



WLCG Tier-1 and Applications @ ASGC

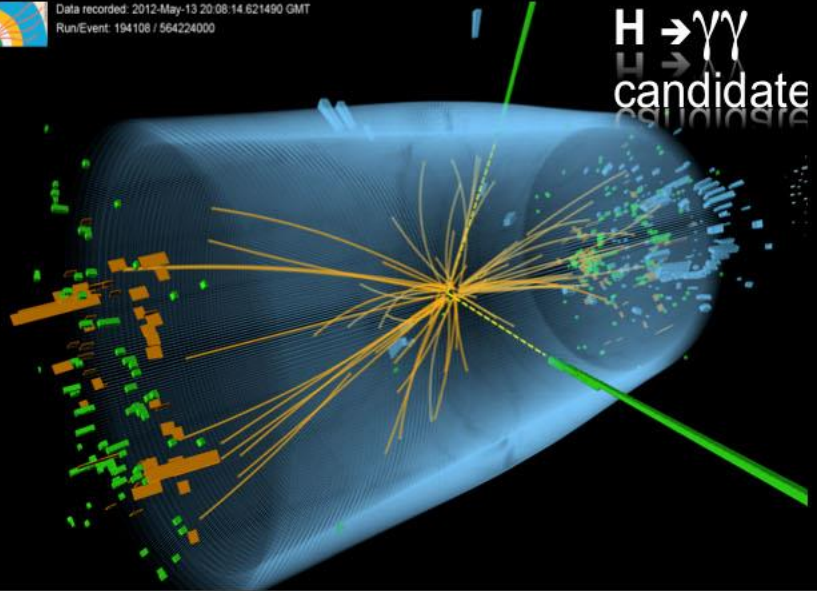
Simon C. Lin
Academia Sinica Grid Computing Centre

30 January 2015
JINR, Dubna



Global Science Achievement Accelerator, Detector & Grid

Data recorded: 2012-May-13 20:08:14 621490 GMT
Run/Event: 194108 / 564224000

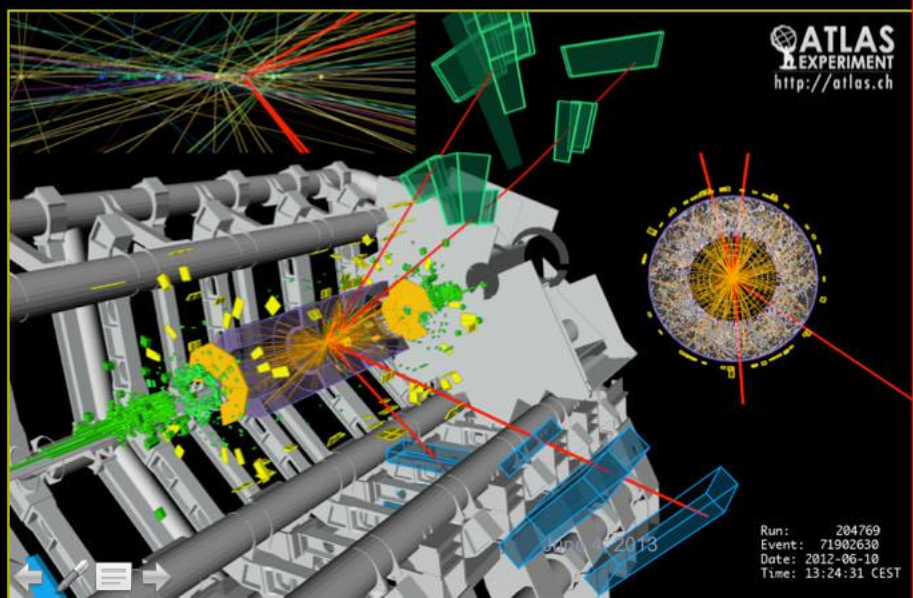


GLOBAL EFFORT, GLOBAL SUCCESS

Discovery of Higgs Boson today only possible due to extraordinary performance of accelerators, experiments, and grid computing.



The Higgs Boson is named after Dr. Peter Higgs.
image @ Craig Strong (<http://build-your-own-particle-detector.org/>)



Run: 204769
Event: 71902630
Date: 2012-06-10
Time: 13:24:31 CEST

Higgs boson-like particle discovery claimed at LHC

COMMENTS (1665)

By Paul Rincon
Science editor, BBC News website, Geneva



The moment when Cern director Rolf Heuer confirmed the Higgs results

Cern scientists reporting from the Large Hadron Collider (LHC) have claimed the discovery of a new particle consistent with the Higgs boson.

Relat

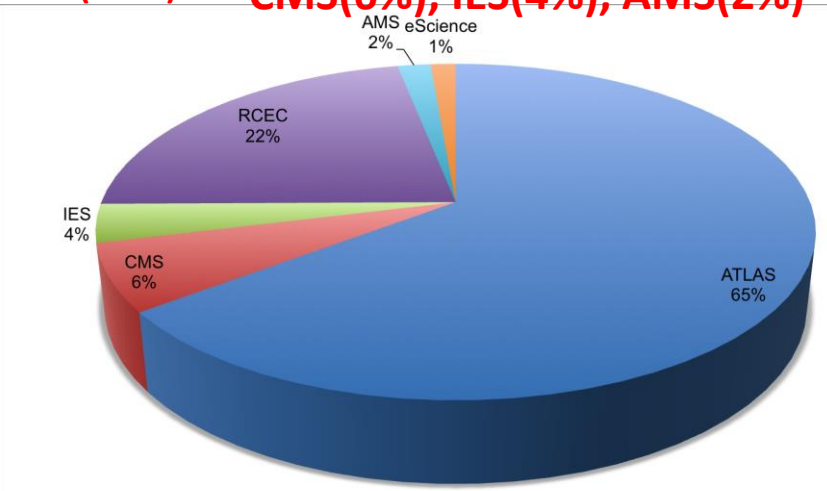
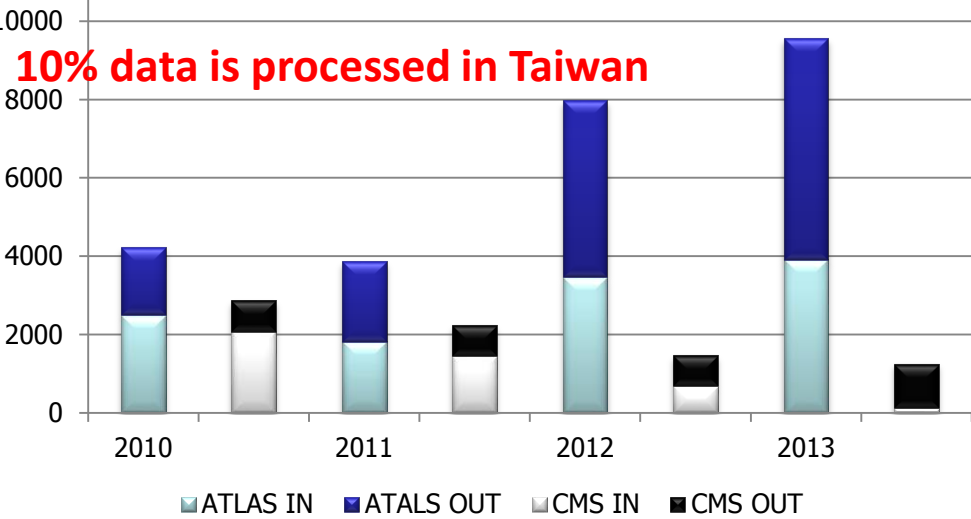
ORA:



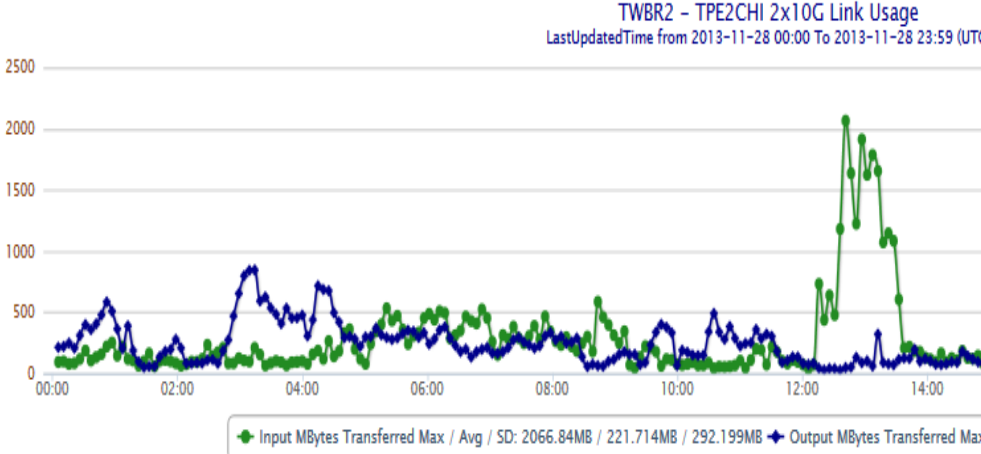
Resource Utilization at ASGC, 1st T1

WLCG: Total data in and out of Taiwan: 33,418 TB
 7,082(2010) → 6,098 (2011) → 9,431 (2012) → 10,806 (2013) → 12 (2014)

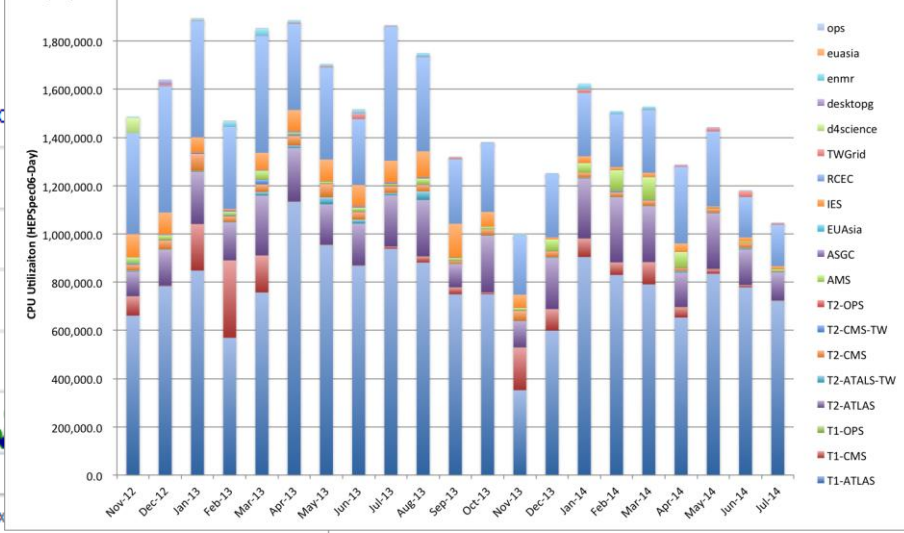
CPU: ATLAS(65%), RCEC(22%), CMS(6%), IES(4%), AMS(2%), eScience(1%)



16 Gb/s inbound performance reached in ASGCNet 20Gb link to Europe



CPU Utilization in Nov.2012 – Jul.2014





ASGC Resources (Jan. 2015)

Resource Groups	CPU (#Cores)	Disk (TB)	Tape (TB)	Inter-connection	User Groups
World Wide Grid	5,508	5,640	4,000	10GbE Storage Server	WLCG, EUAsiaGrid, EGI, e-Science
HPC	10,212	3,356	0	10GbE+IB (DDR, QDR): 5120 HPC-10G: 1956 NUWA: 1984 TCCIP: 1152	HPC, ES, EC, Physics, LS
Cloud & Elastic System	4,076	3,600	0	10GbE + 10GbE Storage	Cloud and Elastic Resources: AMS

