


Computing Infrastructure for Research in Asia

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Importance of Global Grid e-Infrastructure in Asia

- The exponential growth of ICT as Enabling Technology in the last 40 years will drive the global economy in the 21st century
- A pull force, such as building Grid e-Infrastructure, that could integrate the global computing resources will optimise the power of ICT leading to a Paradigm Shift
- The ubiquity of Data Deluge in the global context is the ushering source of applications to run on Grid
- This will provide Leapfrogging opportunity for Asia

The Data Deluge

- A large novel: 1 Mbyte; The Bible: 5 Mbytes
- A Mozart symphony (compressed): 10 Mbytes
- A digital mammogram: 100 Mbytes
- OED on CD: 500 Mbytes
- Digital movie (compressed): 10 Gbytes
- Annual production of refereed journal literature (~20 k journals; ~2 M articles): 1 Tbyte
- Library of Congress: 20 Tbytes
- The Internet Archive (10 B pages) (From 1996 to 2002): 100 Tbytes
- Annual production of information (print, film, optical & magnetic media): 1500 to 3000 Pbytes
- All Worldwide Telephone communication in 2002: 19.3 ExaBytes
- Moore's Law enables instruments and detectors to generate unprecedented amount of data in all scientific disciplines

Large Hadron Collider Data

- 40 million collisions per second
- After filtering, 100 collisions of interest per second
- A Megabyte of digitised information for each collision = recording rate of 0.1 Gigabytes/sec
- 10^{11} collisions recorded each year
  = 10 Petabytes/year of data
- Data: ~15 Petabytes a year
  Processing: ~ 100,000 of today's PC's (200+ TeraFlops)
- Networking:
  10 – 40 Gb/s to all big centres
- computing centres, which were isolated in the past, will now be connected, uniting the computing resources of particle physicists in the world using GRID technology!

LCG Service/ Data Hierarchy

Tier-0 – the accelerator centre

- Data acquisition & initial processing
- Long-term data curation
- Distribution of data → Tier-1 centres

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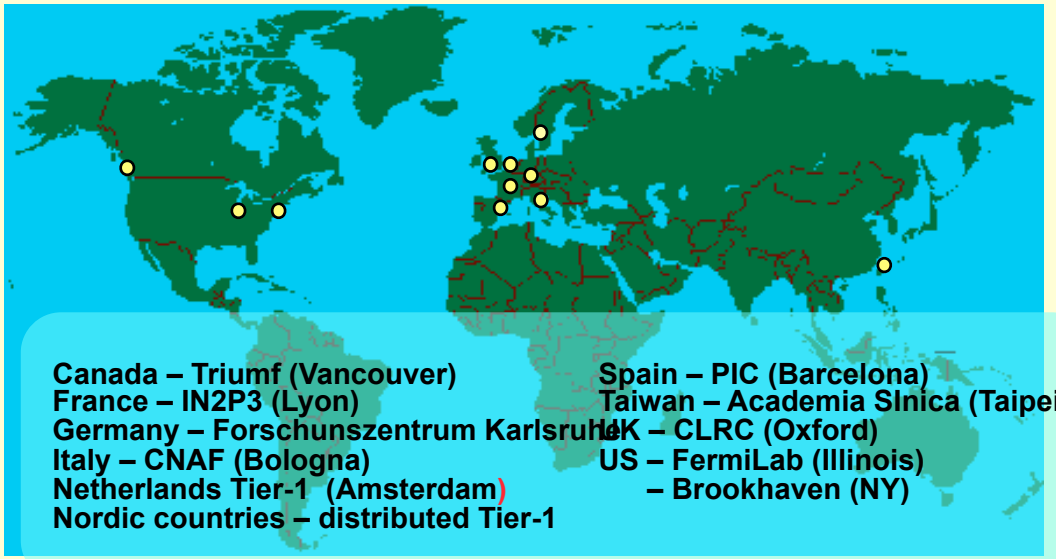

Canada – Triumf (Vancouver)
France – IN2P3 (Lyon)
Germany – Forschunszentrum Karlsruhe
Italy – CNAF (Bologna)
Netherlands Tier-1 (Amsterdam)
Nordic countries – distributed Tier-1
Spain – PIC (Barcelona)
Taiwan – Academia SInica (Taipei)
UK – CLRC (Oxford)
US – FermiLab (Illinois)
– Brookhaven (NY)

Tier-1 – "online" to the data acquisition process → high availability

- Managed Mass Storage – → grid-enabled data service
- Data-heavy analysis
- National, regional support

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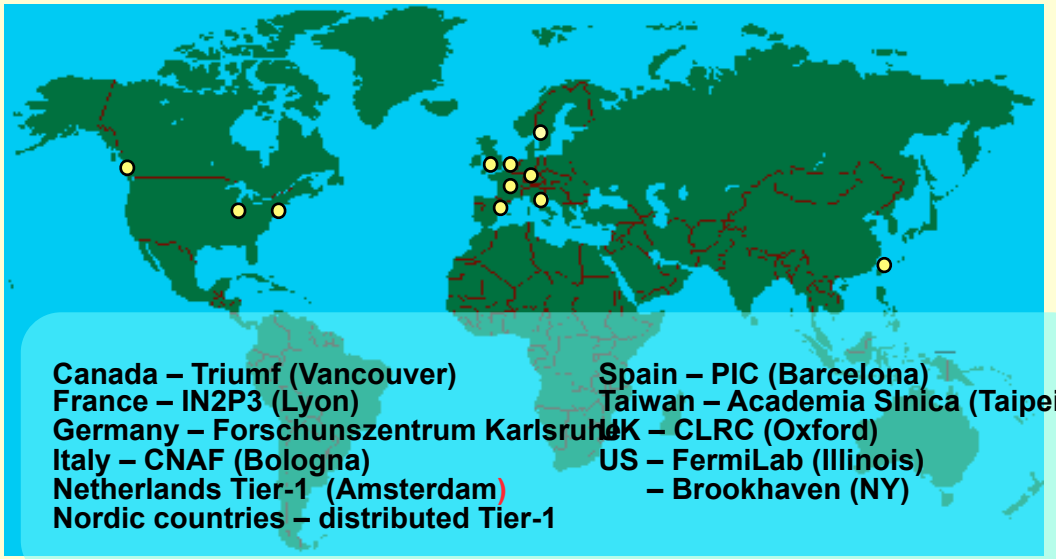

Tier-1 – "online" to the data acquisition process → high availability

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Tier-2 : ~120 centres (40-50 federations) in ~29 countries

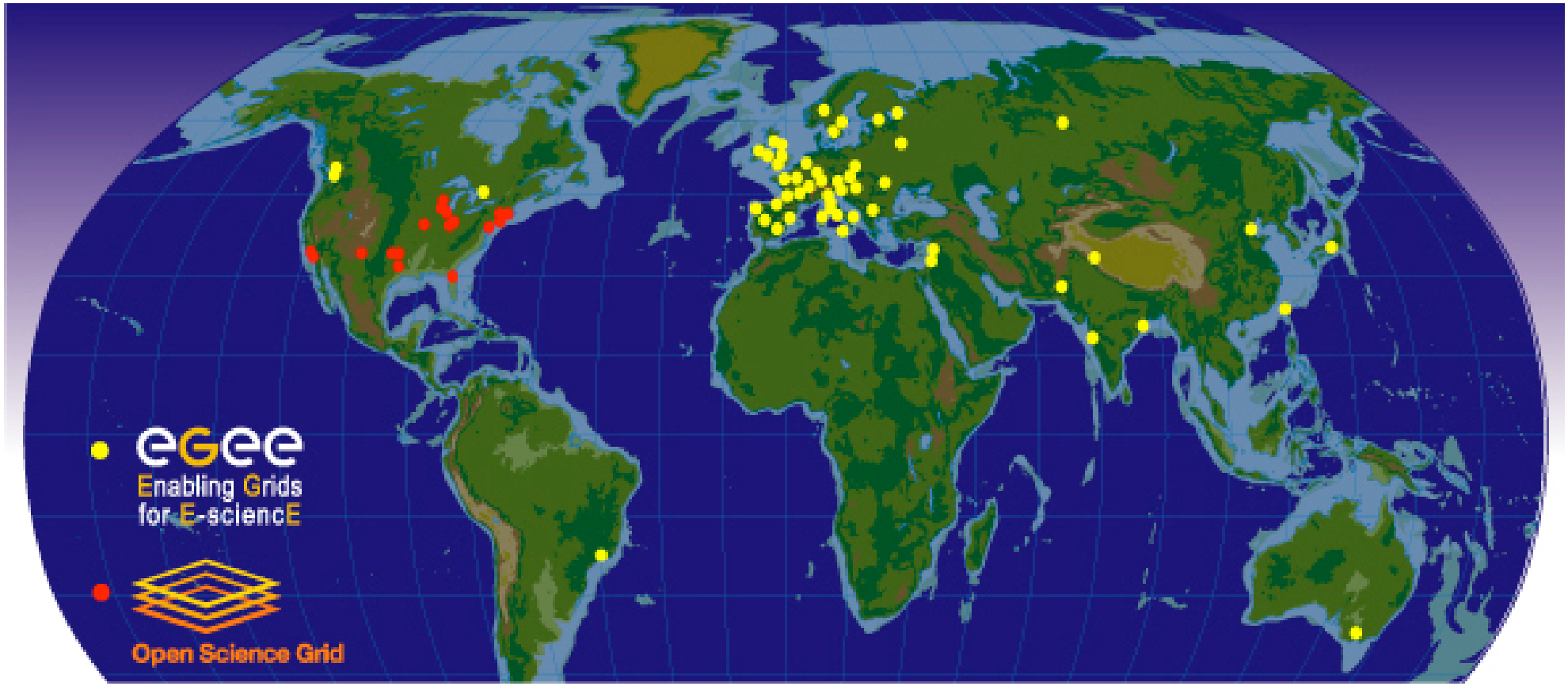
- Simulation
- End-user analysis – batch and interactive

LCG depends on 2 major science grid infrastructures

The LCG service runs & relies on grid infrastructure provided by:

