

E- Science Activities in Pakistan

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Islamabad, Pakistan**

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Research Programs

Experimental High Energy Physics

Pakistan has Collaboration with CERN, since 1994. Became **Associate Member** of CERN, in 2015.

Involved in various Technical & Research Projects.... [RPC Testing/commissioning](#), GEM Detectors R&D, Development of Data Control System (DCS), Testing of Data Quality & Monitoring modules(DQM), Database Development.....

Two (02) Operational WLCG Tier-2 Sites.

• Experimental Physics

- 5 MV Pelletron Tandem, Accelerator Facility.
- Application areas...Material Science, Solid state, Environmental Science, Nano technology.....

• Nano Science & Catalysis

- **Research areas** ...Bio Fuel, Nanocomposites, Energy Storage Devices, Nano medicines.

• Earthquake Studies Centre

- Part of Global Network for Forecasting Earthquakes (GNFEC)
- Perform Statistical analysis on various data sets, for Earthquake predications

• Theoretical Physics

- **Research Areas** ... Plasma Physics, Laser Physics, Advanced computing & Mathematical modelling, Condensed Matter Physics...

Worldwide LHC Computing Grid (WLCG)

Pakistan is Hosting Two (02) x Worldwide LHC Computing Grid Sites, for Collaborative Research project at CERN.

NCP-LCG2 site hosted at National Centre for Physics (NCP) , for WLCG CMS experiment.

Physical CPU Cores	No.
Logical CPU cores	524
HEP-SPEC06	6365
Storage Capacity	330TB

PK-CIIT site, hosted at Comsats Institute of Information, technology (CIIT), providing , WLCG resources to ALICE experiment.

Physical CPU Cores	
Logical CPU cores	112
HEP-SPEC06	1120

New Data Centre with increased number of Resources ...in Progress

WLCG @ NCP



Total Number of Physical CPUs = **106**

Total Number of Logical Cores = **524**

HEPSPEC06 = **6365**

KS12K = **1591**

Storage Capacity = **441 TB (Raw)**
= **330 TB (Usable)**

NCP-LCG2 and TIER-2 Site Requirement

- Requirement of Tier-2 site Resources With respect to CMS Experiment

Resources	Nominal	<u>Recommended</u>	<u>Tolerated</u>	Installed@NCP
CPU	10.9 kHS06	5 kHS06	4 kHS06	6.3 kHS06
Disk	810 TB	400 TB	300 TB	330 TB
Network	10 Gbps	1 Gbps	1 Gpbs	1 Gpbs

Hardware Specification

Computing Servers

Hardware	No. of Sockets	Cores	Quantity	Total Cores
Sun Fire X4150(Intel(R) Xeon(R) CPU X5460 @ 3.16GHz)	02	04	28	224
Dell Power Edge R610 (Intel(R) Xeon(R) CPU X5670 @ 2.93GHz)	02	06	25	300
				524 CPUs

Storage Servers

Storage Server	Total Disks/Server	Servers Quantity	Raw Capacity
Transtec Lynx 4300	23 x 1TB	15	345 TB
Dell Power Edge T620	24 X 2TB	2	96TB
			441 TB Total

