Feb. 6~7, 2012
AFAD, Kolkata India

Cyber-infrastructure of for High Energy Physics in Korea

Kihyeon Cho

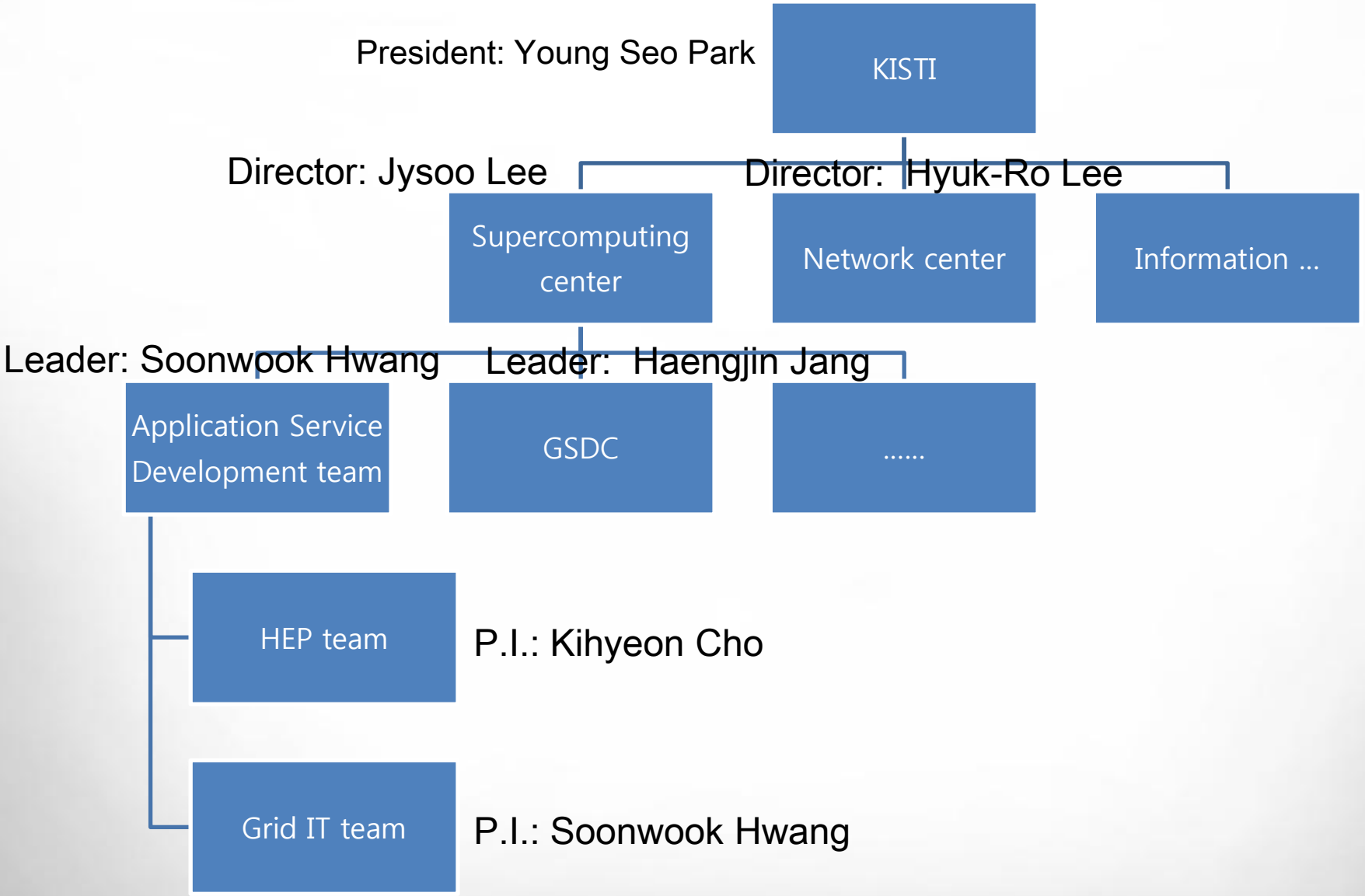
High Energy Physics Team, KISTI

KiSTi 한국과학기술정보연구원
www.kisti.re.kr
Korea Institute of Science and Technology Information

Contents

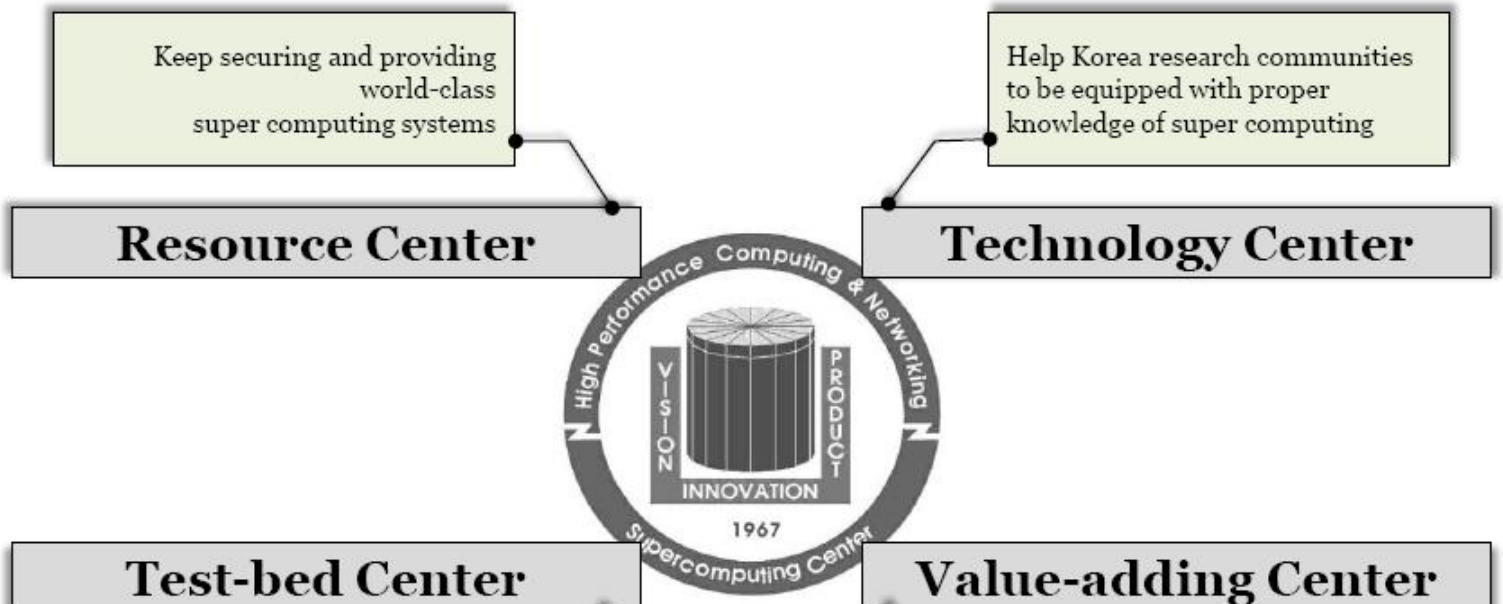
Supercomputing Center @ KISTI

Organization of KISTI



- KISTI is responsible for national cyber-infrastructure (supercomputing and network) of Korea.

Vision and Mission



Expanding the Horizon of Science and Technology

History of KISTI Supercomputers

[KISTI-1]
Cray 2S

2 GFlops

[KISTI-2S]
Cray T3E

115 GFlops

[KISTI-3]
NEC SX-5/6

320 GFlops

[KISTI-4]
SUN Blade 6048

324 TFlops

1988 2GF
1993 16GF
1997 131GF
2001
2002 5.2 TF
2003
2008
2009 360 TF
2011

[KISTI-2]
Cray C90

16 GFlops

[KISTI-3]
IBM p690

4.4 TFlops

[KISTI-4]
IBM p595

36 TFlops

Supercomputer @ KISTI

Top 500 List (http://www.top500.org, 2009/11)

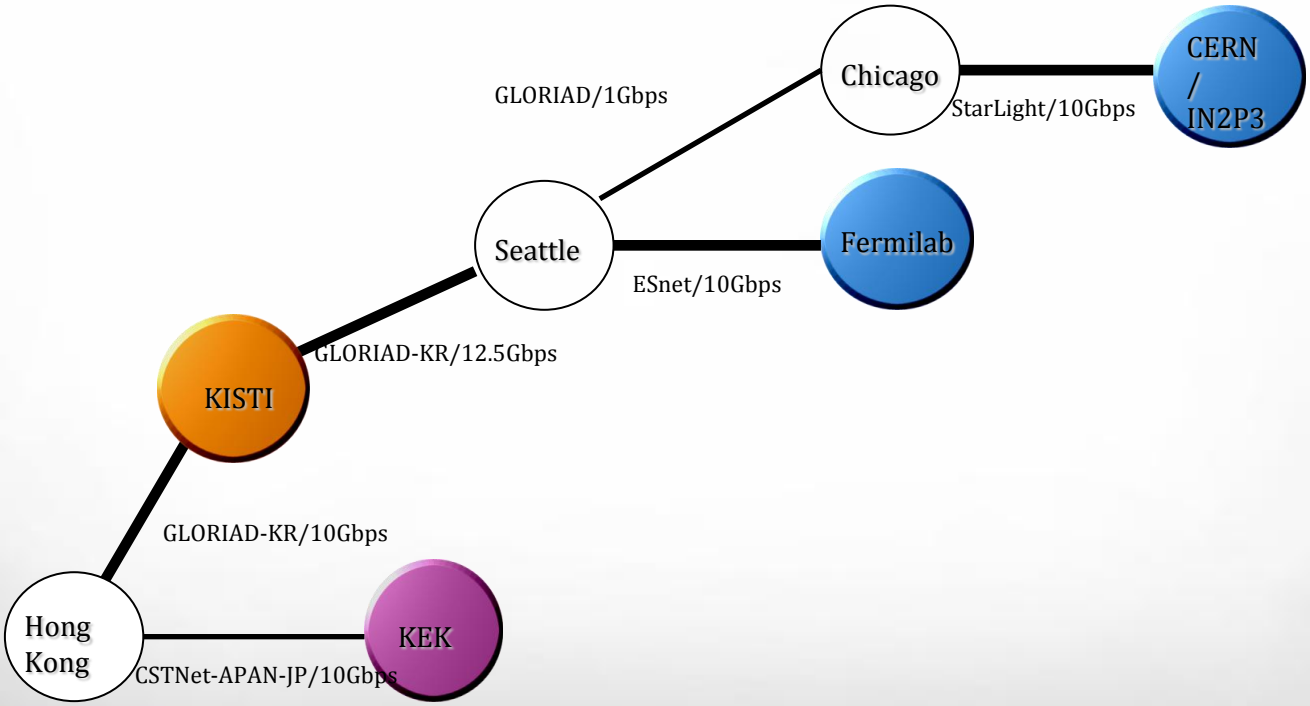
13	Moscow State University - Research Computing Center Russia	Lomonosov - T-Platforms T-Blade2, Xeon 5570 2.93 GHz, Infiniband QDR / 2009 T-Platforms	35360	350.10	414.42	
14	Forschungszentrum Juelich (FZJ) Germany	JUROPA - Sun Constellation, NovaScale R422-E2, Intel Xeon X5570, 2.93 GHz, Sun M9/Mellanox QDR Infiniband/Partec Parastation / 2009 Bull SA	26304	274.80	308.28	1549.00
15	KISTI Supercomputing Center Korea, South	TachyonII - Sun Blade x6048, X6275, IB QDR M9 switch, Sun HPC stack Linux edition / 2009 Sun Microsystems	26232	274.80	307.44	1275.96
16	University of Edinburgh United Kingdom	HECToR - Cray XT6m 12-Core 2.1 GHz / 2010 Cray Inc.	43660	274.70	366.74	
17	NERSC/LBNL United States	Franklin - Cray XT4 QuadCore 2.3 GHz / 2008 Cray Inc.	38642	266.30	355.51	1150.00
18	Grand Equipement National de Calcul Intensif - Centre Informatique National de l'Enseignement Supérieur (GENCI-CINES) France	Jade - SGI Altix ICE 8200EX, Xeon E5472 3.0/X5560 2.8 GHz / 2010 SGI	23040	237.80	267.88	1064.00

Why High Energy Physics @ KISTI?