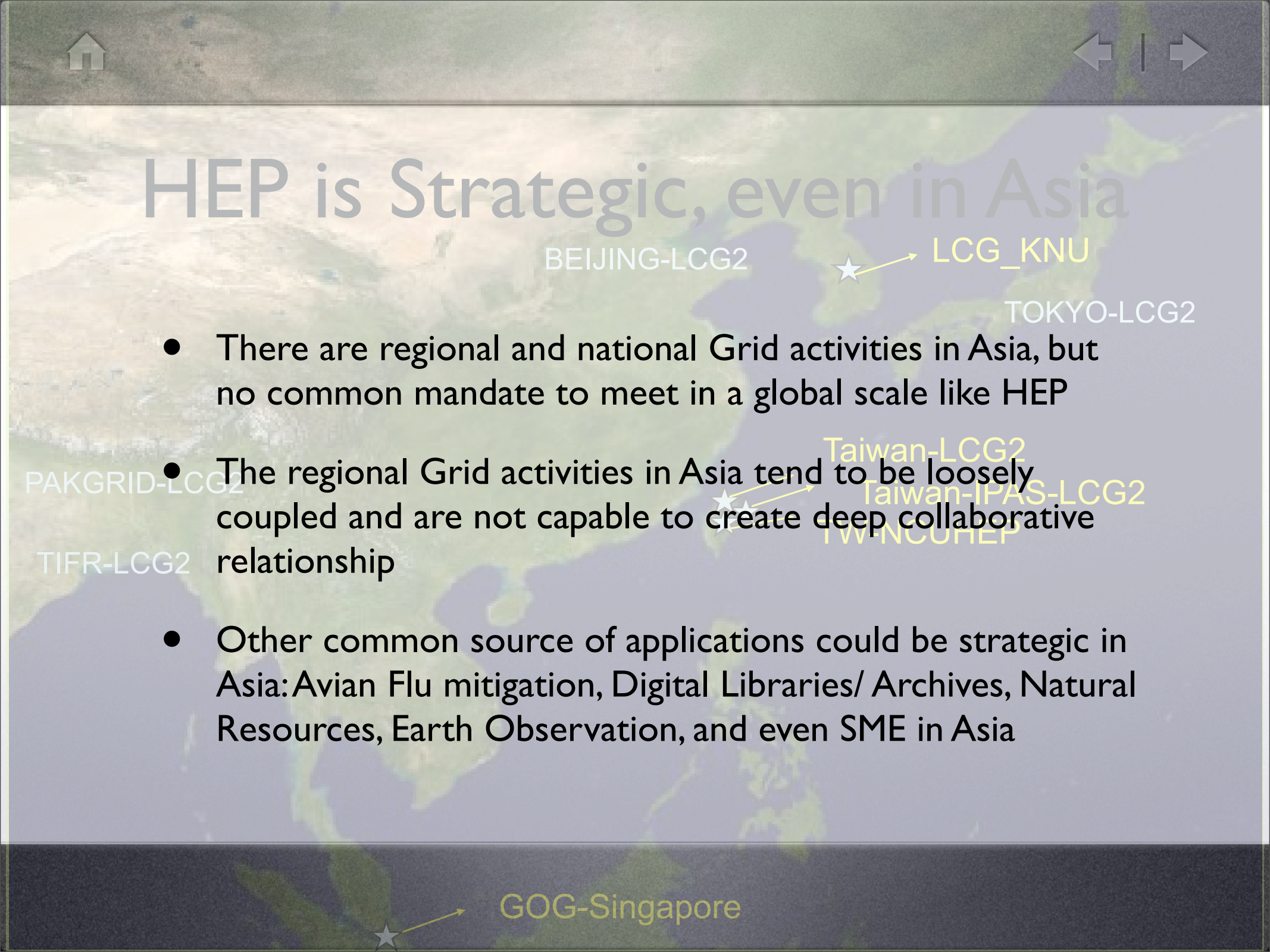
EGEE - Enabling Grids for E-Science

OSG - US Open Science Grid



A map of the worldwide LCG infrastructure operated by EGEE and OSG.

HEP is Strategic, even in Asia



- There are regional and national Grid activities in Asia, but no common mandate to meet in a global scale like HEP
- The regional Grid activities in Asia tend to be loosely coupled and are not capable to create deep collaborative relationship
- Other common source of applications could be strategic in Asia: Avian Flu mitigation, Digital Libraries/ Archives, Natural Resources, Earth Observation, and even SME in Asia


Challenges in Asia

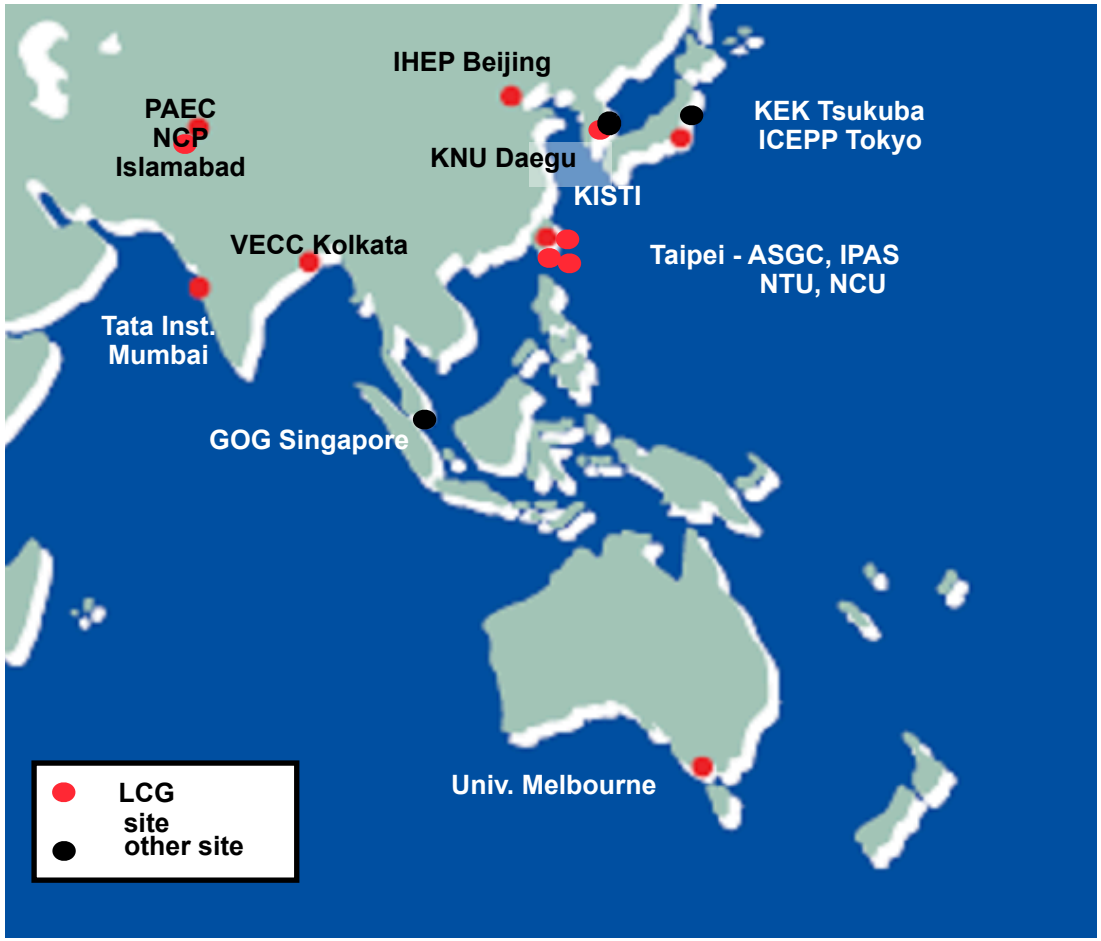
- Large geographic area segmented by sea
- Weaker collaborative scientific tradition within the region, thus, the culture for collaboration to be built
- Largely, focus on its own Grid technology development rather than participating global infrastructure building in the first place
- No coherent, coordinated funding such as in Europe and US


Are the Europe and US Helping?

- Many activities from Europe: TEIN2/3, EU-China Grid, EU-India Grid, EU-SEA, Asia Federation in EGEE, etc
- Activities from US: TransPAC, Gloriad, OSG
- Perhaps, due to different funding sources and project objectives, the above activities do not have enough coordination among each projects
- Difficult to build a single coordinating body in Asia