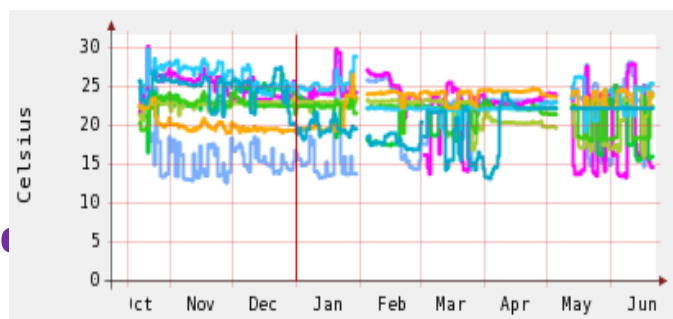
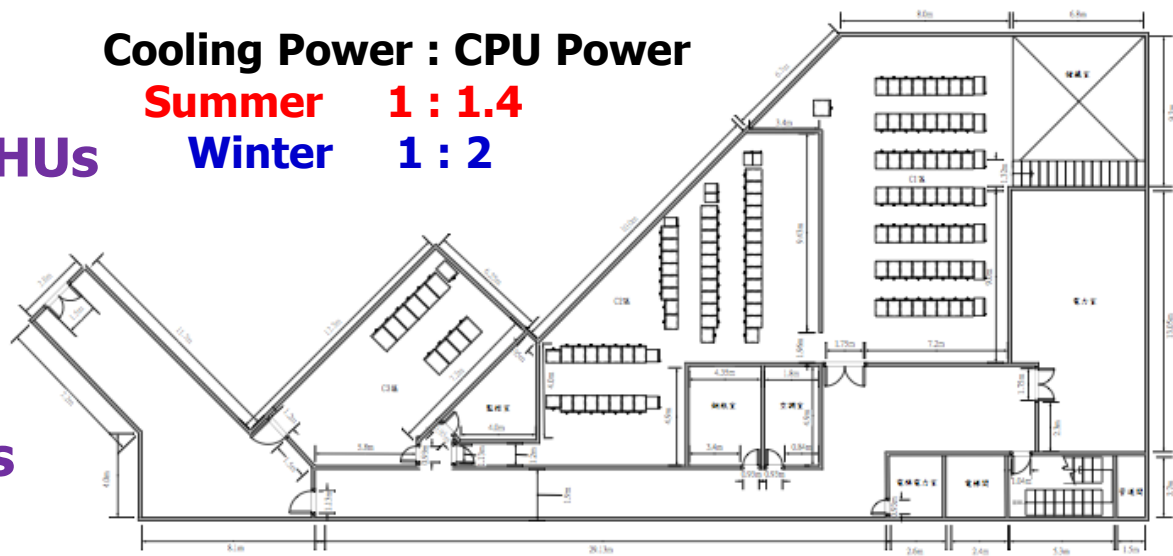


ASGC Computing Center

- **Total Capacity**
- 2MW, 400 tons AHUs
- 93 racks
- ~ 800 m²
- **Resources**
- 20,000 CPU Cores
- 12.5 PB Disk
- 4 PB Tape
- **Rack Space Usage (Racks)**
- AS e-Science: 54.1 (58.4%)
- ASCC: 8.4 (9.0%)
- IPAS: 6.0 (6.3%)
- Free: 24.5 (26.3%)

Cooling Power : CPU Power

Summer 1 : 1.4
Winter 1 : 2



Monitoring the power consumption and temperature of every piece of equipment every 10 seconds.





ASGC on WLCG Technology

Areas	Activities
Distributed Computing	Diane, Ganga, Panda, JEDI, CVMFS, Ceph
Distributed Data Management	DPM, SRM-SRB/iRODS, Rucio, EOS
Information System Monitoring	GStat
Experiment Computing	ATLAS, CMS
Cloud Core Technology	VMIC, Distributed Cloud, OpenStack, Cloud Accounting
Networking	LHCOPN, LHCONE, SDN
Regional Support	APROC, APGridPMA
Data Center	Intelligent & energy saving Center, system efficiency
High Level Coordination	GDB, MB, CB, C/RRB



Asia Pacific Regional Operation Centre (APROC)

- Extending the infrastructure and maximize the availability from 2005: Support 38 sites in 16 countries to join the World Wide Grid and e-Science collaborations
 - Australia, China, Hong Kong, India, Indonesian, Iran, Japan, Korea, Malaysia, New Zealand, Pakistan, Philippine, Singapore, Thailand, Vietnam, and Taiwan
- Training, Workshop and Internship Program (from 2003)
 - Host International Symposium on Grid & Cloud (ISGC) annually
 - Coordinate 65 events in 9 countries (IN, KR, MN, MY, PH, SG, VN, TH and TW)
 - Internship: 10 persons from DE, IN, JP, KR, MY and PK

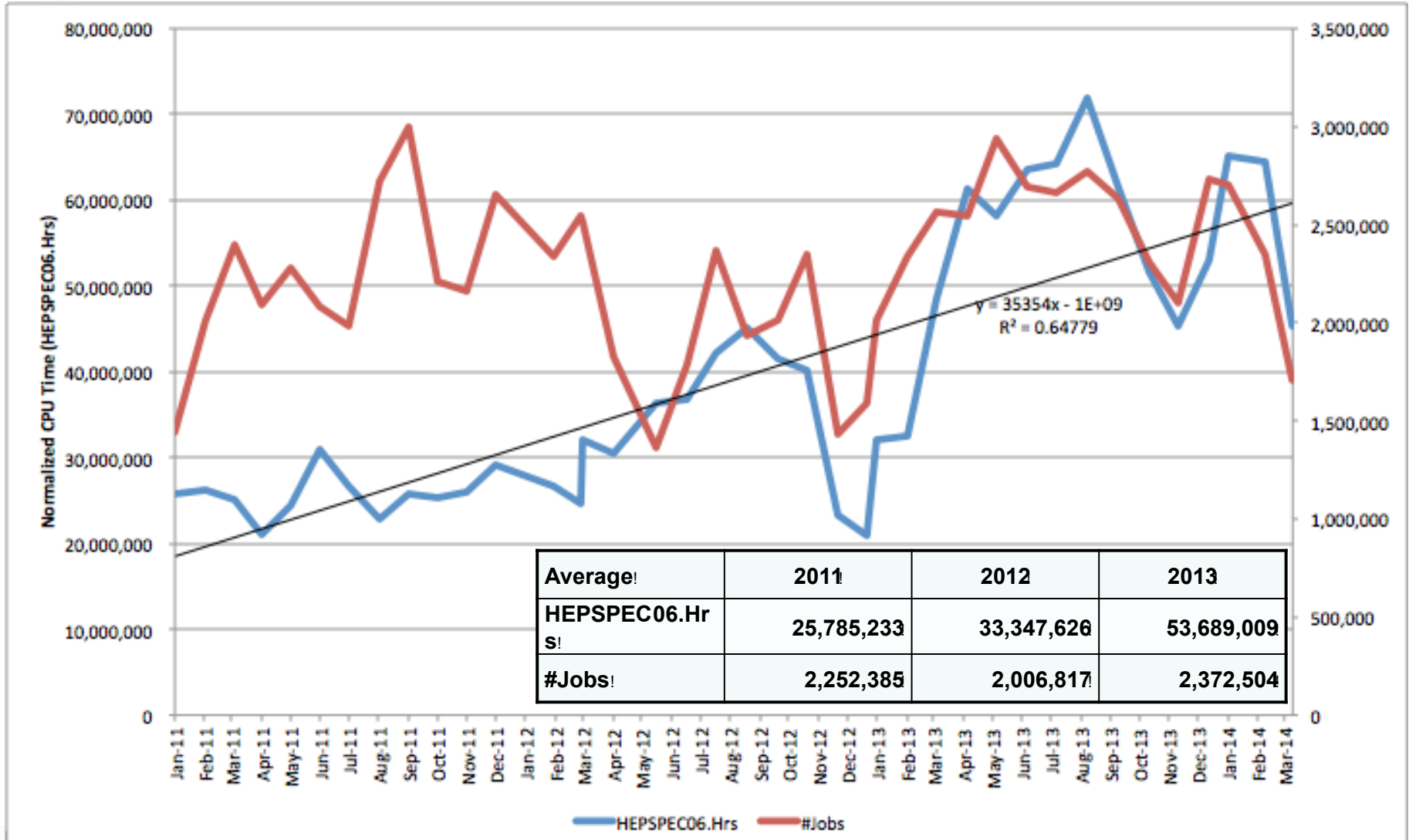


Regional Trust Framework

	IGTF CA	Federated Identity Management !	Remark
Australia	Back in Operation in 2014!	AusCert (AU, NZ, FJ, PG)!	
China	CNIC CA, IHEP CA, SDG CA!		
Hong Kong	HKU Grid CA!		
India	IGCA!		
Indonesia	RA/ASGCCA!		
Japan	HPCI CA, KEK CA!	HPCI!	SSO
Korea	KISTI CA!		
Malaysia	MyIFAM!	SIFULAN (MY, ..)!	Eduroam, Shib!
New Zealand!	RA/ASGCCA!		
Philippine	RA/ASGCCA!		
Singapore	withdrawn!		
Taiwan	ASGCCA, NCHC CA!	Pilot!	SSO: x.509 cert, AS!
Thailand!	NECTEC CA!		
Vietnam	RA/ASGCCA!		

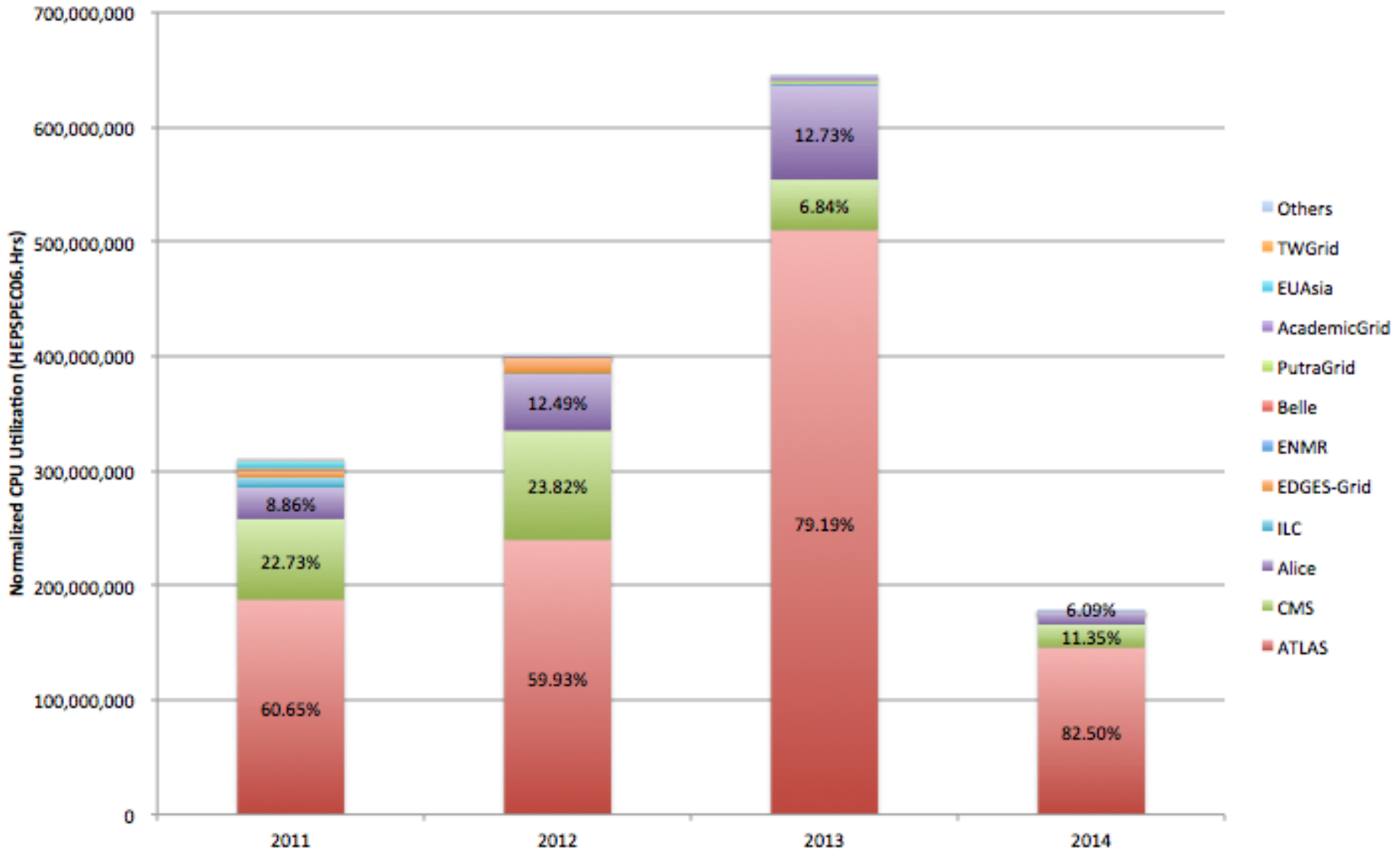


Statistics (CPU Time & #Jobs)





