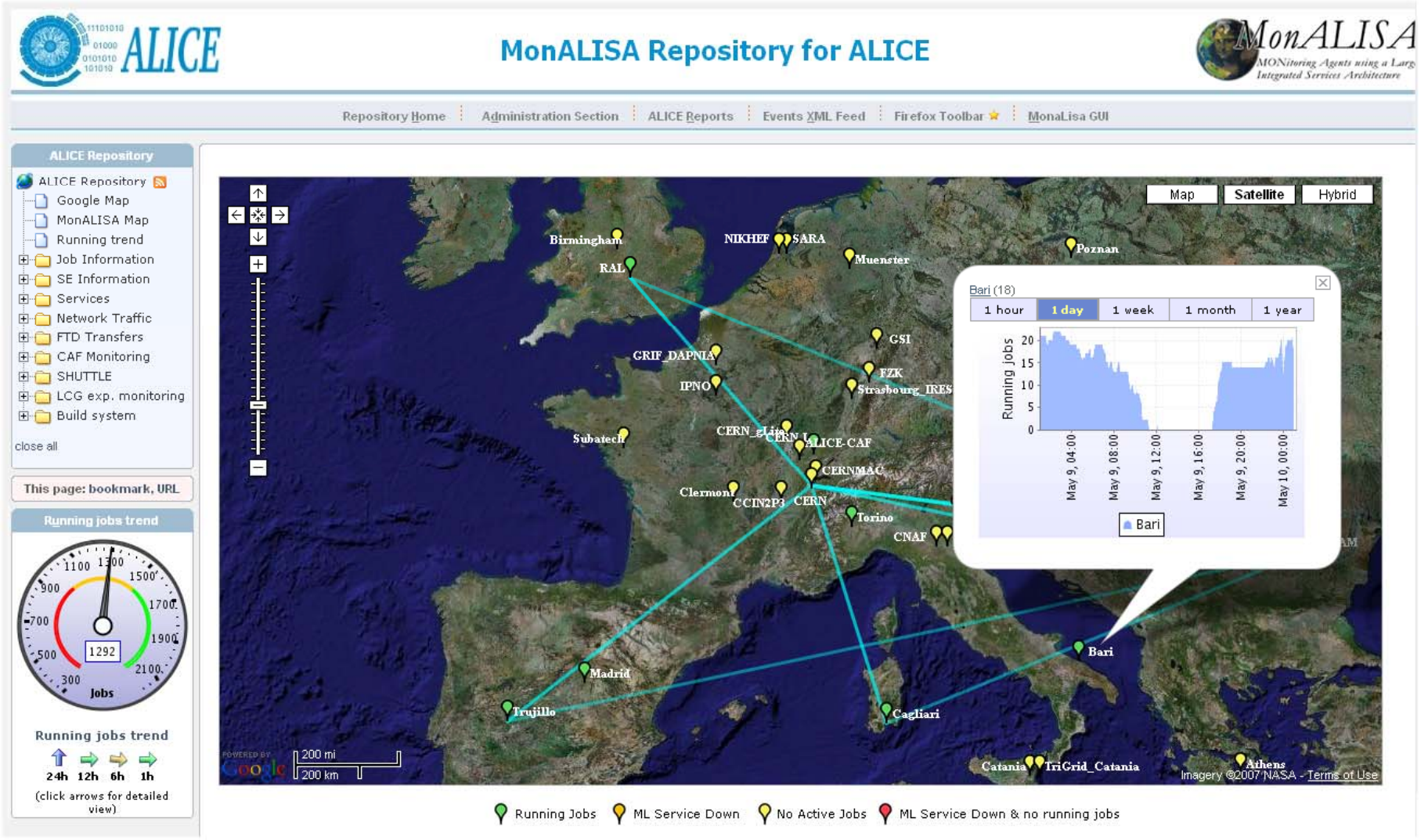


Job status monitoring

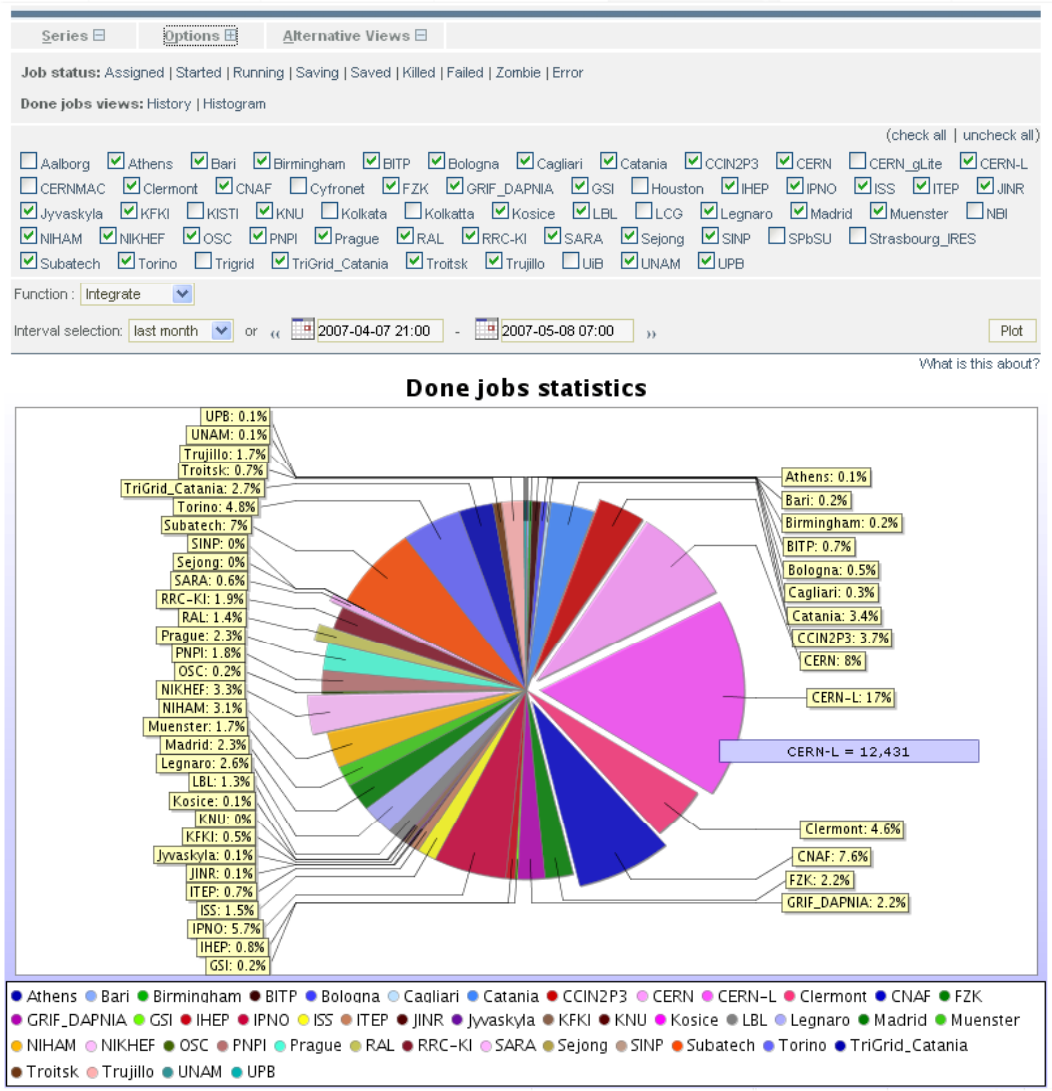
- Global summaries
  - For each/all conditions
  - For each/all sites
  - For each/all users
  - Running & cumulative
- Error status
- From job agents
- From central services
- Real-time map view
- Integrated pie charts
- History plots



