Grid Computing Activities in PKU

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Agenda

- Status: Grid Computing in China
- ChinaGrid & PKU
- EUChinaGRID & PKU
- Grid Computing and Bioinformatics

Status: Grid Computing in China

Status: Grid Computing in China

Project Name	Sponsored By	Undertaken By	Organized By	Grid Middleware
CNGrid	MOST (Ministry of Science & Technology)	ICT (Institute of Computing Technology)	CAS (Chinese Academy of Sciences)	GOS (Grid Operating System)
ChinaGrid	MOE (Ministry of Education)	HUST (Huazhong Univ. of Science & Technology)	CERNET (China Education & Research NETwork)	CGSP (ChinaGrid Supporting Platform)
NSFCGrid	NSFC (National Science Fund of China)	Beihang University		CROWN

ChinaGrid & PKU

ChinaGrid-1st phase (2002-2006)

- China Education and Research Grid covering CERNET univ.
- Coverage: 13 provinces, 20 universities
- Aggregated capability: 16Tflops, 180TB storage
- CGSP (China Grid Support Platform):
  - The 1st grid computing platform on the world based on WSRG
- Grid Applications deployed:
  - Bioinformatics: >120 software tools, 35 related databases, and support 6 typical applications
  - Digital Image Processing: 14 classes and 35 related services, 0.1 million medical images, 10 thousand diagnostic materials
  - Computational Fluid Dynamics: >30 software tools, >40 grid services, and support 4 typical applications
  - Mass Information Processing: 18 university digital museum, 4 classes more than 0.1 million digital samples, and support 3 typical applications
  - University course online: 300 university courses, 3500 hour video courses, VoD services provided by 22 servers over 17 cities
  - Other applications

Peking University
1. One of CGSP developer
2. 1/20 nodes
3. Grid service provider
4. Organizer of Univ. Course Online

Recent Activities of ChinaGrid – CNGI08

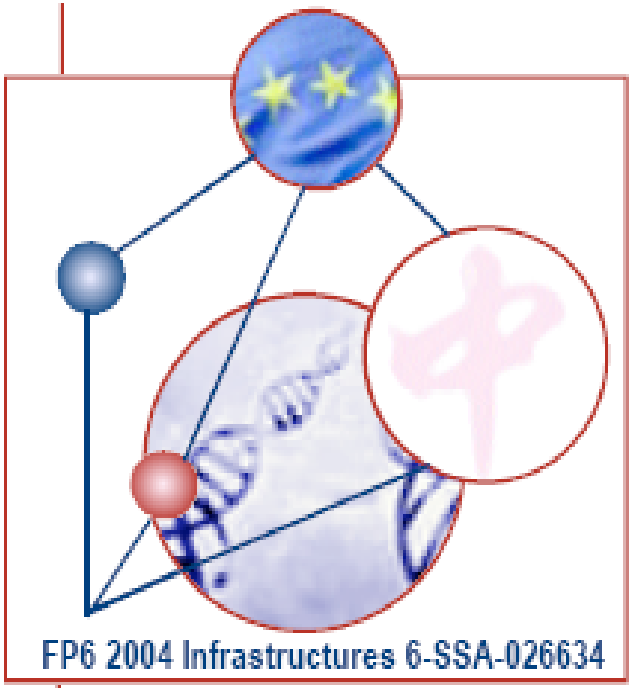
- CNGI: China Next Generation Infrastructure
  - CERNET2 is the biggest Core Network of CNGI
  - CERNET2 covers over 100 Chinese universities
  - Backbone bandwidth: 2.5Gbps/10Gbps
- CNGI08: focusing on trial commercial operation of CERNET2
- ChinaGrid is 1/20 CNGI08 applications
  - Goal: to upgrade ChinaGrid to support IPv6
  - CGSPv6: to support IPv6 in grid supporting layer
  - New direction: Combined with Cloud Computing, extended to support virtual machine management and schedule
- PKU is ¼ nodes of CNGI08-ChinaGrid project

EUChinaGRID & PKU

EUChinaGRID Project (2006-2008)

Target:

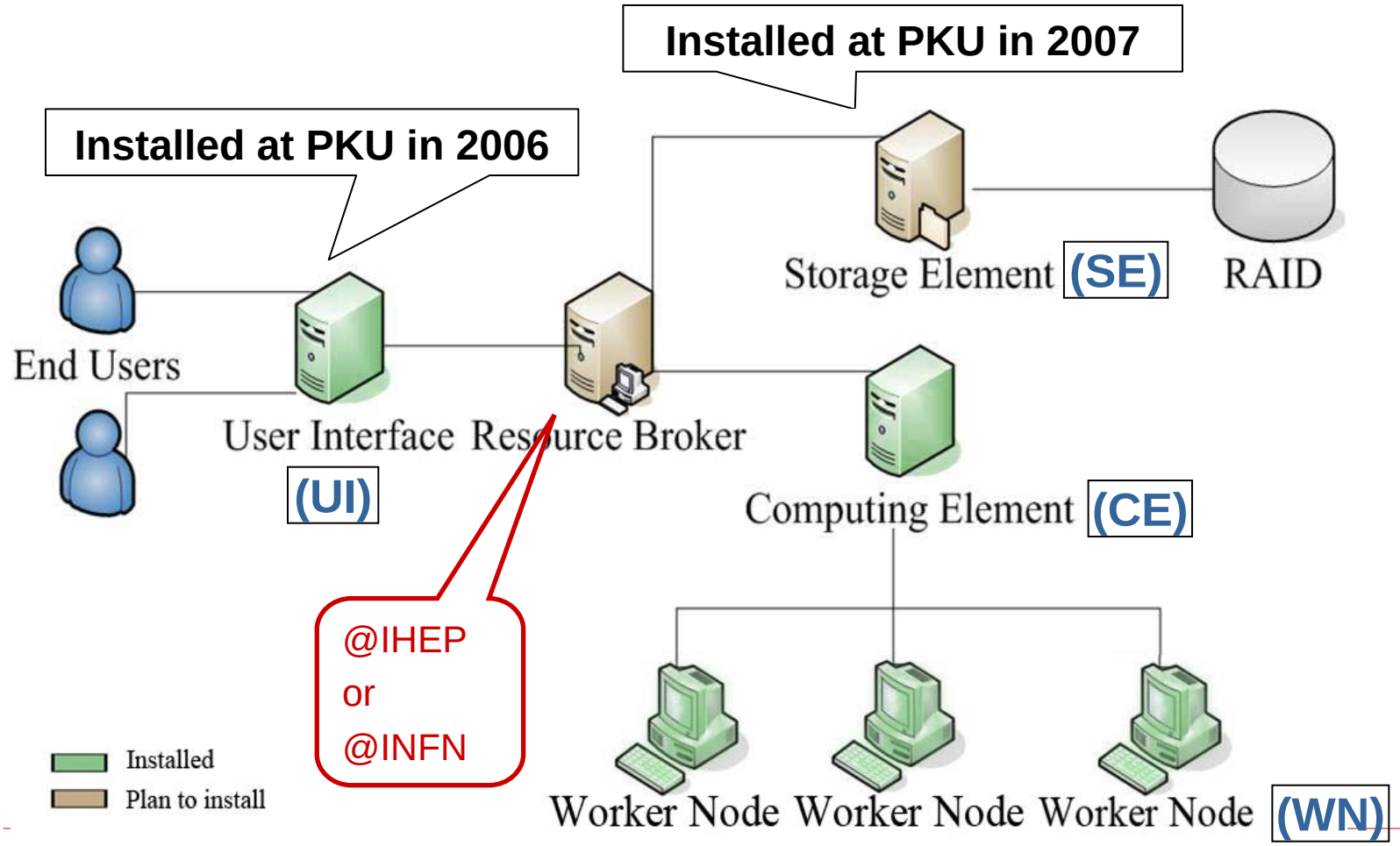
- To foster the creation of an intercontinental eScience community
- To support interoperable infrastructure for grid operations between Europe (EGEE) and China (CNGRID)



EUChinaGRID-PKU Achievements

- High speed network connection to Europe via TEIN2
- Construction of CN-BEIJING-PKU grid site
- Application on biology research (led by Prof. XIA Bin, School of Life Science, PKU)
- Application on particle physics research (led by Prof. QIAN Sijin, School of Physics, PKU)
- Dissemination