Procurement of additional 100 TB in Progress

Status of NCP-LCG2 site

Installed Resources from 2008-2017

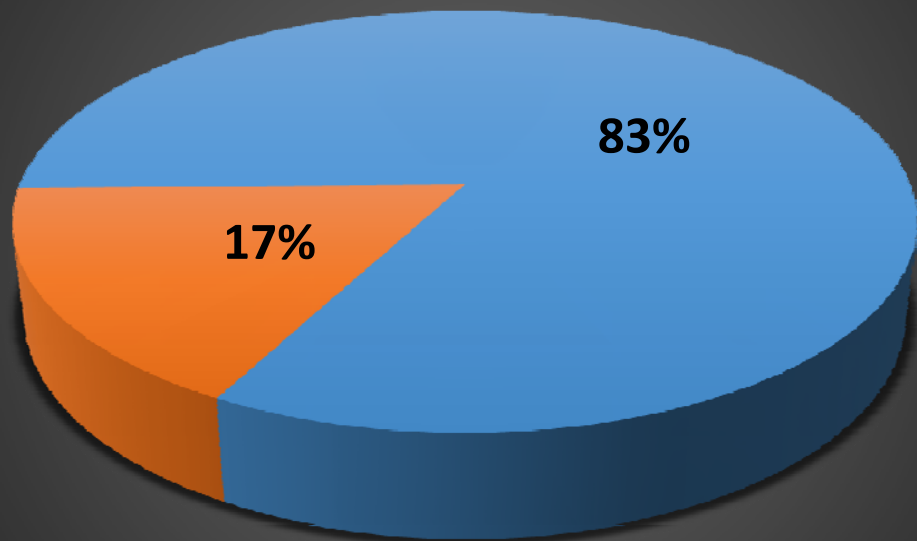
Year	CPU	HEPSPEC06	Storage	Network Connectivity
Jan-08	14	67.2	3.2 TB	2 Mbps (Shared)
April-08	36	172.8	3.2 TB	2 Mbps (Shared)
Sep-08	74	355.2	3.2 TB	10 Mbps (dedicated)
Feb-10	160	1600	3.2 TB	10 Mbps (dedicated)
Jun-10	240	2400	69 TB	155 Mbps (dedicated)
Dec-10	524	6365	87TB	155 Mbps (dedicated)
Jun-11	524	6365	175TB	155 Mbps (dedicated)
May-12	524	6365	260TB	155 Mbps (dedicated)
Oct-14	524	6365	330TB	155 Mbps (dedicated)
April-2015-----	524	6365	330TB	1 Gbps (connectivity)

Resource Utilization (2011-2016)

Year	KSI2K-Hours	No. of Jobs
2011	2,816,009	614,215
2012	3,791,319	630,629
2013	427,846	308,065
2014	609,034	165,002
2015	1,800,557	239,315
2016	1,474,279	347,339

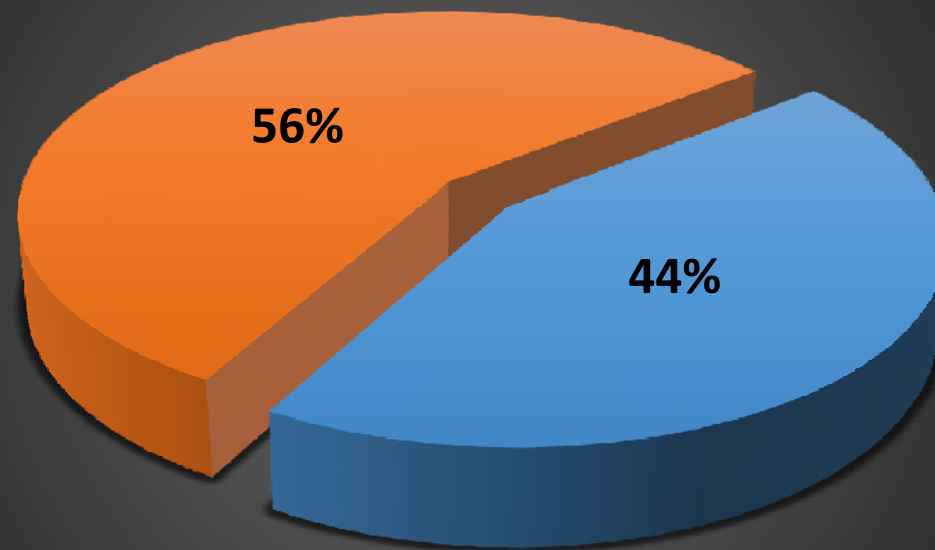
Contribution to CMS & ALICE 2014-2016

No. of Jobs (2014-2016)