- There is no accelerators in Korea.
- To study HEP, we use cyber-infrastructure.
- KISTI is the best place for cyber-infrastructure.

=> for HEP

=> France-Korea Particle Physics Laboratory at KISTI



High Energy Physics @ KISTI

한국과학기술정보연구원 KiSTi

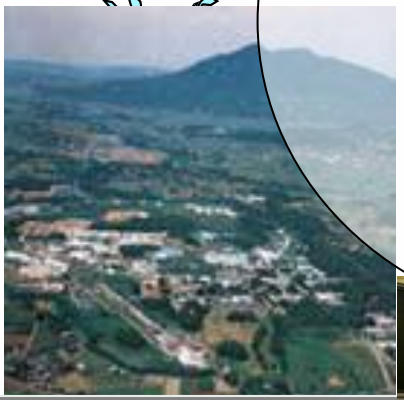
International Collaborations

IN2P3@France

France-Korea Particle Physics Laboratory

CDF*@FNAL, USA

e-HEP* @KISTI



Belle*/Belle II* @ KEK, Japan

*** Official Collaborations**

- The Leader of FKPPL - CDF Project (Kihyeon Cho)
- The Chair of Belle II Data Handling working Group (Kihyeon Cho)

*e-HEP: Ref. Prof. Dongchul Son

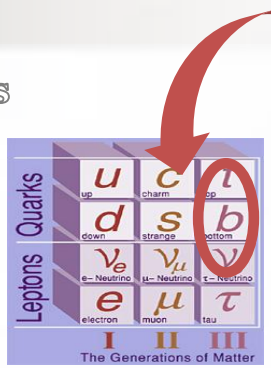
Contents

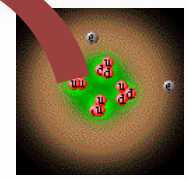
To study B physics both in experiments (Belle & CDF) and theories

Goal

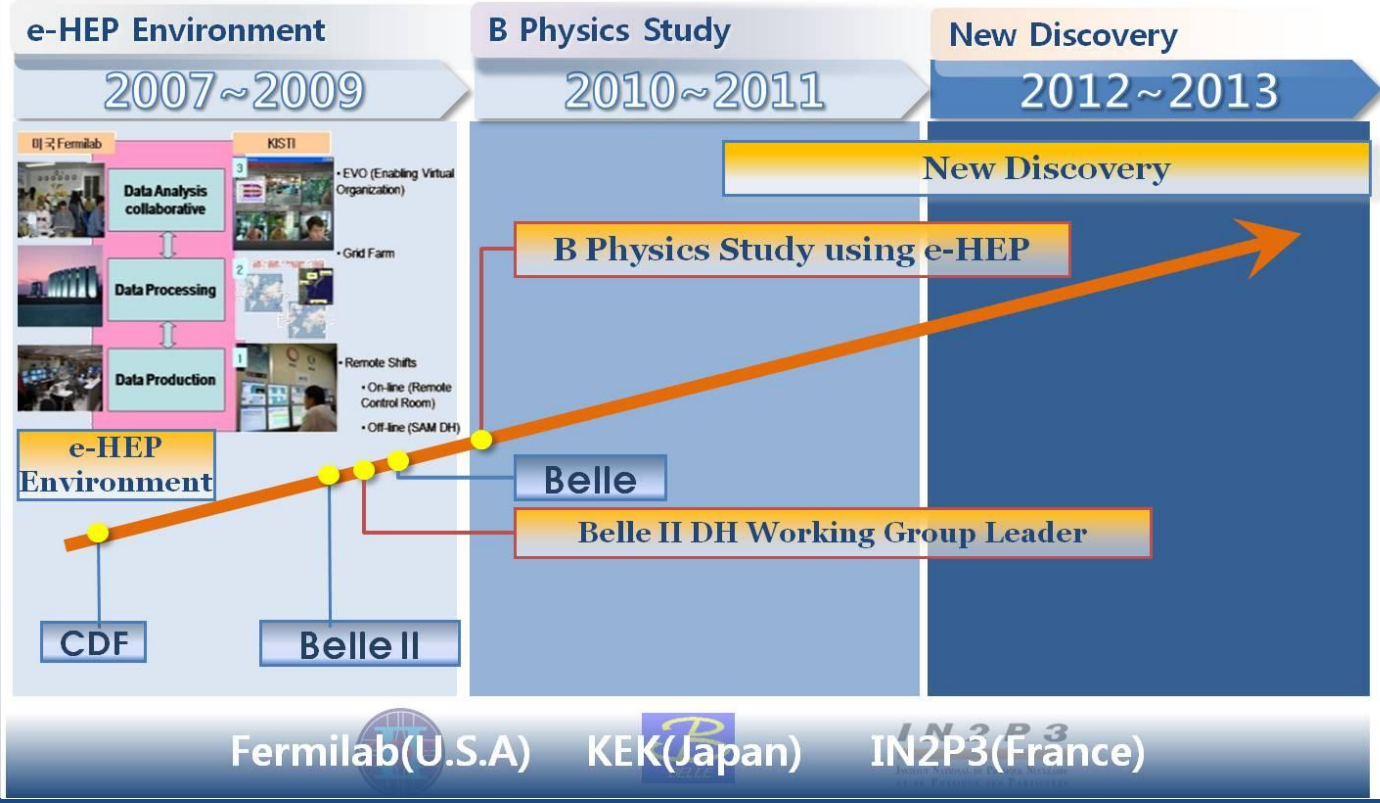
To probe the Standard Model and search for New Physics

⇒ New Discovery





The Standard Model



e-HEP (High Energy Physics)

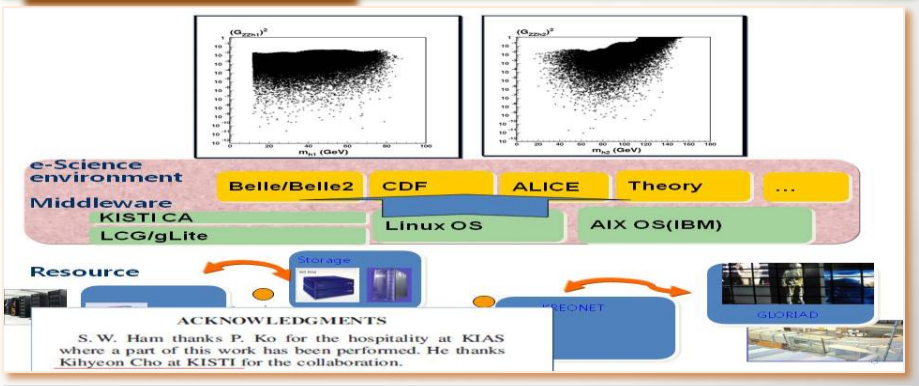
To study high energy physics anytime anywhere even if we are not on-site (accelerator laboratory)

1. Data production
- **CDF Remote Control Room @KISTI**

2. Data processing
- **Pacific CAF(CDF Analysis Farm)**
- **⇒ North America CAF @KISTI**

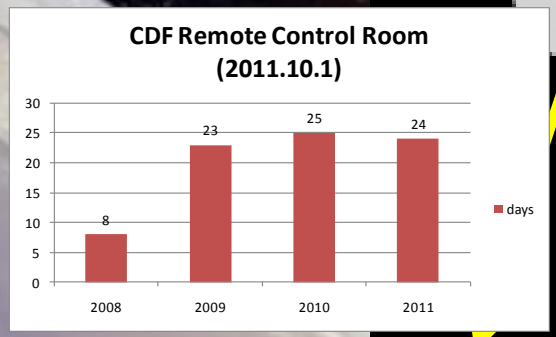
3. Data Analysis Collaboration
- **EVO servers @KISTI**

4. Belle II Data Handling System
- **Working Group Chair (K. Cho)**



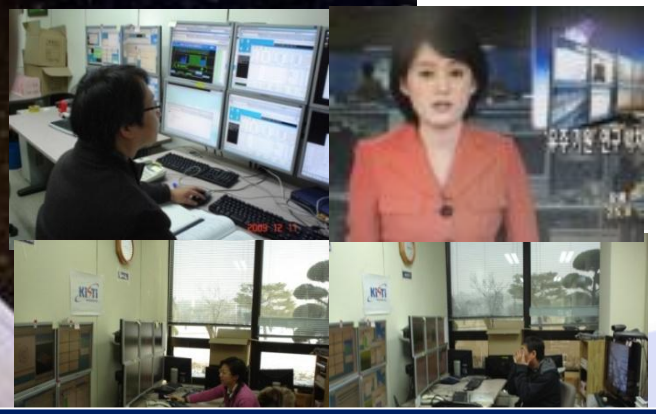
Ex) A study of Higgs model using cyberinfrastructure @KISTI

CDF Remote Control Room



CDF Operation Center

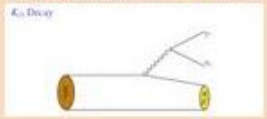
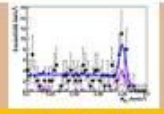
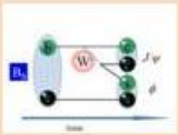
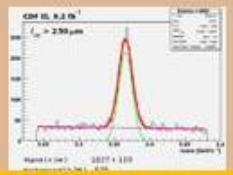
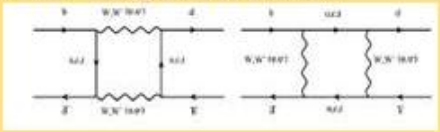
KISTI Remote Control Room



We take shifts at KISTI even if we are not at Fermilab.