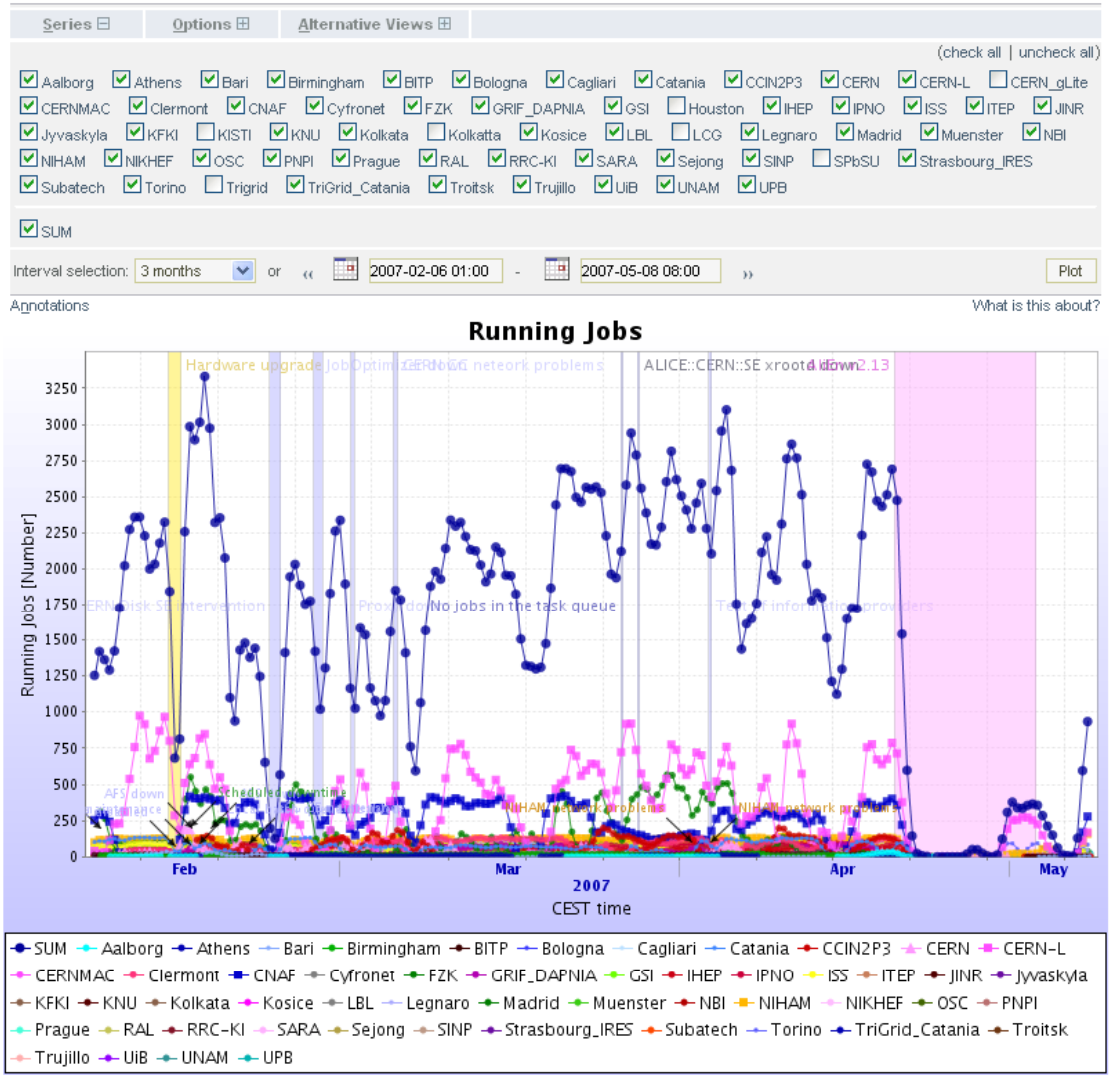
Real-time Map



Integrated Pie Charts



History Plots, Annotations



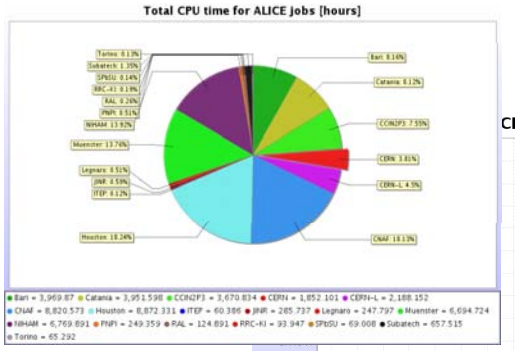
Running Jobs

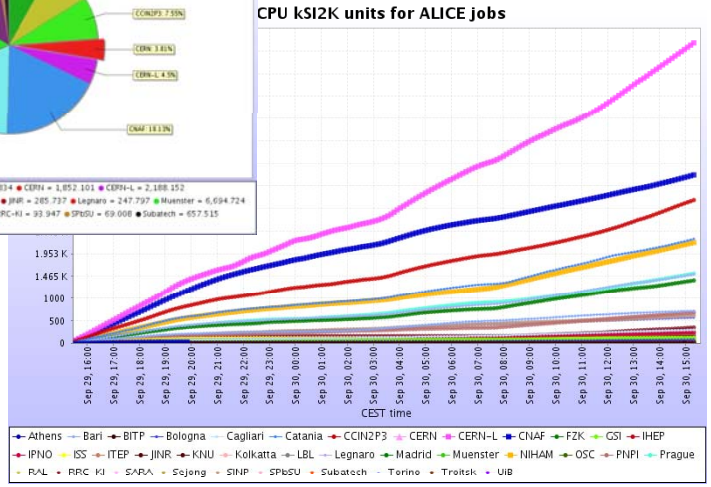
Farm	Last value	Min	Avg	Max
Aalborg	0	0	2.855	35
Athens	1	0	5.021	15
Bari	3	0	3.604	49
Birmingham	0	0	9.695	24
BITP	0	0	9.951	31
Bologna	0	0	6.928	14
Cagliari	13	0	10.62	26
Catania	0	0	67.39	150
CCIN2P3	0	0	78.27	246
CERN	0	-34	21.36	298
CERN-L	169	0	361.4	1342
CERNMAC	0	0	1.083	3
Clermont	0	0	72.32	157
CNAF	279	0	241	450
Cyfronet	0	0	1.789	12
FZK	7	0	176.4	697
GRIF_DAPNIA	0	0	28.52	99
GSI			5.824	186
IHEP			20.32	62
IPNO			56.43	225
ISS	36	0	55.44	105
ITEP	3	0	18.46	47
JINR	0	0	7.638	16
Jyvaskyla	1	0	1.642	5
KFKI	0	0	19.47	30
KNU	0	0	0.442	5
Kolkata	2	0	14.98	46
Kosice	4	0	7.662	15
LBL	21	0	28.88	47
Legnaro	47	0	48.25	129
Madrid	38	0	42.24	100
Muenster	0	0	50.31	80
NBI	0	0	0.5	4
NIHAM	159	0	97.93	269
NIKHEF	1	0	30.64	53
OSC	9	0	18.16	70
PNPI	0	0	26.16	70

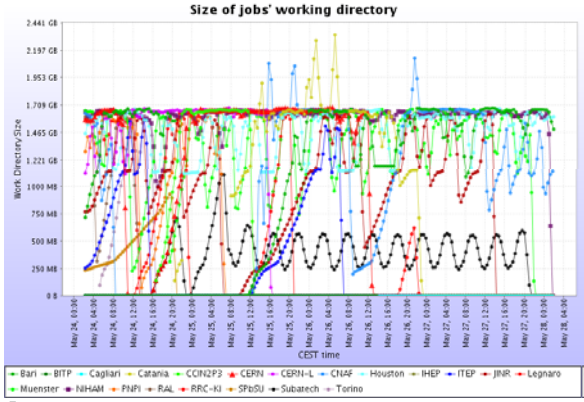
(16.02.2007 02:55, 20.02.2007 01:05)
LCG CE maintenance