VO Statistics by Years





Online Resources (from GStat, 4.2014)

Country	Site	Logical CPU	Online Storage (GB)
Australia	Australia-ATLAS	920	839,794
China	Beijing-LCG2	1,088	375,500
	HK-HKU-CC-01	8	528
	iHEP	5,000	22,000,000
India	INDIACMS-TIFR	320	606,271
	IN-DAE-VECC-02	476	1,000
Iran	IR-IPM-HEP	16	24,371
Japan	JP-Hiroshima-WLCG	1,472	538
	JP-KEK-CRC-02	3,456	13,116,866
	Tokyo-LCG2	2,560	2,640,228
Korea	KR-KISTI-GCRT-01	120	52
	KR-KISTI-GSDC-01	2,688	52
	KR-KNU-T3	20	
	KR-UOS-SSCC	60	107,920
	LCG-KNU	462	706,694
Malaysia	MY-UM-Crystal	128	450,000
	MY-UPM-BIRUNI-01	344	4,943
	MY-USM-GCL	144	2,934
	MY-UTM-Grid	56	3,755
New Zealand	NZ-UOA		
Pakistan	NCP-LCG2	524	229,615
Philippine	PH-ASTI-LIKNAYAN		
Thailand	TH-HAII	48	2,164
	TH-NECTEC-LSR	16	11,840
	T2-TH-CUNSTDA	60	109,951
Taiwan	Taiwan-LCG2	3,384	5,669,536
	TW-EMI-PPS	8	68
	TW-NCU-HEP	4	221,987
	TW-FTT	1,472	
	TW-eScience	1,808	68
	TW-NTU-HEP	24	223,977
Vietnam	VN-IFI		
TOTAL		26,686	47,350,652



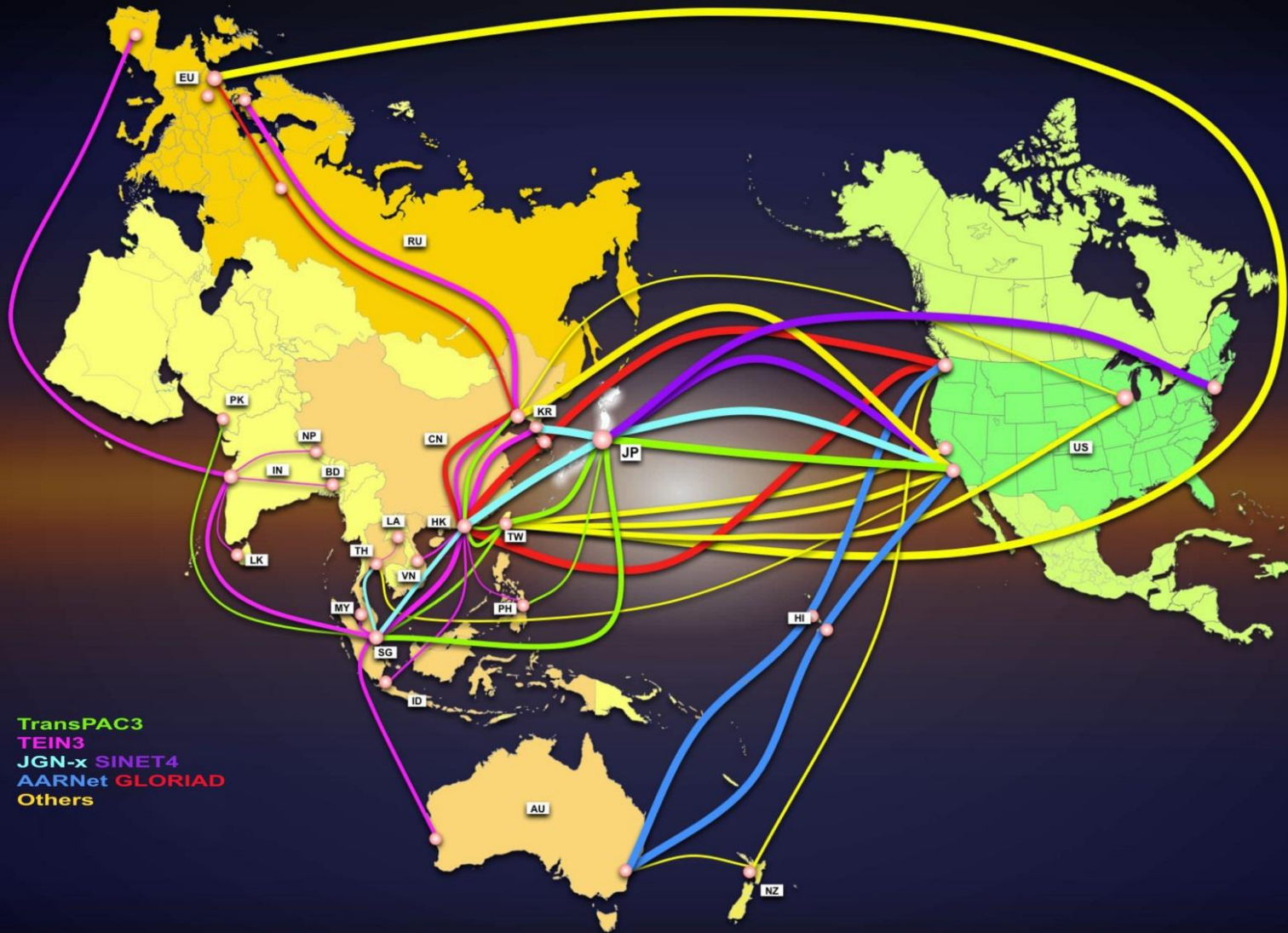
Training, Workshop and GridCamp Events

	Grid Technology	E-Science Applications	Others
2013	TW(dCache, DPM, security, EMI, GridCamp)	TH(gWRF), TW(WeNMR)	TW(CHAIN-REDS)
2012	TW(iRODS, VC, FIM, Cloud)	TW(WeNMR)	TW(CHAIN)
2011	TW(iRODS, IDGF, IGTF)	TW(NDM, Life Sci), MN	TW(OGF31)
2010	TW(gLite, VC, Security, iRODS)	TW(Social Simulation)	TW(EUAsiaGrid)
2009	VN(Grid), TW(Grid, iRODS, Security, GridCamp)	MY(e-Science)	TW(EUAsiaGrid)
2008	KR, PH, TW(EGEE, iRODS)	TW(WLCG)	TW(EUAsiaGrid)
2007	VN(Grid), SG(Grid), MY(Grid), TW(EGEE, GridCamp)		
2006	TW(EGEE)	IN(WLCG)	
2005	TW(Grid), TW(Grid @ 2 univ.)	TW(WLCG SC)	
2004	TW(Grid), TW(Grid @ univ.)		
2003	TW(Grid)	TW(BioGrid)	



Asia-Pacific Backbone Topology

Asia-Pacific Backbone Topology

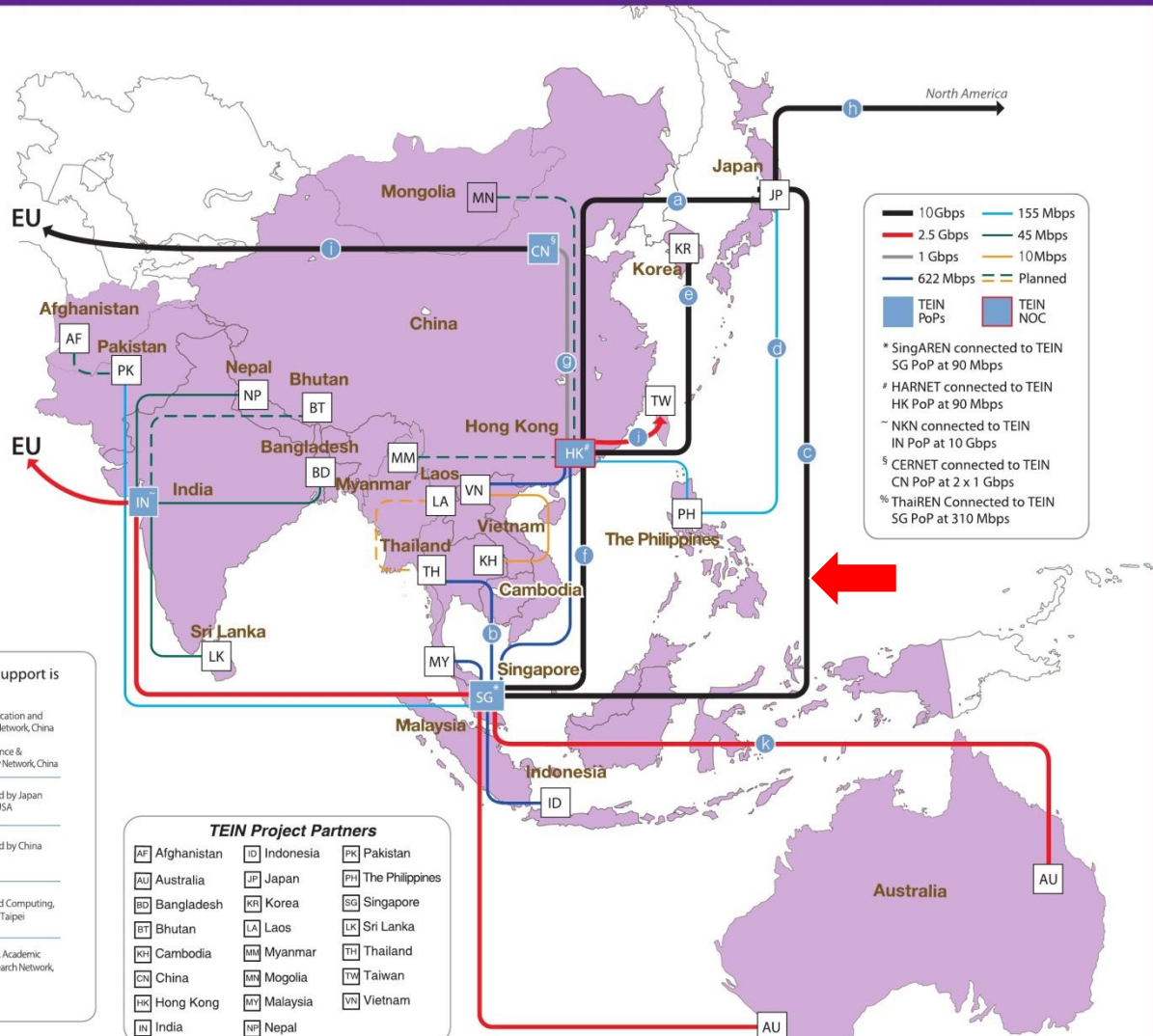


TransPAC3
TEIN3
JGN-x SINET4
AARNet GLORIAD
Others

TEIN Network (June 2014)



Connecting Asia and Europe's Research and Education Communities



The following links are fully financed by the link owners whose support is gratefully acknowledged.

