HEP Computing Coordination in Korea

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Date: May 23 ~ 27, 2005
Place: Hotel Interburgo, Daegu, Korea

Korean HEP activities

- Large-scale enterprise experiments in which Koreans are involved now and will be in the future
  - **Belle** / KEK, **K2K** / KEK – Japan: in progress
  - **CDF** / Fermilab (USA): in progress
  - **AMS** / International Space Station: data taking starts in **2007**
  - **CMS** (CERN, Europe): data taking starts in **2007**
  - and other experiments, such as **PHENIX**, **ZEUS**, **D0**, as well as **ALICE**, **OPERA**, **KIMS**, **STAR** etc.
  - **International Linear Collider** experiment in mid 2010s
- Belle, CDF are producing a large volume of data now, which need be processed and analyzed with simulations. ➔ These need computing facility and data storage and the collaborations are working for data gridification.

Korean Belle Collaborations

- Korea U
- Yonsei U
- Ewha Women U
- Seoul National U
- Sungkyunkwan U
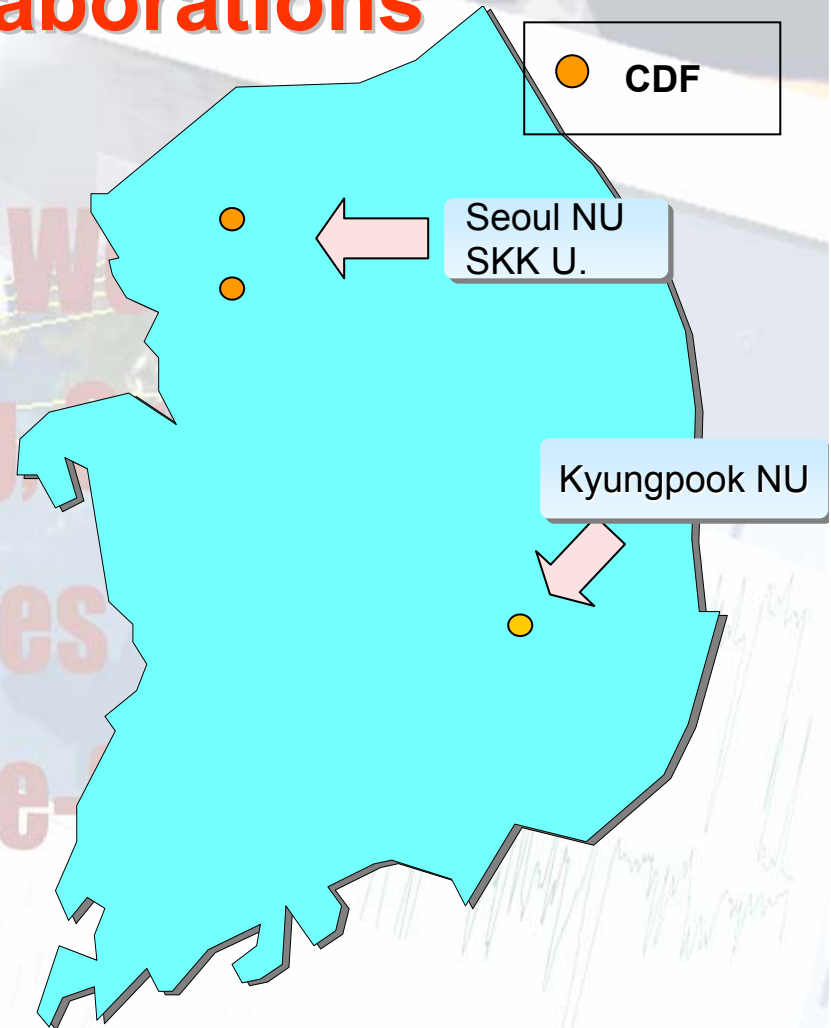- Chonnam National U
- Kyungpook National U
- Gyeongsang National U

BELLE

Korea U, Seoul NU
Ewha WU, Yonsei U.
SKK U.