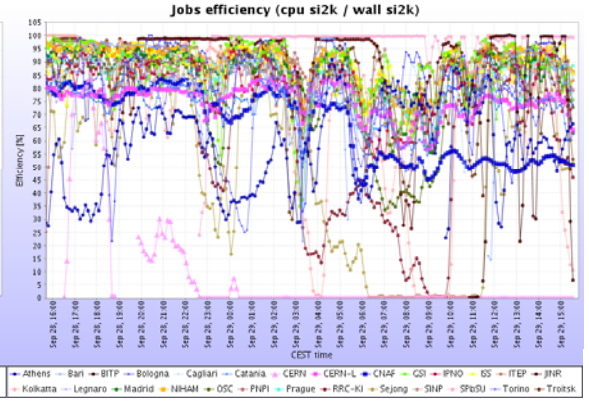
Job Resource Usage

- Cumulative parameters
  - CPU Time & CPU KSI2K
  - Wall time & Wall KSI2K
  - Read & written files
  - Input & output traffic (xrootd)
- Running parameters
  - Resident memory
  - Virtual memory
  - Open files
  - Workdir size
  - Disk usage
  - CPU usage
- Aggregated per site



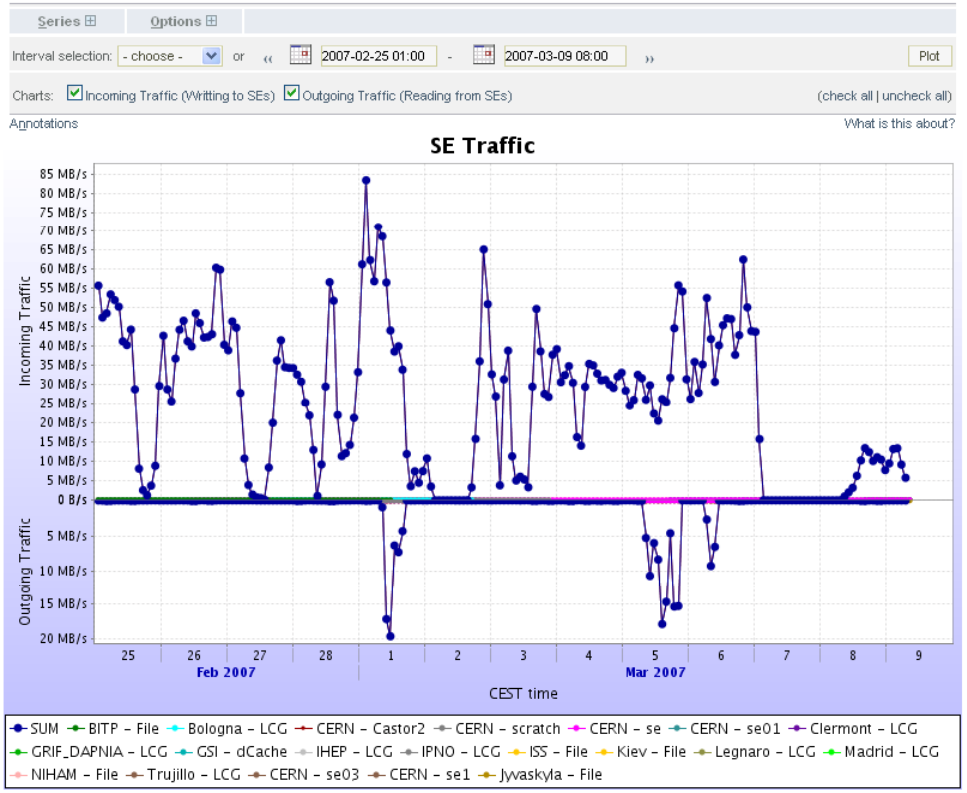






Job Network Traffic

- Based on the xrootd transfer from every job
- Aggregated statistics for
  - Sites (incoming, outgoing, site to site, internal)
  - Storage Elements (incoming, outgoing)
- Of
  - Read and written files
  - Transferred MB/s



Incoming Traffic (Writting to SEs)

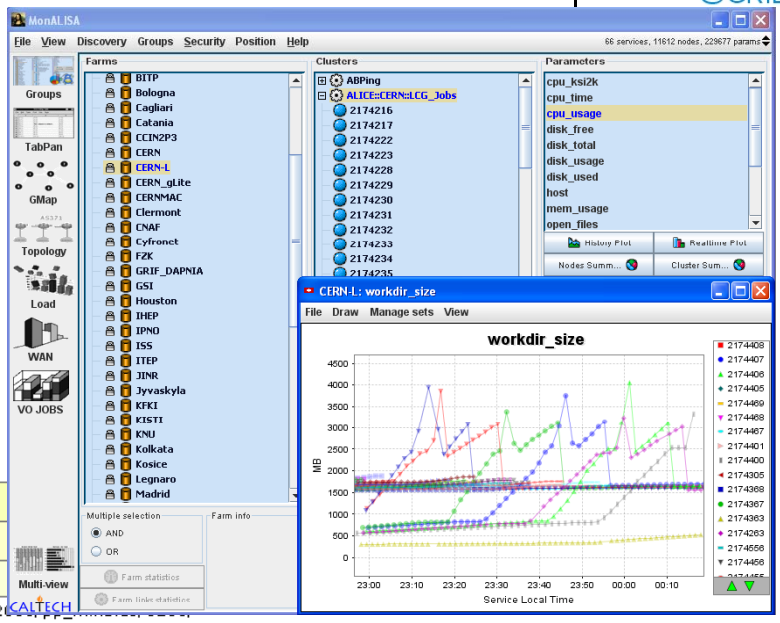
Farm	Last value	Min	Avg	Max	Total
CERN - Castor2	5.827 MB/s	0 B/s	25.4 MB/s	156.3 MB/s	25.6 TB
CERN - se	9.587 KB/s	0 B/s	0.83 KB/s	0.164 MB/s	761.7 MB
NIHAM - File	0 B/s	0 B/s	5.633 KB/s	0.155 MB/s	5.676 GB
Total	**5.836 MB/s**		**25.41 MB/s**		**25.6 TB**