Luckily, WLCG/ EGEE/ OSG are Working Together in Asia

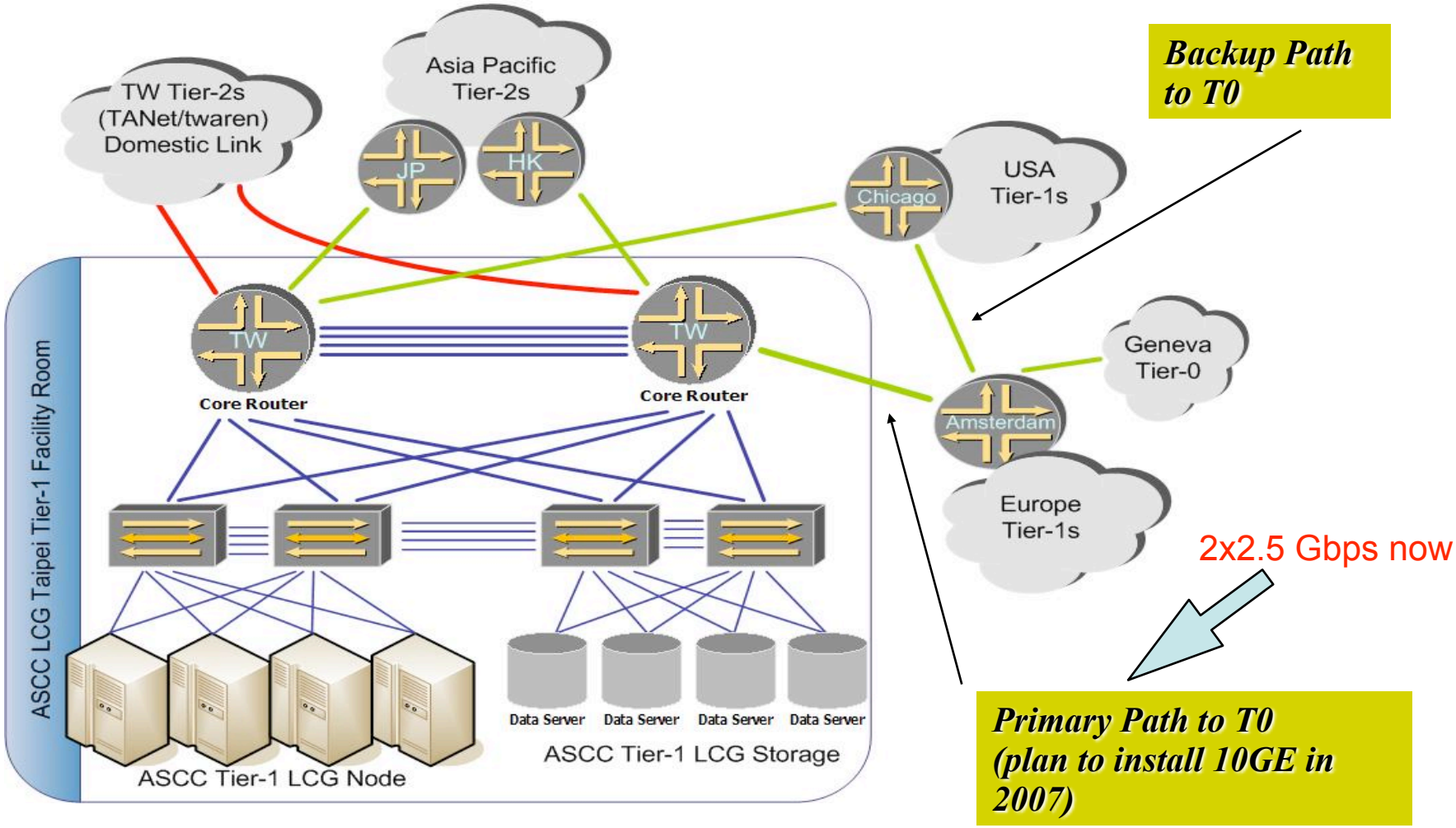
WLCG/EGEE Asia-Pacific



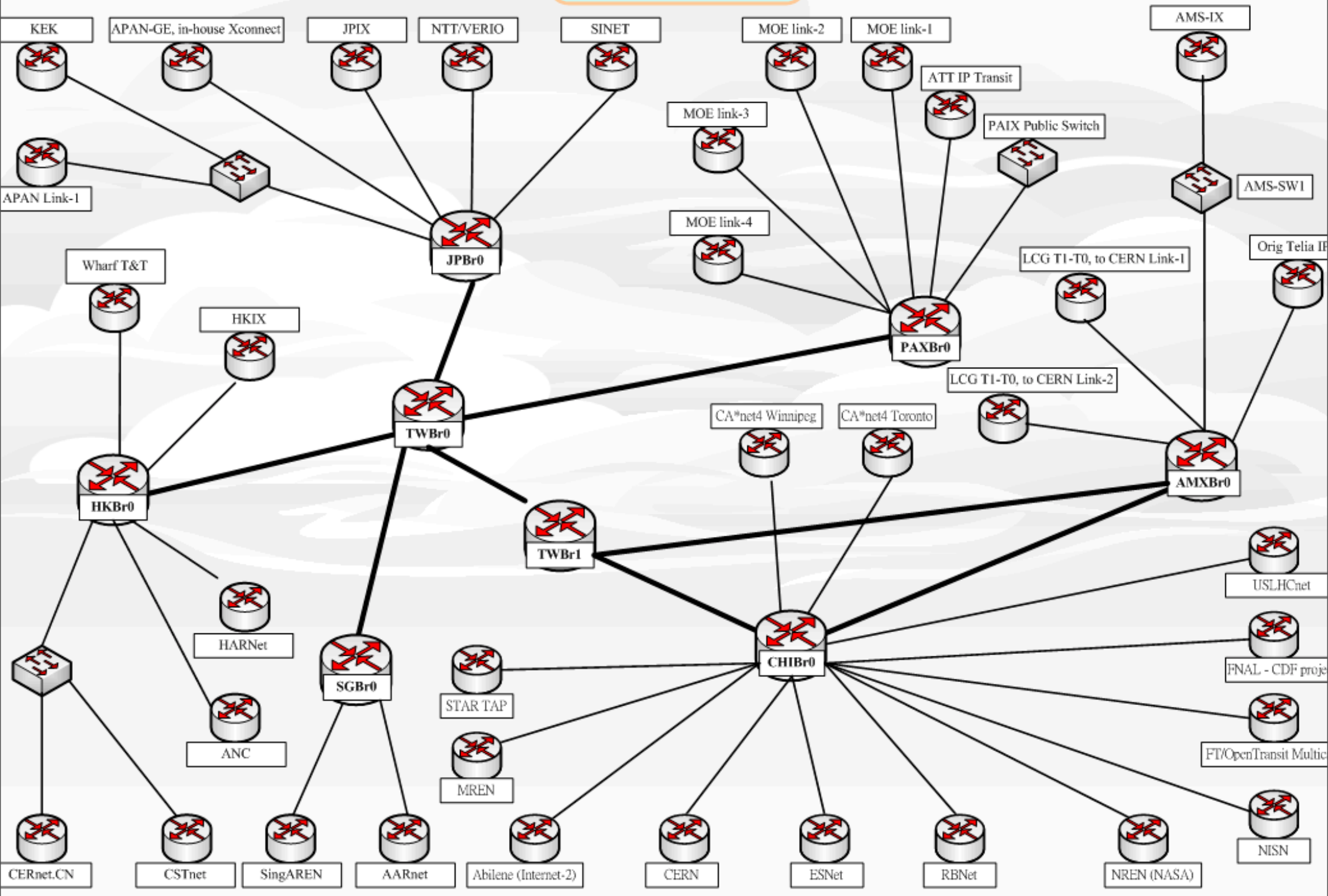
- 12 LCG sites and 3 EGEE sites in Asia Pacific
- Academia Sinica Grid Computing Centre (ASGC) is acting as the coordinator, also
  - the WLCG Tier-1 Centre
  - WLCG/EGEE Operation Centre in Asia Pacific Region
- Potential Sites
  - Thailand, Malaysia, Australia, New Zealand

■AP Federation now shares the e-Infrastructure with WLCG

Plan for Taiwan Tier-1 Network

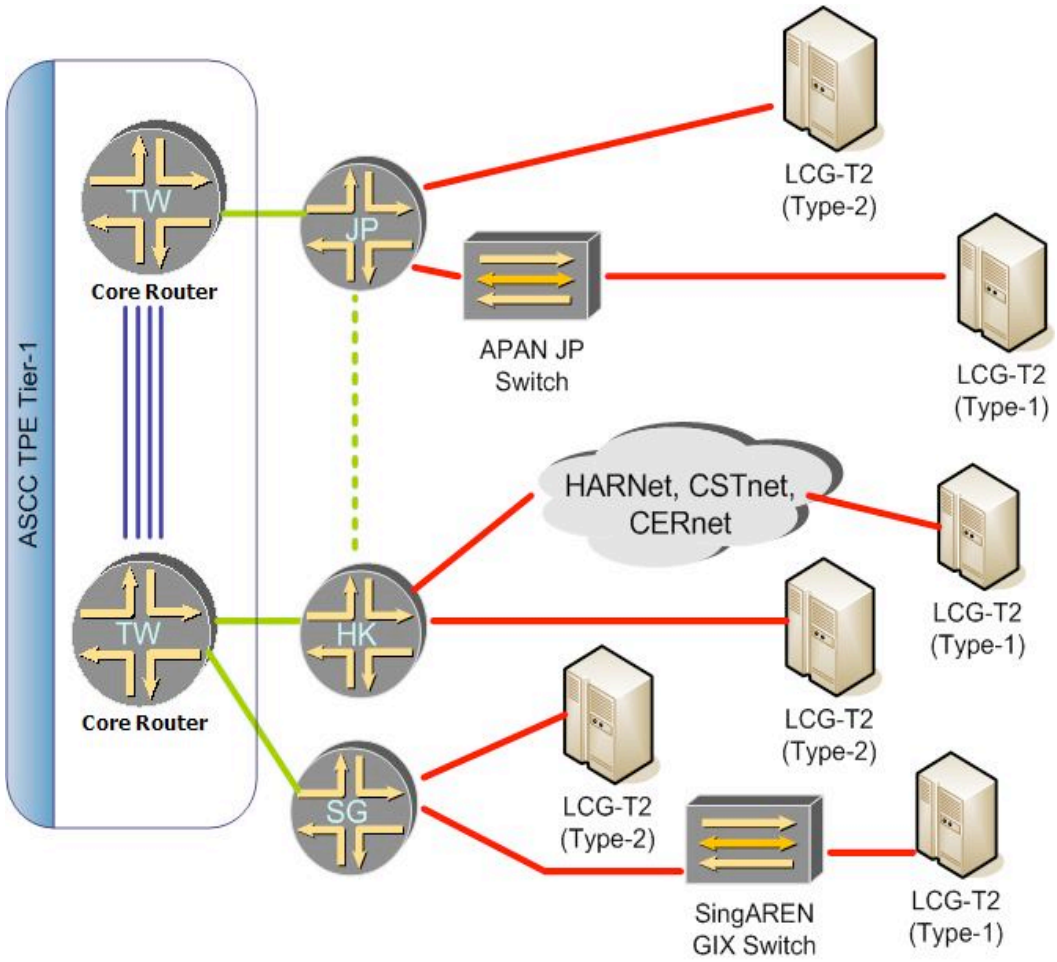


ASnet Peers



2006/09/

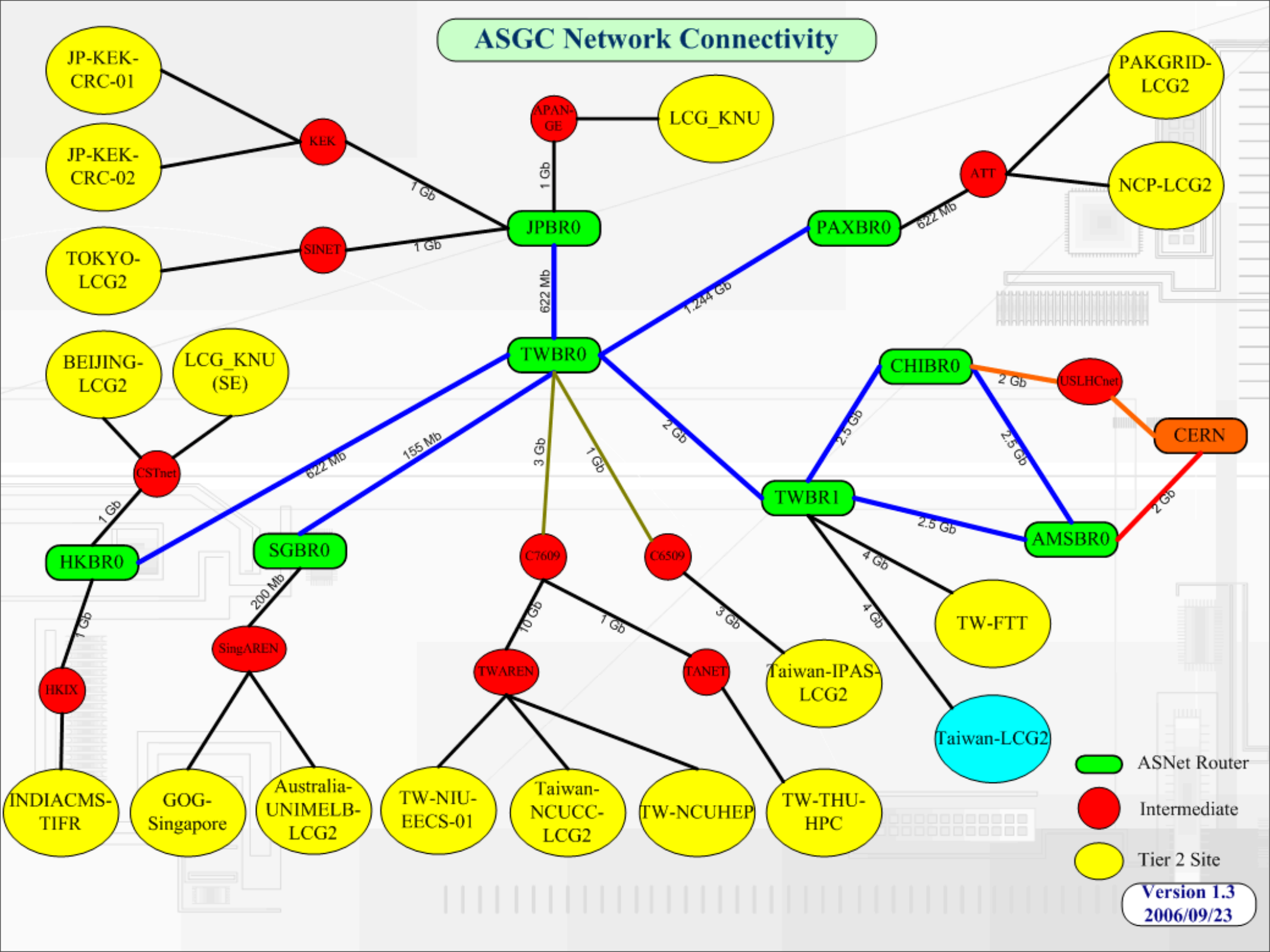
AP Regional LCG Network



Just Build a New Link between TW-AU, reduce RTT from 380 to 138 ms via Singapore!