High Energy Physics @ KISTI

한국과학기술정보연구원 KiSTi

Physics	Experiments	Theories
Kaon Semi-leptonic Form factor 	Belle	LGT using Staggered Fermion T. Bae, Work in progress
Rare B^0 decays 	Belle  J.H.Kim, et. al. Belle (2011)	Left-Right models S.-h Nam, Work in progress
Mixing and CPV on Bs → J/ψ Φ  	CDF  Y.J.Kim, K.Cho et.al. CDF (2011)	Left-Right models  S.-h Nam. et.al, PRD 66, 055008 (2002)
Top Forward-backward asymmetry 	CDF 	Model independent Analysis S.-h Nam. et.al, PLB 691, 238 (2010)
CP violating dimuon charge asymmetry due to B mixing	D0 	Left-Right models S.-h Nam, Work in progress

⇒ Feed-back between experiments (Belle & CDF) and theories inside KISTI

Newspapers

English | 日本語 | 中國語

e-clips 대덕연구개발특구 no.1뉴스
대덕넷에서 보내드리는 뉴스레터입니다

2010-04-

KOREA, 우주 기원 밝히는 '국제 거대실험' 주도

한국과학자, 세계 3대 가속기 이용 실험 '그룹장 역할 톡톡'
조기현 KISTI 박사, 'Belle-II' 데이터 핸들링 그룹장 수행

HelloDD NEWS

세계 4번째 '핵연료 집합체 안전성 시험' 성공

원자력연, 국내 최초 500시간 연속 달성… 2011년 상용화 계획

1년 할 일 하루만에… 초고속 질량분석기 '15T FT-ICR MS'

[KBS]분석과학시리즈⑮]세계적 연구성과 만드는 분석기 개발

대덕넷 기사 프린트하기 페이지 2 / 4

격어도 이번 Belle II 프로젝트의 경우 그동안 국제공동연구에 수동적으로 참여해 왔던 한국 과학기술계의 이미지와는 다른 세상 이야기다.

사실 조 박사가 Belle II 프로젝트의 데이터 핸들링 그룹장을 맡은 지 1년이 넘었다. 2009년 3월부터 그룹장을 맡았다. 중책을 맡고 연구가 시작된 이후 그동안 언론이나 외부에 공개된 적이 없다. 그룹장 선임 자체가 뉴스거리였지만, 조 박사는 "아무것도 해놓은 것이 없어 굳이 알리지 않았다"며 겸연쩍어 했다.

◆ KISTI 개발 소프트웨어 'AMGA', Belle II 데이터 핸들링 시스템에 적용

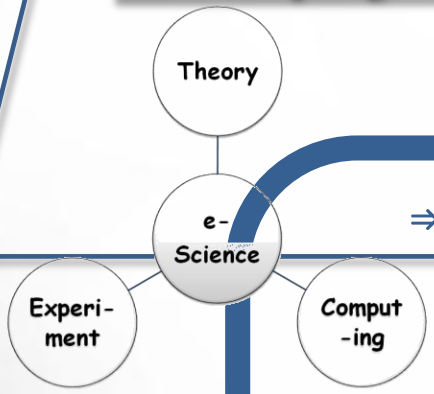
대덕넷 기사 프린트하기 페이지 4 / 4

▲일본 쓰꾸바시에 있는 KEK 가속기 내부 Belle 실험의 제어실 앞에서 '찰칵'.
©2010 HelloDD.com

<대덕넷 김요셉 기자> joesmy@hellodd.com
2010년 04월 06일

Output

B physics using the concepts of e-Science



- To study high energy physics anytime and anywhere
- Fusion research of experiment-computing–theory

⇒ We are applying both concepts to high energy physics. It is a great success!

Publication


Computer Physics Communications 182 (2011) 1756–1759

Contents lists available at ScienceDirect

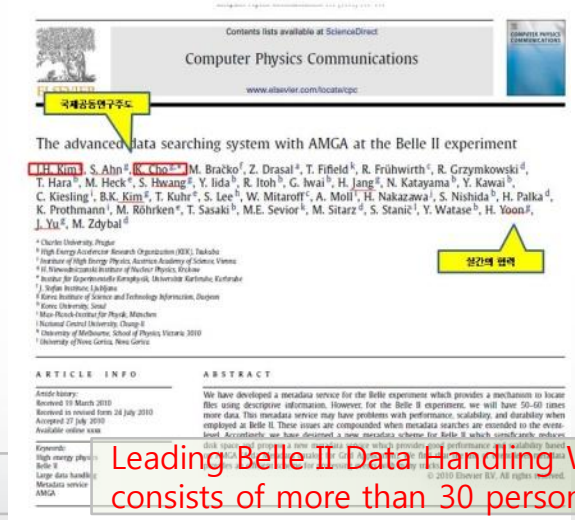
Computer Physics Communications

www.elsevier.com/locate/cpc

Collider physics based on e-Science paradigm of experiment-computing-theory

Kihyeon Cho*, Junghyun Kim, Soo-hyeon Nam

Collider physics using e-Science paradigm of experiment-computing-theory


Contents lists available at ScienceDirect

Computer Physics Communications

www.elsevier.com/locate/cpc

국제공동연구주도

The advanced data searching system with AMGA at the Belle II experiment

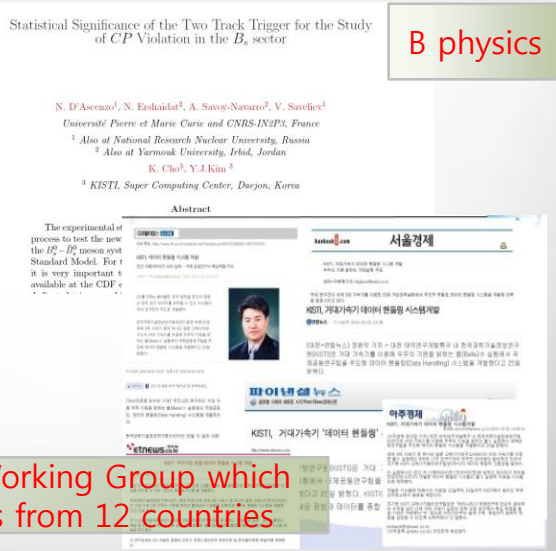
T.H. Kim, S. Ahn, K. Cho*, M. Bračko, Z. Drasal, T. Fifield, R. Frühwirth, R. Grzymkowski, T. Hara, M. Heck, S. Hwang, Y. Iida, R. Itoh, G. Iwai, H. Jang, N. Katayama, Y. Kawai, C. Kiesling, B.K. Kim, T. Kuhr, S. Lee, W. Mitaroff, A. Moll, H. Nakazawa, S. Nishida, H. Palka, K. Prothmann, M. Röhrken, T. Sasaki, M.E. Sevior, M. Sitarz, S. Stanič, Y. Watase, H. Yoon, J. Yu, M. Zdybal

실간의 원격

ARTICLE INFO

ABSTRACT

Leading Belle II Data Handling Working Group which consists of more than 30 persons from 12 countries


Statistical Significance of the Two Track Trigger for the Study of CP Violation in the B_s sector

