

# **A Tier-1 Center for ALICE at KISTI**

**08. February**

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**Global Science Data Center/KISTI**

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# 1. Introduction to KISTI

## KISTI History

- 
- Jan. 1962** • Organized KORSTIC (Korea Scientific & Technology Information Center)
  - Jan. 1980** • Reorganized to KIET (Korea Institute for Industrial Economics and Technology)
    - Merged with KIEI (Korea International Economics Institute)
  - Jan. 1991** • KINITI (Korea Institute of Industry and Technology Information)
    - spun off from KIET
  - Feb. 1991** • Established SERI (System Engineering Research Institute)
    - division under KINITI
  - Apr. 1993** • Founded KORDIC (KORea Research and Development Information Center)
  - Sep. 1999** • Acquisition Super Computing Center
    - from ETRI (Electronics and Telecommunications Research Institute)
  - Jan. 2001** • Established KISTI (Korea Institute of Science and Technology Information)

*Provide Science and Technology Information  
to the public to promote R&D productivity*

# 3 Main Functions of KISTI

## Super Computing Center



- *Supercomputing Management and Operation*
- Supercomputing
- High Speed Research Network
- National Grid Infrastructure

## Knowledge Information Center



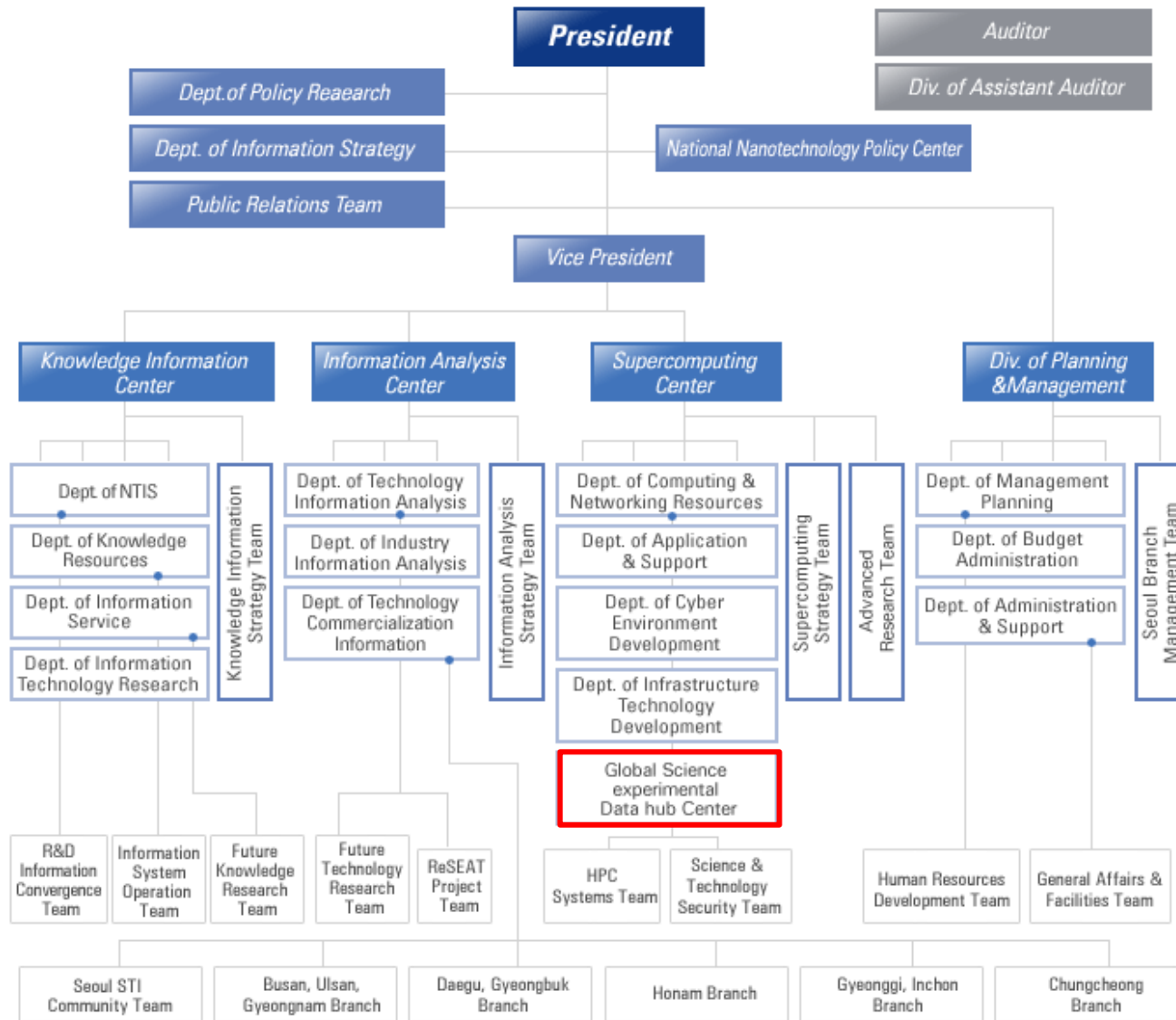
- *Developing National Portal Systems for Information Resources*
- Developing Next Generation Technology in Information Services

## Information Analysis Center



- *Core Technologies Analysis*
- Core Technologies Feasibility study
- Foreign Information Trend Analysis
- Information Analysis System Development

# Organization

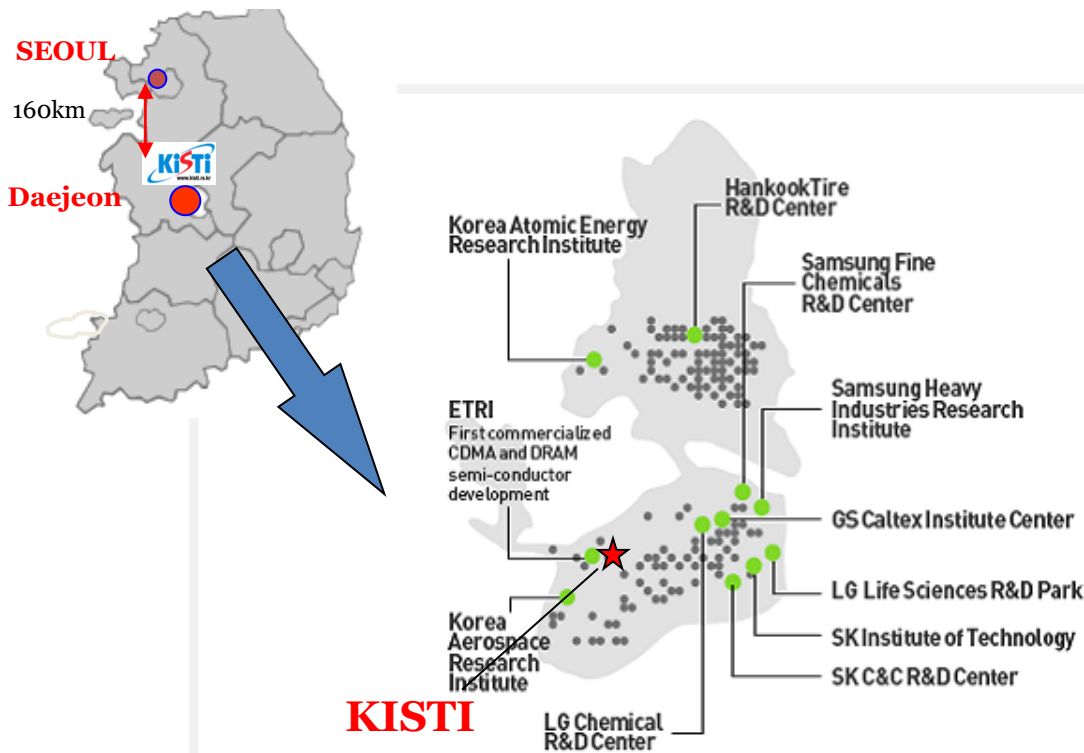




# Location

## Located in the Heart of Science Valley, “Daedeok” Innopolis

The DAEDEOK INNOPOLIS complex consists of a cluster of firms that represents a cross-section of Korea's cutting-edge industries, including information technology, biotechnology and nanotechnology.



- **6 Universities**
- **20 government research institutes**
- **10 government-invested institutes**
- **33 private R&D labs**
- **824 high-tech companies**

<http://www.kisti.re.kr/english>

# Introduction to Super Computing Center at KISTI



1988:  
 - The 1<sup>st</sup> Super Computer in Korea  
 - Cray-2S (2GFlops)

2001:  
 - IBM p690(655.6GFlops)  
 - NEC SX-6(160GFlops)  
 - IBM p690+ (2,655GFlops)



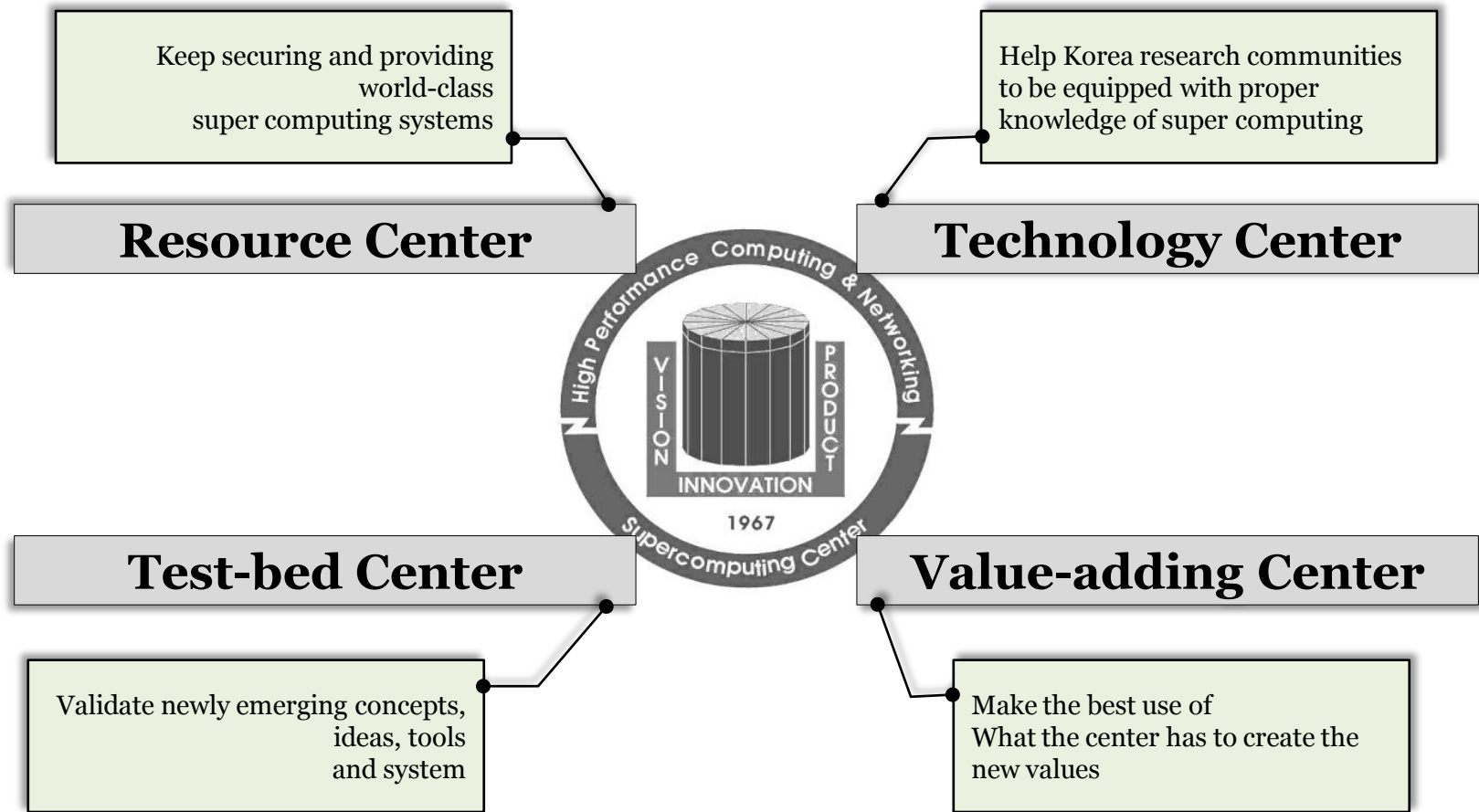
1993:  
 - Cray C90 (16GFlops)