- *Solid lines between routers (circle) and switches (box) and networks are already exist.*
- *Solid lines between T2 and routers / switches /networks are already exist and/or proposed.*
- *Dashed line are currently planned by ASnet and will be installed in 2006/7.*
- *Type-2 is "direct-connect"*

  Type-1 is passing through 3rd party facility or 3rd party network

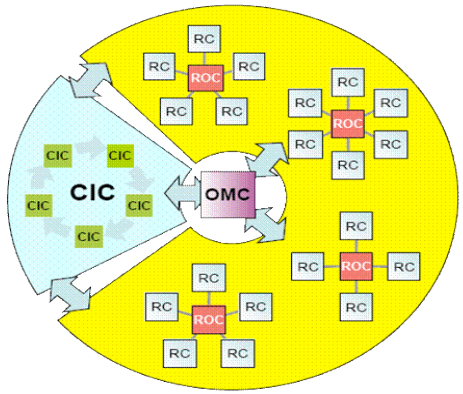

ASGC Network Connectivity
JP-KEK-CRC-01
JP-KEK-CRC-02
TOKYO-LCG2
KEK
SINET
APAN-GE
LCG_KNU
JPBR0
TWBR0
PAXBR0
ATT
PAKGRID-LCG2
NCP-LCG2
BEIJING-LCG2
LCG_KNU (SE)
CSTnet
HKBR0
SGBR0
HKIX
SingAREN
INDIACMS-TIFR
GOG-Singapore
Australia-UNIMELB-LCG2
C7609
C6509
TWAREN
TANET
TW-NIU-EECS-01
Taiwan-NCUCC-LCG2
TW-NCUHEP
TW-THU-HPC
Taiwan-IPAS-LCG2
CHIBR0
USLHCnet
CERN
TWBR1
AMSBR0
TW-FTT
Taiwan-LCG2
1 Gb
622 Mb
1.244 Gb
155 Mb
200 Mb
3 Gb
2 Gb
2.5 Gb
4 Gb
10 Gb
ASNet Router
Intermediate
Tier 2 Site
Version 1.3
2006/09/23

WLCG/EGEE Asia Pacific Services by Taiwan

- Production CA Services: production service from July 2003
- AP CIC/ROC: 9 sites 7 countries, > 400 CPUs
- VO Infrastructure Support: APeSci and TWGrid
- WLCG/EGEE Site Registration and Certification
- Middleware and Operation Support
- User Support: APROC Portal (www.twgrid.org/aproc)
- MW and technology development
- Application Development
- Education and Training
- Promotion and Outreach
- Scientific Linux Mirroring and Services

APROC Services

ASGCCA
Academia Sinica Grid Computing Certification Authority



RC - Resource Centre
ROC - Regional Operations Centre
CIC – Core Infrastructure Centre

APROC Services

- APROC Goal
  - Provide deployment support facilitating Grid expansion
  - Maximize the availability of Grid services

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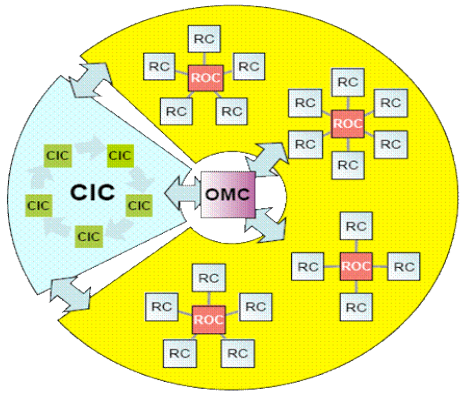

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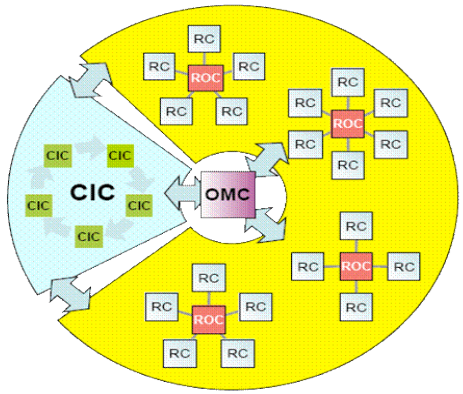

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- Supports EGEE sites in Asia Pacific
  - 16 sites, 7 countries, > 700 CPUs (will grow >1,000 by end 2006)
    - Australia Japan India
    - Korea Pakistan Singapore Taiwan

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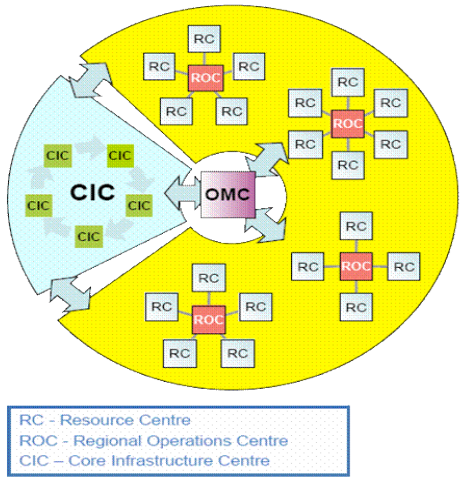

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- EGEE CIC
  - CIC-on-duty rotation: EGEE global operations
  - Monitoring tool development: GStat and GGUS Search
  - Centralized services

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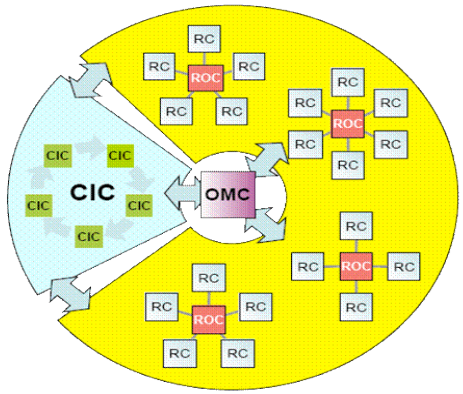

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- EGEE ROC
  - Monitoring, Diagnosis and Problem tracking M/W release deployment support
  - Security Coordination Site Registration
  - Portal and documentation

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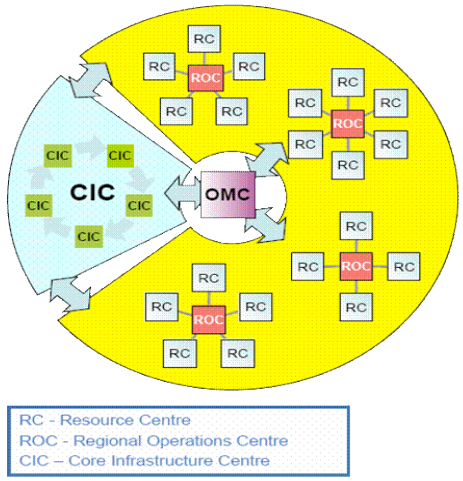

APROC – daily operations

AsiaPacific																	
1.	OK	TW-THU-HPC	ce.hpc.csie.thu.edu.tw	OK	O	2.7.0	I	O	O	??	O	O	W	??	??	X	O
2.	SD	INDIACMS-TIFR	ce.indiacms.res.in	SD	X	??	??	??	??	??	??	??	??	??	??	X	??
3.	CT	NCP-LCG2	pcncp04.ncp.edu.pk	CT	O	2.7.0	I	O	O	O	O	X	W	O	??	O	O
4.	SD	IN-DAE-VECC-01	gridce01.tier2-kol.res.in	SD	O	3_0_2	I	O	O	O	O	W	W	O	!!!	X	O
5.	OK	Taiwan-LCG2	quanta.grid.sinica.edu.tw	OK	O	3.0.0	I	O	O	O	O	O	O				
6.	CT	JP-KEK-CRC-02	rls02.cc.kek.jp	CT	O	3.0.2	I	O	O	O	O	X	W	O	??	O	O
7.	JS	TW-NCUHEP	grid01.phy.ncu.edu.tw	JS	X	3.0.2	I	O	O	O	O	O	O	O	!!!	O	O
8.	OK	Taiwan-IPAS-LCG2	atlasce.phys.sinica.edu.tw	OK	O	2.7.0	I	O	O	O	O	O	W	O	??	O	O
9.	OK	TOKYO-LCG2	dgce0.icepp.jp	OK	O	3.0.1	I	O	O	O	O	O	O	O	??	O	O
10.	OK	Taiwan-LCG2	lcg00125.grid.sinica.edu.tw	OK	O	2.7.0	I	O	X	O	O	O	O	O	??	O	X
11.	CT	PAKGRID-LCG2	CE.pakgrid.org.pk	CT	O	3.0.2	I	O	O	O	O	X	O	O	??	X	O
12.	OK	GOG-Singapore	melon.ngpp.ngp.org.sg	OK	O	3.0.2	I	O	X	O	O	O	O	O	??	X	X
13.	JS	Taiwan-NCUCC-LCG2	ce.cc.ncu.edu.tw	JS	X	2.7.0	I	O	O	O	O	O	O	O	??	O	O
14.	OK	JP-KEK-CRC-01	dg10.cc.kek.jp	OK	O	2.7.0	I	O	O	O	O	O	W	O	??	O	O
15.	OK	LCG_KNU	cluster50.knu.ac.kr	OK	O	2.7.0	I	O	O	O	O	O	O	O	??	X	O
16.	OK	TW-NIU-EECS-01	niugce.grid.niu.edu.tw	OK	O	3.0.2	I	O	O	O	O	O	W	O	??	O	O
17.	OK	Australia-UNIMELB-LCG2	lcg-compute.hpc.unimelb.edu.au	OK	O	3.0.2	I	O	O	O	O	O	W	O	??	O	O