Outgoing Traffic (Reading from SEs)

Farm	Last value	Min	Avg	Max	Total
CERN - Castor2	0 B/s	0 B/s	0.861 MB/s	200.9 MB/s	889 GB
CERN - se	10.92 KB/s	0 B/s	5.703 KB/s	0.441 MB/s	5.747 GB
Jyvaskyla - File	0 B/s	0 B/s	16.12 KB/s	1.218 MB/s	16.24 GB
Total	**10.92 KB/s**		**0.883 MB/s**		**910.9 GB**

Individual job tracking

- Based on AliEn shell cmds.
  - top, ps, spy, jobinfo, masterjob
- Using the GUI ML Client
  - Status, resource usage, per job



Job parameters				Application software				
Run#	PID	Owner	Events	ROOT	ALIROOT	GEANT	Date	
		aliprod (1023)					last year	
5188	2472663	aliprod		v5-14-00	v4-04-Rev-10	v1-6-2	21.03.2007 23:07	/alice/sim/2
5187	2471497	aliprod		v5-14-00	v4-04-Rev-10	v1-6-2	21.03.2007 21:07	/alice/sim/2006/pp_minbias/5187/
5186	2470231	aliprod	8500	v5-14-00	v4-04-Rev-10	v1-6-2	21.03.2007 19:08	/alice/sim/2006/pp_minbias/5186/

pid	owner	first seen	last seen	subjobs	Job states													
	aliprod (1023)	- All -	Active		SPLIT	WAITING		STARTED		RUNNING		SAVING		DONE		ERRORS		ERROR_V		ERROR_SV	
2472663	aliprod	21.03.2007 23:07	22.03.2007 00:07	1000	1	98%	986	0%	4	0%	9										
2471497	aliprod	21.03.2007 21:07	22.03.2007 00:07	1000	1			0%	1	91%	918					8%	81	1%	15		
2470231	aliprod	21.03.2007 19:08	22.03.2007 00:07	1000	1					90%	903	0%	2	8%	85	0%	8	0%	2		
2468832	aliprod	21.03.2007 16:06	22.03.2007 00:07	1000	1			0%	1	58%	587	3%	39	32%	328	3%	35	0%	4		
2467498	aliprod	21.03.2007 13:06	22.03.2007 00:07	1000	1					38%	380	0%	9	59%	592	1%	18	0%	2		
2463641	aliprod	21.03.2007 10:06	22.03.2007 00:07	1000	1					15%	150	0%	4	83%	833	1%	13	0%	1		
2462183	aliprod	21.03.2007 06:06	22.03.2007 00:07	1000	1					13%	132	0%	5	85%	854	0%	9				
2460887	aliprod	21.03.2007 02:06	22.03.2007 00:07	1000	1					6%	62	0%	1	92%	929	0%	8				
2459472	aliprod	21.03.2007 00:06	22.03.2007 00:07	1000	1					4%	44			94%	944	1%	12	0%	2		

AliEn & LCG Services monitoring

- AliEn services
  - Periodically checked
  - PID check + SOAP call
  - Simple functional tests
  - SE space usage
  - Efficiency

Global view

AliEn Services: History of sites' status (efficiency) | Detailed history for each site

LCG Services: History of sites' status (efficiency) | Detailed history for each site

VOBOX AliEn and LCG services status

What is this about?

AliEn services

	VOBox		AliEn services						AliEn tests			
Service	Address	AliEn version	Monitoring script	CE	SE	PackMan	Monitor	FTD	add	get	rm	whereis
1. Aalborg	francis.grid.aau.dk		-	-	-	-	-	-	-	-	-	-
2. Athens	xg010.inp.demokritos.gr	Failed wit...		DEAD...	DEAD...	DEAD...	DEAD...	-	Fail...	Fail...	Fail...	Fail...
3. Bari	alicegrid6.ba.infn.it	v2-13.58			May ...			-	Fail...			
4. Birmingham	epbf008.ph.bham.ac.uk	v2-13.58						-	May ...			
5. BITP	alice9.bitp.kiev.ua	v2-13.58						-	May ...			
6. Bologna	boalice6.bo.infn.it	v2-13.58						-	May ...			

- LCG environment and tools
  - Integrating the VoBOX tests previously run by ML within the SAM framework
    - Proxy lifetime, gsiscp, LCG CE/SE, Job submission, BDII, Local catalog, software area etc.
  - Error messages in case of failure
  - Efficiency
  - ML Alerts are used for problems notification

What is this about?

LCG services

	Site		Proxy												BDII			
Service	Name	Included in LDAP	Machine's proxy	Renewal	Server	Connection	Query	User proxy registration	VOBOX registration	gsiscp	Publication of SE	LCG CE	Job submission	LFC def. in LDAP	Local BDII	Conn. to local BDII	Local catalog	Software area
1. Athens		Fail...							-					Fail...			LFC_...	
2. Bari		Fail...							-	Fail...			Fail...	Fail...			LFC_...	perm...
3. Birmingham									-	Fail...				-			LFC_...	
4. Bologna		Fail...							-	Fail...				Fail...			LFC_...	
5. Cagliari		Fail...		Prox...					-	Fail...				Fail...			LFC_...	
6. Catania		Fail...			Click for more details				-	Fail...				Fail...			Cann...	
7. CCIN2P3					Proxy renewal service not running				-	Fail...	-			-	Loca...	-		