Structure of CN-BEIJING-PKU Site

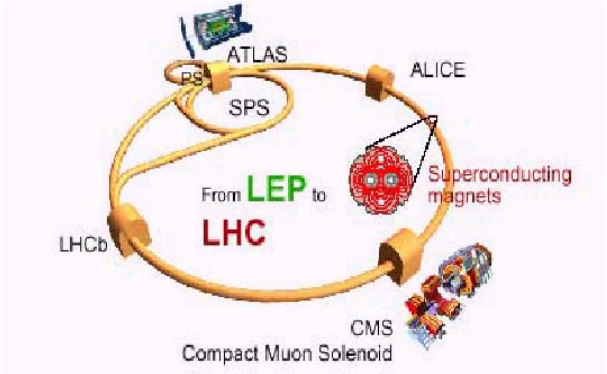


Physics Data Analysis for CMS Experiment

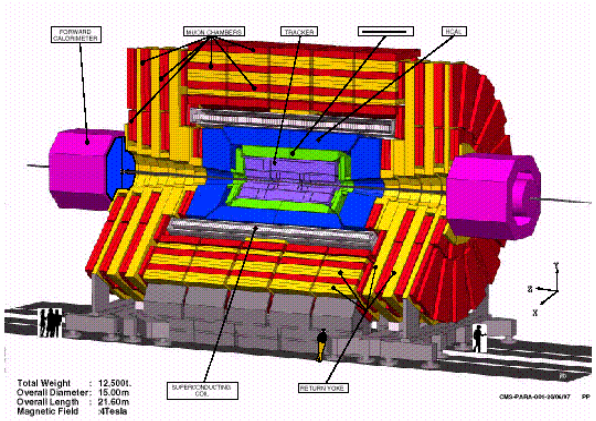
- CMS group in the Physics School of Peking University has started to use Grid tools to analyze physics data of CMS experiments on LHC at CERN since 9/2005
- Huge amount of Monte-Carlo data (from now on) and real data (collected from the end of 2009) shall await for us to analyze