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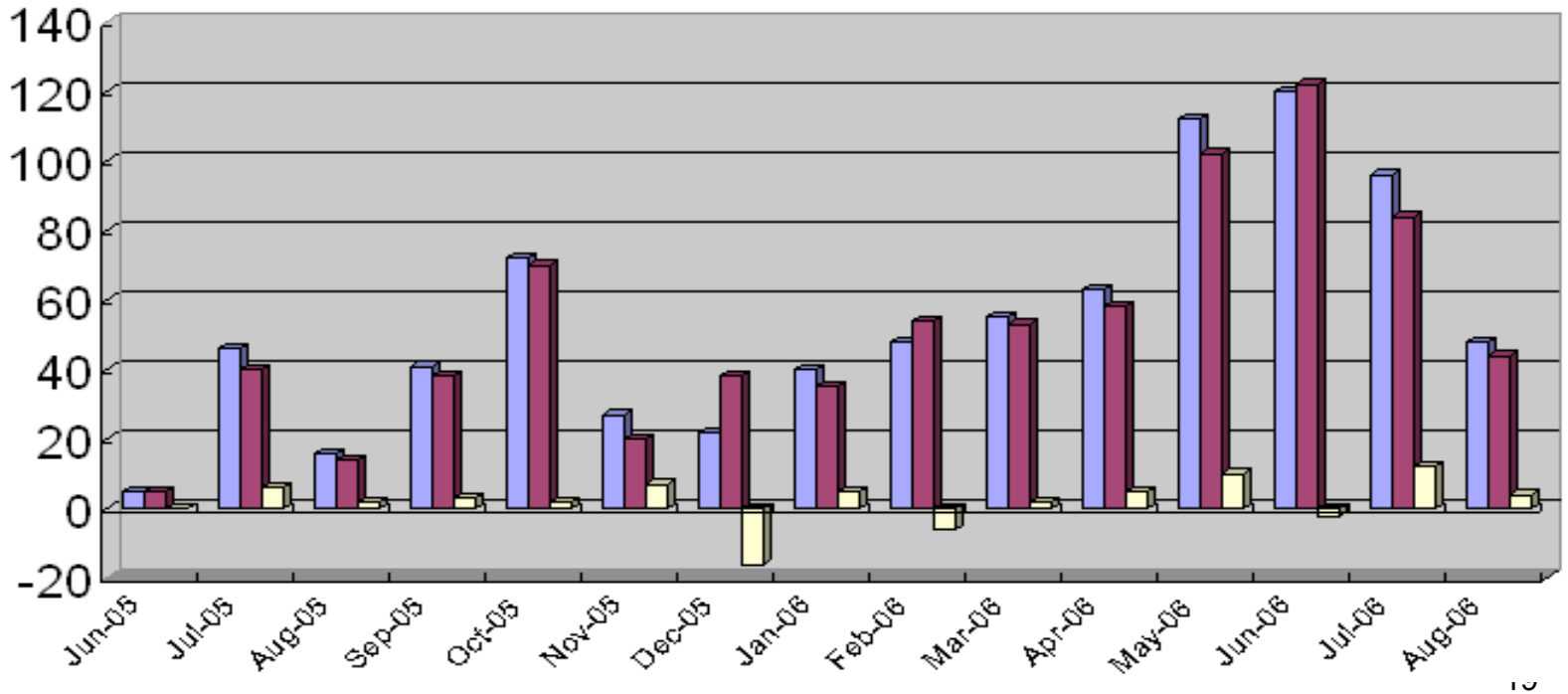
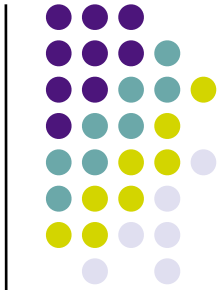
APROC Tickets Statistics

	Statistic (Tot/Ave)
Open tickets	34
Close tickets	777/51
Total tickets	811/54

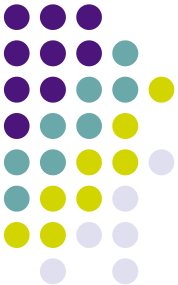


Experiences from FTS performance/ stability evaluations (I)



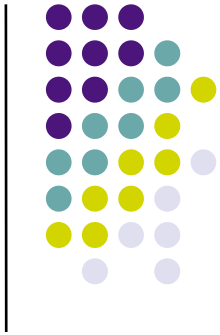
- Goal is to prepare and validate T1-T2 production transfer readiness for WLCG.
  - Primary focus is on stability and not on maximum throughput
- FTS testing is done in multiple phases
  - Functionality
  - Performance
  - Stability
- Recommend using Oracle backend for serving massive data transfer requests
  - MySQL and Oracle backend are evaluated in parallel during the testing
  - Encounter deadlock sometimes in MySQL
  - Performance of Tokyo-LCG2 gain around 17% when migrate using Oracle backend

Experiences from FTS performance/ stability evaluations (II)



- 1TB data files transfers to candidate service endpoint for performance evaluation
- Stability testing are carried out to sustain data transfers for 3-5 days

T1-T2 FTS: Performance Results

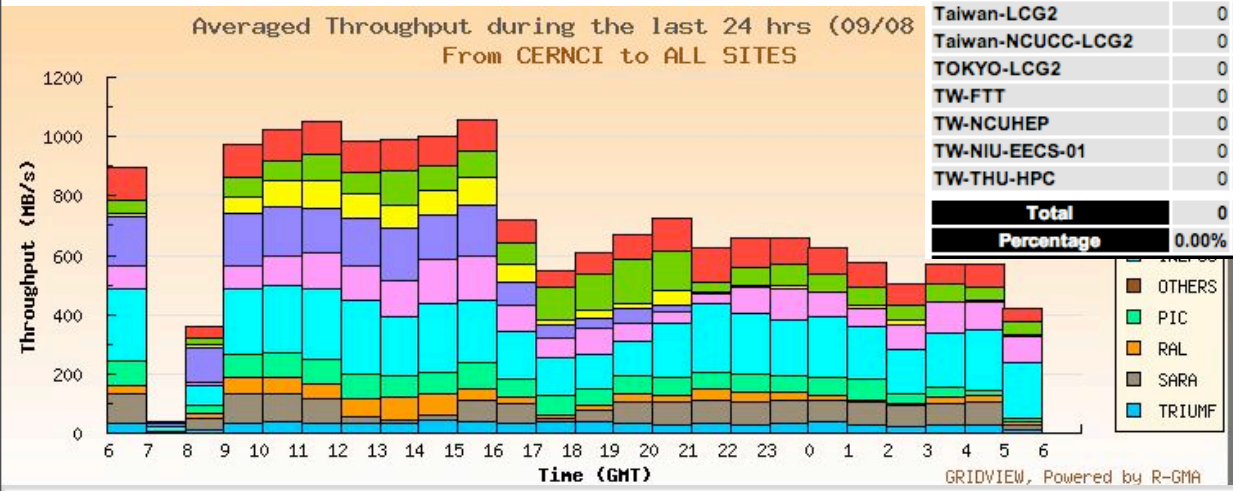


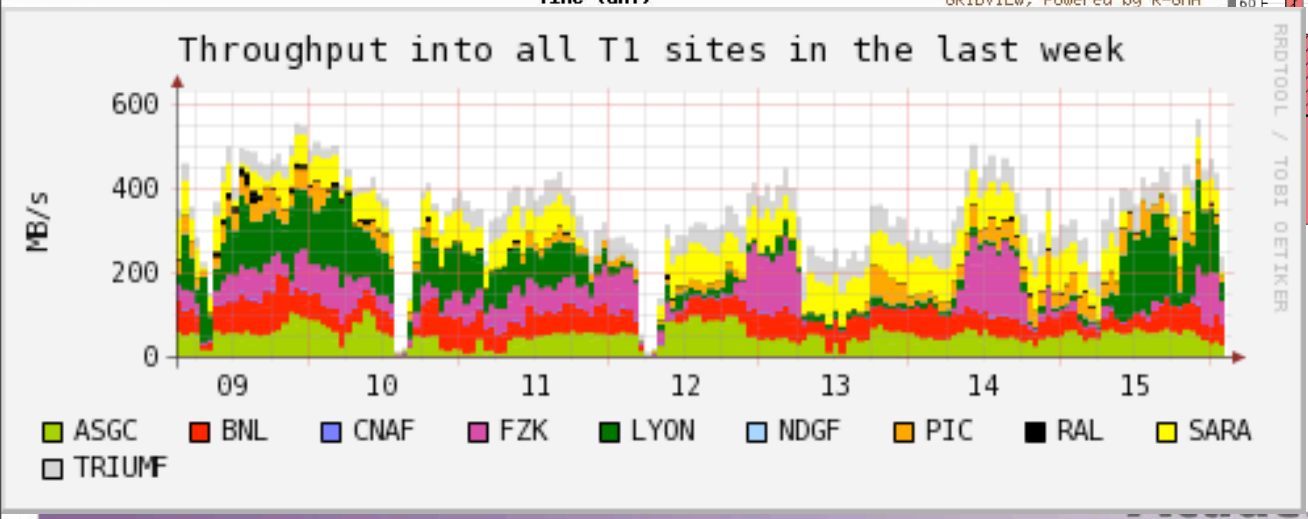
- Regional Centers:
  - Tokyo-LCG2: 48 MB/sec
  - KEK-LCG2 10 MB/sec
  - Australia-UNIMELB-LCG2: 10 MB/sec
  - KNU 37 MB/sec
  - BEIJING-LCG2: 16 MB/sec
- Domestic:
  - IPAS: 37 MB/sec
  - TW-NIU-EECS-01: 4 MB/sec
  - FTT: ~35 MB/sec
  - NCU-HEP: 40 MB/s
- SRM or storage issues:
  - PAKGRID, TIFR, NCP