a National Institute of Information and Communications, Japan	g China Education and Research Network, China
b National Institute of Information and Communications, Japan	h co-funded by Japan and the USA
c National Institute of Informatics, Japan	i co-funded by China and EU
d Ministry of Agriculture, Forestry and Fisheries Research Network, Japan	j Academia Sinica Grid Computing, Republic of Chinese Taipei
e National Information Society Agency, South Korea	k Australia, Academic and Research Network, Australia

TEIN Project Partners

AF Afghanistan	ID Indonesia	PX Pakistan
AU Australia	JP Japan	PH The Philippines
BD Bangladesh	KR Korea	SG Singapore
BT Bhutan	LA Laos	LK Sri Lanka
KH Cambodia	MM Myanmar	TH Thailand
CN China	MN Mongolia	TW Taiwan
HK Hong Kong	MY Malaysia	VN Vietnam
IN India	NP Nepal	

Updated on June 2014



www.tein.asia

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Regional Networking Matrix

	AU	CN	HK	IN	JP	KR	SG	TW
AU			2.5G				2.5G (+2.5G)	
CN			2x2.5G, 2.5G					2x1G
HK	2.5G	2x2.5G, 2.5G		2.5G	10G + 2.5G	10G	10G	2.5G+1 0G
IN			2.5G				2.5G	
JP			12.5G				10G	2.5G
KR			10G					
SG	2.5G (+2.5G)		10G	2.5G	10G			
TW		1G: CERNET , 1G	2.5G+1 0G		2.5G			



Connectivity between Asia and Other Region

	US	Europe
AU	2x40 (2x100G in 2016)	
CN	10G (I2-CERNET2)	10G (Geant)
HK		
IN		2.5G to ES; 10G to Geant
JP	3x10G to LA, NY, WA; 100G (2016)	3x10G to Geant
KR	10G	10G
SG		
TW	2x10G to Chicago + 5x2.5G	2x10G to AMX and CERN

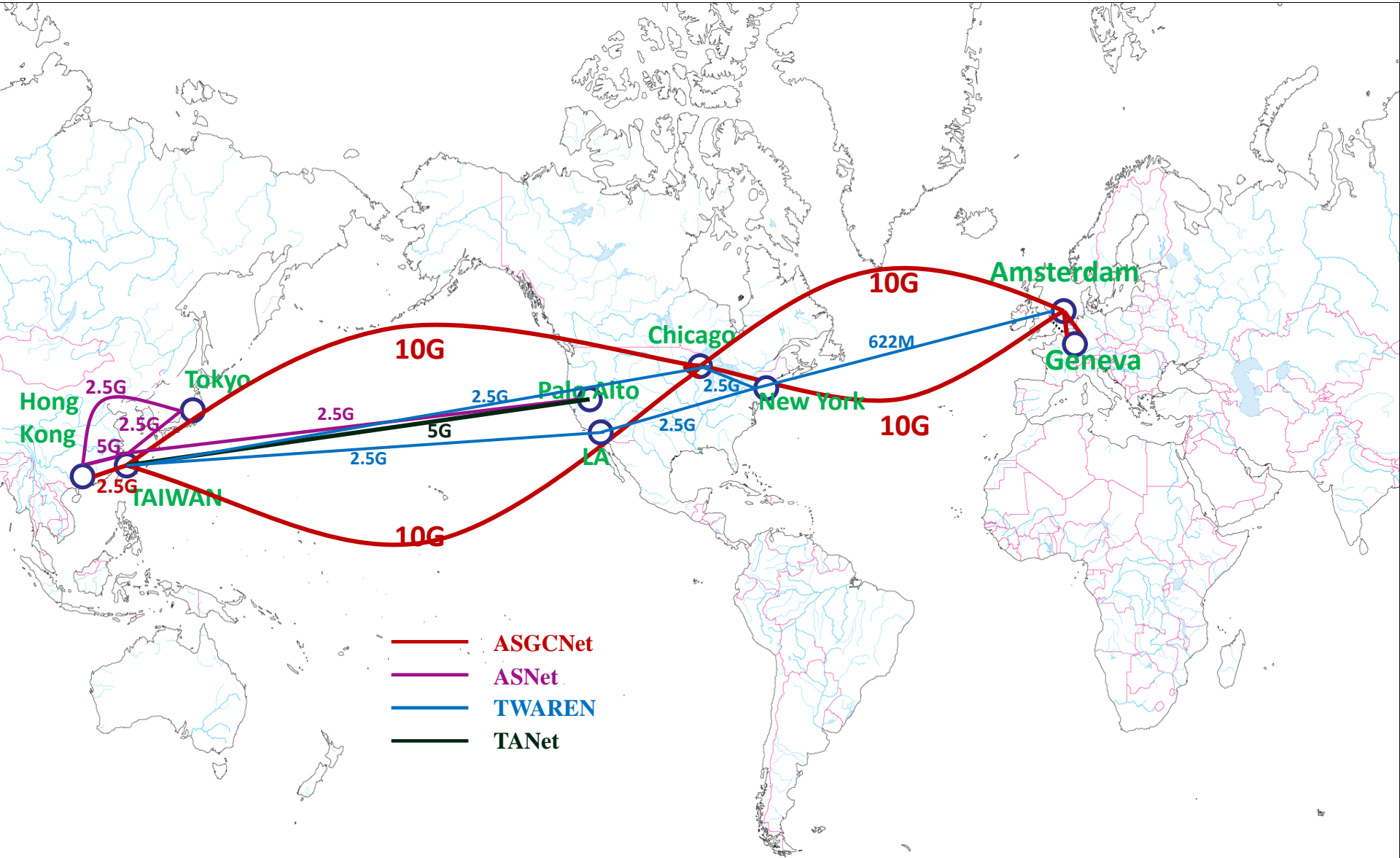
Regional HEP Collaborations

Balance of Requirements and Resources

	Experiments					Networking
	LHC/WLCG (200-4000 MB/s)	AMS/ WLCG	BELLE II/DIRAC (1800 MB/s)	BEPC/BES (3PB/5yr)	Neutrino (Daya Bay) (200TB/yr)	
AU	ATLAS		X			AARNet
CN	ALICE, ATLAS, CMS, LHCb	7	X	X	X	CERNET, CNGI- CERNET2
IN	CMS, ALICE		BELLE II, ILC	X		NKN, TEIN
JP	ATLAS, ALICE		X	X		SINET
KR	ALICE (T1), CMS	2	X			KREONET, Gloriad
TH	CMS/WLCG			X		UniNet
T W	ATLAS (T1), CMS	4	4		1	ASGCNet, TWAREN