N. D'Ascenzo, N. Ershaidat, A. Savoy-Navarro, V. Savelieva

Université Pierre et Marie Curie and CNRS-IN2P3, France

Also at National Research Nuclear University, Russia

Also at Yarmouk University, Irbid, Jordan

K. Cho, Y.J. Kim

KISTI, Super Computing Center, Daejon, Korea

Abstract

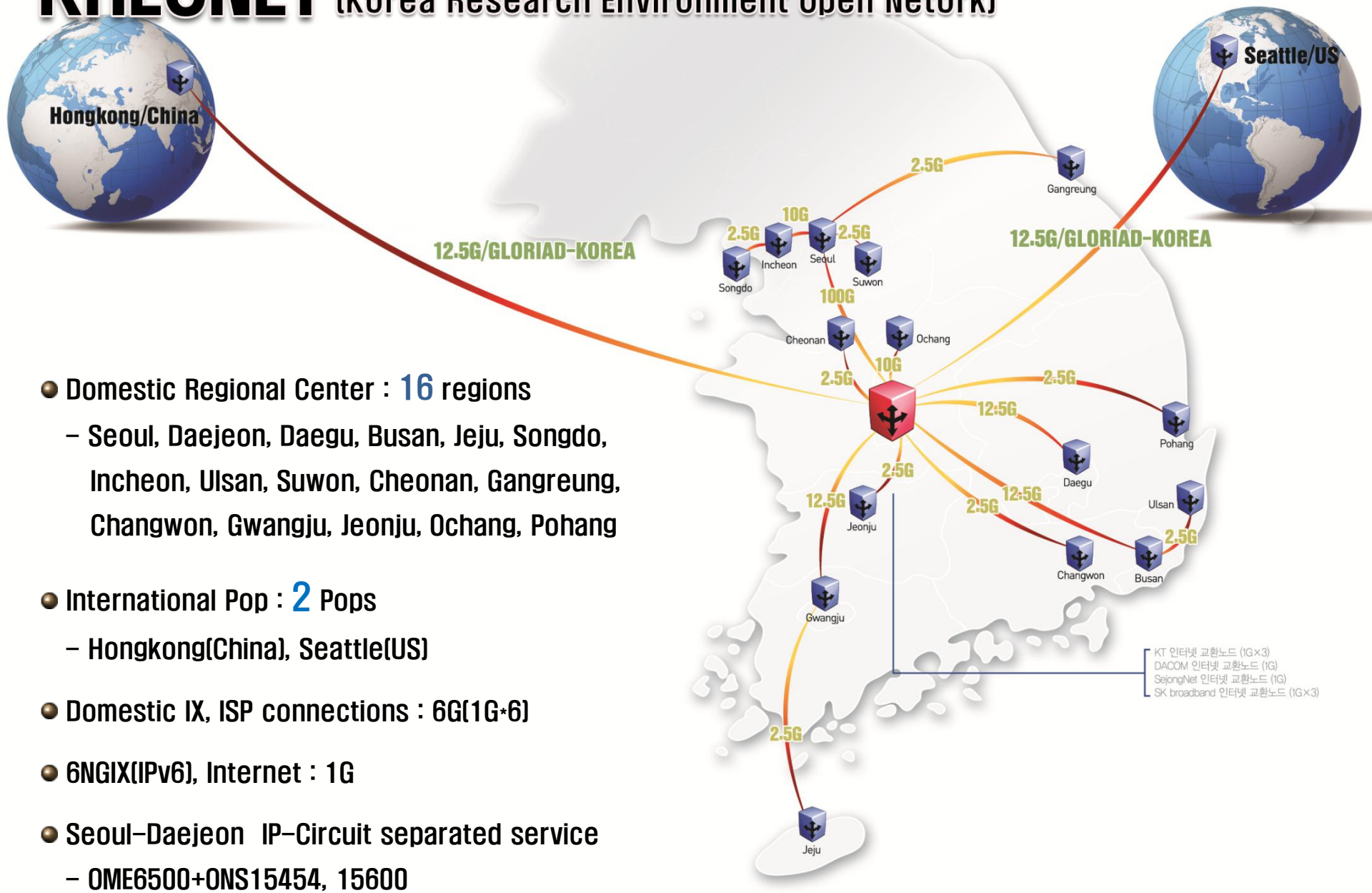
서울경제

KISTI, 거대가속기 '데이터 핸들링' 시스템개발

B physics

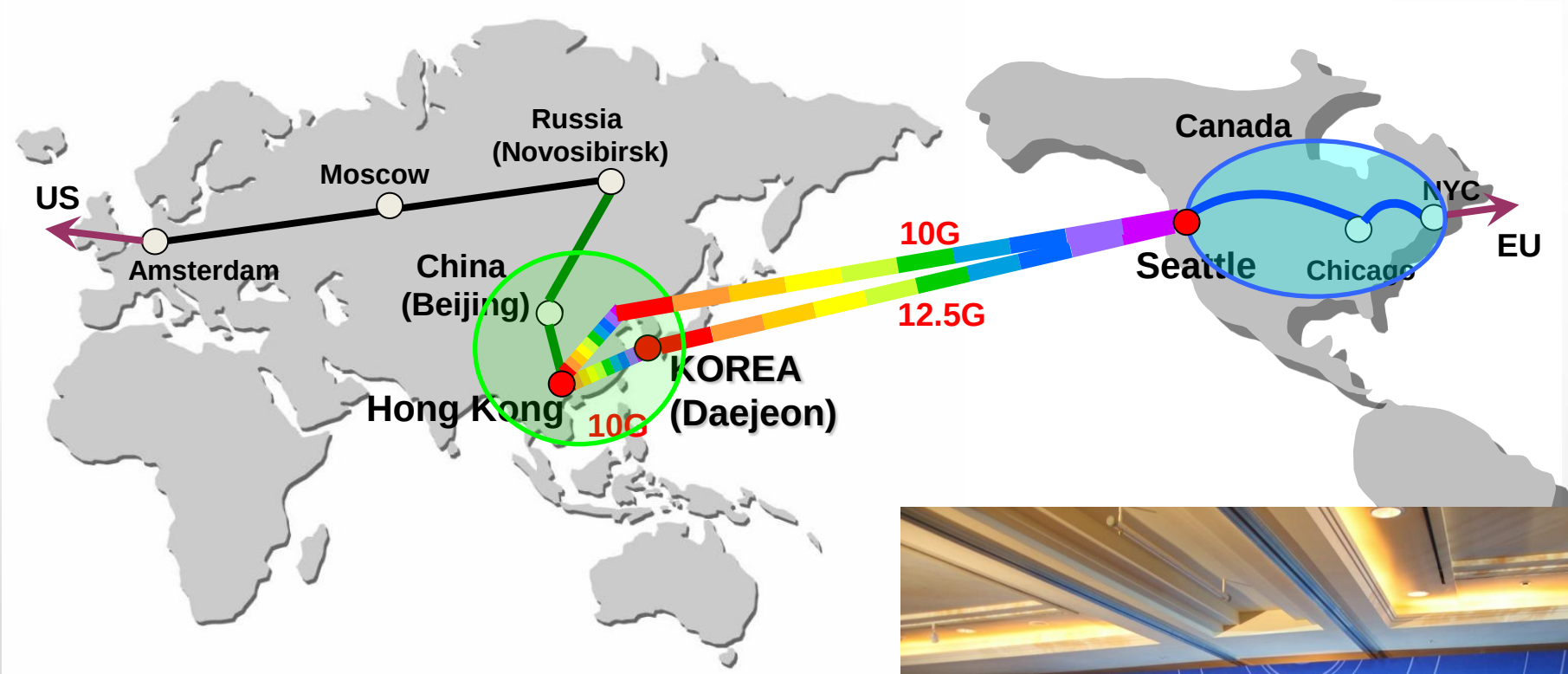
Networks

KREONET (Korea Research Environment Open Netork)



- Domestic Regional Center : 16 regions
  - Seoul, Daejeon, Daegu, Busan, Jeju, Songdo, Incheon, Ulsan, Suwon, Cheonan, Gangreung, Changwon, Gwangju, Jeonju, Ochang, Pohang
- International Pop : 2 Pops
  - Hongkong(China), Seattle(US)
- Domestic IX, ISP connections : 6G(1G*6)
- 6NGIX(IPv6), Internet : 1G
- Seoul-Daejeon IP-Circuit separated service
  - OME6500+ONS15454, 15600

GLORIAD Network



Hong Kong – Daejeon – Seattle - EU

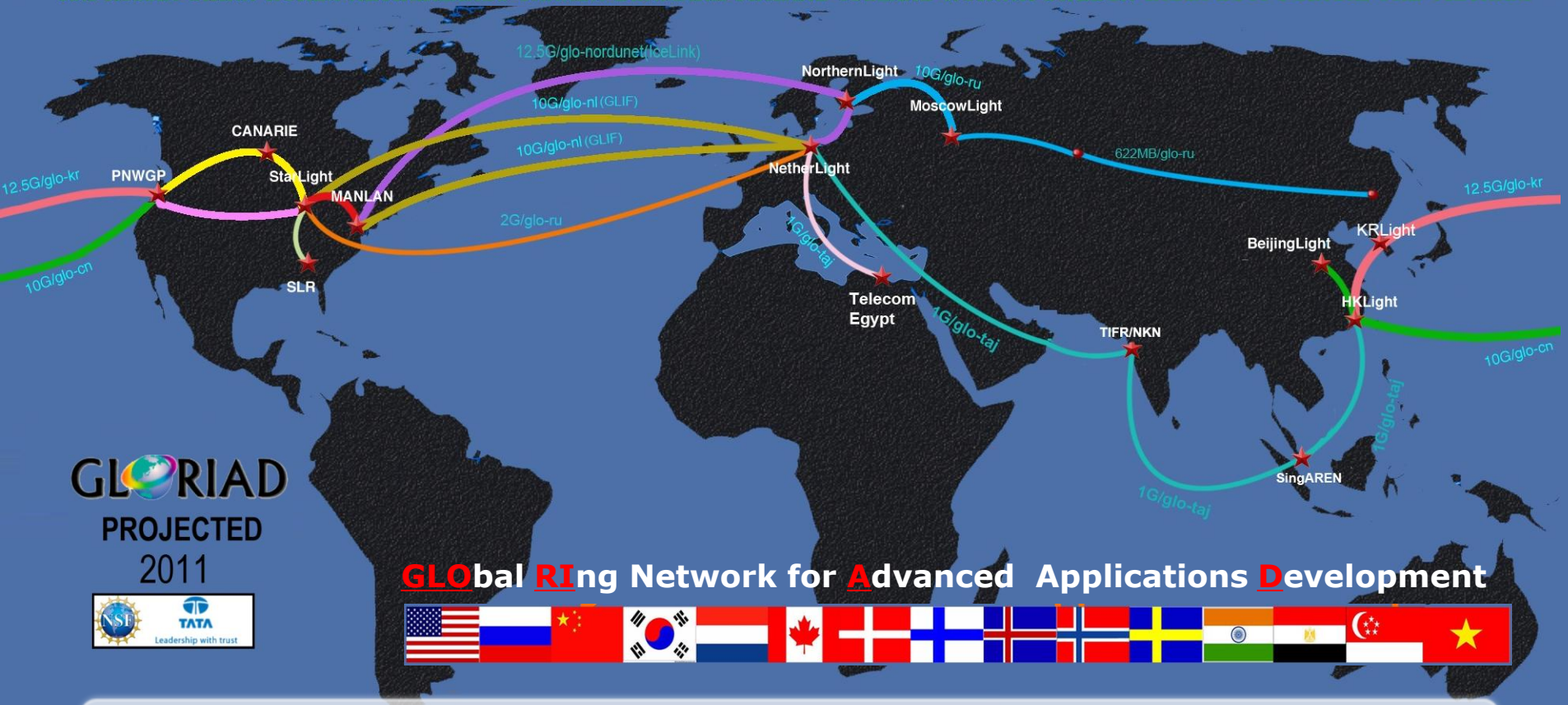
(10Gbps)

http://www.gloriad-kr.org

Grand Opening on Sep. 5, 2005

GLORIAD (GLObal RIng Network for Advanced Applications Development)