2009:  
 - IBM p595 (5.9TFlops)  
 - SUN B6048 (24TFlops)

Rank	Site	Computer/Year Vendor	Cores	R <sub>max</sub>	R <sub>peak</sub>	Power
1	Oak Ridge National Laboratory United States	Jaguar - Cray XT5-HE Opteron Six Core 2.6 GHz / 2009 Cray Inc.	224162	1759.00	2331.00	6950.60
2	National Supercomputing Centre in Shenzhen (NSCS) China	Nebulae - Dawning TC3600 Blade, Intel X5650, NVidia Tesla C2050 GPU / 2010 Dawning	120640	1271.00	2984.30	
3	DOE/NNSA/LANL United States	Roadrunner - BladeCenter QS22/LS21 Cluster, PowerXCell 8i 3.2 Ghz / Opteron DC 1.8 GHz, Voltaire Infiniband / 2009 IBM	122400	1042.00	1375.78	2345.50
4	National Institute for Computational Sciences/University of Tennessee United States	Kraken XT5 - Cray XT5-HE Opteron Six Core 2.6 GHz / 2009 Cray Inc.	98928	831.70	1028.85	
5	Forschungszentrum Juelich (FZJ) Germany	JUGENE - Blue Gene/P Solution / 2009 IBM	294912	825.50	1002.70	2268.00
15	<b>KISTI Supercomputing Center Korea, South</b>	<b>TachyonII - Sun Blade x6048, X6275, IB QDR M9 switch, Sun HPC stack Linux edition / 2009 Sun Microsystems</b>	<b>26232</b>	<b>274.80</b>	<b>307.44</b>	<b>1275.96</b>
16	University of Edinburgh United Kingdom	HECToR - Cray XT6m 12-Core 2.1 GHz / 2010 Cray Inc.	43660	274.70	366.74	

# KISTI Super Computing Center Missions



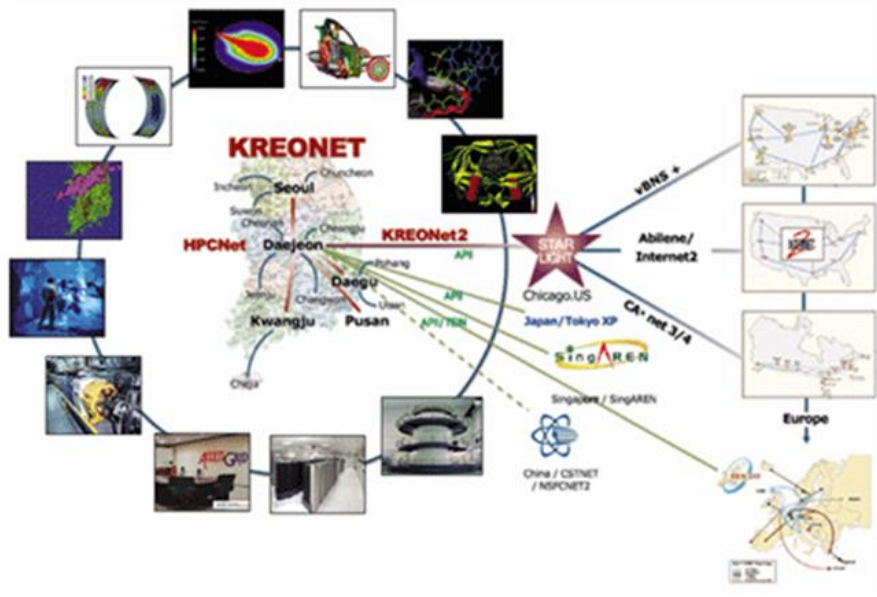
**Expanding the Horizon of Science and Technology**



# Global Research Networks

## ■ GLORIAD

- ✓ **GLOBAL RING** Network for Advanced Applications Development) with 10/40Gbps Optical lambda networking
- ✓ **Consortium of 11 Nations:** Korea, USA, China, Russia, Canada, the Netherlands and 5 Nordic Countries
- ✓ **Supporting Advanced Application Developments** such as **HEP**, Astronomy, Earth System, Bio-Medical, HDTV etc. `
- ✓ Funded by MEST (Ministry of Education, Science and Technology) of KOREA



## ■ KREONET

- ✓ **Korea Research Environment Open NETWORK**
- ✓ National Science & Research Network of Korea, Funded by Government since 1998
- ✓ **20Gbps Backbone**, 1 ~ 20Gbps Access Networks

# Introduction to GSDC: Global Science Data Center

## MISSION

**Supporting to various Data Intensive Researches**



**National Representative Player  
in Data Centric Research Area**



# Main Projects



**Ministry of Education,  
Science and Technology  
(Korean Government)**

**GSDC**

## **Global Hub Project**

- CERN ALICE Tier-1 Prototype
- CDF/FNAL Data Handling
- CERN-KISTI-FNAL/BNL Global Pipeline
- Asian-Pacific CAF and Training Program

## **Science Data Center**

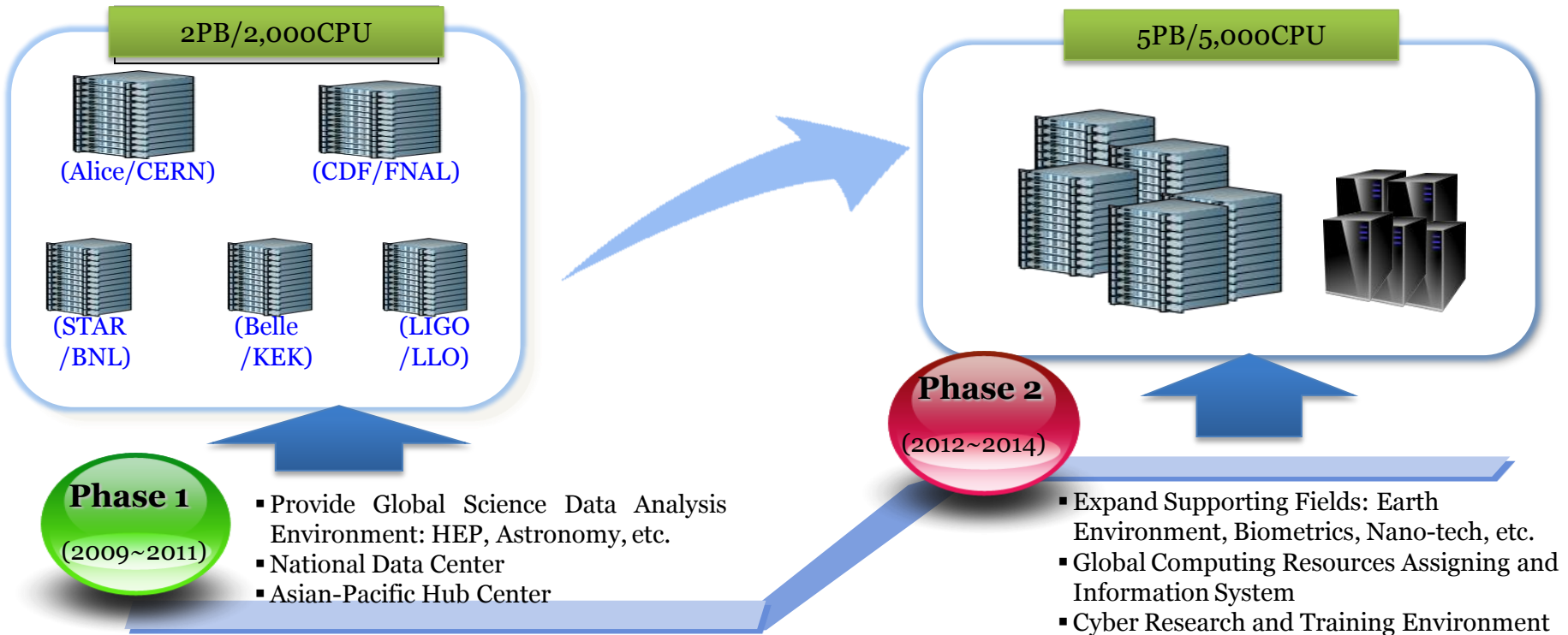
- High Quality System
- Store Various Science Data
- Virtualized Data Farm and Global Sites Establishment
- Integrated Monitoring System
- Mobile User Portal

## **Cyber Convergence Data Centric Research Project**

- Cyber Laboratory
- Advanced Cyber Research and Training Technology
- Support Scientist Community