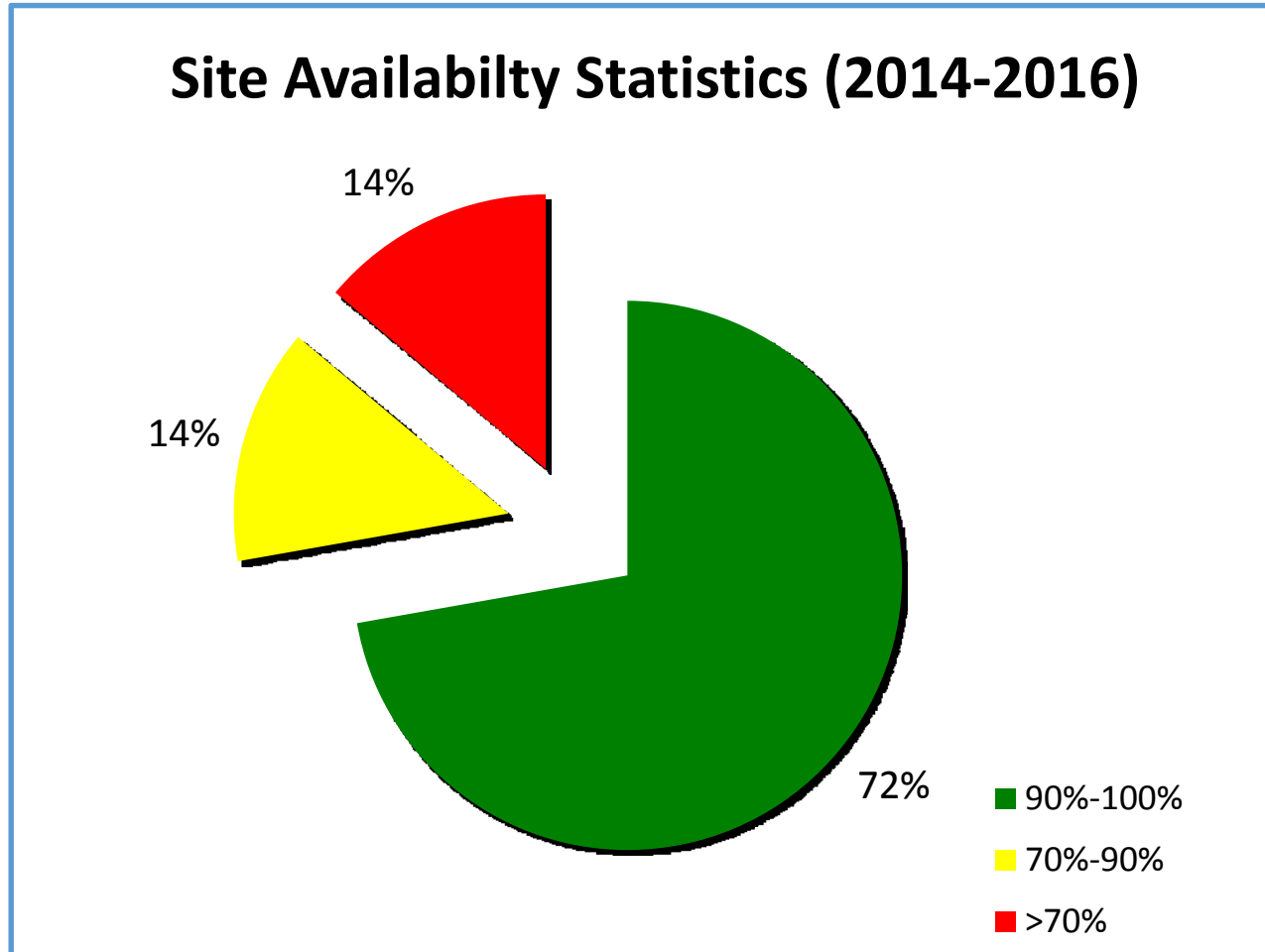
CMS ■ ALICE

Normalised CPU Time