LHC completion date: 9/2008

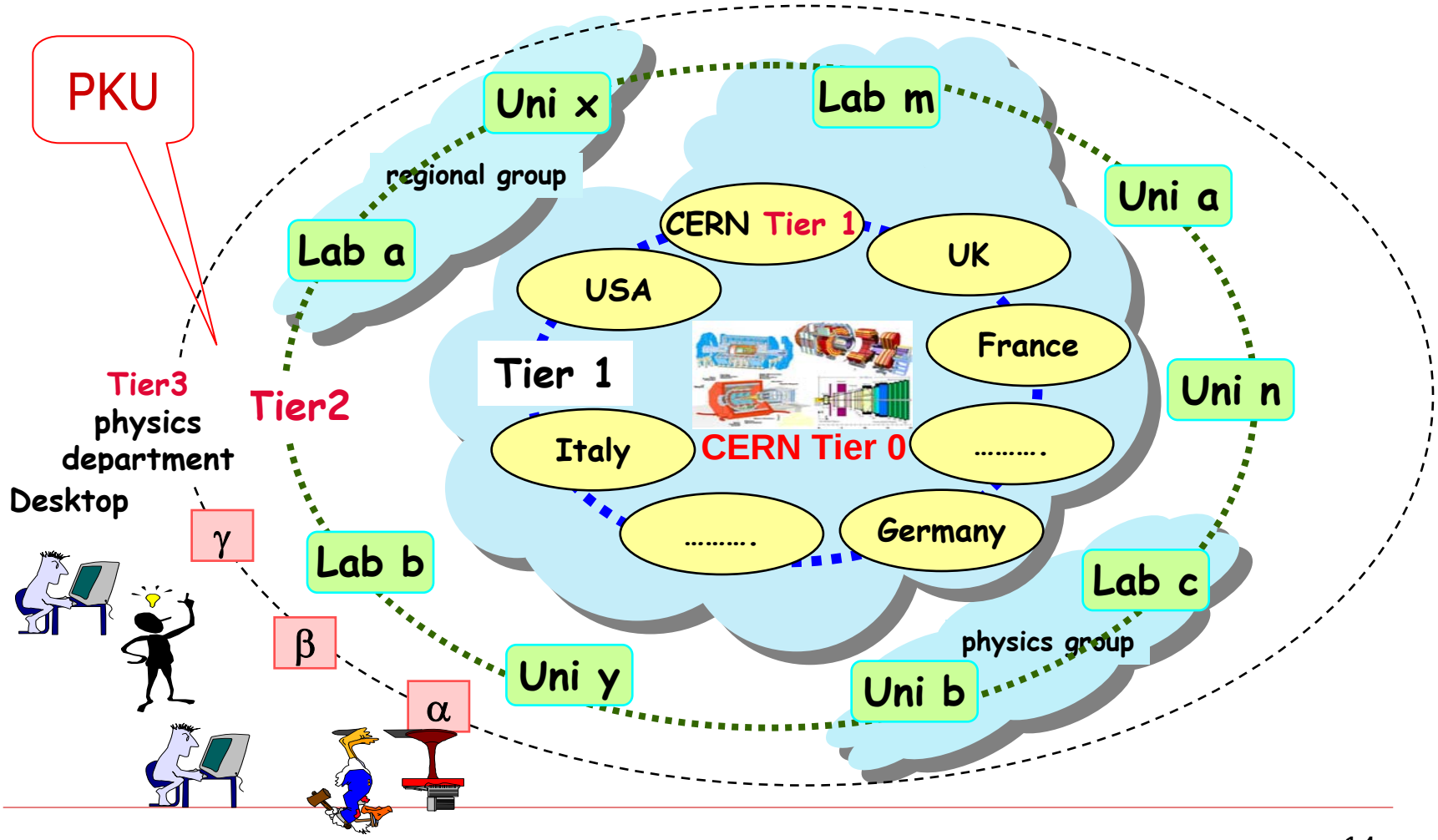
27 km circumference



	Beams	Energy GeV	Luminosity
LEP	e+ e-	200	10^{32} cm^{-2}s^{-1}
LHC	p p	14000	10^{34}
	Pb Pb	1,312,000	10^{27}



LHC Computing Grid Model



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EUChinaGRID - Monitoring

CN-BEIJING-PKU

Service Availibility Monitoring - SE

2007/02/23 - 11:27:53

No	RegionName	SiteName
1	Default	beijing
2	Default	b
3	Default	cy
4	Default	cy
5	Default	g
6	Default	h
7	Default	in

No	Site Reports	GIIS Host	NodeName	Status										
				bnode		qperf	sanity	serv	version	sclust	totalCPU	freeCPU	runJob	waitJob
1	BEIJING-CNIC-LCG2-IA64	ce-lcg.sdg.ac.cn		.	.	ok	ok	ok	LCG-2_7_0	Scientific Linux CERN 3.0.4	32	14	14	0
2	BEIJING-LCG2	lcg0[illegible]p.ac.cn		.	.	ok	ok	ok	GLITE-3_0_1	Scientific Linux 3.0.8	26	16	10	0
3	CYFRONET-IA64	ares02.cyf-kr.edu.pl		.	.	ok	ok	ok	LCG-2_7_0	Scientific Linux CERN 3.0.5	34	2	31	179