# Our Mission

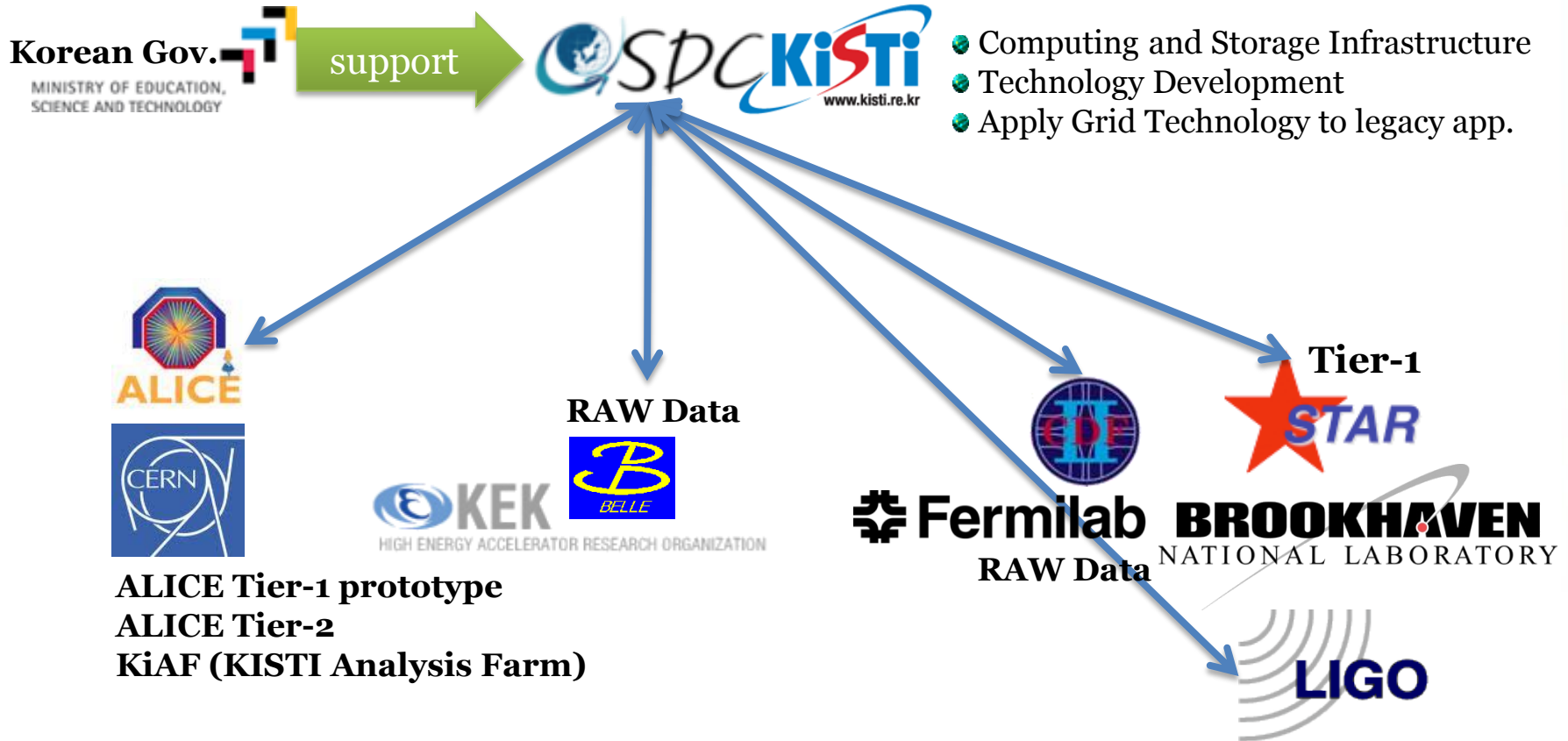
## Providing Cyber Environment for Science Research



**Anywhere and Anytime, you can use science data what you want**



# Current Status



**Supporting Data Centric Research Communities  
&  
Promotion of Research Collaboration**



# Members

Name	Role
Dr. Haengjin Jang	Director of GSDC
Dr. Hyungwoo Park	Deputy
Dr. Sungyun Yu	Strategy
Mr. Heejun Yun	System admin.
Dr. Christophe Bonnaud	System admin.
Mr. Seunghee Lee	System admin.
Dr. Beobkyun Kim	ALICE Tier-2 & KiAF
Dr. Seo-young Noh	CDF
Dr. Jonghu Lee	ALICE Tier-1 & STAR
Mr. GyeongRyoon Kim	gBrain & LIGO
Ms. Tatyana Khan	Belle
Dr. Sulah Ahn	ALICE Tier-1
Dr. Seokmyun Kwon	Cyber Lab.
Mr. Jin Kim	Cyber Lab.
Mr. Jiwoong Kim	Cyber Lab.
Ms. Gooyeun Baek	General Affairs
Ms. Yongsuk Lee	General Affairs



Network experts from KISTI



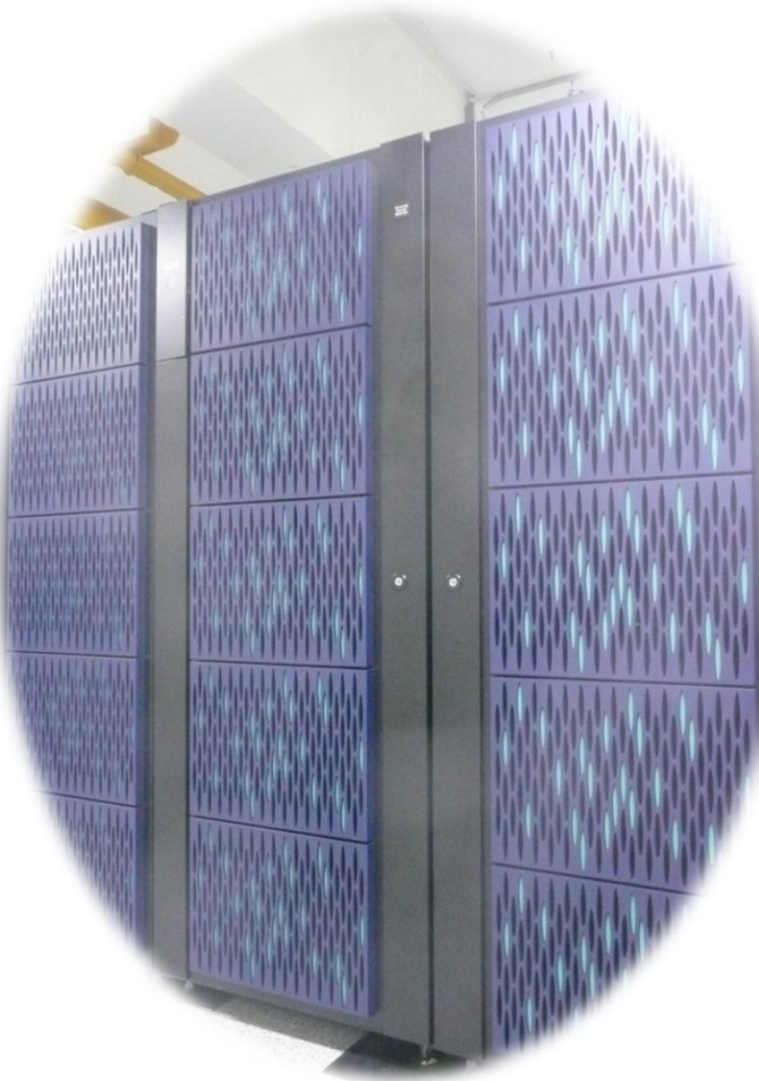
Power and air conditioning  
from KISTI

# 2010 Activities

ALICE Tier-1 prototype	<ul style="list-style-type: none"><li>● Completed set-up ALICE Tier-1 test-bed this year</li><li>● Will provide official service in a few years</li></ul>
ALICE Tier-2	<ul style="list-style-type: none"><li>● Site availability: 98% since Feb. 2009</li></ul>
Belle	<ul style="list-style-type: none"><li>● Providing computing resources for Belle MC production (Grid)</li><li>● Bell to provide their data to KISTI GSDC</li></ul>
CDF	<ul style="list-style-type: none"><li>● Providing computing resources under NAMCAF</li><li>● Supporting CDFSoft development</li></ul>
LIGO	<ul style="list-style-type: none"><li>● Set-up LIGO cluster test-bed</li></ul>
gBrain	<ul style="list-style-type: none"><li>● Planning to cooperate with global brain research project (mainly from McGill Univ. Canada)</li></ul>

## 2. GSDC Current Status

**Totally 144 servers**



CHASSIS 3 192.168.200.144	CHASSIS 2 192.168.200.143	CHASSIS 1 192.168.200.142
12 36 134.75.123.48	12 24 134.75.123.164	12 12 134.75.123.152
11 35 134.75.123.175	11 23 134.75.123.163	11 11 134.75.123.151
10 34 134.75.123.174	10 22 134.75.123.162	10 10 134.75.123.150
9 33 134.75.123.173	9 21 134.75.123.161	9 9 134.75.123.149
8 32 134.75.123.172	8 20 134.75.123.160	8 8 134.75.123.148
7 31 134.75.123.171	7 19 134.75.123.159	7 7 134.75.123.147
6 30 134.75.123.170	6 18 134.75.123.158	6 6 134.75.123.146
5 29 134.75.123.169	5 17 134.75.123.157	5 5 134.75.123.145
4 28 134.75.123.168	4 16 134.75.123.156	4 4 134.75.123.144
3 27 134.75.123.167	3 15 134.75.123.155	3 3 134.75.123.143
2 26 134.75.123.166	2 14 134.75.123.154	2 2 134.75.123.142
1 25 134.75.123.165	1 13 134.75.123.153	1 1 134.75.123.141
<b>KIAF+CDF</b>	<b>Tier-1 WNs</b>	<b>CDF WNs</b>

# Current Computing Resources: CPUs

Experiment	Cluster	Specification	Memory	Node	Core	kSI2k
ALICE Tier-2	ce-alice	Dell Intel Xeon E5405 2.0 GHz Quad 2 CPU	16GB	6	48	48
ALICE Tier-2	ce-01	HP Intel Xeon E5420 2.5GHz Quad 2 CPU	16GB	16	128	219
Belle & etc.	ce-02	IBM Intel Xeon E5450 3.0GHz Quad 2 CPU	16GB	16	152	324
CDF & etc.	ce-03	IBM Intel Xeon E5450 3.0GHz Quad 2 CPU	16GB	16	152	324
		IBM Intel Xeon X5650 2.66GHz 6 Core 2 CPU	24GB	20	240	744
ALICE Tier-1 Prototype	ce-12	IBM Intel Xeon X5650 2.66GHz 6 Core 2 CPU	24GB	12	144	446
KiAF	afmastero 1	IBM Intel Xeon X5650 2.66GHz 6 Core 2 CPU	24GB	4	48	180