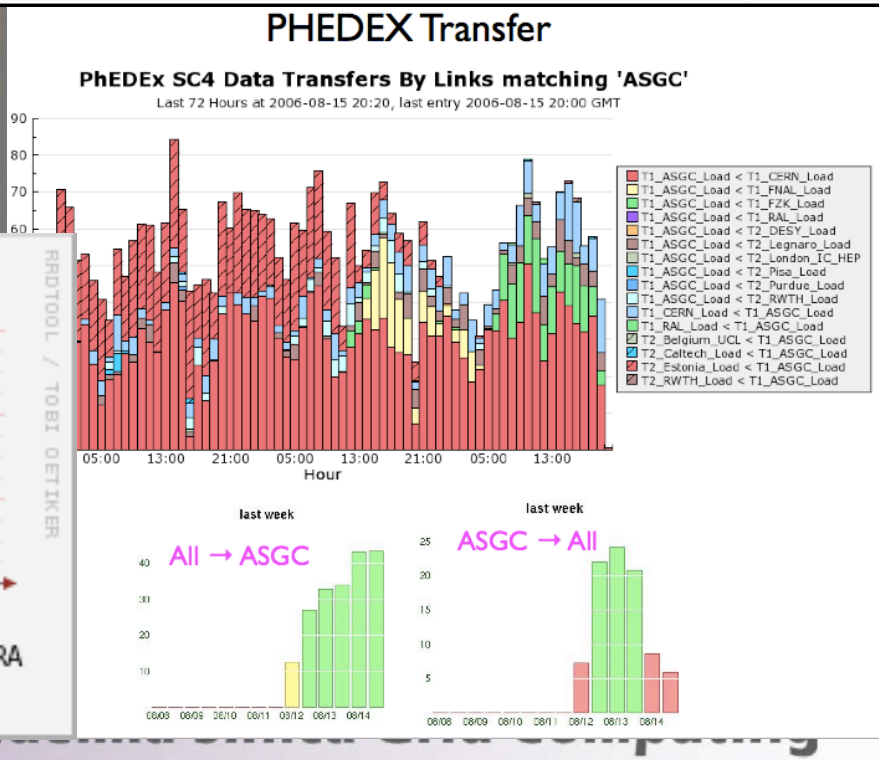
WLCG Services in Asia

Normalised CPU time [units 1K.SI2K.Hours] by SITE and VO

SITE	alice	apdg	atlas	atlasprd	belle	biomed	cms	dteam	lhcb	na48	ops	twgrid	Total	%
Australia-UNIMELB-LCG2	0	0	3,748	0	0	0	0	2	0	0	2	0	3,752	0.67%
GOG-Singapore	0	0	4,795	0	0	1,277	3,734	7	0	0	0	0	9,813	1.76%
INDIACMS-TIFR	0	0	0	0	0	0	56,363	74	0	0	0	0	56,437	10.10%
JP-KEK-CRC-01	0	0	0	0	1,453	0	0	31	0	0	0	0	1,484	0.27%
JP-KEK-CRC-02	0	0	737	0	0	0	0	0	0	0	0	0	737	0.13%
LCG_KNU	0	0	1,259	0	0	0	10,386	12	586	0	1	0	12,244	2.19%
NCP-LCG2	0	0	6,628	0	0	0	11,148	8	1,722	0	0	0	19,506	3.49%
PAKGRID-LCG2	0	0	1,318	0	0	217	3,355	4	255	0	0	0	5,149	0.92%
Taiwan-IPAS-LCG2	0	0	10,670	1,165	0	0	0	20	0	0	0	0	11,855	2.12%
Taiwan-LCG2	0	0	242,140	0	0	25,595	140,613	33	0	0	2	153	408,536	73.13%
Taiwan-NCUCC-LCG2	0	0	1,945	0	0	0	1,476	1	131	0	0	0	3,553	0.64%
TOKYO-LCG2	0	0	13,758	0	0	0	0	2	0	0	0	0	13,760	2.46%
TW-FTT	0	0	126	0	0	0	3,400	7	0	0	0	0	3,533	0.63%
TW-NCUHEP	0	0	0	0	0	0	8,301	9	0	0	0	0	8,310	1.49%
TW-NIU-EECS-01	0	0	0	0	0	0	0	1	0	0	0	0	1	0.00%
TW-THU-HPC	0	0	0	0	0	0	0	4	0	0	0	0	4	0.00%
Total	0	0	287,124	1,165	1,453	27,089	238,776	215	2,694	0	5	153	558,674	
Percentage	0.00%	0.00%	51.39%	0.21%	0.26%	4.85%	42.74%	0.04%	0.48%	0.00%	0.00%	0.03%		

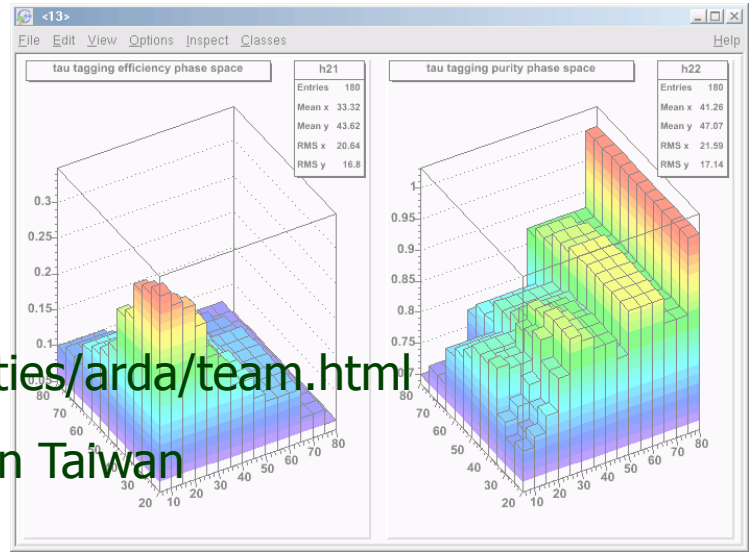






ARDA

- Goal: Coordinate to prototype distributed analysis systems for the LHC experiments using a grid.
- ARDA-ASGC Collaboration: since mid 2003
  - Building push/pull model prototype(2003)
  - Integrate Atlas/LHCb analysis tool to gLite(2004)
  - Provide first integration testing and usage document on Atlas tools:Dial (2004)
  - CMS monitoring system development (2005)
    - Monitoring system to integrate RGMA & MonaLisa
    - ARDA/CMS Analysis Prototype: Dashboard
  - ARDA Taiwan Team: http://lcg.web.cern.ch/LCG/activities/arda/team.html
  - 4 FTEs participated: 2 FTEs at CERN, the other 2 are in Taiwan

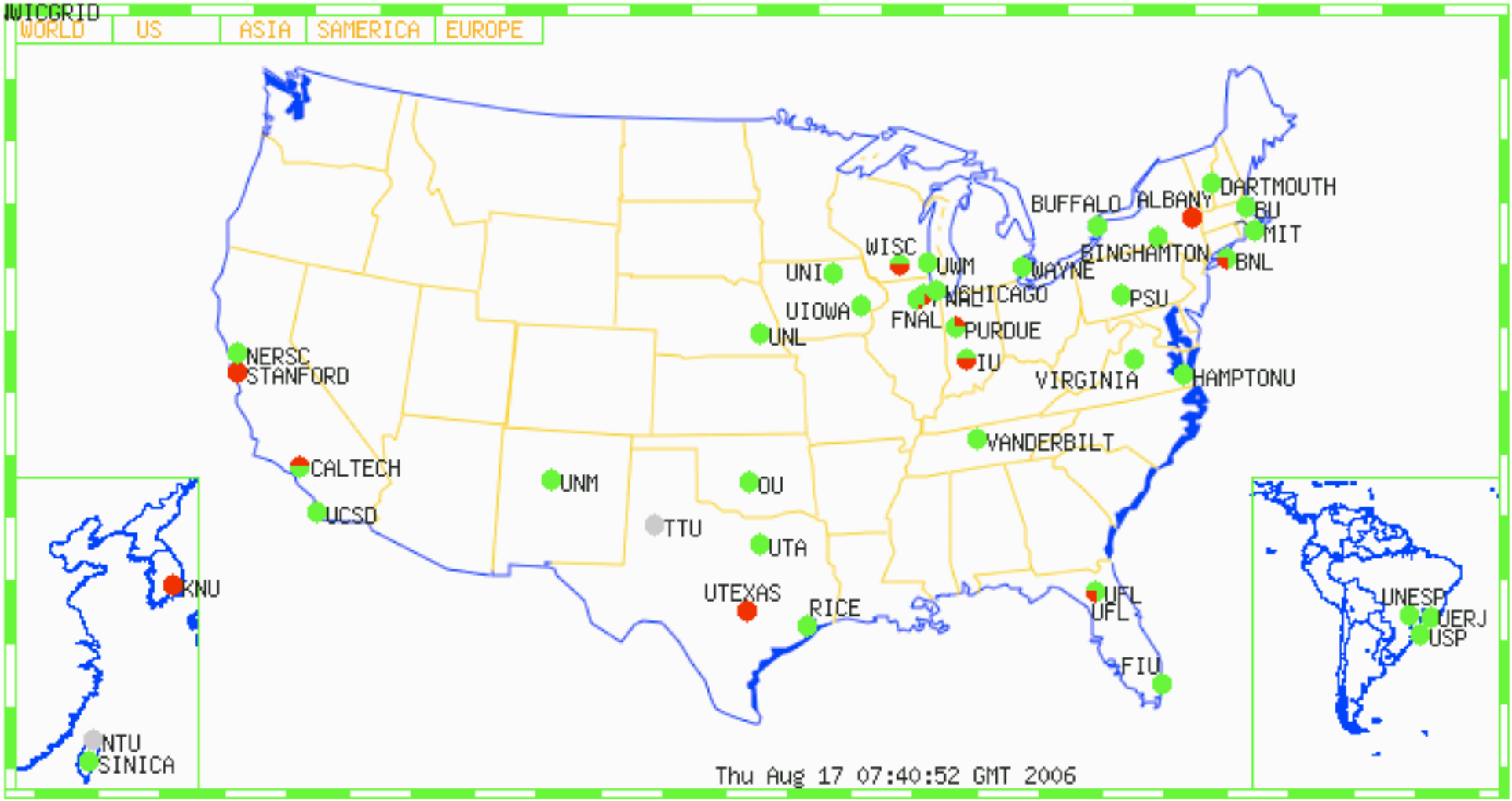


Dissemination & Outreach

- International Symposium on Grid Computing from 2002
- TWGRID Web Portal
- Grid Tutorial, Workshop & User Training: > 700 participants in past 10 events
- Publication
- Grid Café / Chinese (http://gridcafe.web.cern.ch/gridcafe/)

Event	Date	Attendant	Venue
China Grid LCG Training	16-18 May 2004	40	Beijing, China
ISGC 2004 Tutorial	26 July 2004	50	AS, Taiwan
Grid Workshop	16-18 Aug. 2004	50	Shang-Dong, China
NTHU	22-23 Dec. 2004	110	Shin-Chu, Taiwan
NCKU	9-10 Mar. 2005	80	Tainan, Taiwan
ISGC 2005 Tutorial	25 Apr. 2005	80	AS, Taiwan
Tung-Hai Univ.	June 2005	100	Tai-chung, Taiwan
EGEE Workshop	Aug. 2005	80	20th APAN, Taiwan
EGEE Administrator Workshop	Mar. 2006	40	AS, Taiwan
EGEE Tutorial and ISGC	1 May, 2006	73	AS, Taiwan