Kyungpook NU

Gyeongsang NU

Chonnam NU
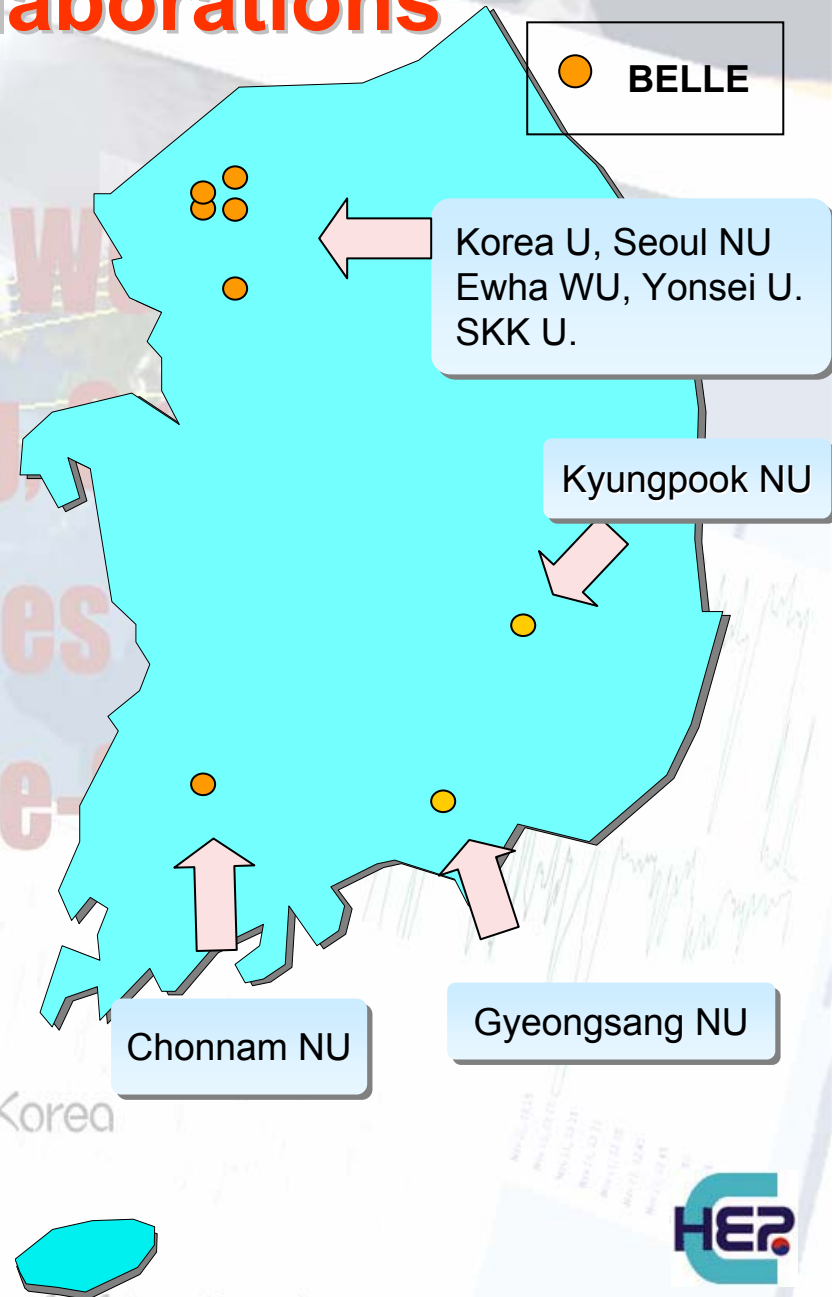
Date: May 23 ~ 27, 2005
Place: Hotel Interburgo, Daegu, Korea