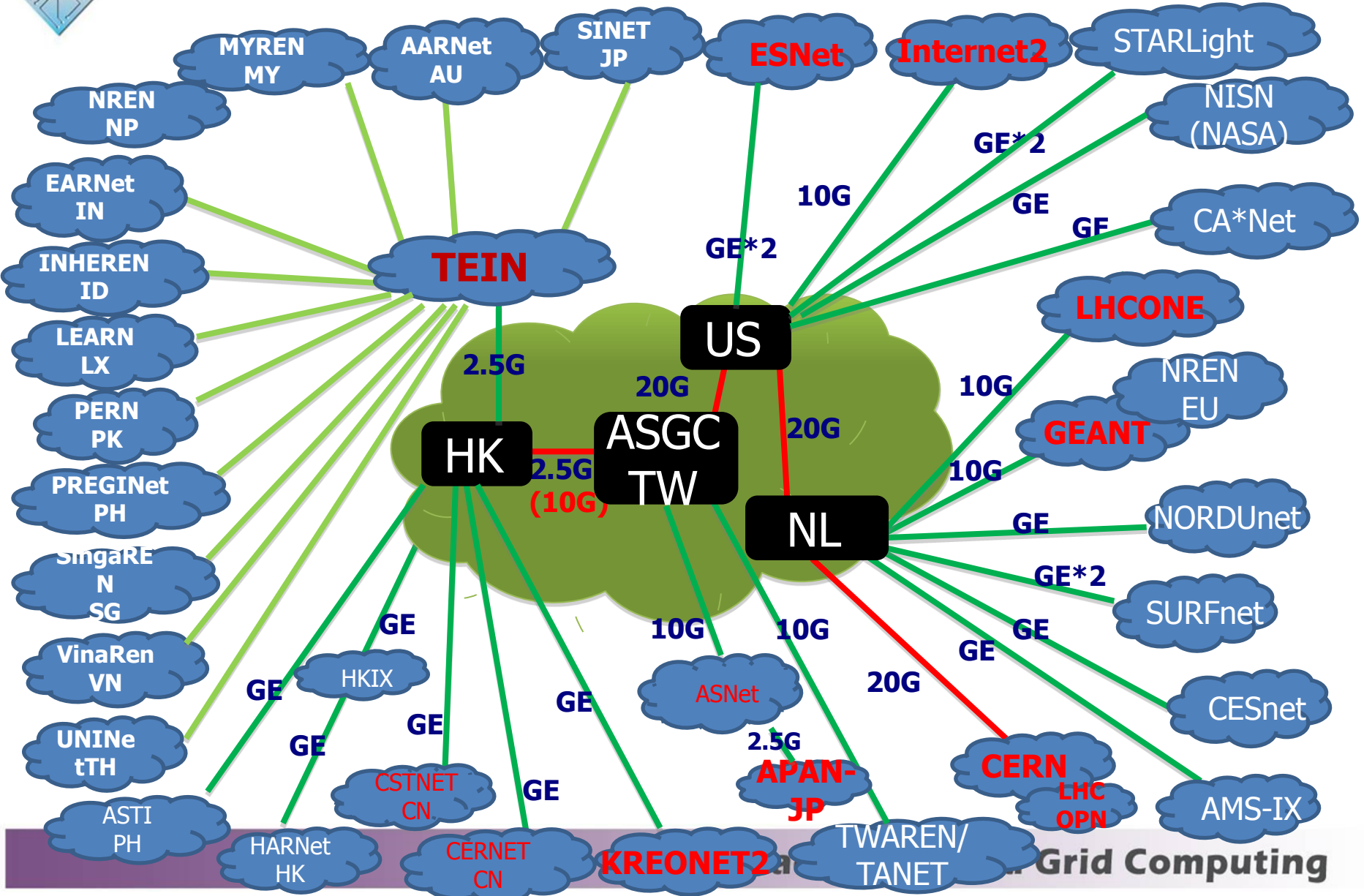


TAIWAN Global R&E Network





ASGC e-Science Global Network

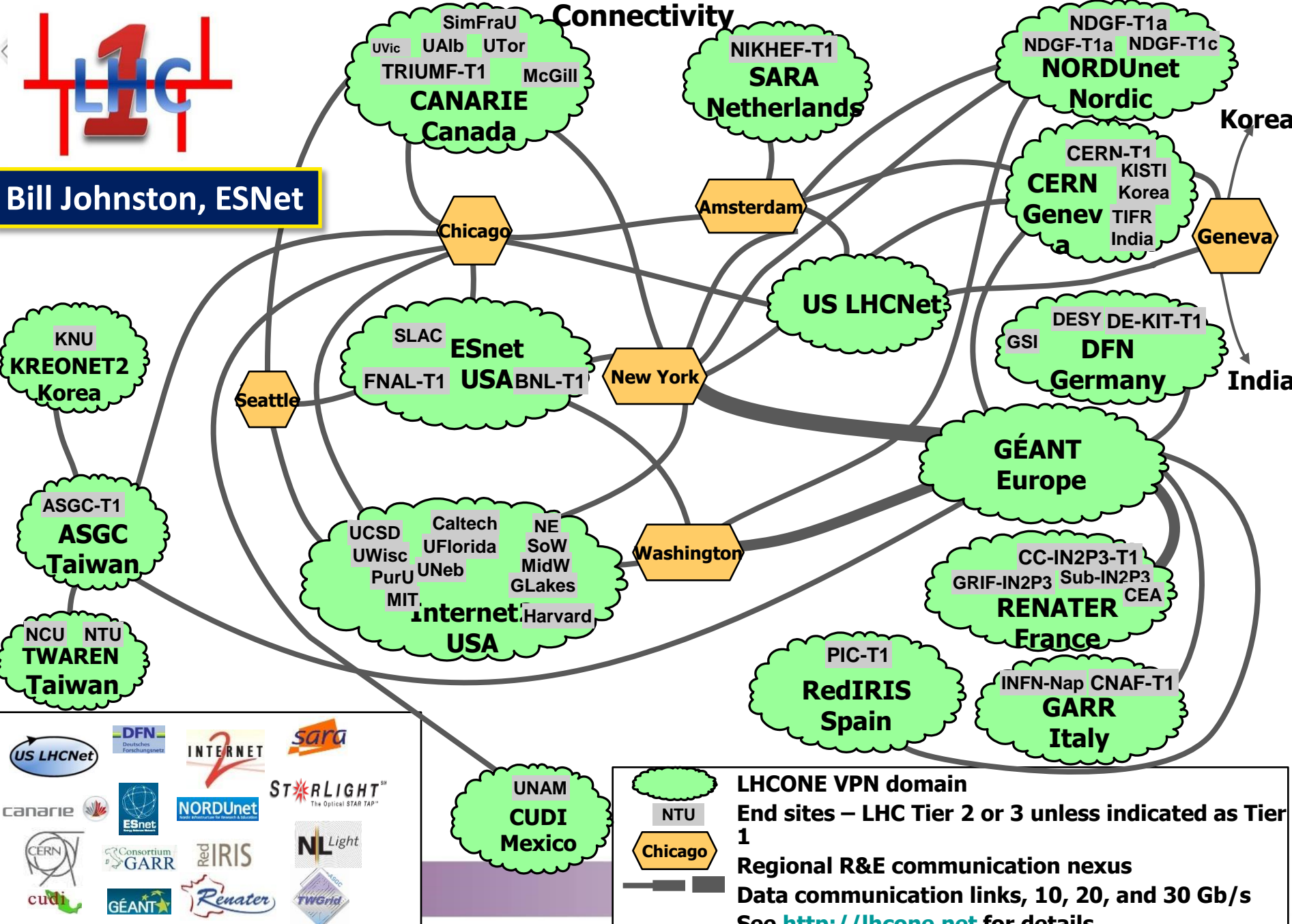


LHCONE: A global infrastructure for the LHC Tier1 Data Center – Tier 2 Analysis Center



Connectivity

Bill Johnston, ESNet



LHCONE VPN domain
 End sites – LHC Tier 2 or 3 unless indicated as Tier 1
 Chicago
 Regional R&E communication nexus
 Data communication links, 10, 20, and 30 Gb/s
 See <http://lhcone.net> for details.



DiCOS: Distributed Cloud OS

- Objectives: Scientific Cloud with federated resources
 - Scalable distributed computing infrastructure with cloud services and customized workflow on Web
 - Energy-saving racks integrated
- Features
 - Certificate-based Single Sign-On, with flexible proxy lifetime
 - Drag and Drop Web interface for distributed data management
 - Dropbox-like services is under development
 - Job workflow management
 - Dynamic job migration with embedded local IaaS mechanism
 - L&B, Accounting and Monitoring
 - By making use of GLUE2-based information system model

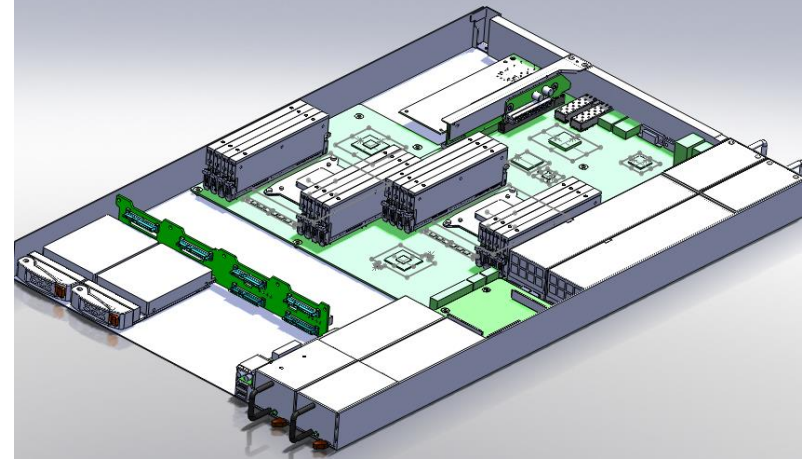
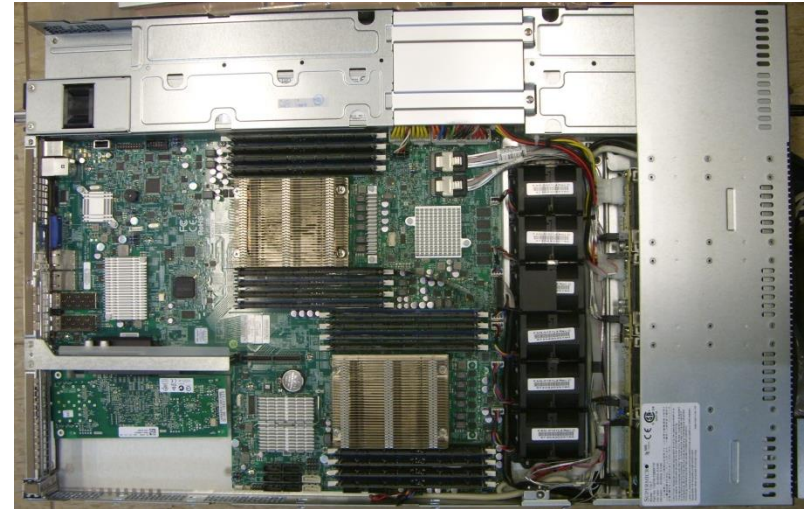


Single Rack Data Center

- **Effective power usage**
 - **No waste** → **Non-UPS solution**
 - Save power, 10% - 20%
 - **High efficiency** → **Fanless solution**
 - Reduce equipment power, 10% - 20%
 - Reduce cooling system power, > 50%
- **Easy to be installed in any office**
 - **Fanless solution** → **No noise**

Fanless 1.5U server

- **Use SuperMicro 1U server with dual Xeon CPU**
 - E5-2630L, 6 cores
 - x16, 8GB DDR3 1333 ECC DIMM
 - On board, Ethernet 10G SFP+ & RAID
- **Status**
 - The mechanical model of original 1U server was built.
 - Fanless thermal design was done and all new parts were built.
 - First server is assembled.
 - Server height will be 1.5U
- **Estimated power of 6 fans**
 - 50W to 72W





System Optimization

- Goals: Intelligent Operation
 - Performance, Cost and Energy Saving, Early Warning and Automation
- Storage System and Data Management
 - Fast access and maximize throughput of each storage server
 - Strategy: Metrics on Distributed analysis pipeline
- Computing System
 - Smart workload management (Pilot Factory Model) over distributed computing infrastructure (service grid + desktop Grid + Cloud)
 - Computing model adaptation and performance tuning
- Networking: from DC to international connection
 - 10Gb backbone between servers
 - Dynamic routing and software defined networking
- Data Center
 - Reduce energy consumption and maximize power efficiency

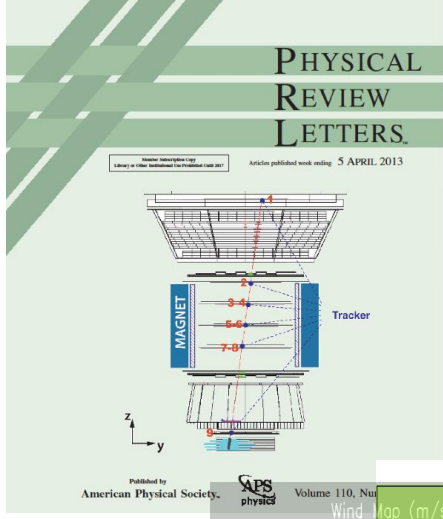
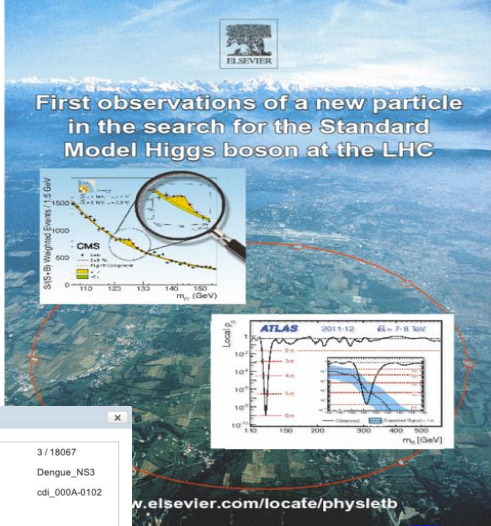


e-Science for the People

- Earthquake, Tsunami, Typhoon, Flood, Pandemic are regional issues and cannot be dealt with by individual countries alone
- Based on the science and analytics, loss from natural disasters could be significantly alleviated
- Bottom-up approach enables unprecedented collaboration which may provide opportunities to leapfrog for the academia communities in Asia
- Interdisciplinary nature will lead to new scientific findings of disaster mitigation
- With BigData Analytics and PaaS over the DCI, detailed, quantitative scientific understandings are becoming possible



Higgs Search at ATLAS



Alpha Magnetic Spectrometer

Weather/ Climate Changes

Docking conformations:

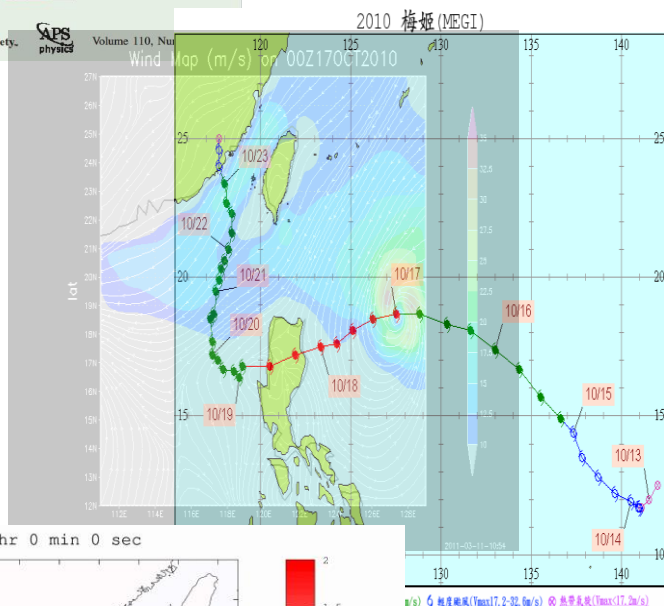
Docking job: 3 / 18067
 Protein Name: Dengue_NS3
 Ligand Name: cdi_000A-0102
 Best docking energy: -8.79
 Best cluster docking energy: null