USA-RUSSIA-CHINA-KOREA-NETHERLANDS-CANADA-DENMARK-FINLAND-ICELAND-NORWAY-SWEDEN-INDIA-EGYPT-SINGAPORE-VIETNAM



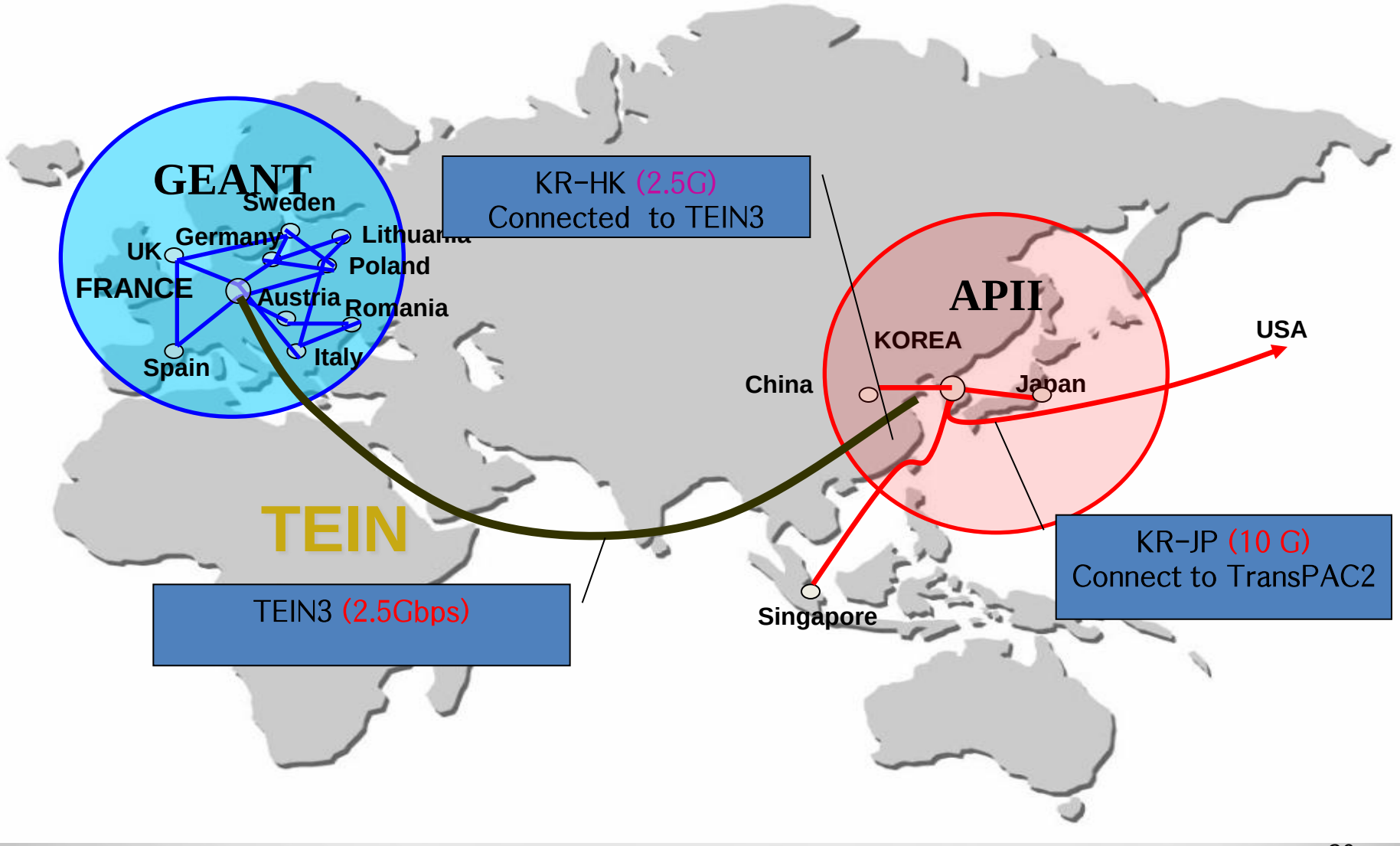
GLORIAD PROJECTED 2011

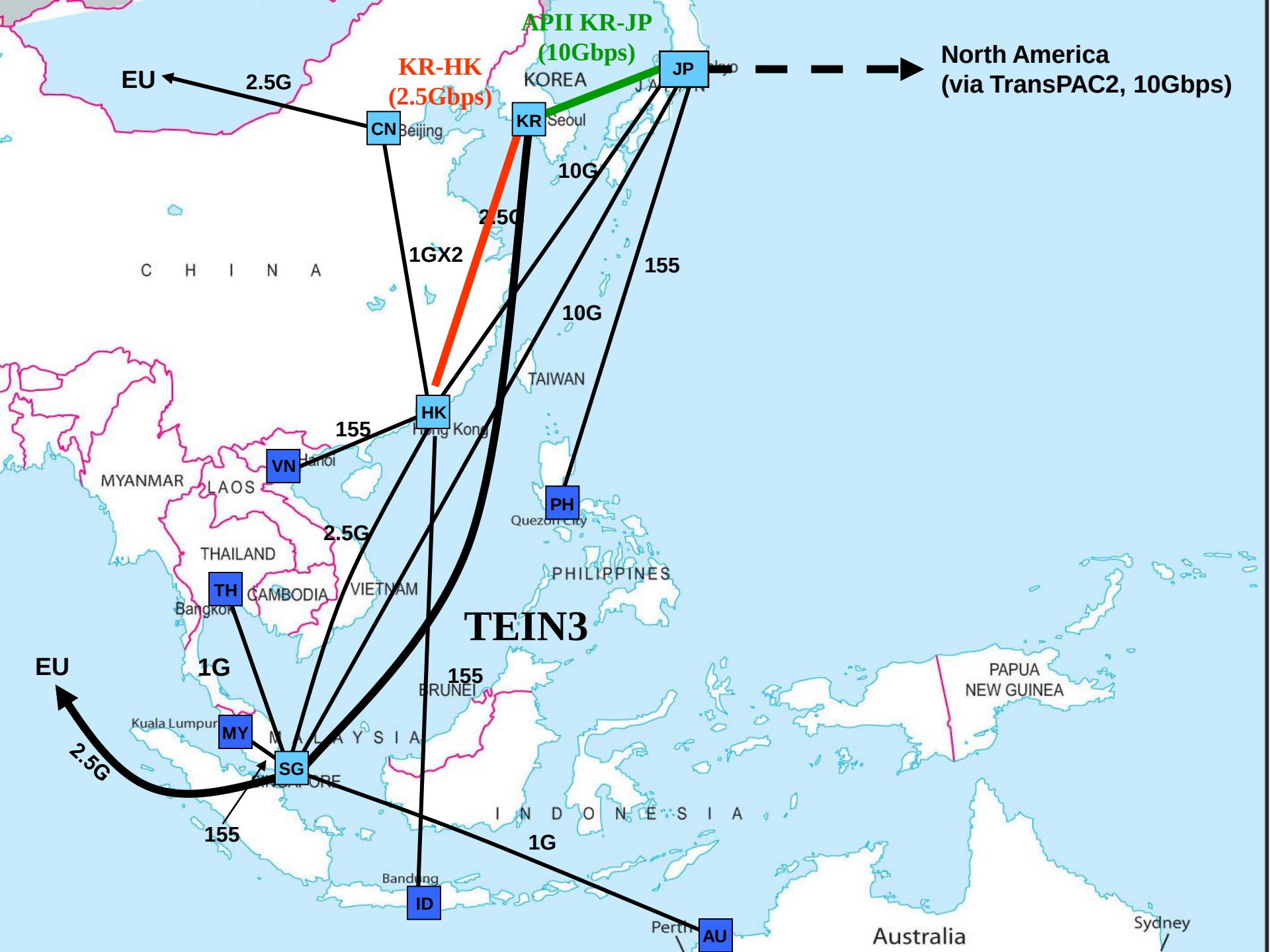
NSF TATA Leadership with trust

GLObal RIng Network for Advanced Applications Development

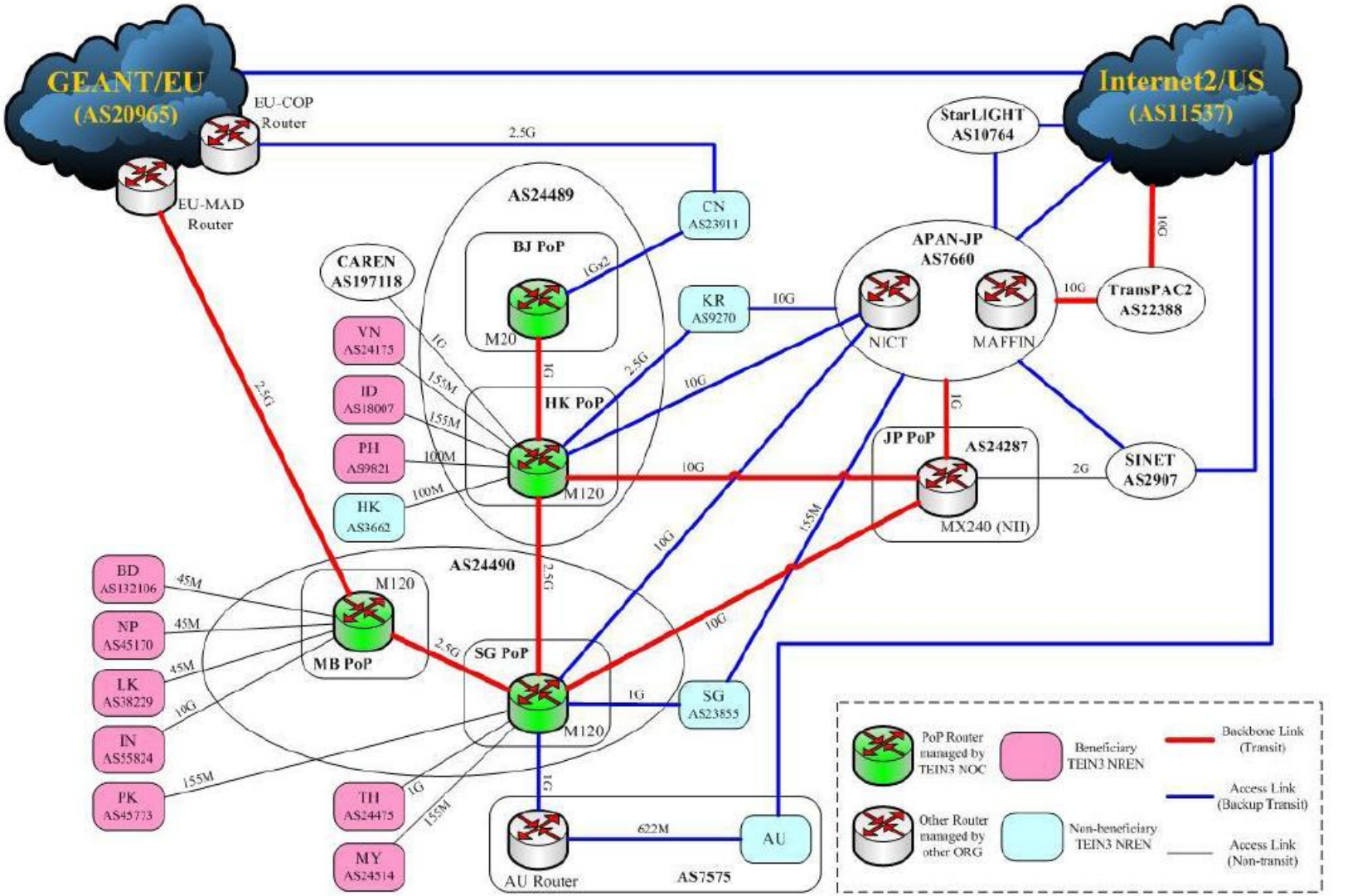
- GLORIAD is the world' s first 10Gbps Global R&D network, which connects the entire world with a circular-shaped optical network that 15 countries. (Secure 2.5G backup link)
- Support the data transfer for international-level R&D collaborative research

APII and TEIN3 (2011)



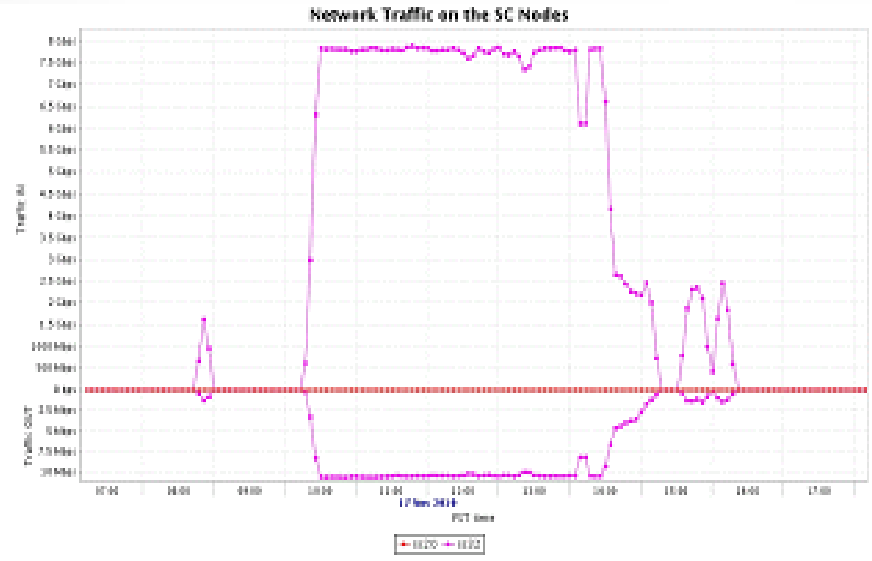

APII KR-JP
(10Gbps)
KR-HK
(2.5Gbps)
JP
North America
(via TransPAC2, 10Gbps)
EU
2.5G
CN
Beijing
KR
Seoul
KOREA
10G
2.5G
1GX2
155
10G
C H I N A
TAIWAN
HK
Hong Kong
155
VN
Hanoi
MYANMAR
LAOS
PH
Quezon City
2.5G
THAILAND
PHILIPPINES
TH
CAMBODIA
VIETNAM
Bangkok
TEIN3
EU
1G
155
BRUNEI
PAPUA
NEW GUINEA
Kuala Lumpur
MY
M A L A Y S I A
2.5G
SG
I N D O N E S I A
155
1G
Bandung
ID
Perth
AU
Australia
Sydney