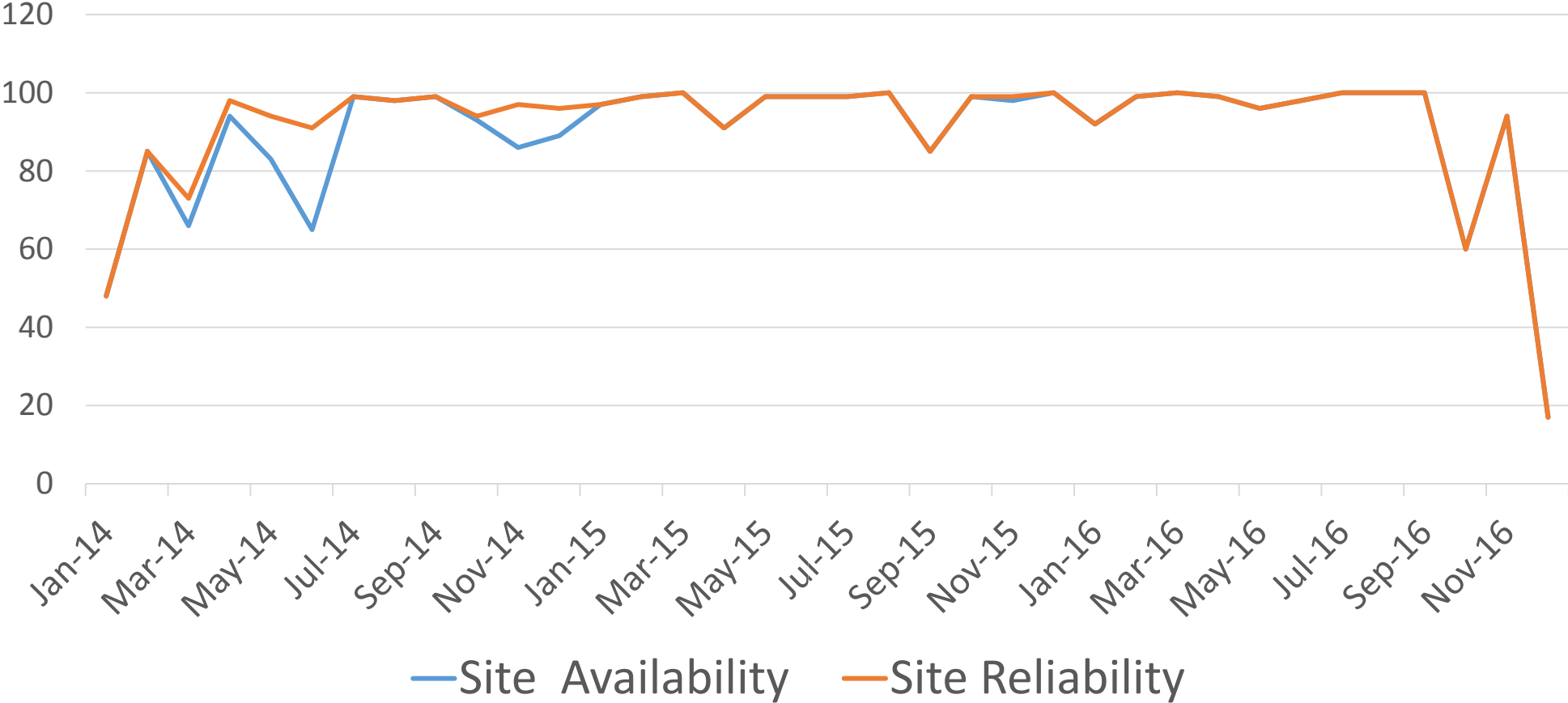
■ CMS ■ ALICE

NCP-LCG2 Status (3 Years)