Site ▼		ROC	GK#	Q#	RunJob	WaitJob	Computing Resources: JobLoad	Power	WN#	CPU#	CPULoad	Storage Resources: Available	Total	%	MH#
BEIJING-CNIC-LCG2-IA64		CERN	1	7	0	31108	-	0	0	0	-	7.1 GB	62.8 GB	89%	11
BEIJING-LCG2		CERN	1	8	5	1	13%	44K	14	30	0%	1000 GB	2.8 TB	66%	7
BEIJING-PKU		EUChina	1	8	0	7	0%	0	2	4	1%	52.6 GB	-	-	4
CYFRONET-IA64		CentralEu	1	13	35	15	89%	47K	22	44	88%	232.8 GB	2 TB	89%	24
CYFRONET-LCG2		CentralEu	2	34	214	133	4%	1M	171	582	22%	78.1 TB	94.1 TB	17%	138
GR-01-AUTH		SEE	1	12	8	47	100%	3K	7	5	99%	106 GB	217.6 GB	51%	11
HG-03-AUTH		SEE	1	19	109	90	-	-	-	-	-	-	-	-	-
INFN-CATANIA		Italy	1	11	321	534	97%	108K	27	77	100%	25.7 TB	27.3 TB	6%	95
INFN-CNAF		Italy	2	8	14	42	88%	8K	4	8	90%	152.9 GB	1.7 TB	91%	11
INFN-ROMA3		Italy	1	6	0	0	0%	57K	22	44	0%	7 TB	7.2 TB	3%	27
SDU-LCG2		CERN	1	5	1	0	-	-	-	-	-	63.2 GB	-	-	-
TOTAL: 11		**4**	**5**	**13**	**131**	**707**	**31977**	**54%**	**1M**	**269**	**794**	**55%**	**112.3 TB**	**135.4 TB**	**52%**	**328**

Grid Computing & Bioinfomatics

Harmonia – A SOA platform

(led by Prof. YU Huashan, School of Computer Science & Technology, PKU)

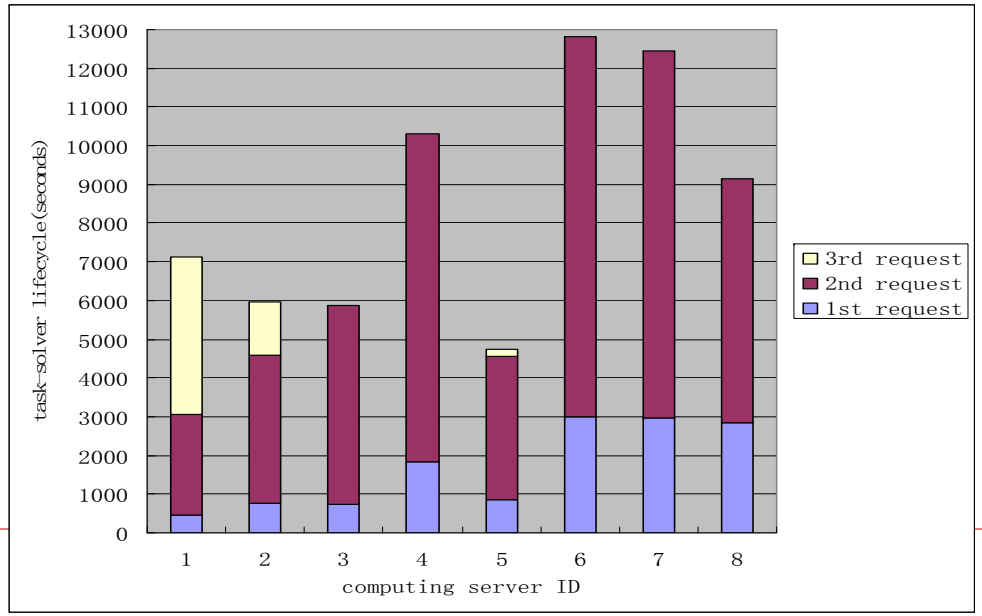
- Cooperated with School of Life Science, PKU
- Focusing on multiple-task computation, especially those in Bioinformatics
- To accelerate the genome-related or proteome-related computations
- Key technologies:
  - Two level parallel computing
    - Independent tasks are scheduled to be executed concurrently on distributed computers
    - Multiple tasks are executed concurrently on each SMP/multi-core sever
  - Dynamic computation partitioning
    - To address computer heterogeneity: difference in performance
    - To address problem irregularity: difference in job complexity
  - Resource virtualization technology: abstracting a computer, an installed software, databases required by the software, and the software's optimal argument options on the computer
    - To reduce Grid midware's complexity
    - To share cost caused by database updating
    - To share runtime performance optimizing expertise

Typical application 1: gSVAP

- Function: to predict all possible mRNAs transcribed from a genome
- Computation characteristics:
  - Consists of up to tens of thousands of tasks that can be scheduled independently
  - The tasks are very irregular in complexity: graph-based problem
- Harmonia's role:
  - Find available computers for the applications
  - Distribute the tasks onto these computers and execute them automatically in an optimized way

What does Harmonia bring?