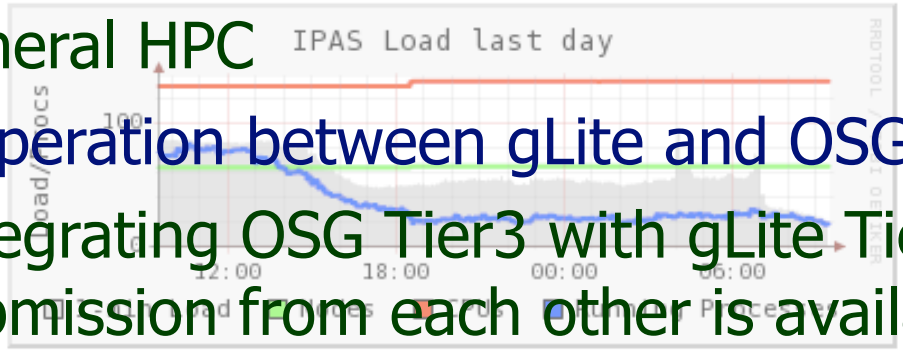
Asian Grid3/OSG since 2004

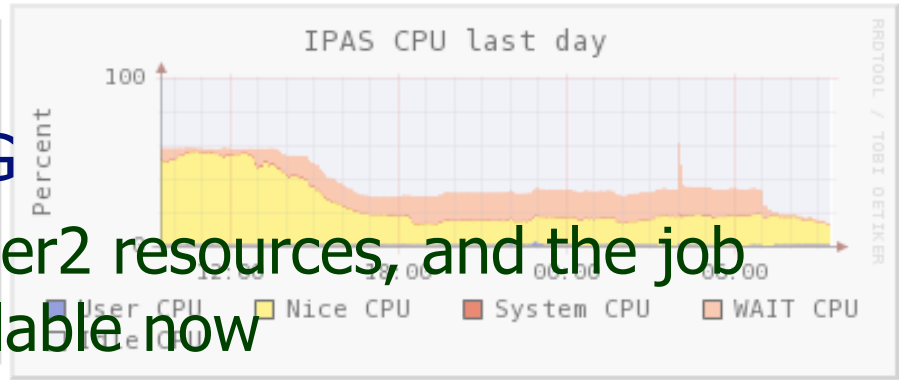


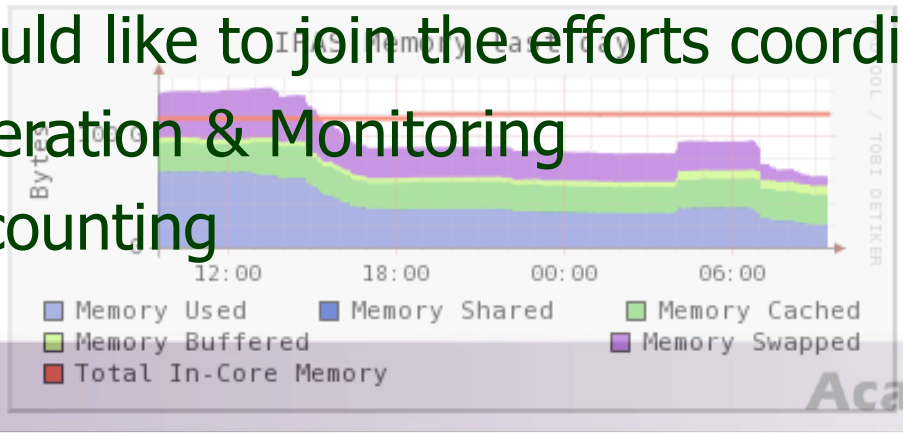
OSG Related Activities of Taiwan

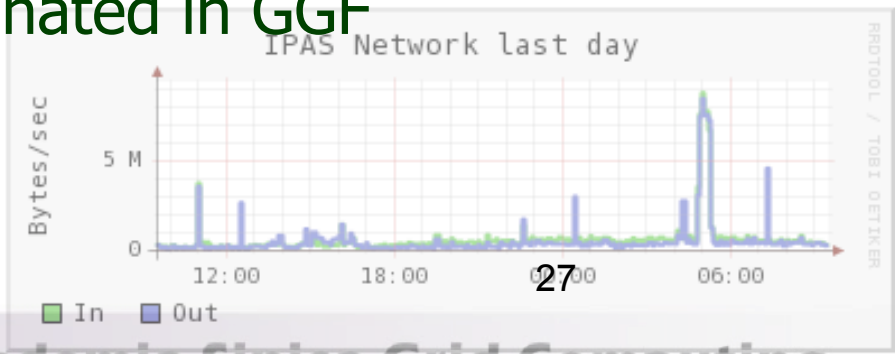
- 1st Grid3 system deployed in 2004, and migrate to OSG follow the formal release from 2005
- Major applications now are for HEP
  - CMS Tier3, and ATLAS Tier3 in Taiwan
  - CDF
  - general HPC
- Interoperation between gLite and OSG
  - Integrating OSG Tier3 with gLite Tier2 resources, and the job submission from each other is available now
  - Would like to join the efforts coordinated in GGF
  - Operation & Monitoring
  - Accounting

IPAS Ganglia





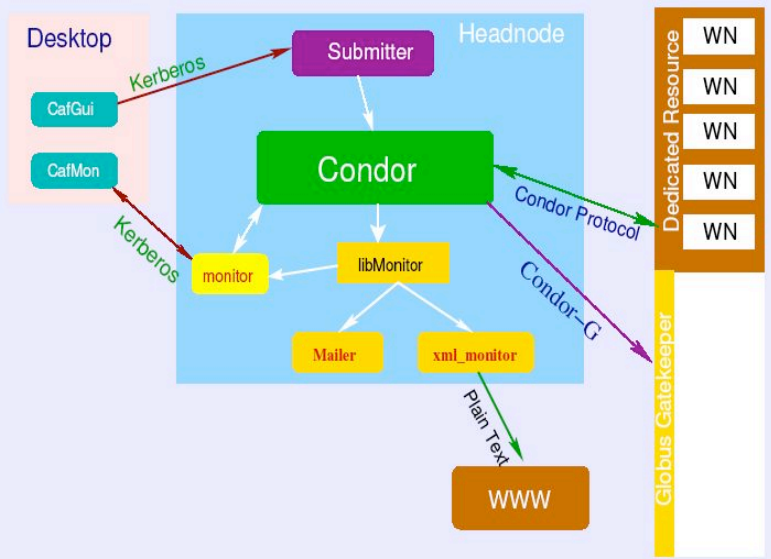




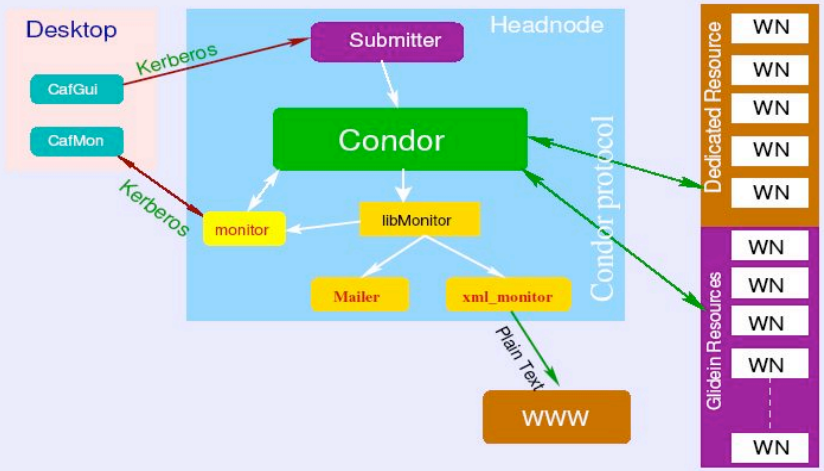
OSG/LCG resource integration in Taiwan

- Mature tech help integrating resources
  - GCB introduced to help integrating with OSG computing resources
  - CDF/OSG users can submit jobs by gliding-in into GCB box
  - Access ASGC T1 computing resources from "twgrid" VO
- Customized UI to help accessing back-end storage resources
  - Help local users not ready for grid
  - HEP users access T1 resources

- Submit condor_glidein jobs to the Tier1 site Gate-keeper

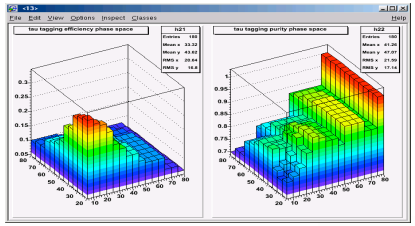


- When the glide-in jobs start, resources become part of the Condor pool
- Headnode is notified about availability of new nodes and jobs pulled from the queue

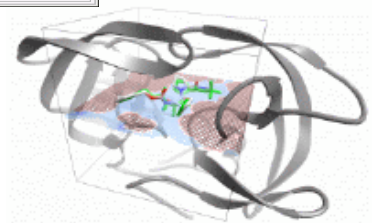


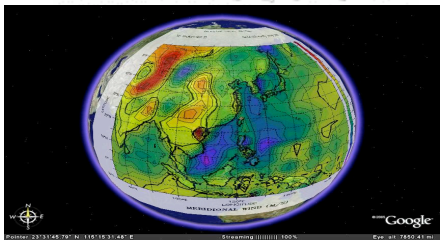
- Monitoring, Computing on Demand (CoD) etc. - works like a native Condor farm
- Jobs run in a single user mode

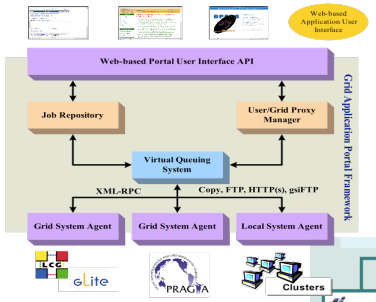
e-Science Applications in Taiwan

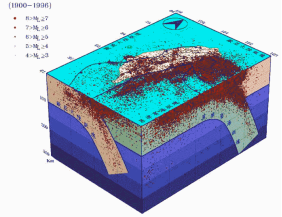


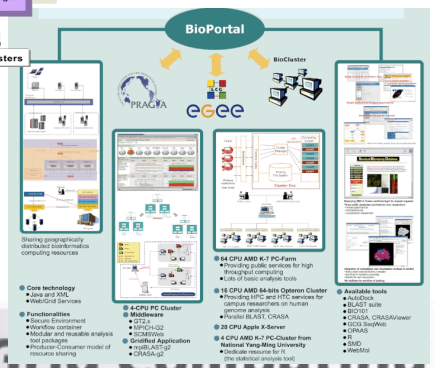
- High Energy Physics: WLCG
- Bioinformatics: mpiBLAST-g2
- Biomedicine: Distributing AutoDock tasks on the Grid using DIANE
- Digital Archive: Data Grid for Digital Archive Long-term preservation
- Atmospheric Science
- Geoscience: GeoGrid for data management and hazards mitigation
- Ecology Research and Monitoring: EcoGrid
- BioPortal
- Biodiversity: TaiBIF/GBIF
- e-Science Application Framework Development