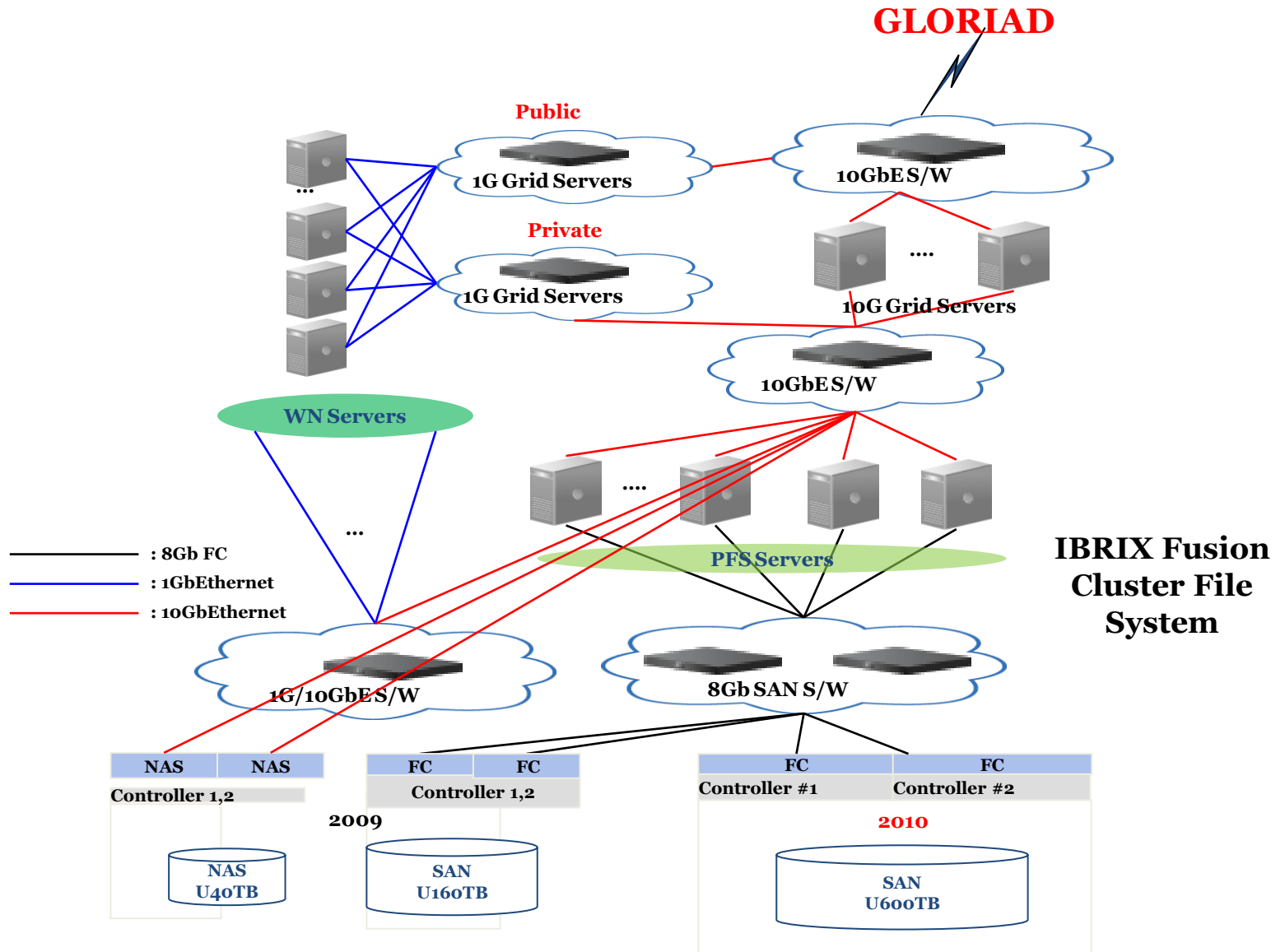


# Current Computing Resources: Storage

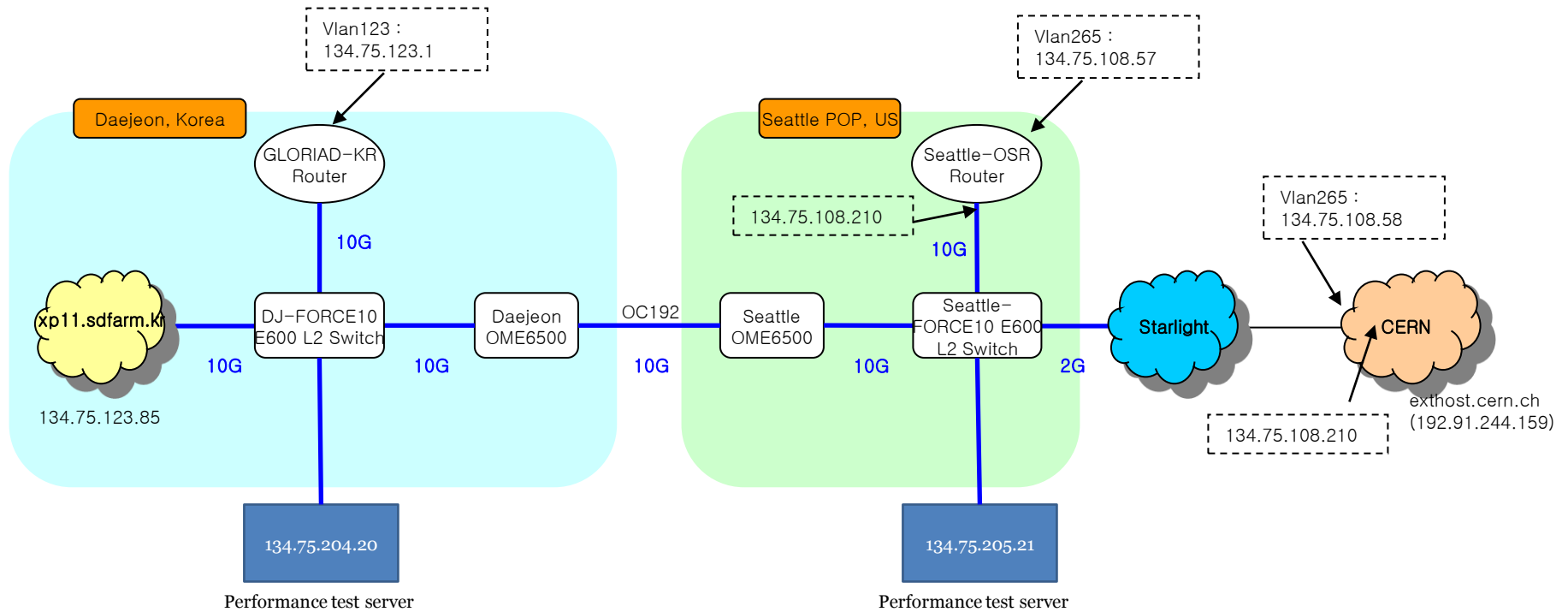
Experiment	Model	Type	Usable Size
ALICE Tier-1 prototype	Hitachi USP-V	Disk (SAN)	100TB (+100TB)
ALICE Tier-2	NetApp FAS2050	Disk (NAS)	30TB
CDF	Hitachi USP-V	Disk (SAN)	200TB
Belle	Hitachi USP-V	Disk (SAN)	200TB
STAR	NetApp FAS6080	Disk (SAN)	100TB
LIGO, gBrain, etc	NetApp FAS6080	Disk (SAN)	100TB
			830TB



# Network Architecture



# KISTI - CERN



# Network Performance

## We have a problem

Network transfer speed tests x 판도라의 상자 :: 『Mac』 화단 x +

alimonitor.cern.ch/speed/index.jsp?site=KISTI\_GSDC

ALICE MonALISA Repository for ALICE

My jobs | My home dir | Catalogue browser | Repository Home | Administration Section | ALICE Reports | Events XML Feed | Firefox Toolbar | MonALISA GUI

ALICE Repository

- ALICE Repository
  - Google Map
  - Shifter's dashboard
  - Run Condition Table
  - Production info
  - Job Information
    - Site views
    - User views
    - Task queue
    - Job timings
    - Memory profiles
      - By site
      - Per user
    - Current jobs
  - SE Information
  - Services
  - Network Traffic
    - Incoming
    - Outgoing
    - Internal
    - Inter-Site
    - Bandwidth tests
  - FTD Transfers
  - CAF Monitoring
  - SHUTTLE
  - Build system
  - HepSpec
  - Dynamic charts

close all

Current page

Running jobs trend

Running jobs trend  
24h 12h 6h 1h

Links: FDT, Kernel parameters tuning

<KISTI\_GSDC>

Chart view >

IN from							OUT to						
No.	ID	Site	Speed (Mbps)	Hops	RTT (ms)	Streams	No.	ID	Site	Speed (Mbps)	Hops	RTT (ms)	Streams
1.	734934	KISTI-CREAM	969.64	1	0.18	1	1.	733967	KISTI-CREAM	928.84	1	0.19	1
2.	734089	LBL	294.66	13	139.30	1	2.	733938	LLNL	108.95	8	138.36	1
3.	735191	CCIN2P3-CREAM	147.34	12	303.17	1	3.	735281	OSC	107.41	8	192.75	1
4.	734005	IPNL	141.90	12	304.74	1	4.	733972	CERN-CREAM	66.14	10	295.29	1
5.	736380	OSC	101.24	15	195.81	1	5.	734725	Catania	64.64	14	325.28	1
6.	734617	LUNARC	98.67	13	302.79	1	6.	734165	Grenoble	59.37			1
7.	734226	UNAM	96.61	9	204.83	1	7.	733860	SUT	52.13	21	126.35	1
8.	732126	CNAF_glexec	96.09	12	299.82	1	8.	733234	ISS_LCG	46.35	16	312.78	1
9.	735872	KFKI	88.76	13	308.24	1	9.	737340	JINR	45.83			1
10.	731548	PDC	85.67	15	293.54	1	10.	733109	LBL	43.27	13	139.34	1
11.	733174	GRIF_IPNO	81.71	11	301.60	1	11.	734601	Poznan	41.18			1
12.	731586	Hiroshima	80.09	15	89.96	1	12.	662539	CERN-LSF	39.58	10	292.47	1
13.	731560	SARA	74.37	11	290.02	1	13.	733742	NSC	33.40	12	299.49	1
14.	733610	Subatech	73.43	16	308.01	1	14.	732264	LUNARC	29.81			1
15.	662445	CERN-LSF	72.98	10	292.14	1	15.	734061	PAKGRID	28.59			1
16.	736936	JINR	72.96	9	335.55	1	16.	736014	RRC-KI	27.08			1
17.	732137	CSC	72.50	9	301.53	1	17.	733848	UIB	26.72	13	304.24	1
18.	727805	Athens	72.32	10	338.61	1	18.	732039	CSC	26.06	9	303.70	1
19.	734593	RRC-KI	71.44	9	333.97	1	19.	733597	IPNL	26.04	12	303.14	1
20.	737290	Poznan	71.23	10	295.89	1	20.	734851	Hiroshima	24.67			1
21.	731644	CNAF-CREAM	70.26	12	301.50	1	21.	735462	Bari	21.89	12	309.99	1
22.	733077	SUT	67.04	19	118.84	1	22.	727592	Athens	20.31	11	335.66	1
23.	736323	Bologna	57.12	11	300.13	1	23.	733301	Trieste	19.81	14	307.50	1
24.	734210	CyberSar	54.70	13	319.02	1	24.	736239	Bologna	19.79	11	301.58	1
25.	734758	TriGrid	53.54	14	327.16	1	25.	733460	Kosice	18.75			1
26.	733245	Bratislava	53.17	11	298.17	1	26.	734543	BITP	16.14	23	366.96	1
27.	734214	Catania	49.45	14	323.85	1	27.	735117	Cyfronet	15.10	12	305.28	1
28.	733876	IHEP	49.26			1	28.	736674	ISS	13.02	16	311.51	1
29.	733608	CERN-CREAM	48.95	10	293.81	1	29.	736375	CSIR	12.50	13	525.71	1
30.	733859	LLNL	46.72	8	138.81	1	30.	734163	UNAM	11.47	9	204.39	1
31.	734416	UIB	46.72	14	305.72	1	31.	733469	CyberSar	9.38	13	317.55	1
32.	733681	NSC	33.52	15	259.48	1	32.	734108	CNAF_glexec	7.82	12	301.41	1
33.	733649	KNU	29.71	26	391.50	1	33.	733918	Cagliari	7.30	13	319.01	1
34.	735790	CSIR	27.37			1	34.	733750	CNAF	6.78	12	301.40	1
35.	734870	CERN-L	26.06	10	290.68	1	35.	733377	Madrid	6.69			1