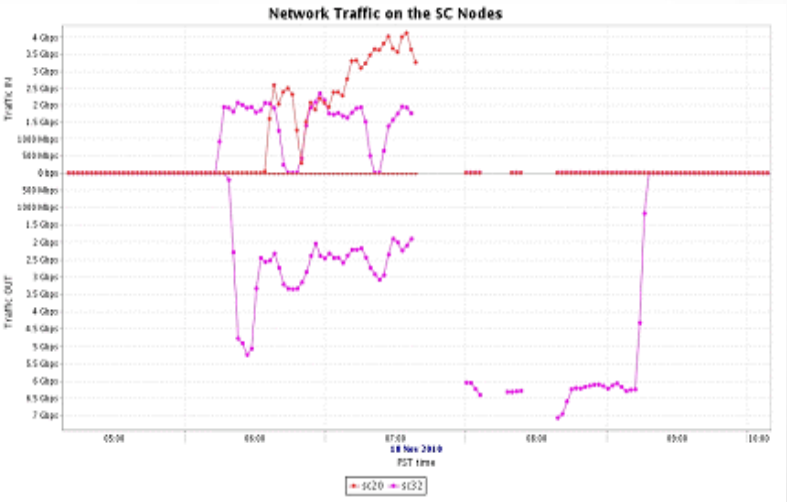
Topology for TEIN3



Large File Transfer demonstration

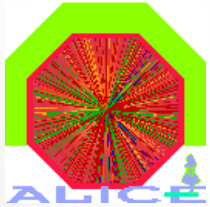
- SC10, New Orleans, USA
- Nov. 17~18, 2010
- KNU Collaboration with Caltech
- KNU ~ Seattle ~ New Orleans
  - ❖ Memory-to-memory Transfer: Maximum 8 Gbps
  - ❖ Disk-to-disk Transfer: Average 3.8 Gbps



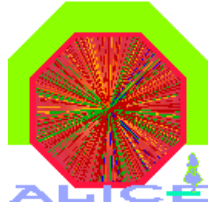


Ref. Prof. Dongchul Son

ALICE / CMS Tier-2



ALICE Tier2 Center @ KISTI

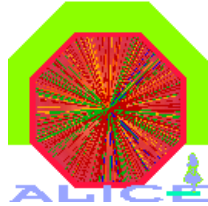


- **PI: Dr. Soonwook Hwang (KISTI)**
- **Location: KISTI, Daejeon, Korea**

- **ALICE Services & Computing Resources**
  - ALICE-related services
    - RB, WMS+LB, PX, RGMA, BDII, VOMS, LFC, VOBOX, UI, VOMS
  - CREAM-CE
    - 128 CPU cores (HP Blade Server 16 nodes)
    - Dedicated to the ALICE experiment
  - SE
    - 50 TB disk space with 10Gbps international connection
    - At first, DPM (Disk Pool Manager) used as Storage Management System
    - Since September 2010, a pure xrootd server has been up and running

Ref. Dr. Soonwook Hwang

ALICE Tier2 Centre – Site Overview



Select site: KISTI-CREAM »

MonALISA information Version: 1.9.6 (JDK 1.6.0_24)
Running on: vobox01.sdfarm.kr
Administrator: <trugens@gmail.com>

Service health NTP: SYNC, offset: 0s

Services status
AliEn: v2-19.82
ClusterMonitor: OK
PackMan: OK
CE: OK
CE info: At the moment we are busy (we ...
Max running jobs:
Max queued jobs:

Proxies status
AliEn proxy: OK (1 day, 23:49)
Delegated proxy: n/a (n/a)
Proxy server: n/a (n/a)
Proxy of the machine: n/a (n/a)

SAM tests
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

Current jobs status
Assigned: 9
Running: 118
Saving: 37

Accounting (last 24h)
Success jobs: 3444 (profile)
Failed jobs: 0
Error jobs: 642
kSI2k units: 188 / 150 pledged

Site averages (last 24h)
Active nodes: 23
Average kSI2k/node: 1.115

Storages status

Name	Status	Size	Used	Free	Usage	No of files	Type	ADD test
ALICE::KISTI::SE	OK	49.95 TB	77.51%	11.23 TB	38.72 TB	1.282 M	File	OK

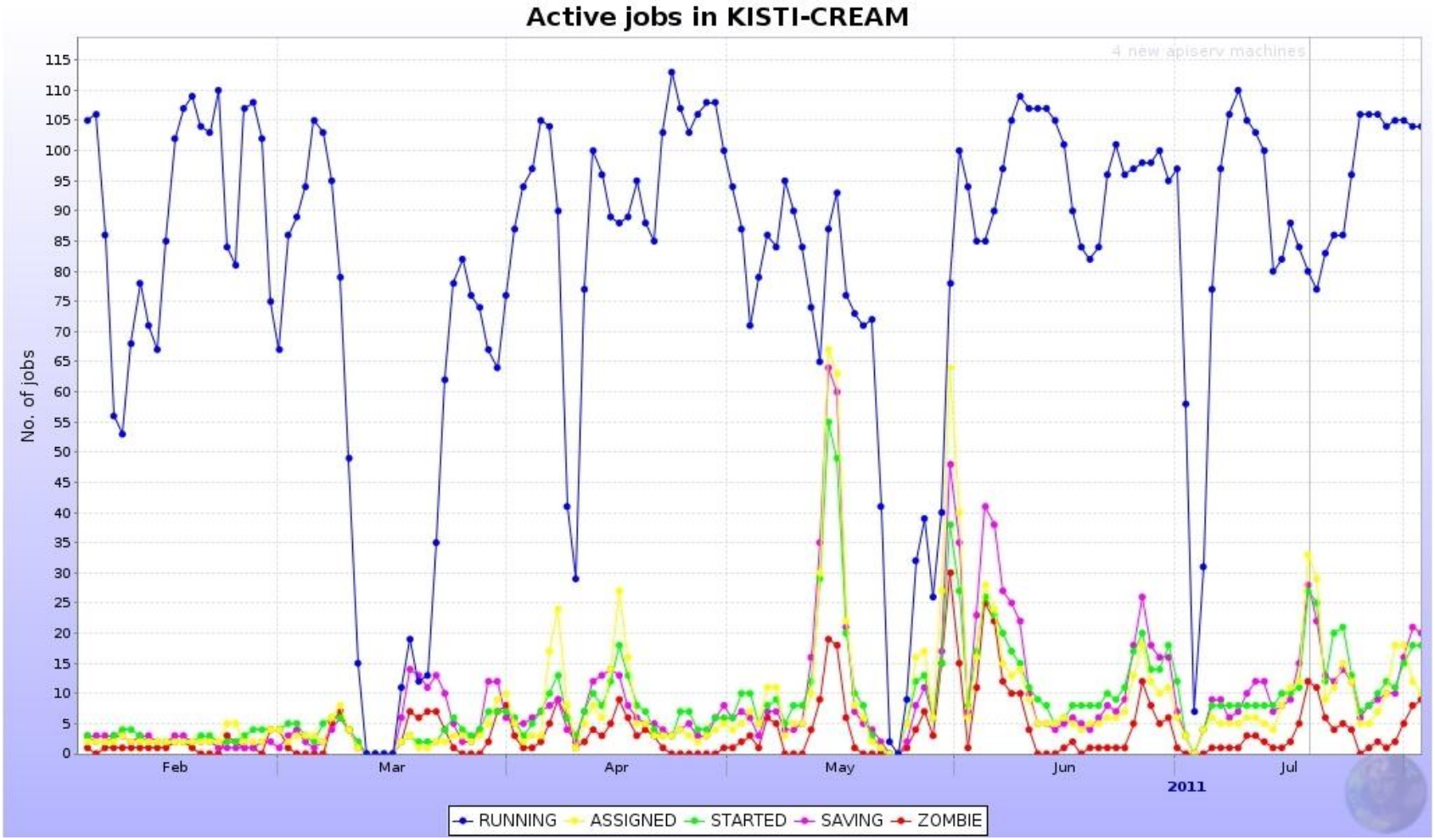
VoBox health
CPUs: 2x 3000MHz
Mem usage: 42.86% of 3.863 GB
Processes: 127
Sockets: 163 TCP / 26 UDP
Uptime: 192 days, 20:54

CPU usage (last 1h avg)
Load: ***0.297***
User: 2.684%
System: 0.668%
IOWait: 6.512%
Idle: 89.84%
Int: 0.016%
Soft int: 0.171%
Nice: 0.104%
Steal: 0%

AliEn LDAP var	VoBox path	Size	Used	Free	Use%
TMP	/home/sgmalice/ALICE/tmp	58.12			%
LOG	/home/sgmalice/alien-logs	58.12			%
CACHE	/home/sgmalice/ALICE/cache	58.12 GB	9.69 GB	45.43 GB	18%

Ref. Dr. Soonwook Hwang

Active jobs on the KISTI CREAM-CE



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Status of Storage Element

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SE Name	AliEn SE: AliEn name	Statistics: Size	Used	Free	Usage	No. of files	Type
10. CNAF - SE	ALICE::CNAF::SE	873.3 TB	506.5 TB	366.8 TB	58%	9,042,027	File
11. CyberSar_Cagliari - SE	ALICE::CyberSar_Cagliari::SE	93.23 TB	36.11 TB	57.12 TB	38.73%	954,784	File
12. Cyfronet - SE	ALICE::Cyfronet::SE	10 TB	11.7 TB	-	117%	520,501	File
13. FZK - SE	ALICE::FZK::SE	1.254 PB	714.6 TB	569.4 TB	55.65%	11,761,895	File
14. Grenoble - DPM	ALICE::Grenoble::DPM	72 TB	6.121 TB	65.88 TB	8.501%	205,643	SRM
15. Grenoble - SE	ALICE::Grenoble::SE	31 TB	24.1 TB	6.899 TB	77.74%	533,355	File
16. GRIF_IPNO - DPM	ALICE::GRIF_IPNO::DPM	91 TB	85.97 TB	5.026 TB	94.48%	2,550,376	SRM
17. GRIF_IPNO - SE	ALICE::GRIF_IPNO::SE	153.1 TB	142.1 TB	11 TB	92.81%	3,829,505	File
18. GRIF_IRFU - DPM	ALICE::GRIF_IRFU::DPM	171 TB	42.4 TB	128.6 TB	24.79%	783,831	SRM
19. GSI - SE	ALICE::GSI::SE	312.6 TB	340.7 TB	-	109%	6,556,964	File
20. GSI - SE2	ALICE::GSI::SE2	28 TB	468.4 GB	27.54 TB	1.634%	9,134	File
21. HHLR_GU - SE	ALICE::HHLR_GU::SE	200 TB	32.94 TB	167.1 TB	16.47%	965,821	File
22. Hiroshima - SE	ALICE::Hiroshima::SE	79 TB	48.04 TB	30.96 TB	60.81%	1,666,761	File
23. IHEP - SE	ALICE::IHEP::SE	35.55 TB	9.437 TB	26.11 TB	26.55%	654,320	File
24. IPNL - SE	ALICE::IPNL::SE	36 TB	51.29 TB	-	142.5%	1,160,843	File
25. ISS - FILE	ALICE::ISS::FILE	140.5 TB	119.8 TB	20.67 TB	85.29%	4,396,913	File
26. ITEP - SE	ALICE::ITEP::SE	100 TB	41.44 TB	58.56 TB	41.44%	1,109,510	File
27. JINR - SE	ALICE::JINR::SE	149.6 TB	90.48 TB	59.08 TB	60.5%	4,374,935	File
28. KFKI - SE	ALICE::KFKI::SE	73 TB	39.89 TB	33.11 TB	54.65%	1,260,057	File
29. KISTI_GSDC - SE	ALICE::KISTI_GSDC::SE	100 TB	37.5 TB	62.5 TB	37.5%	1,240,095	File
30. KISTI - SE	ALICE::KISTI::SE	49.95 TB	38.72 TB	11.23 TB	77.51%	1,344,567	File
31. Kolkata - SE	ALICE::Kolkata::SE	73.24 TB	18.27 TB	54.97 TB	24.95%	641,473	File
32. Kosice - SE	ALICE::Kosice::SE	61.84 TB	49.47 TB	12.37 TB	79.99%	1,642,789	File
	ICE::LBL::SE	358 TB	60.61 TB	297.4 TB	16.93%	2,010,848	File
	:Legnaro::SE	138.3 TB	128.3 TB	9.983 TB	92.78%	3,946,834	File
	CE::LLNL::SE	688 TB	36.9 TB	651.1 TB	5.363%	1,801,659	File
	E::Madrid::SE	37.5 TB	20.39 TB	17.11 TB	54.36%	832,228	File
	E::MEPHI::SE	18.2 TB	7.989 TB	10.21 TB	43.9%	254,332	File