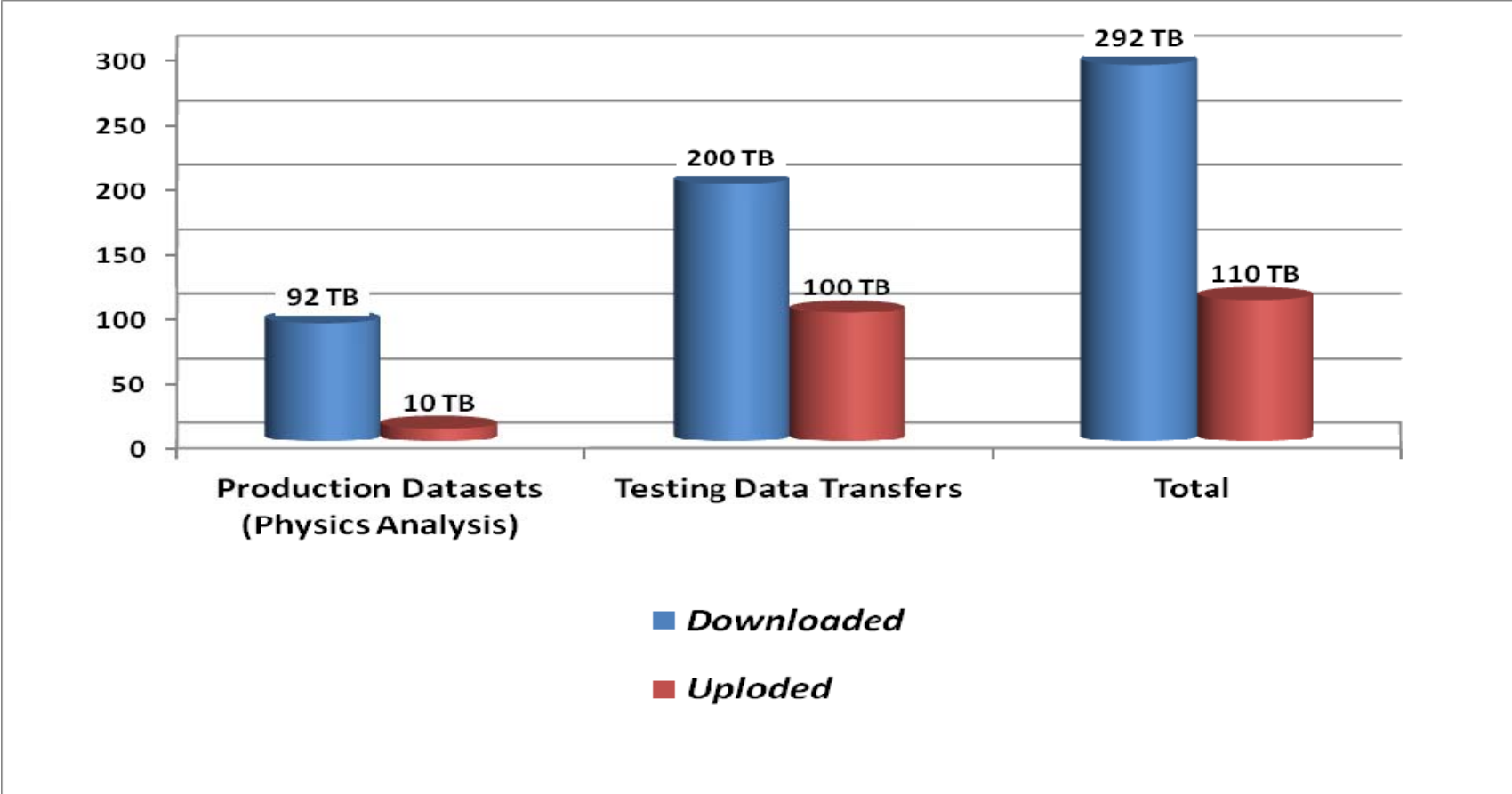


NCP-LCG2 Status

NCP-LCG2 site status



Data Transfer (Last 6 Months)



Non GRID HPC

- Local Linux/MPI cluster based on [Rocks Cluster Distribution](#).
- 84 CPU cores are reserved for non grid computing.
- This cluster is being used by researchers working in different disciplines across Pakistan.
- The user base of this facility comprises students, researchers and faculty members of different universities and research institutes.

Non GRID HPC Research Areas

Some of the scientific areas where researchers are benefitting from this facility are as follows:

- Computation Fluid Dynamics (CFD)
- Molecular Biology
- Bio Chemistry
- Condensed Matter Physics
- Space Physics
- Weather Forecasting
- Density Functional Theory (DFT)
- Ion channeling
- Multi-Particle Interaction
- Earthquake studies.