- Speedup computation by parallel computing
- Optimize resource accessing efficiency by submitting 51242 tasks with 19 requests
- Improve resource utilization by executing multiple serial tasks concurrently on servers

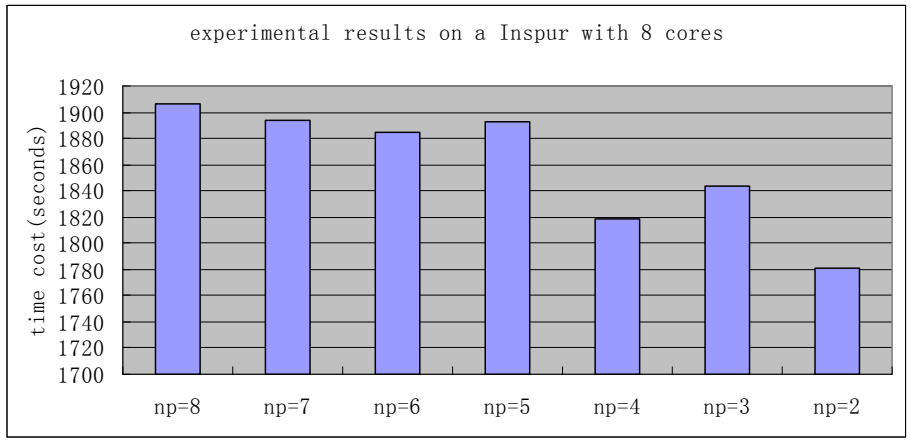


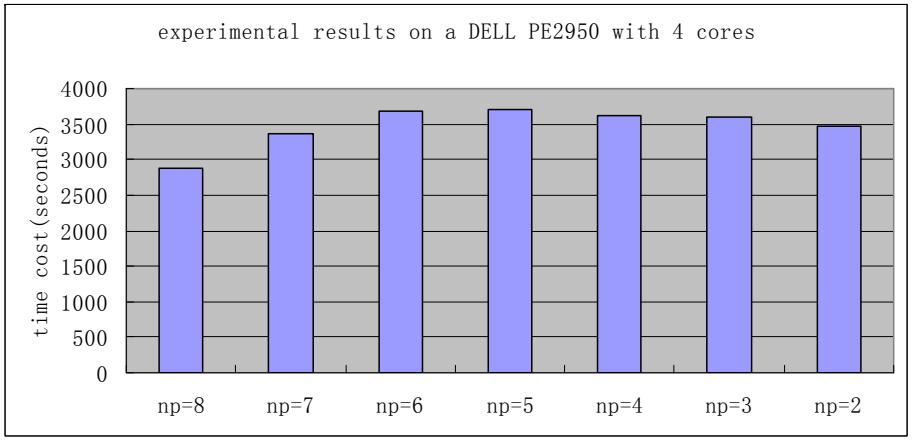
Typical application 2: gBLAST

- Function: to aggregate distributed gene databases for BLAST computing
- Key characteristics
  - Each database is updated frequently
  - A user often has to perform BLAST on different databases for the same gene sequence, like that in flu virus analysis
- Harmonia's role
  - Find an appropriate server for each BLAST task, according to its database requirement
  - Optimize each BLAST task's performance with expertise

What does Harmonia bring?

- Reducing cost for updating database by resource sharing
- Minimizing computing cost with expert argument options
- Performing NCBI BLAST BENCHMARK
  - megablast on NT





Conclusion

- Grid Computing is a meaningful complement to HPC.
- Traditional HPC is still very important for daily scientific computations.
  - Campus HPC cluster operated by Computer Center is not in any grids yet.
  - The demand for computational capability is much larger than the supply, no spare capability to share.
- Cloud Computing is developing rapidly.
  - Same vision, to reduce the cost of computing, increase reliability, increase flexibility. (By Ian Foster)
  - Focusing more on integrating computational capabilities in an administrative domain.
  - Architecturally simpler and operationally more feasible than grid computing.

Thank you!