# Daejeon - Seattle Performance Test (UDP)

```
[root@seattle ~]# iperf -s -u -i 1
```

```
-----  
Server listening on UDP port 5001  
Receiving 1470 byte datagrams  
UDP buffer size: 107 KByte (default)  
-----
```

```
[ 3] local 134.75.205.21 port 5001 connected with 134.75.204.20 port  
41490  
[ 3] 0.0- 1.0 sec 233 MBytes 1.96 Gbits/sec 0.006 ms 0/166343 (0%)  
[ 3] 1.0- 2.0 sec 233 MBytes 1.96 Gbits/sec 0.005 ms 0/166533 (0%)  
[ 3] 2.0- 3.0 sec 234 MBytes 1.96 Gbits/sec 0.005 ms 0/166643 (0%)  
[ 3] 3.0- 4.0 sec 234 MBytes 1.96 Gbits/sec 0.005 ms 0/166659 (0%)  
[ 3] 4.0- 5.0 sec 234 MBytes 1.96 Gbits/sec 0.007 ms 0/166652 (0%)  
[ 3] 5.0- 6.0 sec 234 MBytes 1.96 Gbits/sec 0.005 ms 0/166664 (0%)  
[ 3] 6.0- 7.0 sec 233 MBytes 1.96 Gbits/sec 0.006 ms 0/166363 (0%)  
[ 3] 7.0- 8.0 sec 234 MBytes 1.96 Gbits/sec 0.005 ms 0/166644 (0%)  
[ 3] 8.0- 9.0 sec 234 MBytes 1.96 Gbits/sec 0.006 ms 0/166663 (0%)  
[ 3] 0.0-10.0 sec 2.28 GBytes 1.96 Gbits/sec 0.008 ms 0/1665755  
(0%)
```

```
[root@localhost ~]# iperf -c 134.75.205.21 -u -b 1.8g -i 1 -t 10
```

```
-----  
Client connecting to 134.75.205.21, UDP port 5001  
Sending 1470 byte datagrams  
UDP buffer size: 64.0 KByte (default)  
-----
```

```
[ 3] local 134.75.204.20 port 41490 connected with 134.75.205.21 port 5001  
[ ID] Interval Transfer Bandwidth  
[ 3] 0.0- 1.0 sec 233 MBytes 1.96 Gbits/sec  
[ ID] Interval Transfer Bandwidth  
[ 3] 1.0- 2.0 sec 233 MBytes 1.96 Gbits/sec  
[ ID] Interval Transfer Bandwidth  
[ 3] 2.0- 3.0 sec 234 MBytes 1.96 Gbits/sec  
[ ID] Interval Transfer Bandwidth  
[ 3] 3.0- 4.0 sec 234 MBytes 1.96 Gbits/sec  
[ ID] Interval Transfer Bandwidth  
[ 3] 4.0- 5.0 sec 234 MBytes 1.96 Gbits/sec  
[ ID] Interval Transfer Bandwidth  
[ 3] 5.0- 6.0 sec 234 MBytes 1.96 Gbits/sec  
[ ID] Interval Transfer Bandwidth  
[ 3] 6.0- 7.0 sec 233 MBytes 1.96 Gbits/sec  
[ ID] Interval Transfer Bandwidth  
[ 3] 7.0- 8.0 sec 234 MBytes 1.96 Gbits/sec  
[ ID] Interval Transfer Bandwidth  
[ 3] 8.0- 9.0 sec 234 MBytes 1.96 Gbits/sec  
[ ID] Interval Transfer Bandwidth  
[ 3] 0.0-10.0 sec 2.28 GBytes 1.96 Gbits/sec  
[ 3] Sent 1665755 datagrams  
[ 3] Server Report:  
[ ID] Interval Transfer Bandwidth Jitter Lost/Total Datagrams  
[ 3] 0.0-10.0 sec 2.28 GBytes 1.96 Gbits/sec 0.008 ms 0/1665755 (0%)
```

# Daejeon - Seattle Performance Test (TCP)

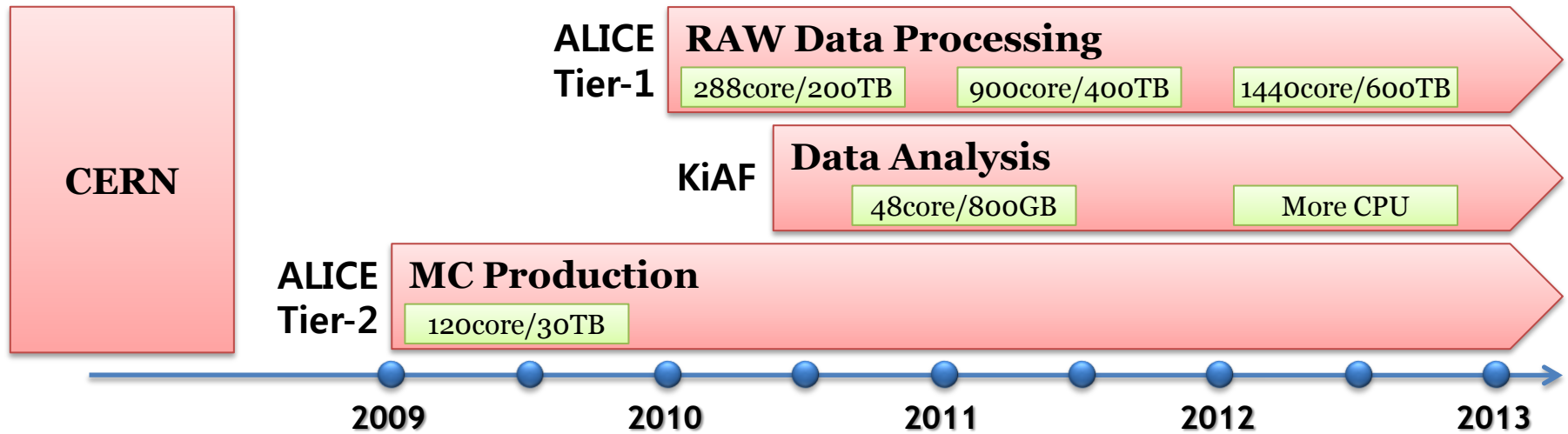
```
[root@seattle ~]# iperf -c 134.75.204.20 -i 1 -w 30m -t 60
```

```
-----  
Client connecting to 134.75.204.20, TCP port 5001  
TCP window size: 60.0 MByte (WARNING: requested 30.0 MByte)  
-----
```

```
[ 3] local 134.75.205.21 port 46831 connected with 134.75.204.20 port 5001  
[ 3] 0.0- 1.0 sec 52.3 MBytes 439 Mbits/sec  
[ 3] 1.0- 2.0 sec 0.00 Bytes 0.00 bits/sec  
[ 3] 2.0- 3.0 sec 0.00 Bytes 0.00 bits/sec  
[ 3] 3.0- 4.0 sec 0.00 Bytes 0.00 bits/sec  
[ 3] 4.0- 5.0 sec 0.00 Bytes 0.00 bits/sec  
[ 3] 5.0- 6.0 sec 20.9 MBytes 176 Mbits/sec  
[ 3] 6.0- 7.0 sec 0.00 Bytes 0.00 bits/sec  
[ 3] 7.0- 8.0 sec 21.5 MBytes 180 Mbits/sec  
[ 3] 8.0- 9.0 sec 20.2 MBytes 169 Mbits/sec  
[ 3] 15.0-16.0 sec 46.0 MBytes 386 Mbits/sec  
[ 3] 16.0-17.0 sec 41.0 MBytes 344 Mbits/sec  
[ 3] 17.0-18.0 sec 45.0 MBytes 377 Mbits/sec  
[ 3] 18.0-19.0 sec 69.5 MBytes 583 Mbits/sec  
[ 3] 19.0-20.0 sec 42.1 MBytes 353 Mbits/sec  
[ 3] 20.0-21.0 sec 70.0 MBytes 587 Mbits/sec  
[ 3] 21.0-22.0 sec 78.5 MBytes 659 Mbits/sec  
[ 3] 22.0-23.0 sec 77.8 MBytes 653 Mbits/sec  
[ 3] 23.0-24.0 sec 110 MBytes 921 Mbits/sec  
[ 3] 24.0-25.0 sec 98.4 MBytes 825 Mbits/sec  
[ 3] 25.0-26.0 sec 108 MBytes 905 Mbits/sec  
[ 3] 26.0-27.0 sec 118 MBytes 987 Mbits/sec  
[ 3] 27.0-28.0 sec 136 MBytes 1.14 Gbits/sec  
[ 3] 28.0-29.0 sec 170 MBytes 1.43 Gbits/sec  
[ 3] 29.0-30.0 sec 158 MBytes 1.33 Gbits/sec  
[ 3] 30.0-31.0 sec 174 MBytes 1.46 Gbits/sec
```



# 3. ALICE Tier-1 Prototype Deployment



# Grid Services Installation for Tier-1

Service Name	OS	Network	CPU/RAM	# of machines	Type
lcg-CE	SL4.8 32-bits	1G/1G	1core/2G	1	VM
site-bdii	SL5.5 64-bits	1G/1G	1core/2G	1	VM
CREM-CE	SL5.5 64-bits	1G/1G	16core/16G	1	Real machine
xrootd-redirector for disk	SL5.5 64-bits	1G/1G	16core/16G	1	Real machine
xrootd-pool for disk	SL5.5 64-bits	10G/10G	16core/16G	2	Real machine
xrootd-redirector for tape	SL5.5 64-bits	1G/1G	16core/16G	1	Real machine
xrootd-pool for tape	SL5.5 64-bits	10G/10G	16core/16G	2	Real machine
Vobox	SL5.5 64-bits	1G/10G	2core/4G	1	VM
worker nodes	SL5.5 64-bits	1G/1G	-	-	Real machine

# KISTI\_GSDC Status

Running with

## MonALISA Repository for ALICE

[Catalogue browser](#) | 
 [Repository Home](#) | 
 [Administration Section](#) | 
 [ALICE Reports](#) | 
 [Events XML Feed](#) | 
 [Firefox Toolbar](#) | 
 [MonaLisa GUI](#)