Cluster Usage Trend

Report at Thu, 02 Mar 2017 11:04:01 +0500

Get Fresh Data

hour 2hr 4hr day week month year job or from to Go Clear

Physical View

cluster > --Choose a Node

Overview of cluster @ 2017-03-02 11:03

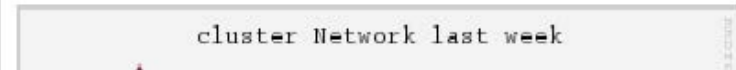
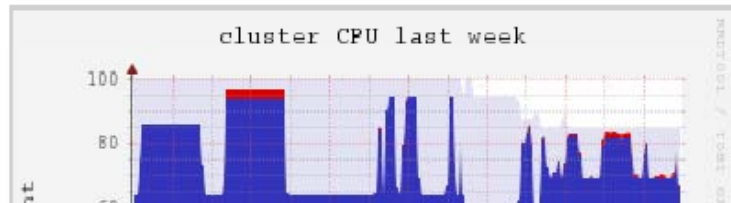
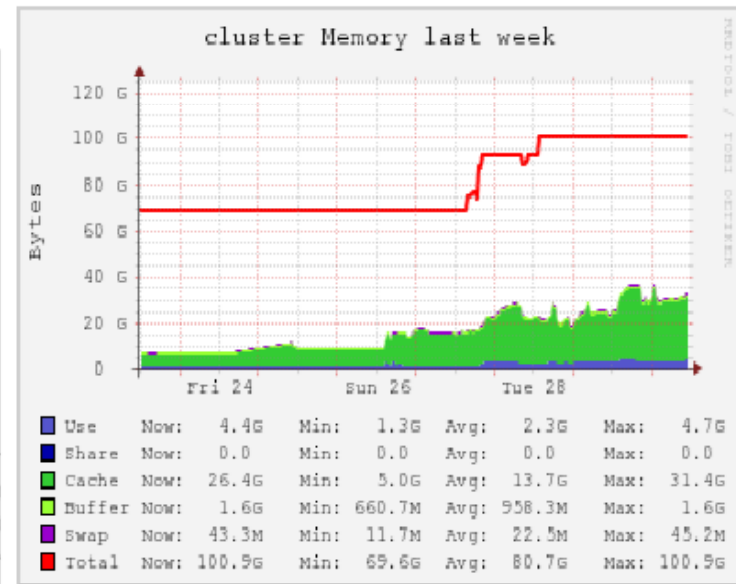
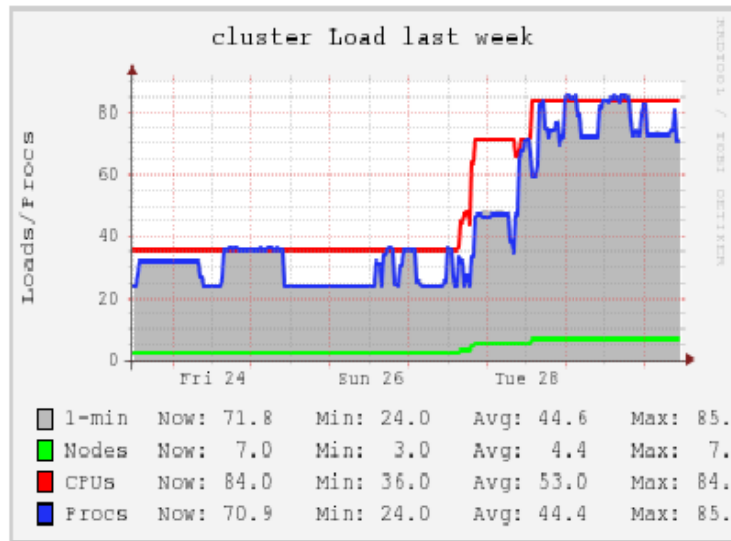
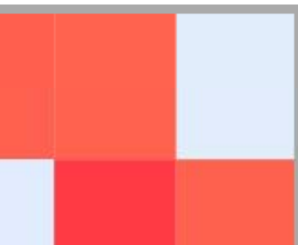
Total: 84
 up: 7
 down: 0

1-min Load Avg (15, 5, 1m):
 0, 74%, 74%

utilization (last week):

0

Server Load Distribution



Private Cloud @ NCP

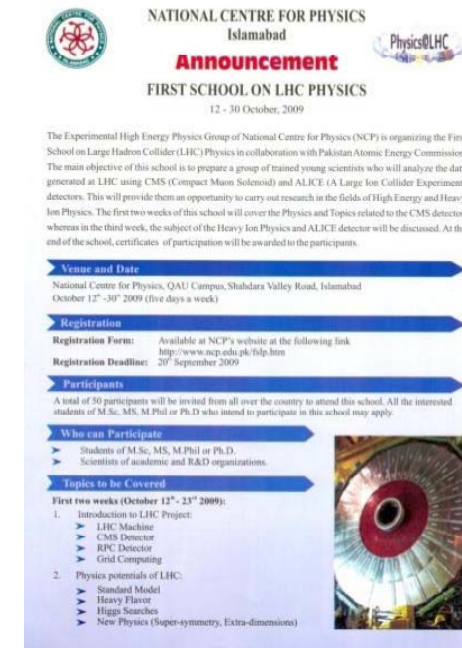
- As, NCP is hosting two different computing environments:
 - WLCG-TIER-2 site for EHEP community
 - Local computing cluster for other scientific community
- Open Stack based Private cloud has been deployed recently , to provision computing resources to different these computing environments in a flexible way.