FTD/FTS Monitoring

- Status of the transfers
- Transfer rates
- Success/failures
- Efficiency via ARDA Experiment Dashboard

FTS EFFICIENCY

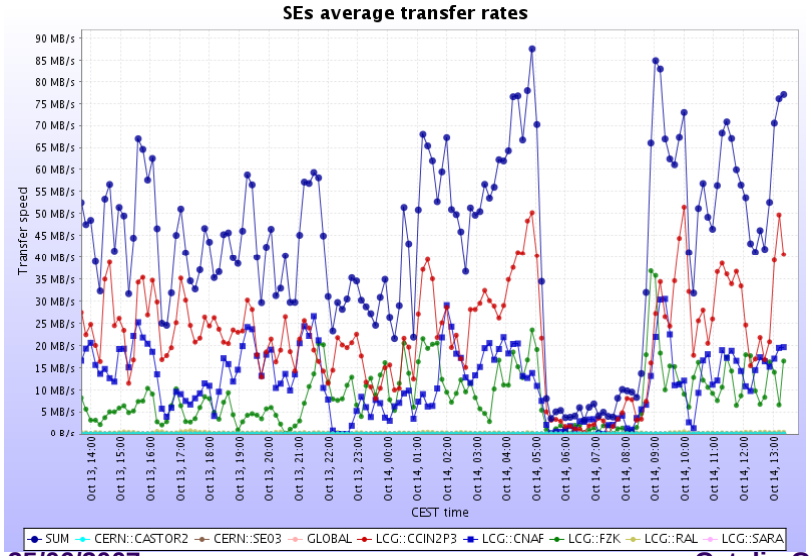
Click on any Site, and you will have a breakdown according to the errors trasnfering files to that site

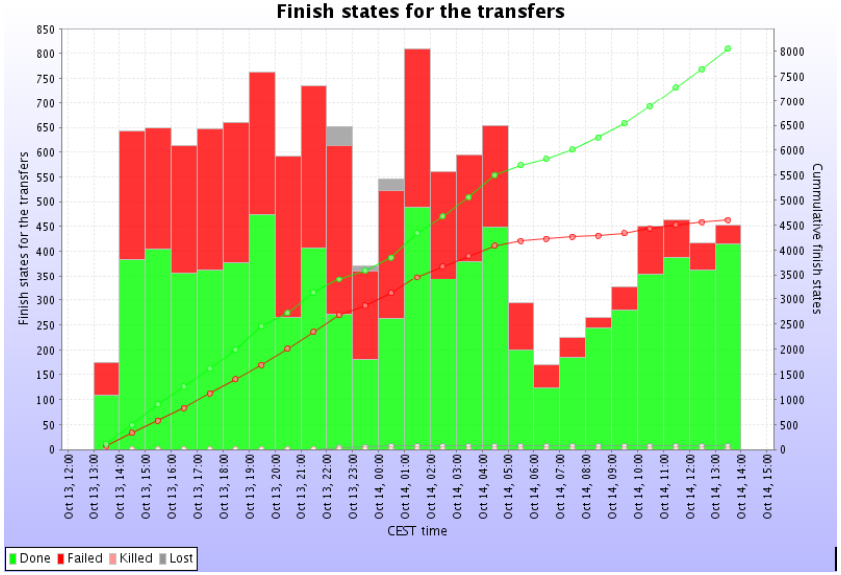
This table presents the transfers that have been done from CERN to the ALICE T1

Transfers done on: Sat 20 Jan 2007

Site (click on any site)	Successful transfers	Failed transfers	Efficiency
ALICE::CCIN2P3::LCG	0	2079	0.00 %
ALICE::HOUSTON::FILE	152	287	34.62 %
ALICE::CCIN2P3::TAPE	1723	1	99.94 %
ALICE::FZK::LCG	5168	1	99.98 %

Error message	Counter
The FTS transfer _transferid_ failed (Transfer failed. ERROR the server sent an error response: 425 425 Cannot open port: java.lang.Exception: Pool manager error: Best pool too high : 2.0E8)	2075
The FTS transfer _transferid_ failed (Failed on SRM put: Failed SRM put on httpg://ccsrm.in2p3.fr:8443/srm/managerv1	3
executing /usr/local/grid/glite/3.0.4/UI/glite/bin/glite-transfer-submit	1





VOBox/Head node monitoring

- Machine parameters, real-time & history
  - Load, memory & swap usage, processes, sockets

Global views: General status

Detailed history: Load | Cpu usage | Memory usage | Swap usage | eth0 IN | eth0 OUT | eth1 IN | eth1 OUT | Processes | Sockets