Select site:



**MonALISA information** Version: 1.9.2 (JDK 1.6.0\_22) **Service health** NTP: SYNC, offset: 0s  
 Running on: vobox11.sdfarm.kr  
 Administrator: Jong Hu Lee (jong.hu.lee@cern.ch)

<b>Services status</b> AllEn: v2-19.64 ClusterMonitor: <b>OK</b> PackMan: <b>OK</b> CE: <b>OK</b> CE info: <i>We could start 2 agents</i> Max running jobs: 1500 Max queued jobs: 100	<b>Proxies status</b> AllEn proxy: <b>OK</b> (1 day, 23:45) Delegated proxy: n/a (n/a) Proxy server: n/a (n/a) Proxy of the machine: n/a (n/a)	<b>SAM tests</b> Delegated proxy duration: n/a Proxy of the machine: n/a Proxy renewal: n/a Proxy server registration: n/a RB status: n/a Software area: n/a User proxy registration: n/a WMS stats: n/a
--	--	--

<b>Current jobs status</b> Assigned: 0 Running: <b>105</b> Saving: 1	<b>Accounting</b> (last 24h) Success jobs: <b>608</b> (profile) Failed jobs: <b>0</b> Error jobs: <b>432</b> kSI2k units: <b>0</b> / pledged	<b>Site averages</b> (last 24h) Active nodes: 15.54 Average kSI2k/node:
---	---	--

Storages status	Name	Status	Size	Used	Free	Usage	No of files	Type	ADD test
	ALICE::KISTI_GSDC::SE	OK	100 TB	8.566%	0 BB	8.566 TB	224.4 K	File	<b>OK</b>

**VoBox health**  
 CPUs: 4x 2000MHz  
 Mem usage: 38.98% of 3.862 GB  
 Processes: 157  
 Sockets: 67 TCP / 25 UDP  
 Uptime: 16 days, 21:46

**CPU usage** (last 1h avg)  
 Load: **0.153**  
 User: 0.927%  
 System: 0.556%  
 IOWait: 1.012%  
 Idle: 97.4%



Int: 0.004%  
 Soft int: 0.056%  
 Nice: 0.047%  
 Steal: 0%

AllEn LDAP var	VoBox path	Size	Used	Free	Use%
<b>TMP</b>	/home/sgmalit1/ALICE/tmp	48.43 GB	8.034 GB	38.4 GB	18%
<b>LOG</b>	/home/sgmalit1/allen-logs	48.43 GB	8.034 GB	38.4 GB	18%
<b>CACHE</b>	/home/sgmalit1/ALICE/cache	48.43 GB	8.034 GB	38.4 GB	18%

# Jobs on KISTI\_GSDC

Active jobs in KISTI\_GSDC - / x 판도라의 상자. :: 「Mac」 회 x +

← → ALICE Experiment public pages n.ch/display ☆ f 6 π ★ ↻

 **MonALISA Repository for ALICE** 

My jobs | My home dir | Catalogue browser | Repository Home | Administration Section | ALICE Reports | Events XML Feed | Firefox Toolbar | MonaLisa GUI


**ALICE Repository**

- ALICE Repository
  - Google Map
  - Shifter's dashboard
  - Run Condition Table
  - Production info
    - Job Information
      - Site views
      - User views
      - Task queue
      - Job timings
      - Memory profiles
        - By site
        - Per user
        - Current jobs
    - SE Information
    - Services
    - Network Traffic
      - Incoming
      - Outgoing
      - Internal
      - Inter-Site
      - Bandwidth tests
    - FTD Transfers
    - CAF Monitoring
    - SHUTTLE
    - Build system
    - HepSpec
    - Dynamic charts

dose all

**Current page**

**Running jobs trend**



Running jobs trend  
24h 12h 6h 1h

Statistics ▾


Series ▾ Options ▾ Alternative Views ▾

Sum series [disabled] Select site: KISTI\_GSDC Area view [disabled] Image size: 1280x700

Interval selection: last month or < 2011-01-09 01:00 - 2011-02-08 11:00 Plot

Charts:  Jobs in each state  Queued JobAgents (check all | uncheck all)

Annotations What is this about?



**Active jobs in KISTI\_GSDC**

The chart displays the number of jobs in various states over time. The top panel shows the total number of jobs (No. of jobs) on the y-axis (0 to 125) against time on the x-axis (Jan 2011 to Feb 2011). The bottom panel shows the number of queued job agents (Queued JA) on the y-axis (0 to 14000) against time on the x-axis. The legend indicates the following series: RUNNING (blue line), ASSIGNED (green line), STARTED (yellow line), SAVING (red line), ZOMBIE (purple line), and Queued JA (black line).

Repository Home · ALICE Web Page · ALICE Clusters · Contact · Links

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# Storage Status

SE Name	AliEn name	Size	Used	Free	Usage	No. of files	Type	Size	Used	Free	Version
1. Bari - SE	ALICE::Bari::SE	893.4 TB	68.83 TB	824.6 TB	7.704%	1,923,073	File	1.679 PB	1.438 PB	247 TB	20100510-1509 dbg
2. Bratislava - SE	ALICE::Bratislava::SE	38.2 TB	22.98 TB	15.22 TB	60.16%	705,414	File	38.2 TB	26.49 TB	11.7 TB	20100510-1509 dbg
3. Catania - SE	ALICE::Catania::SE	100.4 TB	88.17 TB	12.23 TB	87.82%	1,978,904	File	100.4 TB	94.33 TB	6.117 TB	20100510-1509 dbg
4. CCIN2P3 - SE	ALICE::CCIN2P3::SE	96 TB	111 TB	-	115.6%	2,253,283	File	-	-	-	
5. CERN - ALICEDISK	ALICE::CERN::ALICEDISK	849.6 TB	713.5 TB	136.1 TB	83.98%	10,748,226	CASTOR	-	-	-	
6. CERN - GLOBAL	ALICE::CERN::GLOBAL	-	0	1.863 TB	-	4,373	root	-	-	-	
7. CERN - SE	ALICE::CERN::SE	20.49 TB	13.63 TB	6.855 TB	66.54%	3,378,942	File	20.46 TB	6.739 TB	13.72 TB	20100510-1509 dbg
8. Clermont - SE	ALICE::Clermont::SE	121 TB	112.8 TB	8.182 TB	93.24%	2,531,992	File	-	-	-	
9. CNAF - SE	ALICE::CNAF::SE	465.7 TB	261.7 TB	204 TB	56.18%	5,579,956	File	465.7 TB	172.6 TB	293.2 TB	20100510-1509 dbg
10. CyberSar_Cagliari - SE	ALICE::CyberSar_Cagliari::SE	30.83 TB	31.86 TB	-	103.3%	858,267	File	92.71 TB	84.52 TB	8.181 TB	20100510-1509 dbg
11. Cyfronet - SE	ALICE::Cyfronet::SE	10 TB	11.53 TB	-	115.3%	513,646	File	9.995 TB	9.36 TB	649.8 GB	20100510-1509 dbg
12. FZK - SE	ALICE::FZK::SE	762.4 TB	454.1 TB	308.3 TB	59.56%	7,583,567	File	762.4 TB	733.1 TB	29.29 TB	20100510-1509 dbg
13. Grenoble - DPM	ALICE::Grenoble::DPM	72 TB	5.897 TB	66.1 TB	8.191%	194,009	SRM	-	-	-	
14. GRIF_IPNO - DPM	ALICE::GRIF_IPNO::DPM	85.24 TB	76.45 TB	8.789 TB	89.69%	2,117,745	SRM	-	-	-	
15. GRIF_IPNO - SE	ALICE::GRIF_IPNO::SE	136.1 TB	93.33 TB	42.77 TB	68.58%	2,612,690	File	153.1 TB	99.05 TB	54.08 TB	20100510-1509 dbg
16. GRIF_IRFU - DPM	ALICE::GRIF_IRFU::DPM	171 TB	34.59 TB	136.4 TB	20.23%	705,289	SRM	-	-	-	
17. GSI - SE	ALICE::GSI::SE	312.6 TB	321.1 TB	-	102.7%	6,041,594	File	0	0	0	20100510-1509 dbg
18. HHLR_GU - SE	ALICE::HHLR_GU::SE	200 TB	2 KB	200 TB	0%	1	File	-	-	-	
19. Hiroshima - SE	ALICE::Hiroshima::SE	79 TB	15.63 TB	63.37 TB	19.78%	484,499	File	78.78 TB	17.87 TB	60.91 TB	20100510-1509 dbg
20. IHEP - SE	ALICE::IHEP::SE	35.55 TB	7.107 TB	28.44 TB	19.99%	453,677	File	36.38 TB	7.029 TB	29.35 TB	20100510-1509 dbg
21. IPNL - SE	ALICE::IPNL::SE	36 TB	46.94 TB	-	130.4%	1,061,518	File	37.3 TB	32.52 TB	4.772 TB	20100510-1509 dbg
22. ISS - FILE	ALICE::ISS::FILE	140.5 TB	50.29 TB	90.21 TB	35.79%	2,130,029	File	140.5 TB	53.99 TB	86.5 TB	20100510-1509 dbg
23. ITEP - SE	ALICE::ITEP::SE	100 TB	33.95 TB	66.05 TB	33.95%	887,059	File	99.93 TB	32.46 TB	67.47 TB	20100510-1509 dbg
24. JINR - SE	ALICE::JINR::SE	112.3 TB	47.81 TB	64.5 TB	42.57%	2,528,119	File	149.1 TB	43.64 TB	105.5 TB	20100510-1509 dbg
25. KFKI - SE	ALICE::KFKI::SE	39.34 TB	25.29 TB	14.04 TB	64.3%	622,778	File	36.38 TB	31.55 TB	4.825 TB	20100510-1509 dbg
26. KISTI_GSDC - SE	ALICE::KISTI_GSDC::SE	100 TB	8.574 TB	91.43 TB	8.574%	230,399	File	101.8 TB	12.13 TB	89.65 TB	20100510-1509 dbg
27. KISTI - SE	ALICE::KISTI::SE	49.95 TB	23.49 TB	26.46 TB	47.02%	570,164	File	49.95 TB	17.7 TB	32.25 TB	20100510-1509 dbg
28. Kolkata - SE	ALICE::Kolkata::SE	73.24 TB	11.61 TB	61.63 TB	15.86%	314,651	File	-	-	-	



# This Year Plan

- we will complete to deploy additional 200TB early May – we will have 400TB disks totally.
- And we will deploy the 200TB new storage as a separate SE, which we will use exclusively for RAW data transfer.
- But we should solve network problem.
- And we have another plan.
  - KISTI Tier-1 storage will be of a rather innovative type, consisting of an array of SSDs for the reconstruction and analysis data and a set of slower and cheaper SATA disk servers for the custodial storage of replicated RAW data