Status of KISTI SE

- Size: 50TB
- Used: 38.7TB
- no of files: 1,344,567

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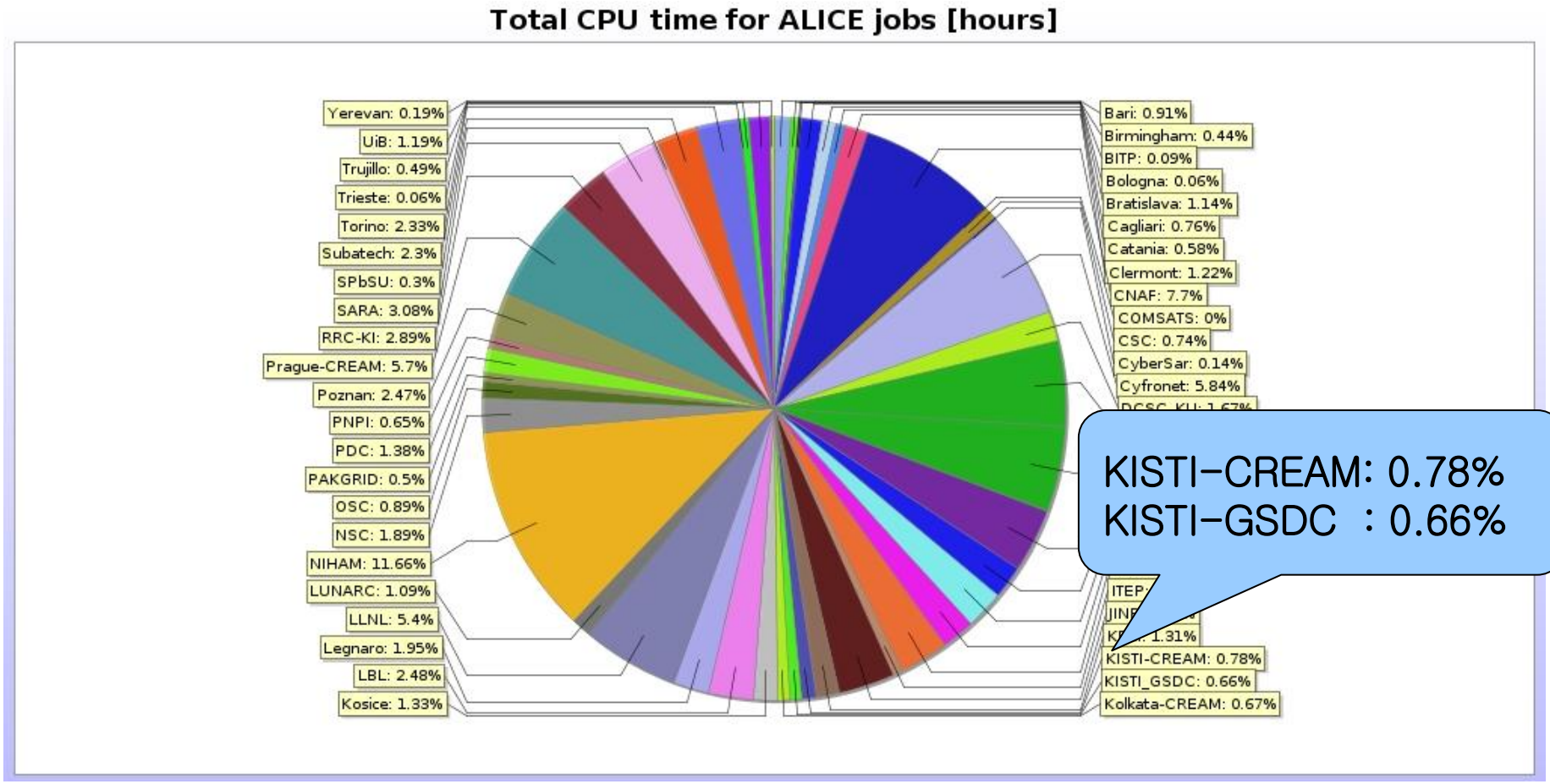
KISTI's Contribution to ALICE Computing

CPU Time for ALICE Last 6 month:



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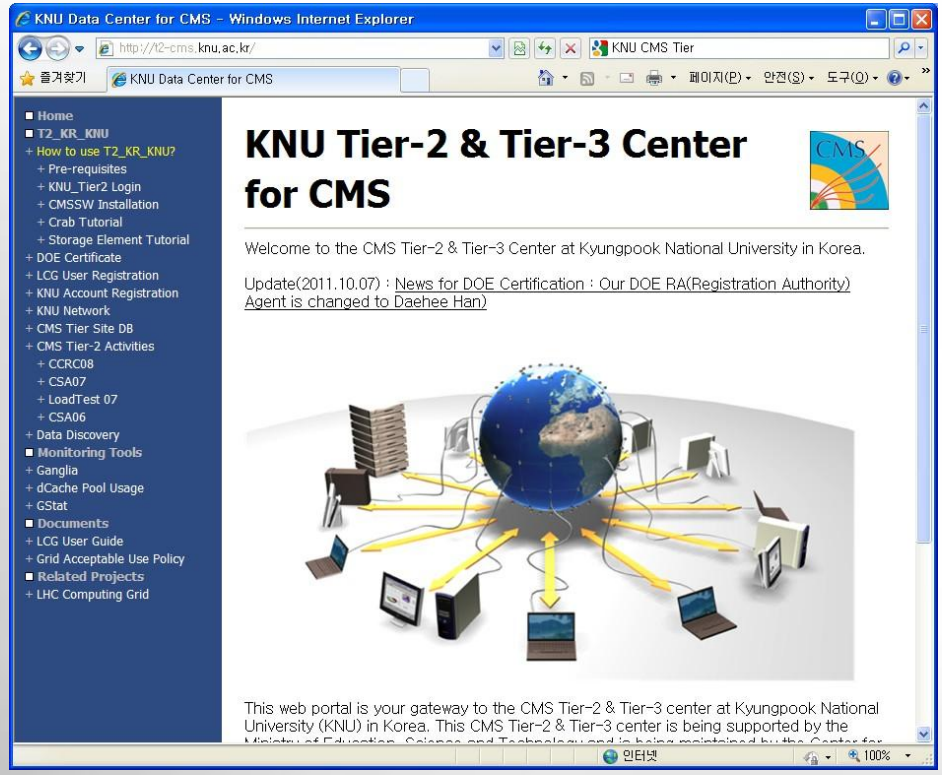
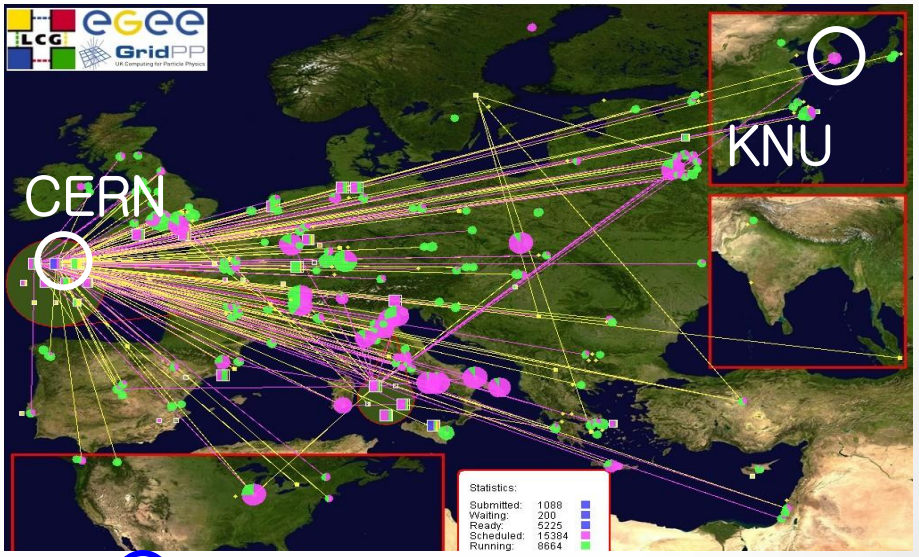
CMS Tier-2 Center @ KNU

- PI: Prof. Dongchul Son (KNU)
- Location: KNU in Daegu, Korea
- 20 Gbps WAN
- To generate MC events and store at Tier-2 Center
- To support Korean CMS users





CMS Tier-2 Center @ KNU

- **Hardware**
  - CPU : 470 + 247=717 kSi2k (64 bit, 448 nodes),
    - 67 kSi2k (32 bit, 88 nodes)
    - Total 784 kSi2k, 536 nodes
  - Disk (TB) : 215 TB + 48 TB
  - Tape Library : 45 TB
  - WAN : 20 Gbps
    - KREONET2-GLORIAD 10 Gbps
    - KOREN-APII 10 Gbps

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Hardware

Computing work nodes

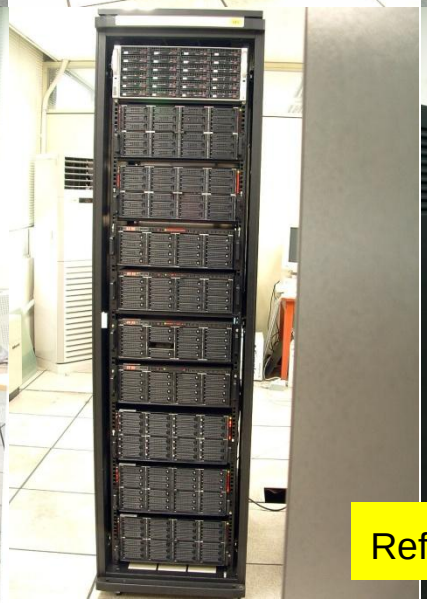
Computing work nodes

Storage Disk Arrays

Storage Disk Server

Tape Library

Tape Library



Storage Disk Arrays

Network

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Operations of Tier-2 center @ KNU