VO Box machine status

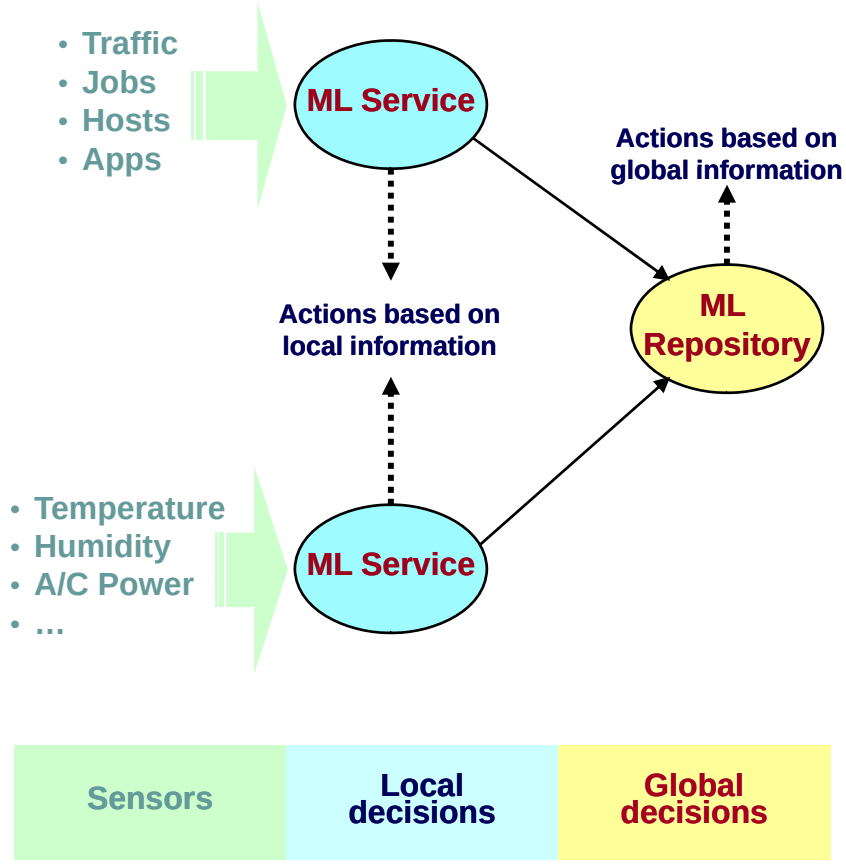
What is this about?

Machine status (last hour average values)

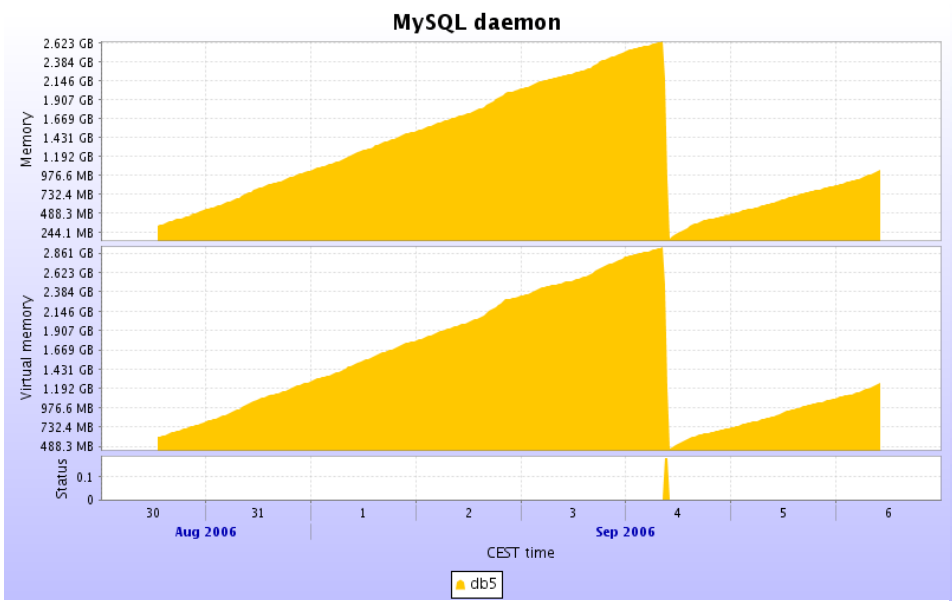
		CPU											Mem [% MB]		Swap [% MB]		Eth0 [KB/s]			Eth1 [KB/s]		Eth2 [KB/s]		System
Site name	Last seen online	Load5	User	System	IOWait	Int	SoftInt	Nice	Steal	Idle	Cnt	MHz	Usage	Total	Usage	Total	In	Out	In	Out	In	Out	Procs	Socks
1. Aalborg	2007-05-06 08h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Athens	2007-05-08 06h	0.042	3.449	0.792	0.016	0.067	0.053	0	-	95.62	1	2680	17	2010	0	1992	12.58	5.263	-	-	-	-	57	26
3. Bari	2007-05-08 06h	0.106	4.206	1.212	0.134	0.023	0.397	0	-	94.03	2	1800	46	1001	6.787	2047	0.196	0.072	27.64	9.307	-	-	74	52
4. Birmingham	2007-05-08 06h	0.223	8.699	1.612	0.201	0.01	0.373	0	-	89.1	2	800	54	1001	4.093	2047	11.08	2.335	-	-	-	-	91	58
5. BITP	2007-05-08 06h	0.035	0.737	0.204	0.679	0	0.115	0	-	98.27	4	3192	21	3999	0	8181	1.098	0.25	8.8	1.26	-	-	91	56
6. Bologna	2007-05-08 06h	0.145	2.904	0.495	0.099	0.006	0.112	0.002	-	96.38	4	3067	17	4005	0	2000	-	-	23.55	11.56	-	-	99	52
7. Cagliari	2007-05-08 06h	0.044	1.95	0.68	0.021	0.007	0.256	0	-	97.09	2	3199	31	2007	0	2000	16.86	7.491	-	-	-	-	92	63
8. Catania	2007-05-08 06h	0.323	6.155	1.162	0.744	0.022	0.176	0	-	91.74	4	2799	36	2006	0.193	4094	45.36	26.09	-	-	-	-	98	58
9. CCIN2P3	2007-05-08 06h	1.012	3.159	10.32	14.8	0.042	0.15	0	-	71.54	4	3000	40	2007	3.791	2047	1.709	0.14	14.97	4.482	-	-	105	61
10. CERN	2007-05-08 06h	0.66	13.15	2.425	0.167	0.016	1.979	0	-	82.26	4	2387	28	5768	0.1	8000	28.89	13.9	-	-	-	-	305	604