## 4. Data Center Management

- System Automation Efforts
- Monitoring
- Log Activities – Security
- Trouble shooting

# System Automation Efforts

## Remote Installation via WWW Interface

Server Administration - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://150.183.234.134

conversion hotmail admin\_server ELOG chris elog twiki nagios ganglia

ALiEn Repository 9 Running Jobs Open issues (4) Central Services Admin Section

ALICE Grid ... Gridview: V... ALICE Grid ... DLFP: fil de... Le Journal ... Serve... x

ADMINISTRATION SERVER

<b>Farm</b> <a href="#">farm view</a> <a href="#">farm view(법균)</a> <a href="#">farm view(재원)</a> <a href="#">ip view</a>	<b>Servers</b> <a href="#">view server</a> <a href="#">Add a new server</a> <a href="#">Modify a server</a> <a href="#">Generate File for remote installation</a>
<b>Hardware</b> <a href="#">view models</a> <a href="#">Add a new model of server</a> <a href="#">Modify a model</a>	
<b>Site info</b> <a href="#">Add a farm siteinfo</a>	<b>Storage FAS6080</b> <a href="#">Storage status</a>
<a href="#">Password generator</a>	

Done

31 **N** 13 service warnings 7 critical services

GRID of the Americas Workshop

- ‘The remote installation service’ makes possible to install a machine through the network, totally automatically.
- A web interface allow you to enter necessary information for a server a then generate all necessary file for the installation process.
- Server information are registered in a MySQL database. It contain also information to install the middleware if necessary

The screenshot shows the phpMyAdmin web interface in a Mozilla Firefox browser. The browser address bar shows the URL: `http://150.183.234.134/phpmyadmin/index.php?db=KRIS&token=c6595a7f5c4ee92e2a24bd3a84e4dc34`. The interface displays a table of server information for the 'KRIS' database. The table has 12 columns: a checkbox, a pencil icon, a red 'X' icon, server name, IP address, MAC address, another IP address, another MAC address, two time intervals, a server ID, a server type, a server role, and a final IP address. The row for 'bdii.sdfarm.kr' is highlighted in green.

<input type="checkbox"/>			xrdp0.sdfarm.kr	134.75.123.8	00:1A:64:9D:A4:3E	192.168.123.8	00:1A:64:9D:A4:40	0000-00-00 00:00:00	99P8391	si460-i386	STORAGE	192.168.200.8
<input type="checkbox"/>			rb.sdfarm.kr	134.75.123.11	00:1A:64:20:10:44	192.168.123.11	00:1A:64:20:10:45	0000-00-00 00:00:00	99A0314	si460-i386	GRID	192.168.200.11
<input type="checkbox"/>			wmslb.sdfarm.kr	134.75.123.12	00:1A:64:20:10:A7	192.168.123.12	00:1A:64:20:10:A8	0000-00-00 00:00:00	99A0320	si460-i386	GRID	192.168.200.12
<input type="checkbox"/>			squid0.sdfarm.kr	134.75.123.62	00:1A:64:20:10:74	192.168.123.62	00:1A:64:20:10:75	0000-00-00 00:00:00	99A0323	si520-x86_64	OTHER	192.168.200.13
<input type="checkbox"/>			rgma.sdfarm.kr	134.75.123.14	00:1A:64:20:10:20	192.168.123.14	00:1A:64:20:10:21	0000-00-00 00:00:00	99A0317	si460-i386	GRID	192.168.200.14
<input type="checkbox"/>			bdii.sdfarm.kr	134.75.123.15	00:1A:64:20:11:85	192.168.123.15	00:1A:64:20:11:86	0000-00-00 00:00:00	99A0318	si460-i386	BDII	192.168.200.15
<input type="checkbox"/>			ce02.sdfarm.kr	134.75.123.32	00:1A:64:20:11:9A	192.168.123.32	00:1A:64:20:11:9B	0000-00-00 00:00:00	99A0324	si460-i386	CE	192.168.200.32
<input type="checkbox"/>			battlestar1.sdfarm.kr	134.75.123.60	00:1A:64:20:10:3B	NA	NA	0000-00-00 00:00:00	99A0312	si480-i386	OTHER	192.168.200.60
<input type="checkbox"/>			vobox01.sdfarm.kr	134.75.123.27	00:1A:64:20:0F:ED	192.168.123.27	00:1A:64:20:0F:EE	0000-00-00 00:00:00	NA	si520-x86_64	VOBOX	192.168.200.18
<input type="checkbox"/>			se001.sdfarm.kr	134.75.123.19	00:1A:64:20:11:61	192.168.123.19	00:1A:64:20:11:62	0000-00-00 00:00:00	99A0316	si520-i386	OTHER	192.168.200.19
<input type="checkbox"/>			xrdhn.sdfarm.kr	134.75.123.7	00:1A:64:20:10:6E	192.168.123.7	00:1A:64:20:10:6F	0000-00-00 00:00:00	99A0321	si480-i386	STORAGE	192.168.200.7
<input type="checkbox"/>			dgas.sdfarm.kr	134.75.123.21	00:1A:64:20:10:B6	192.168.123.21	00:1A:64:20:10:B7	0000-00-00 00:00:00	99A0322	si460-i386	OTHER	192.168.200.21



# System Automation Efforts: ipmi

- ipmi is a protocol which allow to interact through a BMC card with a server at a very low level. It's possible to turn on/off a machine, have sensor information and, with recent server, access to the serial console. This is really usefull when you want to interact with a server when ssh don't work or during the boot sequence.
- Ipmi is used on a special network, let call it "administration network", which is '192.168.200.0'. This network is accessible from "ui-alice.sdfarm.kr" and "se001.sdfarm.kr".
- Ipmitools is tool used to send ipmi command to the servers. A typicall command is:

```
[root@se001 ~]# ipmitool -I lanplus -H 192.168.200.101 -U USERID -P PASSWoRD  
power status
```

*Chassis Power is on*



# System Automation Efforts: puppet

- Puppet is a tool to automatically configure servers. A puppet client installed on all machine connect on a regularly basis to a central server and ask the configuration it should have. If it actual configuration differ from the response of the central server, puppet take action to make it identical.
- For each point you want to control, you need to create a "module" on the central server. For the moment I created modules for:
  - users
  - groups
  - iptables
  - /etc/hosts file
  - mounted area
  - nagios configuration
  - yum configuration
  - sudo configuration
  - syslog configuration (for log centralization)

# Monitoring

- Nagios is a tool for monitoring commonly used in computer center in the LHC community. It is now used for SAM test which is a very important monitoring system in the LCG grid. This software give the status for a farm in real time, no history is kept. The aim is to make an alarm when a problem occur, in different possible ways.

The screenshot displays the Nagios web interface in a Mozilla Firefox browser window. The address bar shows the URL <http://dgas.sdfarm.kr/nagios/>. The interface includes a left-hand navigation menu with sections for General, Monitoring, Service Problems, Network Outages, Reporting, and Configuration. The main content area features several summary tables and a large grid of service status details.

**Current Network Status**  
Last Updated: Tue Jul 7 14:59:31 KST 2009  
Updated every 90 seconds  
Nagios® 3.0.3 - [www.nagios.org](http://www.nagios.org)  
Logged in as nagiosadmin

**Host Status Totals**

Up	Down	Unreachable	Pending
83	0	0	0

**Service Status Totals**

OK	Warning	Unknown	Critical	Pending
510	0	0	11	0

**Service Overview For All Host Groups**

Services for KISTI Alice T2 (grid-services)

Host	Status	Services	Actions
bd1	UP	OK	
se-alice	UP	OK	
se01	UP	OK	
se02	UP	OK	
slmo1	UP	OK	
px	UP	OK	
qz	UP	OK	
sema	UP	OK	
sa1	UP	OK	
ui-alice	UP	OK	
yjobbox-alice	UP	OK	
yjob01	UP	OK	
ymalb	UP	OK	

Workers for KISTI Alice T2 (grid-workers)

Host	Status	Services	Actions
tw001	UP	OK	
tw002	UP	OK	
tw003	UP	OK	
tw004	UP	OK	
tw005	UP	OK	
tw006	UP	OK	
tw007	UP	OK	
tw008	UP	OK	
tw009	UP	1 WARNING	
tw010	UP	OK	
tw011	UP	1 WARNING	
tw012	UP	1 CRITICAL	
tw013	UP	OK	
tw014	UP	1 WARNING	
tw015	UP	OK	
tw016	UP	OK	
tw017	UP	OK	
tw018	UP	OK	
tw019	UP	OK	
tw020	UP	OK	
tw021	UP	OK	
tw022	UP	OK	
tw023	UP	OK	
tw024	UP	OK	
tw025	UP	OK	
tw026	UP	OK	
tw027	UP	OK	
tw028	UP	OK	
tw029	UP	OK	
tw030	UP	OK	
tw031	UP	OK	
tw032	UP	OK	
tw033	UP	OK	
tw034	UP	OK	
tw035	UP	OK	
tw036	UP	OK	
tw037	UP	OK	
tw038	UP	OK	
tw039	UP	OK	
tw040	UP	OK	
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tw042	UP	OK	
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tw087	UP	OK	
tw088	UP	OK	
tw089	UP	OK	
tw090	UP	OK	
tw091	UP	OK	
tw092	UP	OK	
tw093	UP	OK	
tw094	UP	OK	
tw095	UP	OK	
tw096	UP	OK	
tw097	UP	OK	
tw098	UP	OK	
tw099	UP	OK	
tw100	UP	OK	

Workers for KISTI Alice T2 (grid-workers-2)

Host	Status	Services	Actions
wm001	UP	OK	
wm002	UP	OK	
wm003	UP	OK	
wm004	UP	OK	
wm005	UP	OK	
wm006	UP	OK	
wm007	UP	OK	
wm008	UP	OK	
wm009	UP	OK	
wm010	UP	OK	
wm011	UP	OK	
wm012	UP	OK	
wm013	UP	OK	
wm014	UP	OK	
wm015	UP	OK	