PK-GRID-CA

- PK-GRID-CA at National Centre for Physics (NCP), is an accredited and First certification Authority (CA), in Pakistan.
- Formally approved as Certification Authority (CA) from [EU-GRID-PMA](#), in 2004.
 - Total Certs Issued : 510
 - User Certs : 284
 - Host Certs : 226
 - Certificates Expired : 353
 - Certificates Revoked : 86
 - Active Certificates : 71

Events/Workshops and Conferences for HRD

- National Centre for Physics (NCP) hosts/organize number of scientific events throughout the year, in collaboration with CERN, ICTP (Italy) and other National Institutes.
 - International Scientific School (ISS)
 - International NathiaGali Summer College (INSC)
 - LHC School on Physics
 - International College on Plasma Physics
 - TEIN HRD workshop on IPv6 Deployment (*Funded By TEINCC, 2015*)



NATIONAL CENTRE FOR PHYSICS
Islamabad

Announcement

FIRST SCHOOL ON LHC PHYSICS
12 - 30 October, 2009

The Experimental High Energy Physics Group of National Centre for Physics (NCP) is organizing the First School on Large Hadron Collider (LHC) Physics in collaboration with Pakistan Atomic Energy Commission. The main objective of this school is to prepare a group of trained young scientists who will analyze the data generated at LHC using CMS (Compact Muon Solenoid) and ALICE (A Large Ion Collider Experiment) detectors. This will provide them an opportunity to carry out research in the fields of High Energy and Heavy Ion Physics. The first two weeks of this school will cover the Physics and Topics related to the CMS detector, whereas in the third week, the subject of the Heavy Ion Physics and ALICE detector will be discussed. At the end of the school, certificates of participation will be awarded to the participants.


Venue and Date
National Centre for Physics, QAU Campus, Shubkara Valley Road, Islamabad
October 12th -30th 2009 (five days a week)

Registration
Registration Form: Available at NCP's website at the following link
<http://www.ncp.edu.pk/fslp.htm>
Registration Deadline: 20th September 2009

Participants
A total of 50 participants will be invited from all over the country to attend this school. All the interested students of M.Sc., MS, M.Phil or Ph.D who intend to participate in this school may apply.

Who can Participate
➤ Students of M.Sc., MS, M.Phil or Ph.D.
➤ Scientists of academic and R&D organizations.

Topics to be Covered
First two weeks (October 12th - 23rd 2009):
1. Introduction to LHC Project:
➤ LHC Machine
➤ CMS Detector
➤ RPC Detector
➤ Grid Computing
2. Physics potentials of LHC:
➤ Standard Model
➤ Heavy Flavor
➤ Higgs Searches
➤ New Physics (Super-symmetry, Extra-dimensions)



E-Infrastructure for R&D

Pakistan's National Education & Research Network, managed by Higher Education Commission(HEC)

- PERN (2003-2008)
- ~ 87 Universities/institutes and R&D connected.
- 155 Mbps CORE bandwidth.
- 4-24Mbps Last mile bandwidth.
- PERN2 (2009-2015)
- 250 + Universities/Institutes and R&D organization connected.
- Core bandwidth 10 Gbps.
- International NREN connectivity 1Gbps

PERN3 (2016)

- Upgradation of core bandwidth to 40Gbps
- Last Mile 10Gbps connectivity to University/Research centre.
- Connectivity to International Academic institutes.
- SMART universities
Wireless Coverage

E-Infrastructure for R&D

Pakistan's National Education and Research Network, With Other NREN's through Trans-EurAsia Information Network (TEIN)