11. CERN_gLite	2007-05-08 06h	0.106	3.337	1.426	0.436	0.005	0.158	0	-	94.64	2	3000	30	3995	0	4094	9.933	1.555	-	-	-	-	100	37
12. CERN-L	2007-05-08 06h	1.098	25.04	5.07	5.342	0.136	1.841	0	-	62.58	2	2793	29	3991	0.901	4094	1957	69.1	-	-	-	-	146	107
13. CERNMAC	2007-05-08 06h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14. Clermont	2007-05-08 06h	0.102	5.721	1.142	0.016	0.192	0.173	0	-	92.76	1	2007	17	3013	0	8189	18.16	7.845	-	-	-	-	110	66
15. CNAF	2007-05-08 06h	0.524	16.14	1.775	0.438	0.048	0.813	0	-	80.79	2	3067	28	4005	0	4000	95.66	43.46	-	-	-	-	208	112
16. Cyfronet	2007-05-08 06h	0.499	3.537	0.535	12.72	0.027	0.113	0	-	83.07	2	1300	58	1982	40.48	1000	-	-	20.93	15.02	-	-	102	146
17. FZK	2007-05-08 06h	0.099	0.021	0.594	2.591	0.002	0.362	1.988	-	94.44	4	3000	72	2007	10	3827	9.564	1.506	36.23	1.602	-	-	164	162
18. GRIF_DAPNIA	2007-05-08 06h	0.026	3.493	0.688	0.042	0.032	0.039	0	-	95.71	1	2793	50	2001	0.044	2047	14.04	6.082	-	-	-	-	99	54
19. GSI	2007-05-08 06h	1.075	44.73	5.522	0.131	5.664	0.224	0	0	43.73	1	2667	58	820.9	0.636	512	28.11	9.568	-	-	-	-	84	72
20. Houston	2007-05-08 06h	0.047	3.06	0.581	0.02	0.015	0.386	0	-	95.94	1	1396	18	4014	2.861	4095	0.018	0.036	34.1	14.91	-	-	106	81
21. IHEP	2007-05-08 06h	0.172	2.942	0.638	0.559	0.011	0.155	0.353	-	95.34	4	2791	55	2006	11.69	1999	21.34	7.266	17.02	94.06	-	-	209	129
22. IPNO	2007-05-08 06h	0.039	2.081	0.676	0.096	0.003	0.132	0	-	97.01	2	2394	28	3994	0	1992	17.2	8.175	-	-	-	-	98	57