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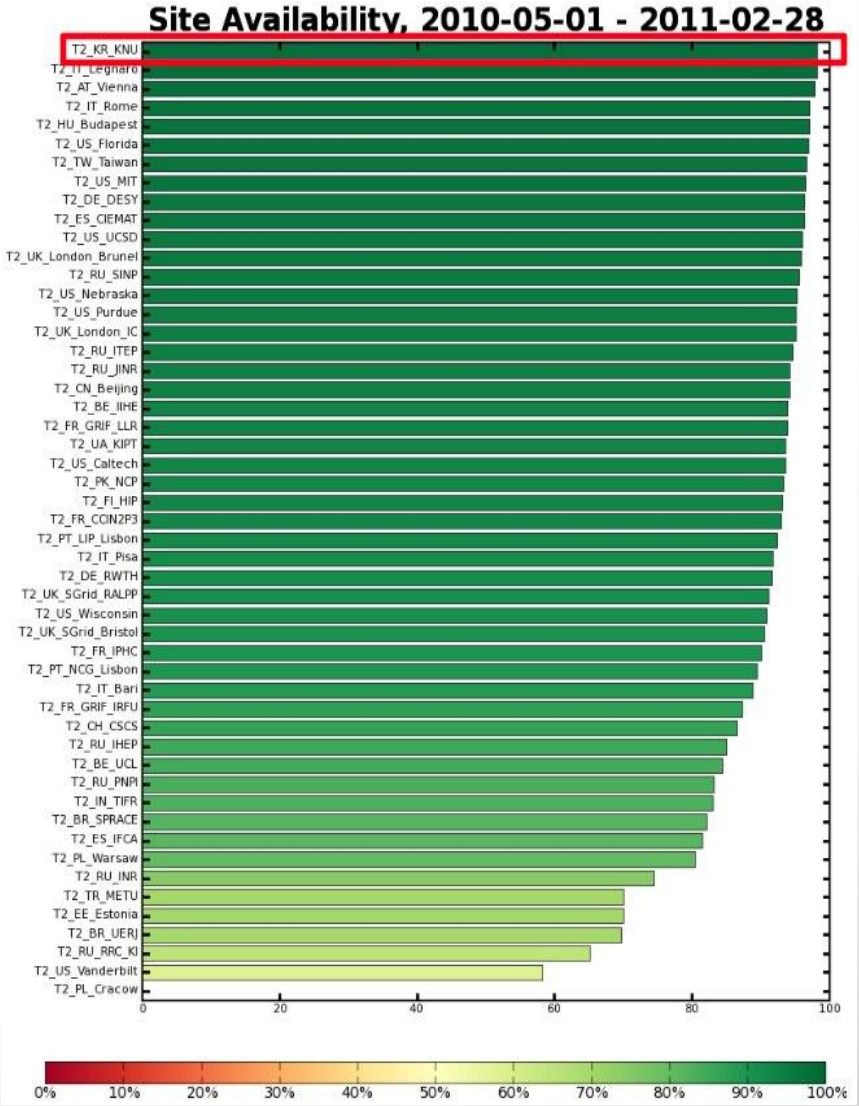
Korea Institute of Science and Technology Information

- **Site Availability**
  - SAM (Site availability Monitoring)
  - Requirement
    - availability > 80%
- **Operations**
  - During May 2010 ~ Feb. 2011
  - Almost 100% at KNU site (T2_KR_KNU)
  - Best among CMS Tier-2 center operations



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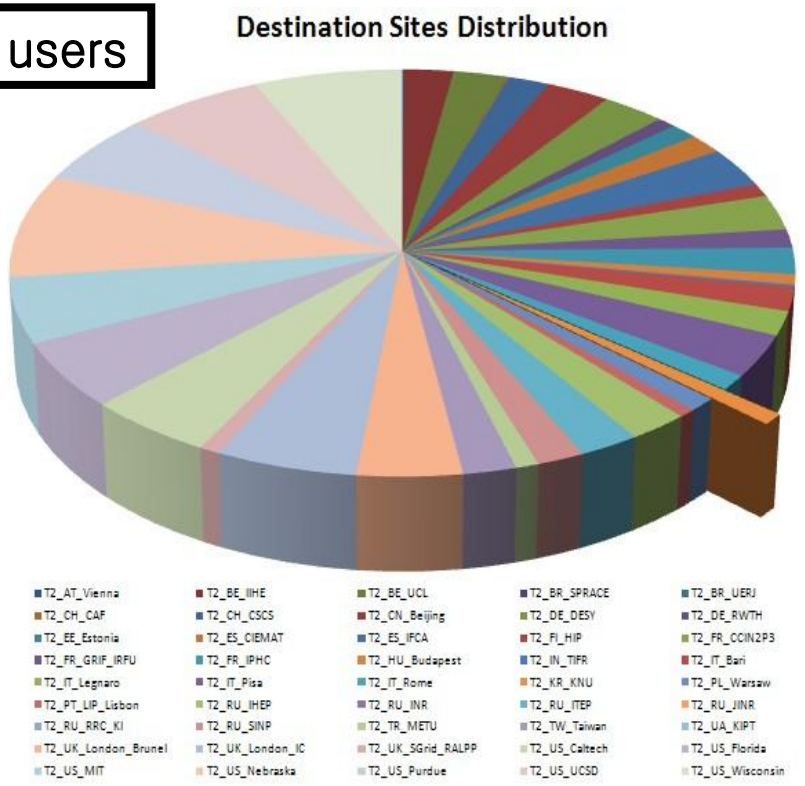
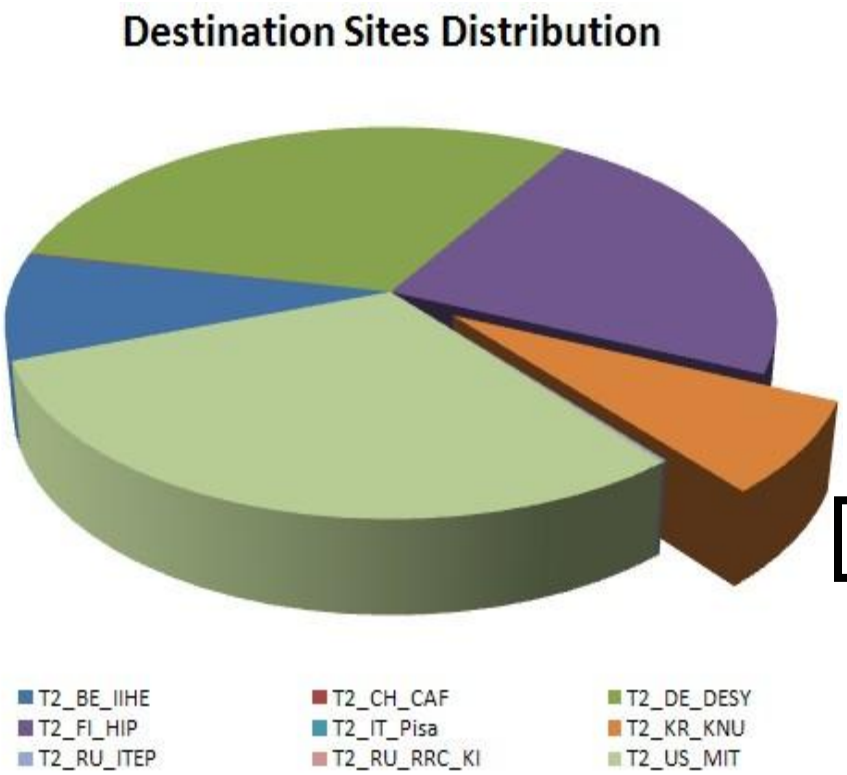
CMS Tier-2 Usage

Physics Analysis for users





Jets Missing E_T group

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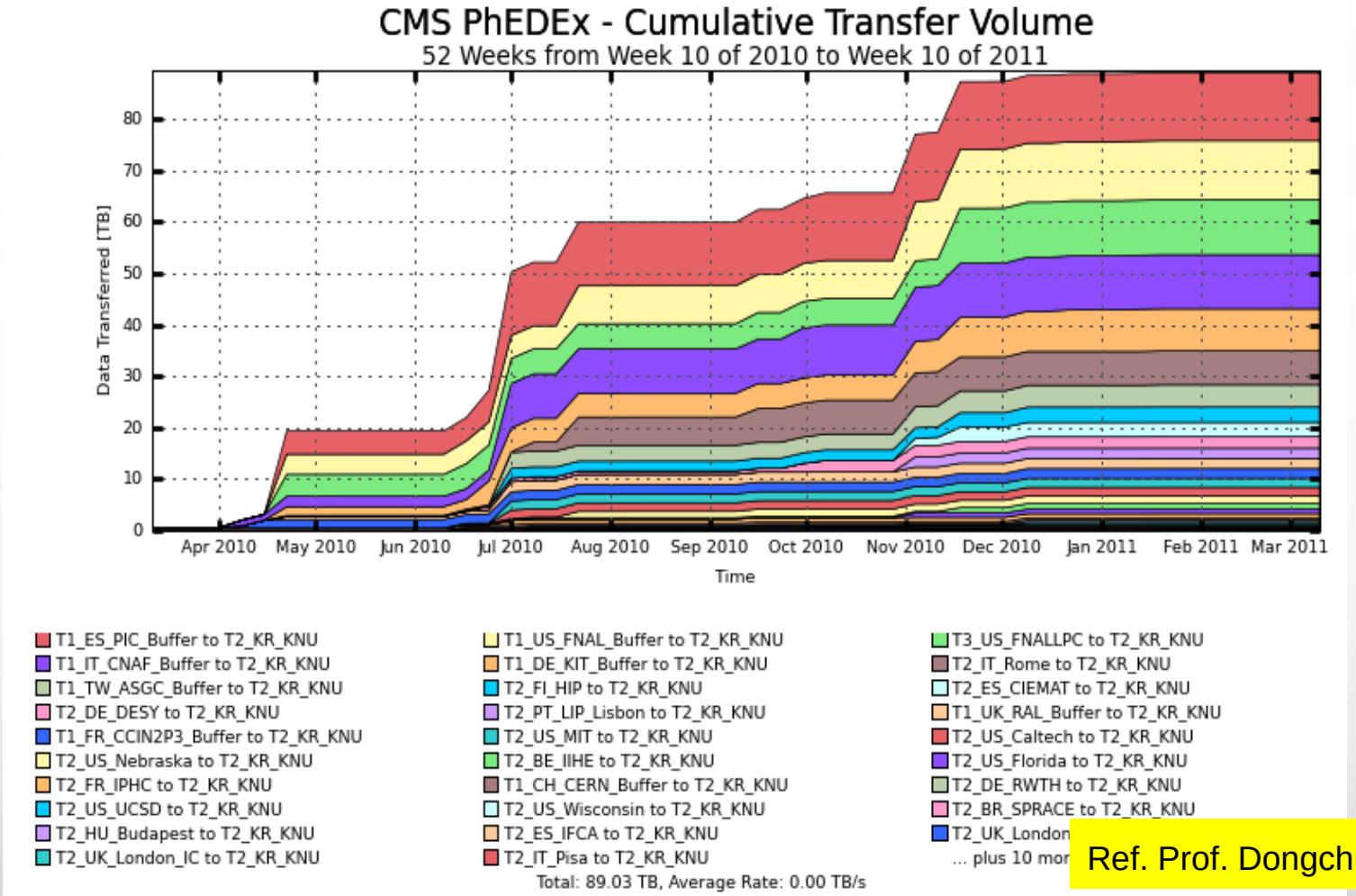
Data Transfer

- PhEDEx Data: 89Tera Bytes received (52 weeks)



Ref. Prof. Dongchul Son

Summary

- **KISTI supports computing and network for HEP in Korea.**
  - ❖ Therefore, KISTI is the best place for HEP.
- **ALICE Tier-2 center at KISTI and CMS Tier2-center at KNU operate very well.**
  - ❖ Both need more hardware.
- **ALICE Tier-1 center at KISTI and CMS Tier1-center at KNU are proposed .**

Thanks

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HEP@KISTI

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