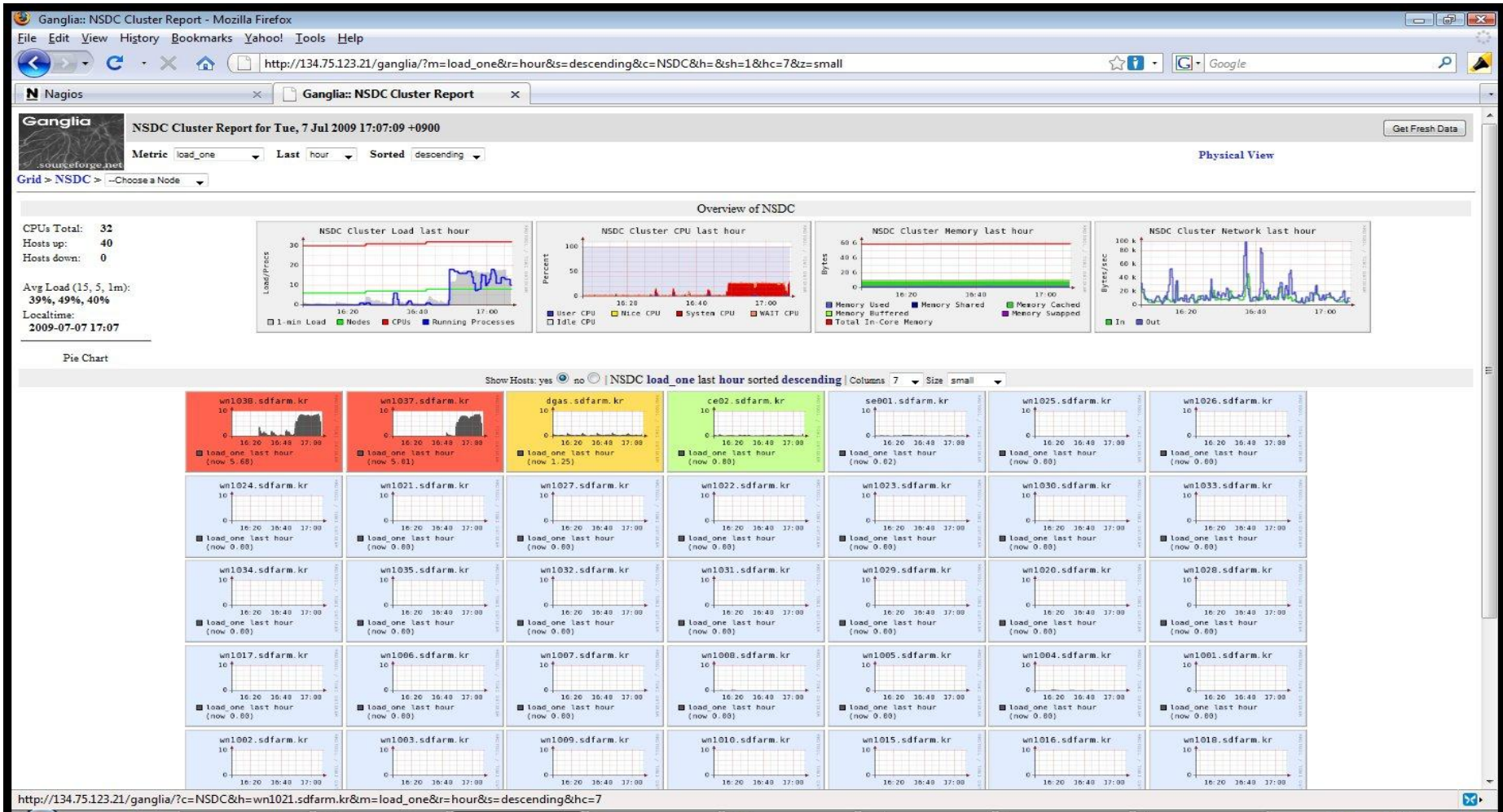
Workers for NSDC KISTI (grid-workers-NSDC)

Host	Status	Services	Actions
nsdc001	UP	OK	

Servers for test services (test)

Host	Status	Services	Actions
test001	UP	OK	

- Ganglia is commonly used in computer center. This service was tested on our farm for several month.





# Log Activity

- Security is maybe the most critical thing for administration system. If we want a very secure installation we need to know what happen on all the machine at every moment. As it's not possible to connect to all machines to keep a look on log files, it's necessary to centralize log files to a single place.
- On Linux server the log files are managed by Syslog. It's possible to configure this software to send logs, a part or all of them, through the network to a specify server. On the target server, logs are simply written to a log file which is not so clear to monitor activity
- php-syslog is a free software which will allow to kept log event in a mysql database (through syslog-ng which is an improvement of syslog) and to monitor those event thanks to a web interface. The web interface display all event in real time with some color code which make the log read very easy and efficient. it's also possible to apply filters to concentrate on a particular kind of event or server. Now php-syslog is used to monitor connection activity on the servers but the usage can be extend to any other log event

Donate

The code you support today may turn out to be SkyNet tomorrow...

Logout Search Config Help About

BACK TO SEARCH

DEBUG INFO NOTICE WARNING ERROR CRIT ALERT EMERG

HOST	FACILITY	TIME	PROGRAM	MESSAGE
ui01.sdfarm.kr	authpriv	12:08:12	sshd	sshd[16453]: Failed password for invalid user hacker from 150.183.234.132 port 36023 ssh2
ui01.sdfarm.kr	authpriv	12:08:10	sshd	sshd[16453]: pam_succeed_if(sshd:auth): error retrieving information about user hacker
ui01.sdfarm.kr	authpriv	12:08:10	sshd	sshd[16453]: pam_unix(sshd:auth): check pass; user unknown
ui01.sdfarm.kr	authpriv	12:08:03	sshd	sshd[16453]: Failed password for invalid user hacker from 150.183.234.132 port 36023 ssh2
ui01.sdfarm.kr	authpriv	12:08:01	sshd	sshd[16453]: pam_succeed_if(sshd:auth): error retrieving information about user hacker
ui01.sdfarm.kr	authpriv	12:08:01	sshd	sshd[16453]: pam_unix(sshd:auth): authentication failure; logname= uid=0 euid=0 tty=ssh ruser= rhost=150.183.234.132
ui01.sdfarm.kr	authpriv	12:08:01	sshd	sshd[16453]: pam_unix(sshd:auth): check pass; user unknown
ui01.sdfarm.kr	authpriv	12:08:00	sshd	sshd[16454]: input_userauth_request: invalid user hacker
ui01.sdfarm.kr	authpriv	12:08:00	sshd	sshd[16453]: Invalid user hacker from 150.183.234.132
twn001.sdfarm.kr	authpriv	12:07:46	sshd	sshd[1037]: Connection closed by 150.183.234.132
twn001.sdfarm.kr	authpriv	12:07:38	sshd	sshd[1037]: Failed password for invalid user test from 150.183.234.132 port 42763 ssh2
twn001.sdfarm.kr	authpriv	12:07:38	sshd	sshd[1036]: Failed password for invalid user test from 150.183.234.132 port 42763 ssh2
twn001.sdfarm.kr	authpriv	12:07:35	sshd	sshd[1037]: Failed none for invalid user test from 150.183.234.132 port 42763 ssh2
twn001.sdfarm.kr	authpriv	12:07:35	sshd	sshd[1037]: input_userauth_request: invalid user test
twn001.sdfarm.kr	authpriv	12:07:35	sshd	sshd[1036]: Invalid user test from 150.183.234.132
twn001.sdfarm.kr	authpriv	12:07:30	sshd	sshd[1035]: Connection closed by 150.183.234.132
twn001.sdfarm.kr	authpriv	12:07:20	sshd	sshd[1034]: Failed password for invalid user hacker from 150.183.234.132 port 42752 ssh2
twn001.sdfarm.kr	authpriv	12:07:20	sshd	sshd[1035]: Failed password for invalid user hacker from 150.183.234.132 port 42752 ssh2
twn001.sdfarm.kr	authpriv	12:07:16	sshd	sshd[1034]: Failed password for invalid user hacker from 150.183.234.132 port 42752 ssh2
twn001.sdfarm.kr	authpriv	12:07:16	sshd	sshd[1035]: Failed password for invalid user hacker from 150.183.234.132 port 42752 ssh2
twn001.sdfarm.kr	authpriv	12:07:13	sshd	sshd[1035]: Failed none for invalid user hacker from 150.183.234.132 port 42752 ssh2
twn001.sdfarm.kr	authpriv	12:07:13	sshd	sshd[1035]: input_userauth_request: invalid user hacker
twn001.sdfarm.kr	authpriv	12:07:13	sshd	sshd[1034]: Invalid user hacker from 150.183.234.132
twn001.sdfarm.kr	authpriv	2010-02-24 10:41:20	sshd	sshd[22217]: User kisti_admin attempting to execute command scp -t /home/kisti_admin\' on command line
twn001.sdfarm.kr	authpriv	2010-02-24 10:41:20	sshd	sshd[22216]: Accepted publickey for kisti_admin from 150.183.234.134 port 48396 ssh2

Done

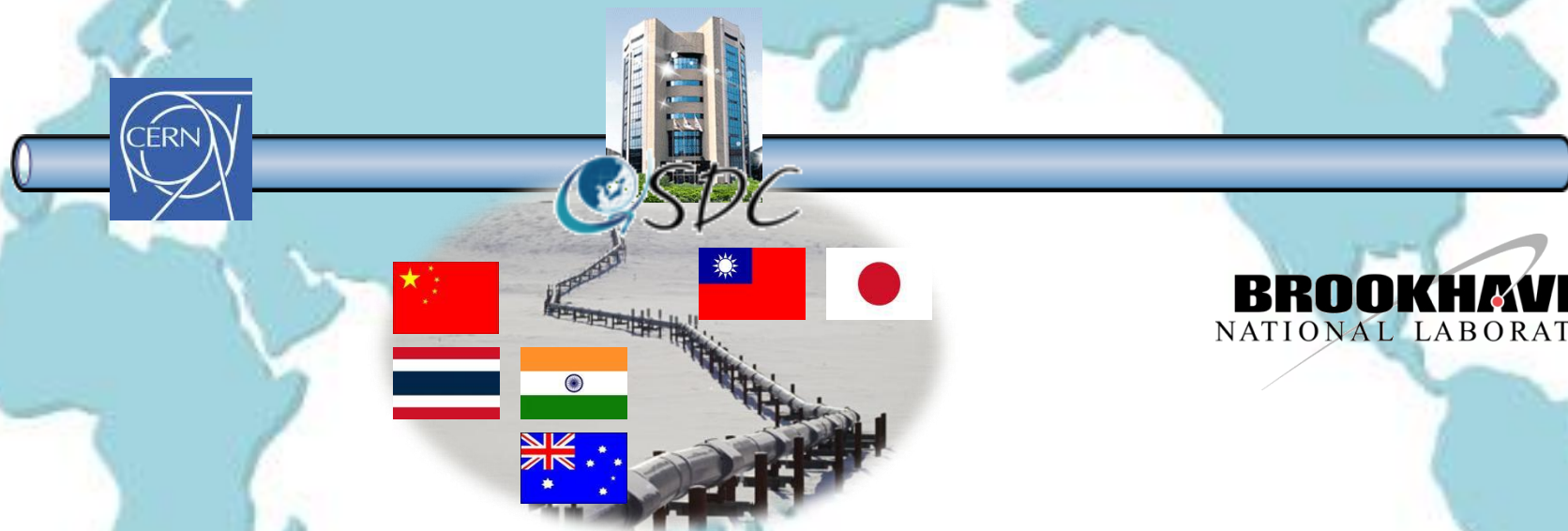
2 service warnings 11 critical services





## 5. Future Plans

# GLOBAL SCIENCE DATA PIPELINE





**Thank you!**