Highlight Ligand

- Don't highlight
- Highlight carbons of the ligand
- Highlight whole ligand

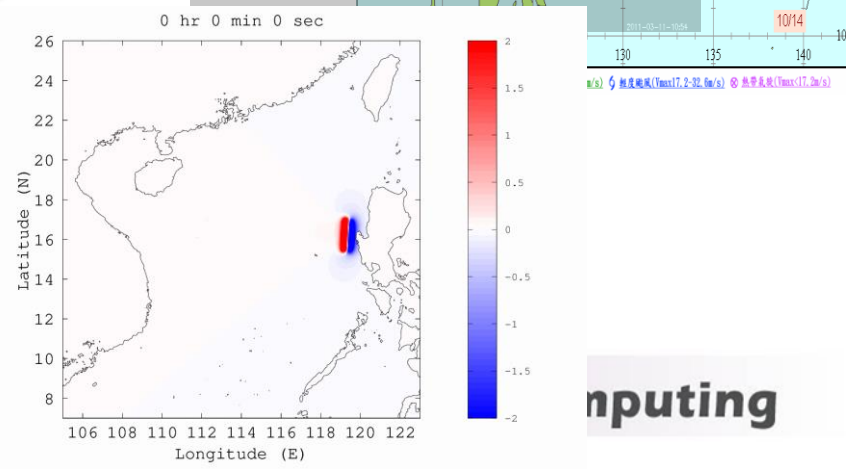
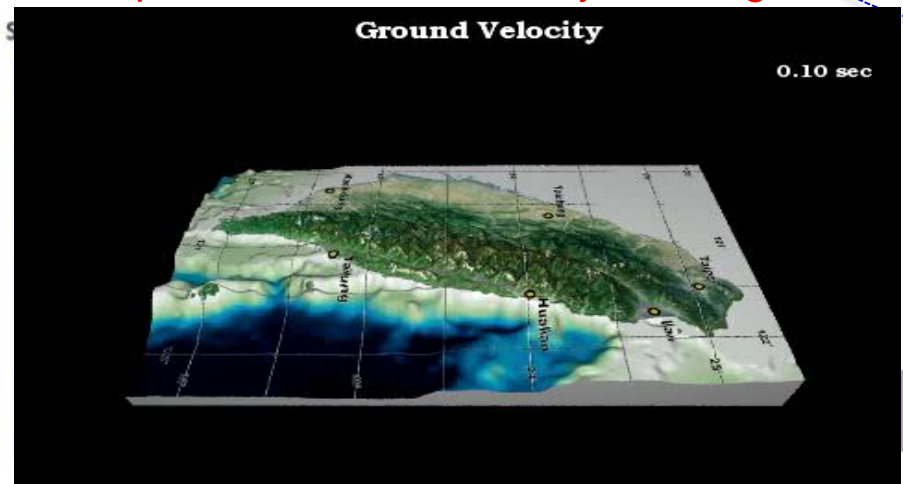
prev next

Distributed Computing Infrastructure (HW, SW, Networking)



Drug Discovery Application Portal

Earthquake and Tsunami Early Warning



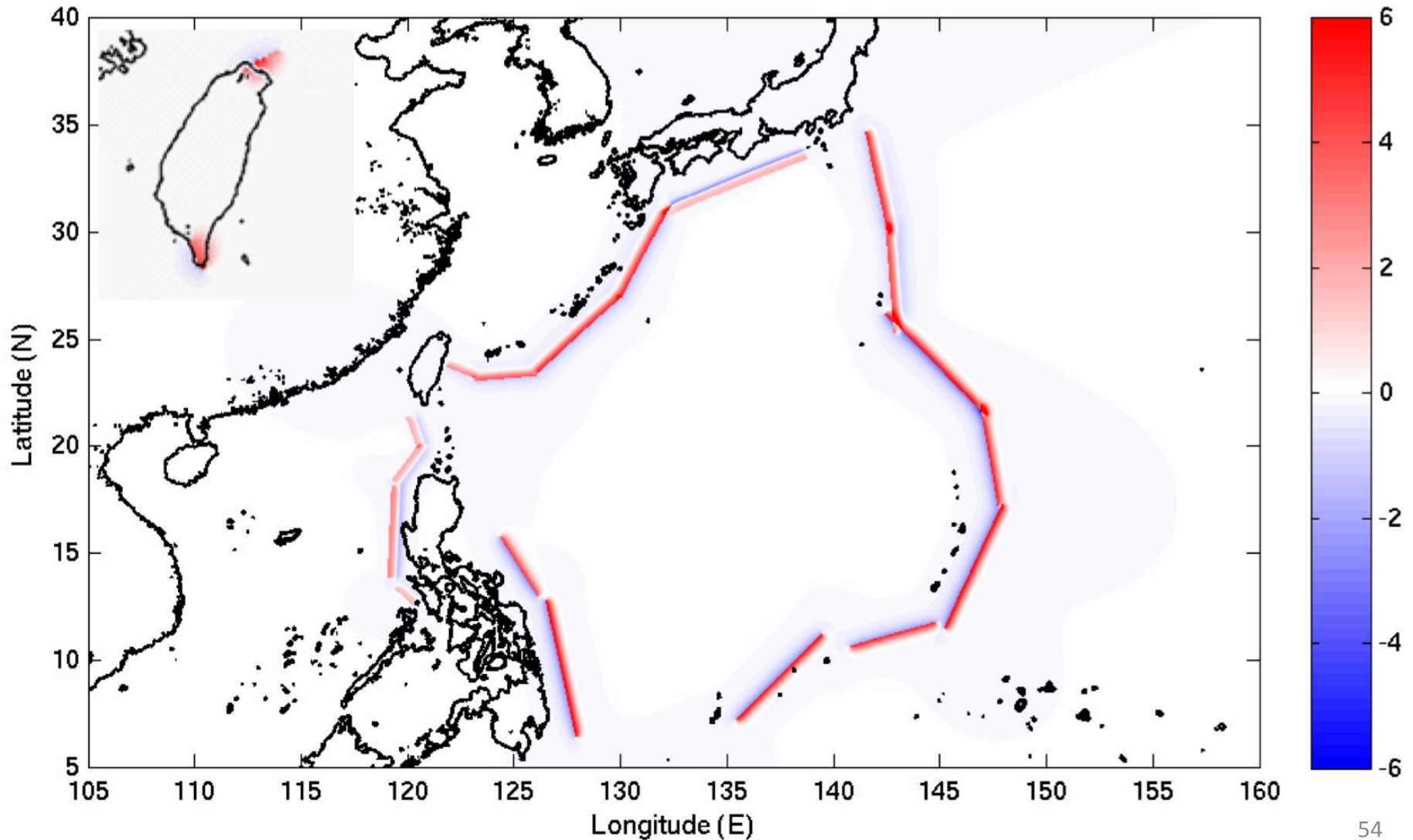
nputing

Tsunami Sources of

18 Trench and 4 Fault Segments

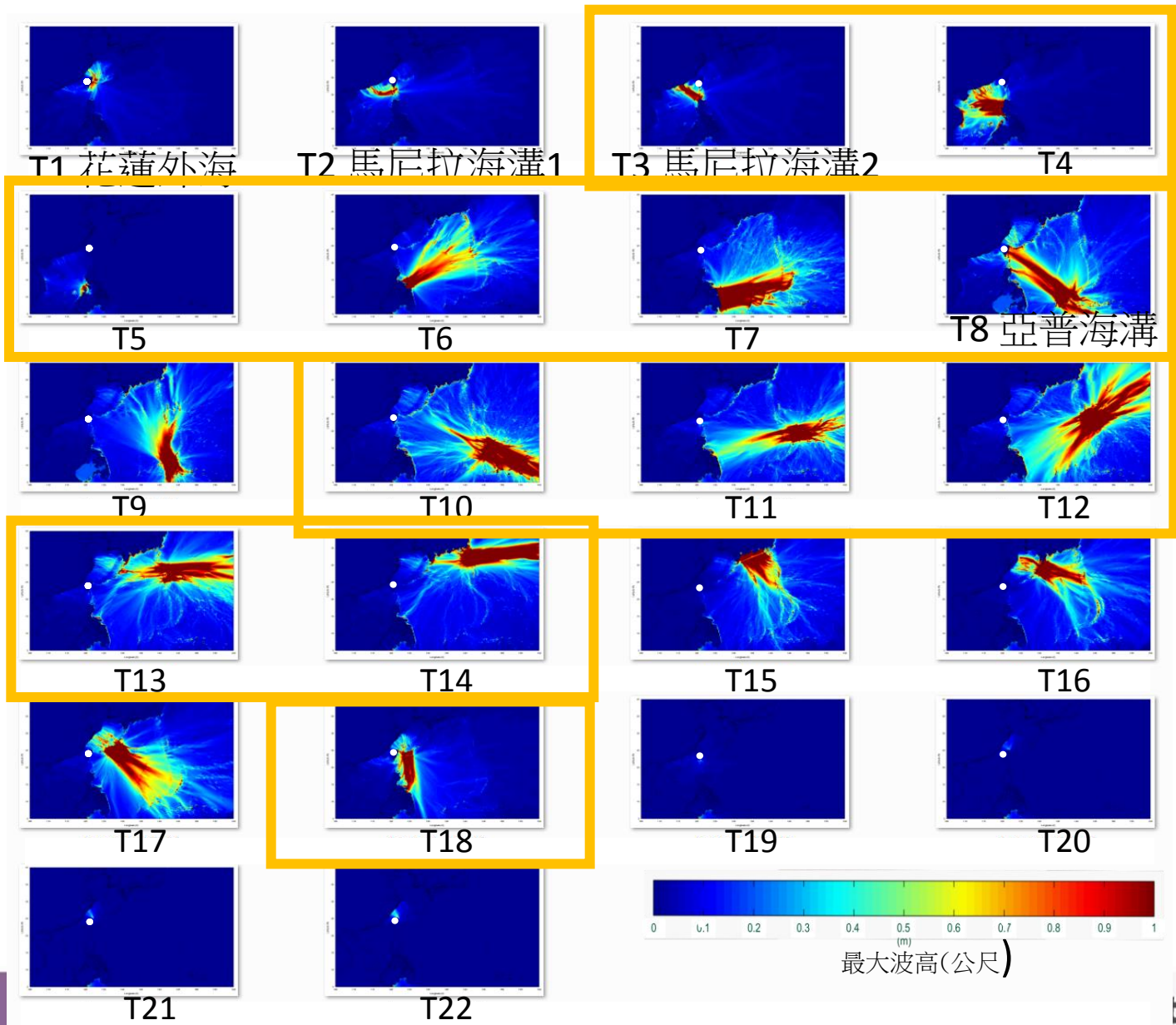
18 Trench-type tsunami sources (T1~T18)

4 Fault-type tsunami sources (T19~T22)

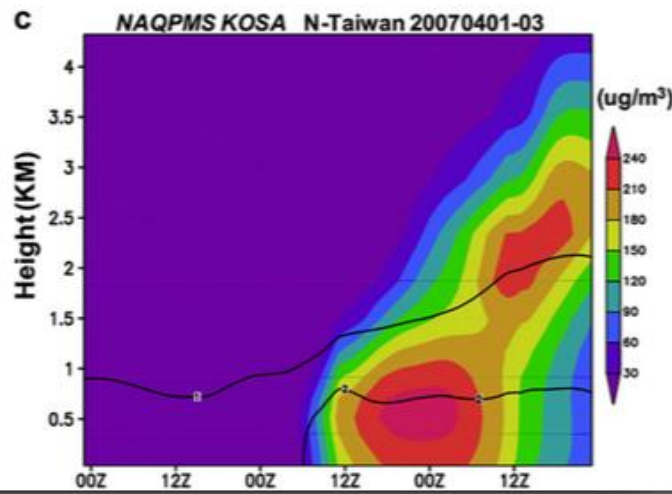
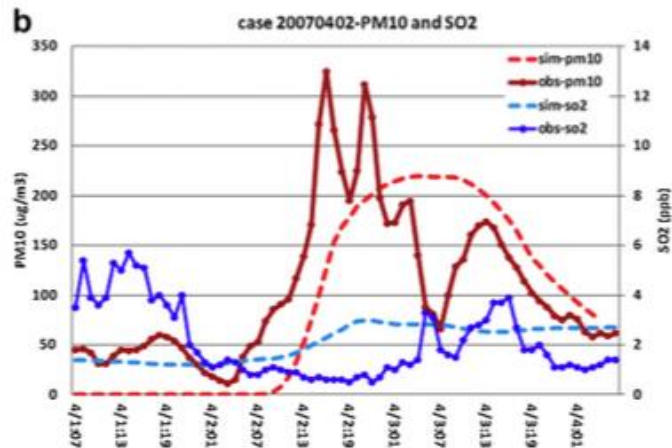
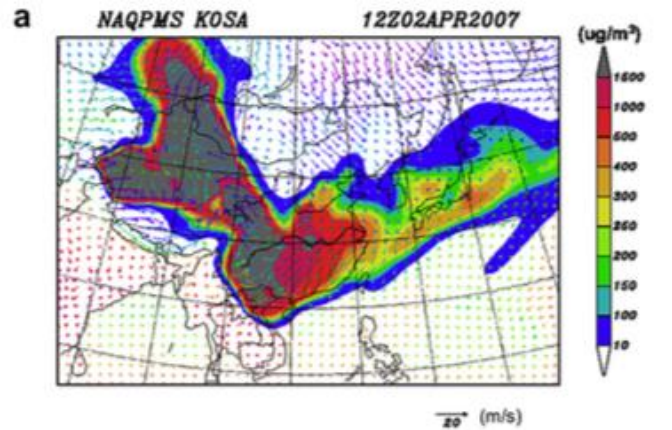