Actions framework

- Based on monitoring information, actions can be taken in
  - ML Service
  - ML Repository
- Actions can be triggered by
  - Values above/below given thresholds
  - Absence/presence of values
  - Correlation between multiple values
- Possible actions types
  - Alerts
    - e-mail
    - Instant messaging
    - RSS Feeds
  - External commands
  - Event logging

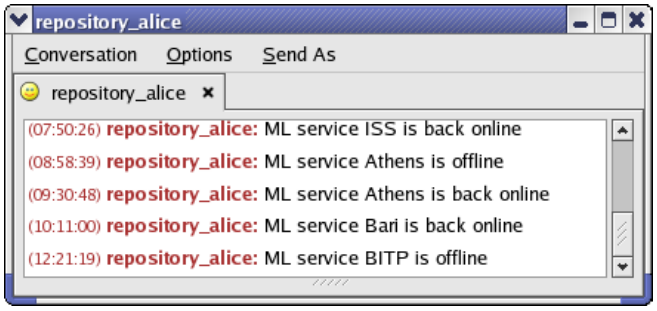


Alerts and actions



MySQL daemon is automatically restarted when it runs out of memory
Trigger: threshold on VSZ memory usage

ALICE Production jobs queue is automatically kept full by the automatic resubmission
Trigger: threshold on the number of *aliprod* waiting jobs



Administrators are kept up-to-date on the services' status
Trigger: presence/absence of monitored information

Fact figures

- Raw parameters when running 4K Jobs
  - Unique data series: 300K with frequency 1-15 minutes
  - Message rate: 16K / minute
- Site aggregated parameters
  - Message rate: 2K / minute
  - Bandwidth rate: 300Kbps
- Repository
  - DB Size: 70 GB ~ 700M records
  - Data Reduction Schema
    - 2 Months with 2 minutes bins
    - 1 Year with 30 minutes bins
    - ~Forever with 2 hours bins
- Response time
  - App -> ML Service – network speed
  - ML Service -> ML Clients
    - Subscribed parameters – network speed
    - One shot requests (history requests) – ~5 seconds
  - Repository dynamic history requests – ~300ms / page
- No incoming ports are required

Summary

- The MonALISA framework is used as a primary monitoring tool for the ALICE Grid since 2004
- Presently the system is used for monitoring of all (identified) services, jobs and network parameters necessary for the Grid operation and debugging
- The add-on tools for automatic events notification allow for more efficient reaction to problems
- The framework design and flexibility answers all requirements for a monitoring system
- The accumulated information allows to construct and implement automated decision making algorithms, thus increasing further the efficiency of the Grid operations

Thank you!

Questions?

http://alien.cern.ch

http://monalisa.caltech.edu