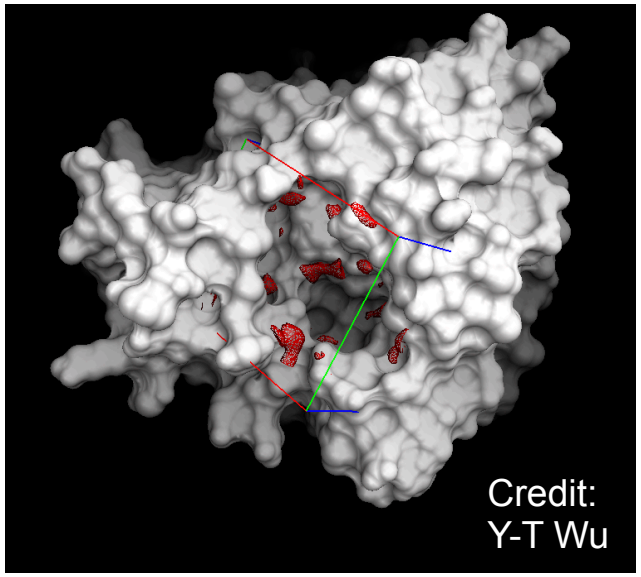




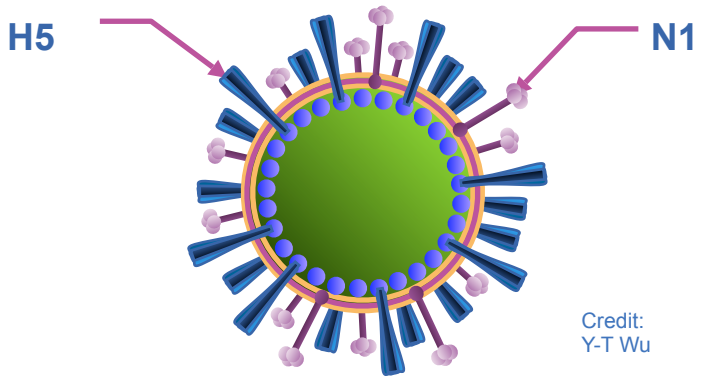


EGEE Biomed DC II – Large Scale Virtual Screening of Drug Design

- **Biomedical goal**
  - accelerating the discovery of novel potent inhibitors thru minimizing non-productive trial-and-error approaches
  - improving the efficiency of high throughput screening



- **Grid goal**
  - massive throughput: reproducing a grid-enabled in silico process (exercised in DC I) with a shorter time of preparation
  - interactive feedback: evaluating an alternative light-weight grid application framework (DIANE)



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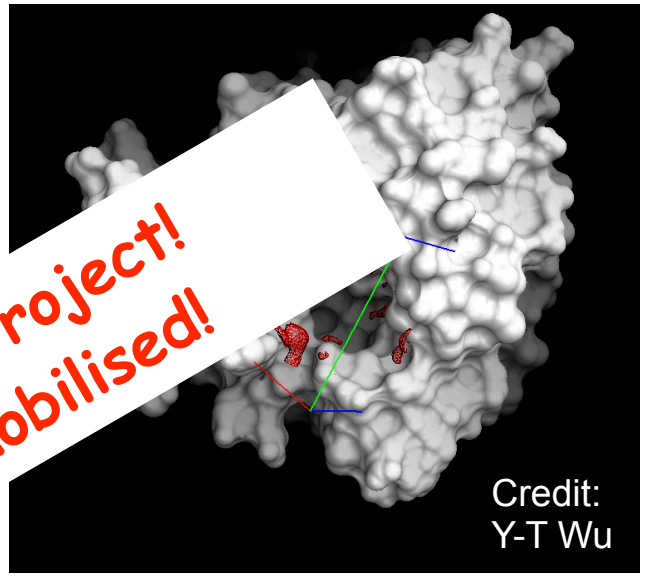

Initiated by ASGC, Taiwan and WISDOM Project!
137 CPU-Years in 4 Weeks! 5,000 CPU mobilised!

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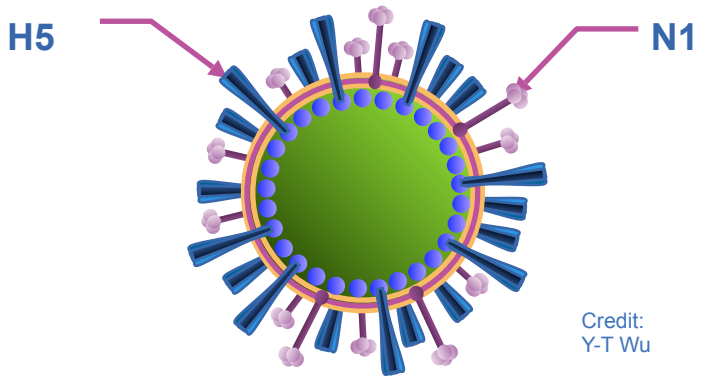
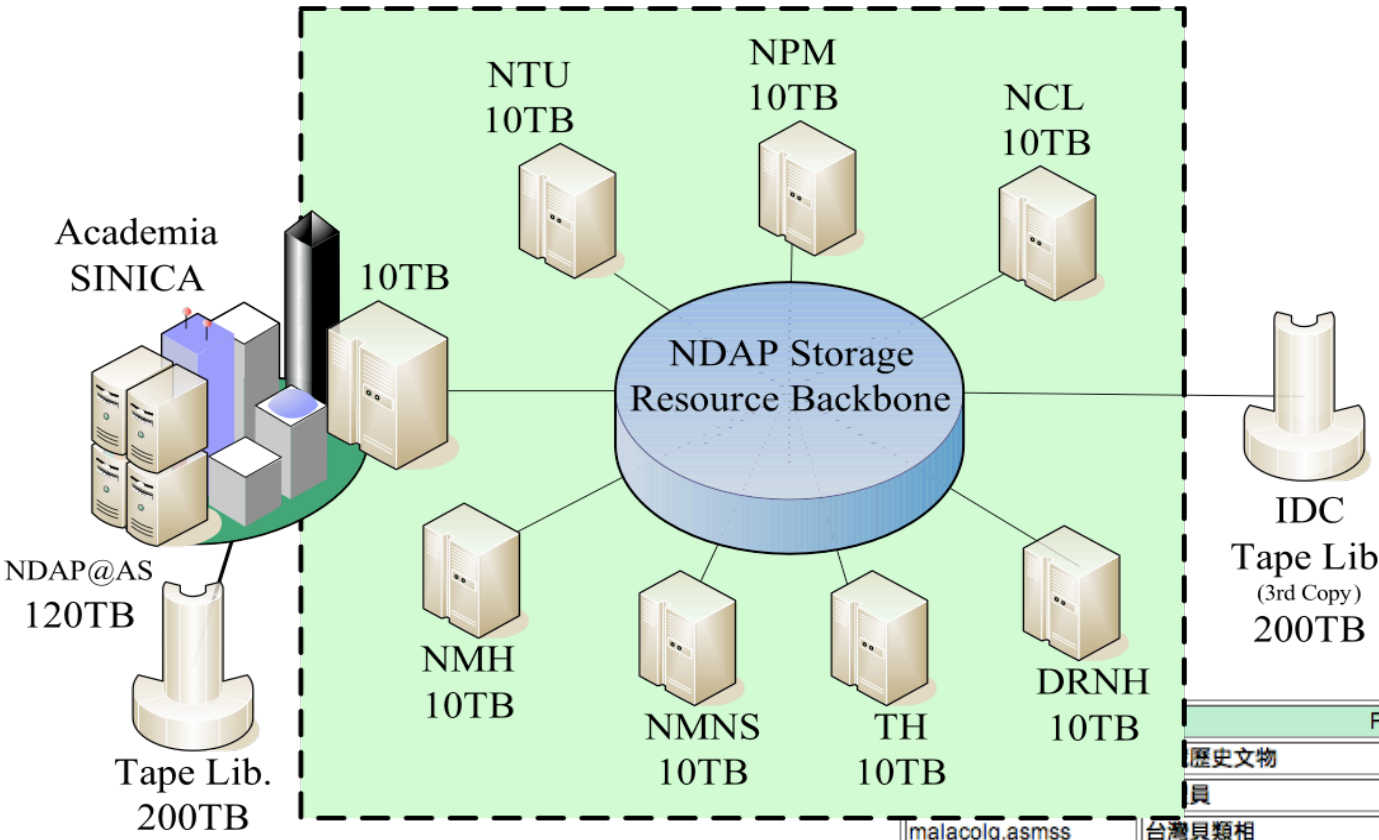


Distributed Data Management & Long-term Preservation of NDAP

- Long-term Preservation
  - Automatic remote replication with 3 copies in different sites
  - Effective migration based on metadata
    - not just the digitized contents were archived, but als o their metadata, methods/procedures, standard format, and management information
    - Separation of data representation and presentation
- Secure Access
- Reduce the total cost of management
- Data Management Framework could be shared for content-based applications, e.g., federation etc.
- Sustainable Operation and Services

SRB-based Data Grid System Architecture for NDAP



Project		Totel Files	Total Size (Byte)
	歷史文物	110,243	9,427,834,020,738
	員	11,085	981,332,124
malacolg.asmss	台灣貝類相	22,127	71,677,099,489
gis.asmss	近代中國歷史地圖與遙測影像資訊典藏計畫	77,734	1,152,358,082,818
la.asmss	語言典藏計畫	1	7,049,563
daal.asmss	技術研發分項計畫	473,106	670,011,927,564
fishdb.asmss	魚類資料庫	32,070	4,199,317,364
ithda.asmss	台史所	121,346	168,408,646,949
muchwood.asmss	台灣本土植物	32,542	1,640,317,250,276
archives.asmss	近代外交經濟重要檔案計畫	640,222	21,824,130,034,178
twnative.asmss	台灣原住民	601,715	1,516,242,052,811
Total		2,122,191	36,476,166,813,874

SRM-SRB Development

- Objectives
  - Middleware Persistence: Integrate SRB into the e-Science infrastructure (gLite+OSG) of Taiwan
  - Interoperation:
- Approach & Focus
  - Use Case Collection and Analysis
  - Make use of the current SRM implementations as the code base
    - e.g., CERN Castor SRM, DESY/FNAL dCache SRM, LCG DPM, LBNL DRM, JLab SRM, etc.
  - Evaluate how authentication works in both SRM and SRB
  - Evaluate the similar services of gLite

Success on a Worldwide scale

- If we can bring together people from all over the world (whether they be physicists, biologists, computer scientists, climate researchers or ….) and they
  - Want to be part of building the "cyber infrastructure" or Grid environments or "e-science environments" for the future
  - Actively participate
  - Get benefit from the collaboration

Then we will be succeeding

Source: Vicky White

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Some sort of coordinating structure is still needed in Asia!

Then we will be succeeding

Source: Vicky White