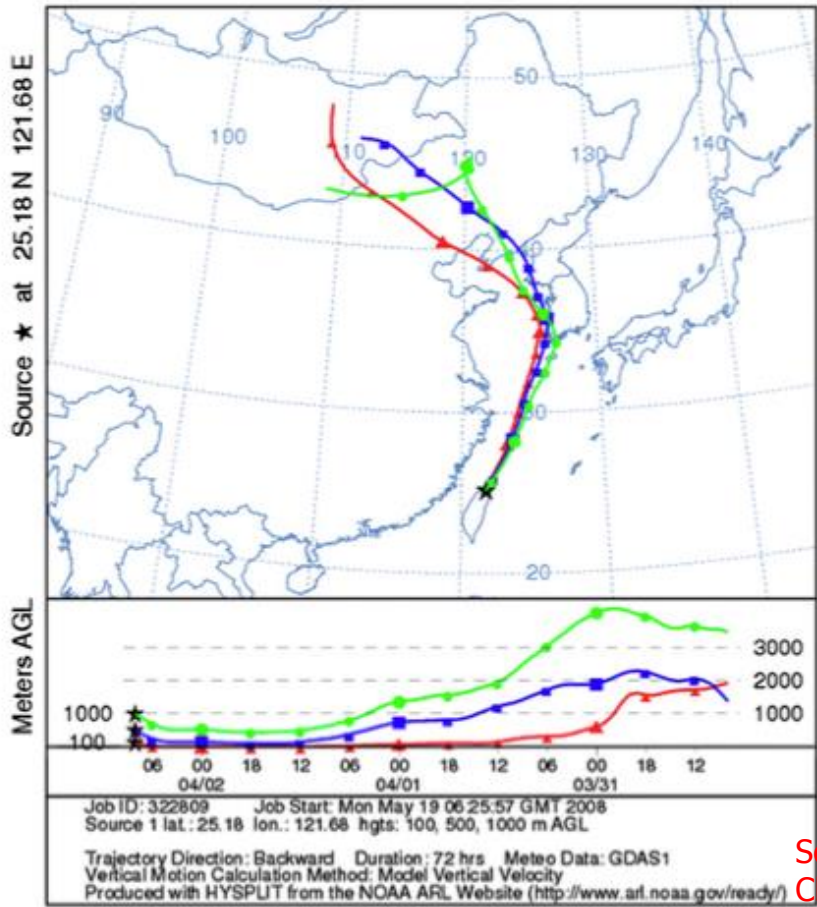
Taiwan has to be aware of the tsunamis from T1, T2, T3, and T8



Climate Change: Asian Dust Transportation, Extreme Precipitation, and Urban Heat Island Effects



b NOAA HYSPLIT MODEL
Backward trajectories ending at 08 UTC 02 Apr 07
GDAS Meteorological Data



Source Prof
Chuan-Yao Lin,
RCEC AG

GVSS:

Grid Virtual Screening System

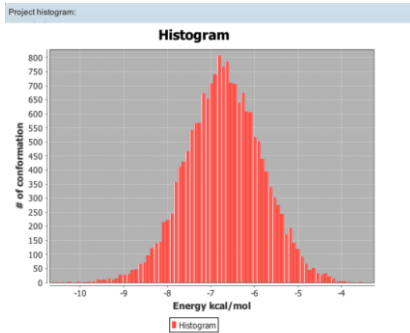
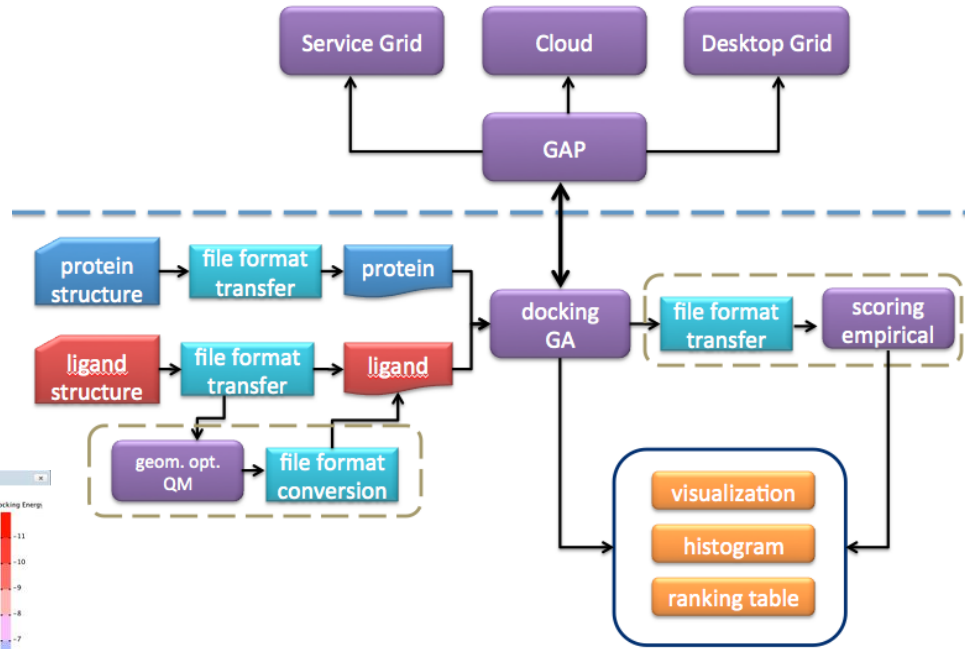
Docking job: 3 / 18067
 Protein Name: Dengue_NS3
 Ligand Name: cdi_000A-0102

Best docking energy: -8.79
 Best cluster docking energy: null

Highlight Ligand
 Don't highlight
 Highlight carbons of the ligand
 Highlight whole ligand

prev next

Click to view the docking conformation [View](#)



Home - Protein - Ligand - Project - Analysis - Grid - Log out

Project Docking Jobs

Project Name: test0120215
 Docking Tool: AutoDock 4

Protein Information

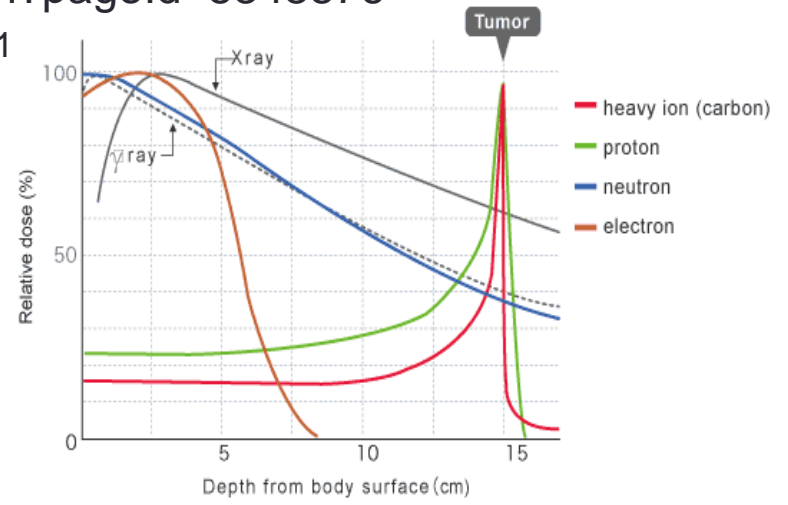
PDB ID: 1avt
 Primary: THREE-DIMENSIONAL STRUCTURE OF THE TETRAGONAL CRYSTAL FORM OF EGG-WHITE AVIDIN IN ITS FUNCTIONAL COMPLEX WITH BIOTIN AT 2.7 ANGSTROMS RESOLUTION
 Classification: BIOTIN-BINDING PROTEIN
 X-Ray Resolution: 2.7
 View Map: [View](#)

Ligand name	Ligand 2D	Best docking energy	Best cluster docking energy	DLG download	Energy table download
cdi_K085-0025: cdi_K085-0025.pdbqt		-6.03	-6.03	download DLG	download TBL
cdi_3807-3231: cdi_3807-3231.pdbqt		-4.66	-4.66	download DLG	download TBL
cdi_7054-0875: cdi_7054-0875.pdbqt		-5.39	2.0	download DLG	download TBL
cdi_7054-0876: cdi_7054-0876.pdbqt		-5.6	-5.6	download DLG	download TBL
cdi_D112-0116: cdi_D112-0116.pdbqt		-7.33	-7.33	download DLG	download TBL
cdi_D087-0018: cdi_D087-0018.pdbqt		-5.14	N/A	download DLG	download TBL

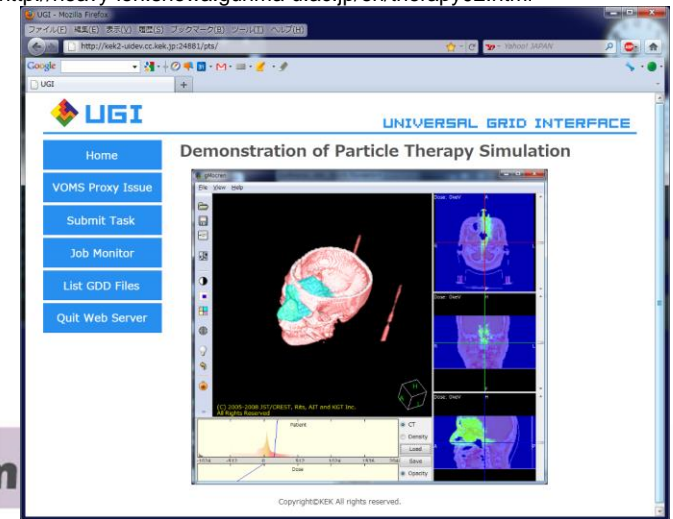
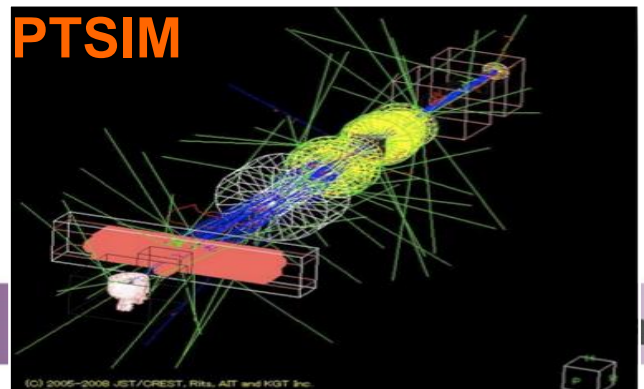
- Support biomedical researchers responding to the pandemic disease by high speed assay process on Grids/Clouds.
- Must be competitive to the fast in-vitro facility!
- Available DB: ZINC (10M ligands), CDI (30K ligand) and Protein (700)

Geant4 Particle Therapy Simulation Framework

- PTSIM : <http://wiki.kek.jp/pages/viewpage.action?pageId=5343876>
- An application program based on Geant4*1
- Modeling a treatment port
 - A beam delivery system and treatment head
 - A patient geometry from CT images
 - Modifying configuration by using UI commands.
- Providing a common platform to cover different facility specifications
- PTSIM users/Activities
 - In Japan
 - HIBMC, FPHPTC, NPTC, NCC, GHMC, etc.
 - In Taiwan, Tutorial in CGU / CGMH in Nov. 2014 with support of Academia Sinica.