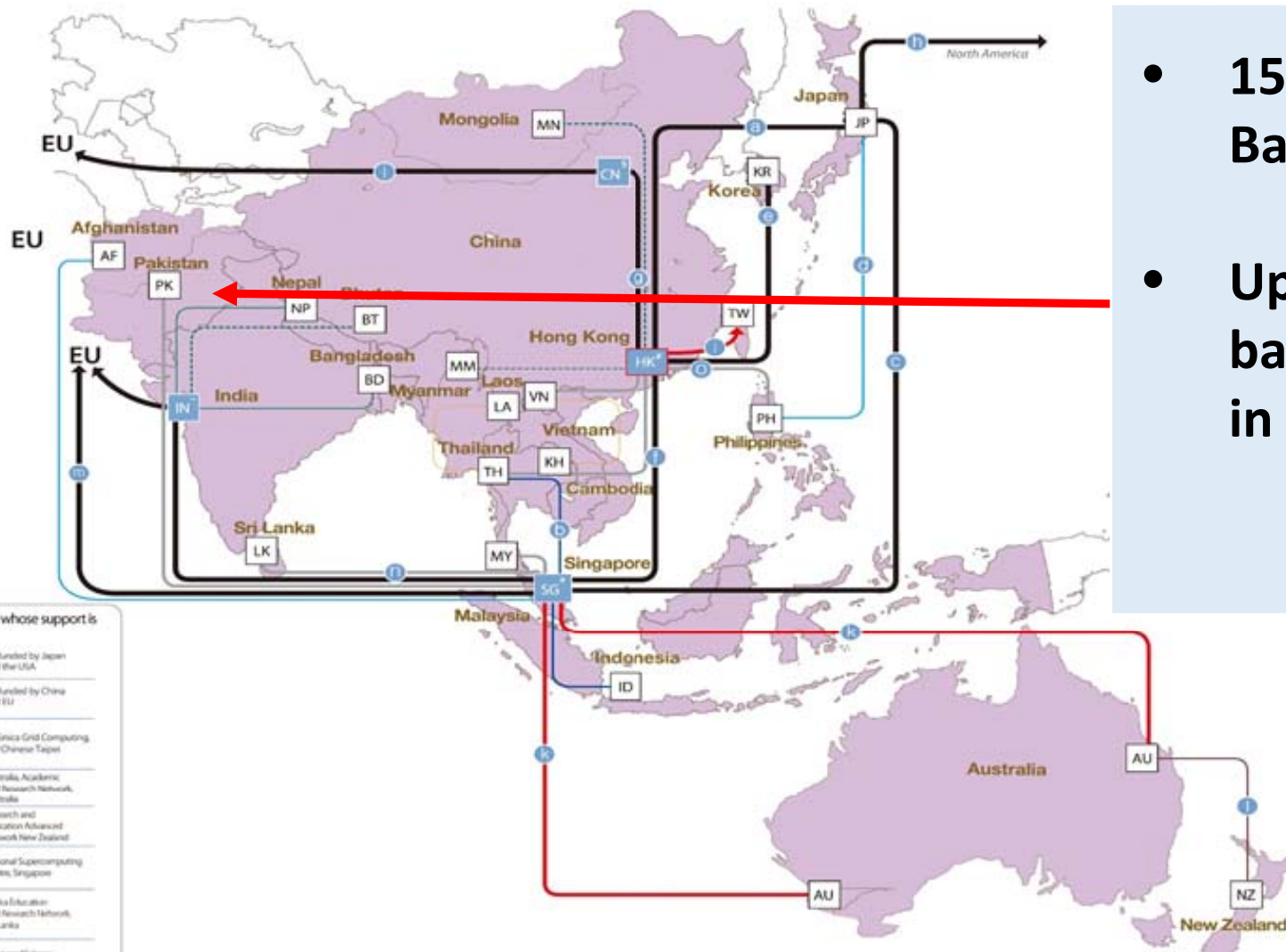
TEIN
Connecting Asia and Europe's Research and Education Communities
www.tein.asia

TEIN Project Partners

Afghanistan	ID	Indonesia	NZ	New Zealand
Australia	JP	Japan	PK	Pakistan
Bangladesh	KR	Korea	PH	Philippines
Bhutan	LA	Laos	SG	Singapore
Cambodia	MM	Myanmar	LK	Sri Lanka
China	MN	Mongolia	TH	Thailand
Hong Kong	MY	Malaysia	TW	Taiwan
India	NP	Nepal	VN	Vietnam

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National Information Society Agency, South Korea	National Supercomputing Centre, Singapore
China Education and Research Network, China	Lanka Education and Research Network, Sri Lanka



- 155 Mbps Bandwidth in 2008
- Upgraded bandwidth 1Gbps in 2015

Thanks for Attention.

Question?