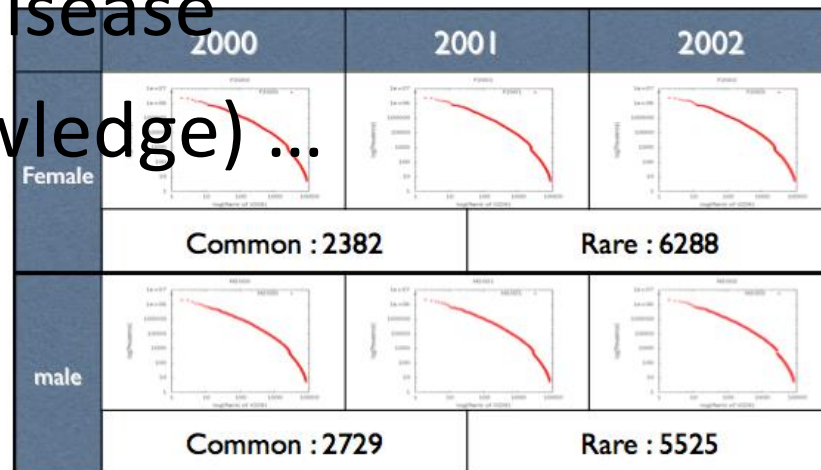
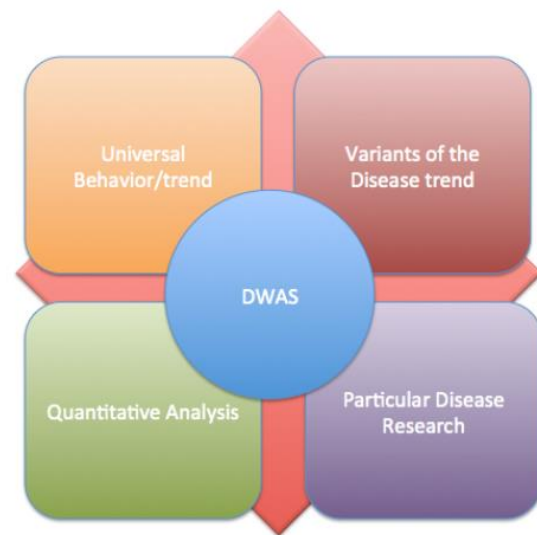


Gunma Univ. Heavy Ion Medical Center
<http://heavy-ion.showa.gunma-u.ac.jp/en/therapy02.html>



DWAS: Disease Wise Association Study

- The first full population medical record analysis
- Zipf's Law identified on ...
 - Prevalence Analysis
 - Correlation Length and anti-correlation
- Discover numerical differentiation between rare disease and common disease
- Collaboration (domain knowledge) ...

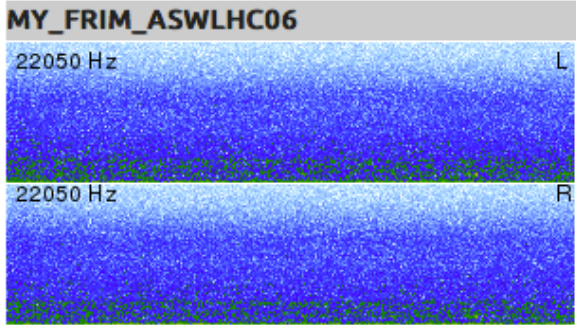




Soundscape: understand the characteristics of soundscape across spatial-temporal scales, by studying impacts of soundscape on human and organism and vice versa

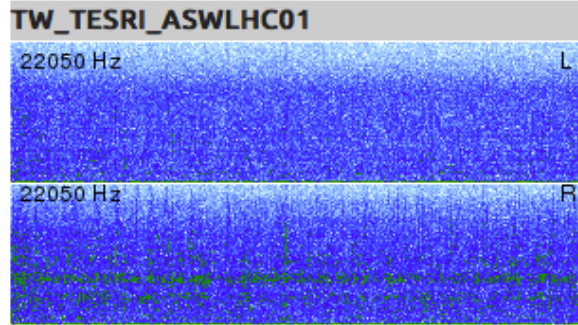
Date: 19-Nov-2014 - total of 4 sounds in the sites selected

◀ 18-Nov-2014 | 19-Nov-2014 | 20-Nov-2014 ▶



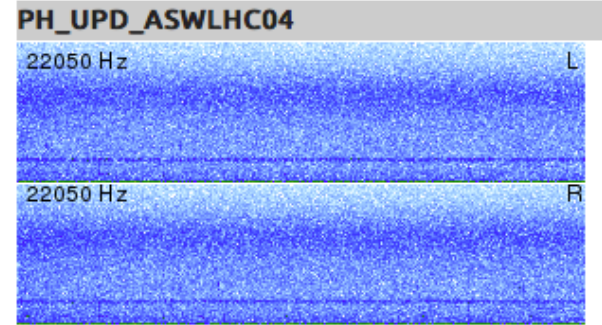
[MY_FRIM_LHC01_20141119_060000.wav](#)

Date: 2014-11-19 06:00:00



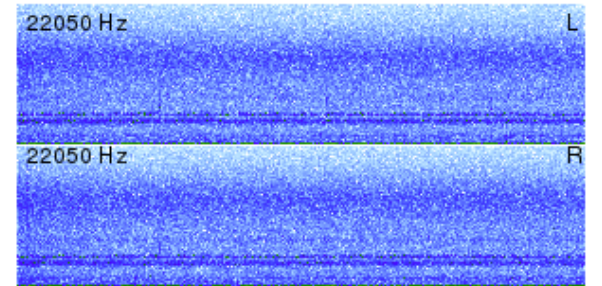
[TW_ESRI-LHC01_20141119_060000.wav](#)

Date: 2014-11-19 06:00:00



[PH_UPD_TFRI_20141119_060000.wav](#)

Date: 2014-11-19 06:00:00



[PH_UPD_TFRI_20141119_180000.wav](#)

Date: 2014-11-19 18:00:00



Multispectral Data Analysis for Cultural Preservation

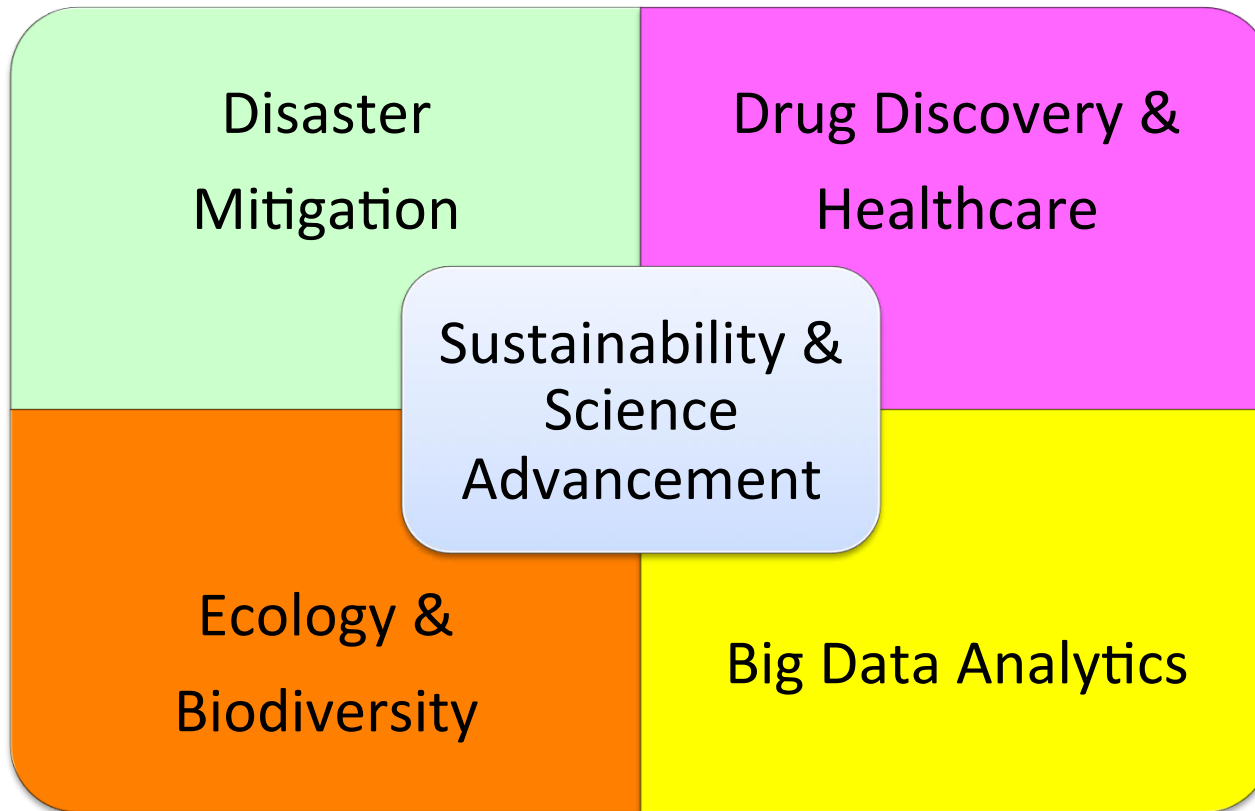
公山氏之往乎
者而豈徒哉如
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道於東方。程
不可有為之人

公山氏之往乎
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乎
豈徒哉言必用
道於東方。程
不可有為之人

略每斤鈔壹錢
鹿子每斤鈔壹兩
相河每斤鈔壹兩伍錢
百藥煎每斤鈔壹兩
筋心每兩鈔壹錢
草藥每斤鈔肆兩捌錢
木耳上每斤鈔三兩
白礬每斤鈔伍錢
醋每斤
墨煤
醬每斤
海青
台椒
酒每
蘇木

Asia Pacific e-Science: The Strategy

e-Infrastructure/Technology



Application/Service Providers

User Communities



Regional e-Science Collaborations

- Started from Big Sciences, the new distributed infrastructure, and human network across countries
- Taking advantages of Global collaborations
 - Middleware, User Communities and Applications, Operation Technology, etc.
- Saving lives by e-Science: Natural Disaster Mitigation (including earth, climate, neglected diseases, etc.) is the common focal point
- Towards Big Data Analysis
- More countries start to deploy the production applications (Drug Discovery, Earthquake & Tsunami simulation, weather simulation, Climate Changes, etc.) and develop new features according to user requirements.
- Vision is to share data, infrastructure, tools, analytics, human resources, etc.



International Symposium on Grids and Clouds 2015

15~20 March 2015, Academia Sinica, Taipei, Taiwan

ISGC 2015

Global e-Infrastructure for Global Challenges

- Topics include Physics (including HEP) and Engineering Applications, Biomedicine & Life Sciences Applications, Earth & Environmental Sciences & Biodiversity Applications, Humanities, Arts, and Social Sciences (HASS) Application, Virtual Research Environment (including Middleware, tools, services, workflow, etc.), Data Management, Big Data, Infrastructure & Operations Management, Infrastructure Clouds and Virtualisation, Interoperability, Business Models & Sustainability, Highly Distributed Computing Systems, and High Performance & Technical Computing (HPTC)



Summary

- Scalable Distributed Computing Infrastructure
 - Fanless single rack is devised as the building block: energy saving and flexibility purposes
 - Cloud services are developed for both site level dynamic resources & cross sites easy application environment deployment and migration
 - Operation technology developed for architecture & performance optimization, monitoring & analysis, as well as intelligent operation
 - Advanced networking capacity and technology are necessary
- Wider discipline and multi-disciplinary e-Science applications
 - web-based application gateway, by working closely with user communities, is the best recipe.
 - Keep improving the system and technology by user feedback and VO domain knowledge
 - Towards common data and sharing of analysis tools & methodology
- Closer Regional & International Collaborations
 - APROC model is essential
 - Coordinated by VO and APGI is the best model
- e-Science for the People is our principal strategy