Korean CDF Collaborations

- Seoul National U
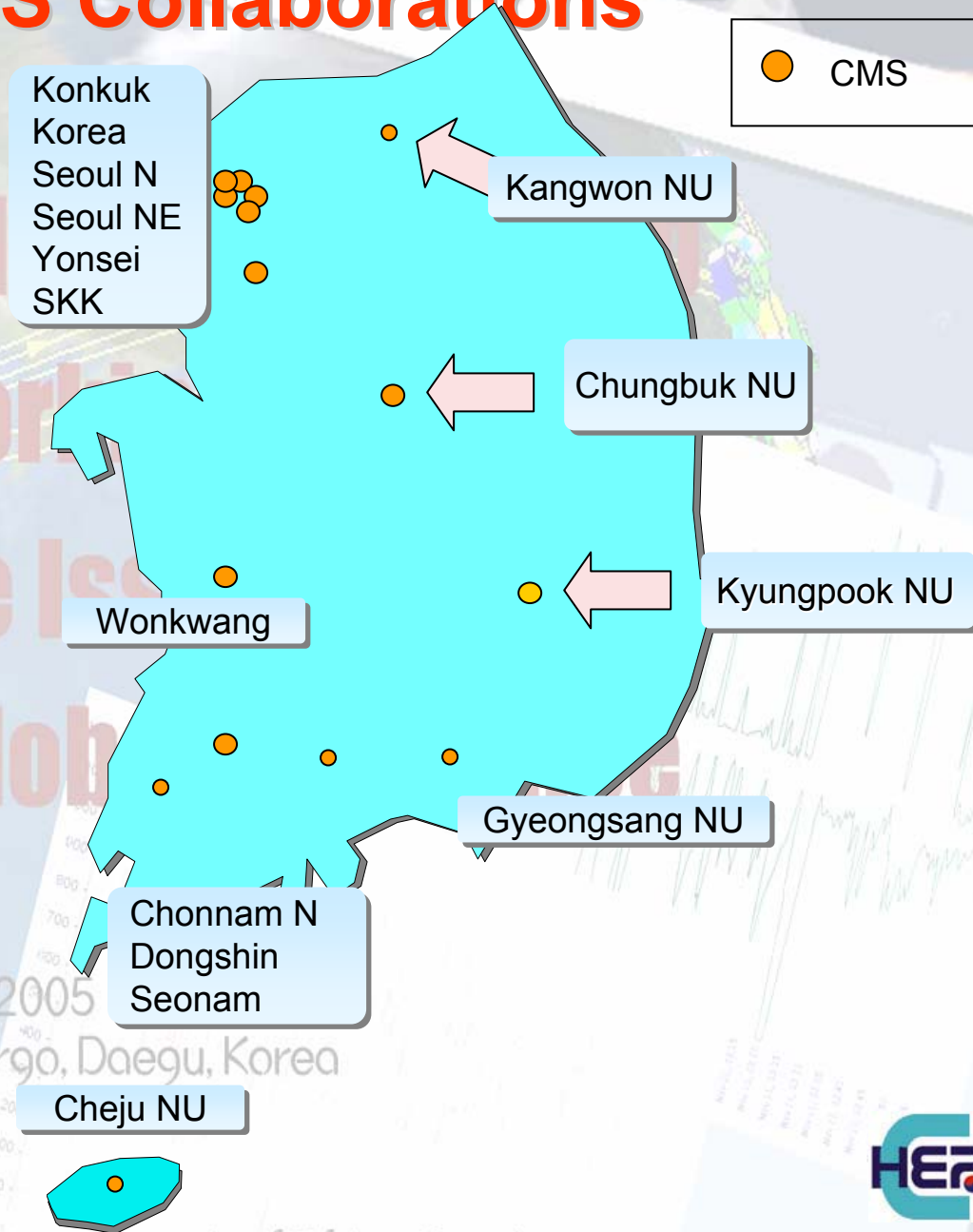- Sungkyunkwan U
- Kyungpook National U

○ CDF

Seoul NU
SKK U.

Kyungpook NU

Date: May 23~27, 2005
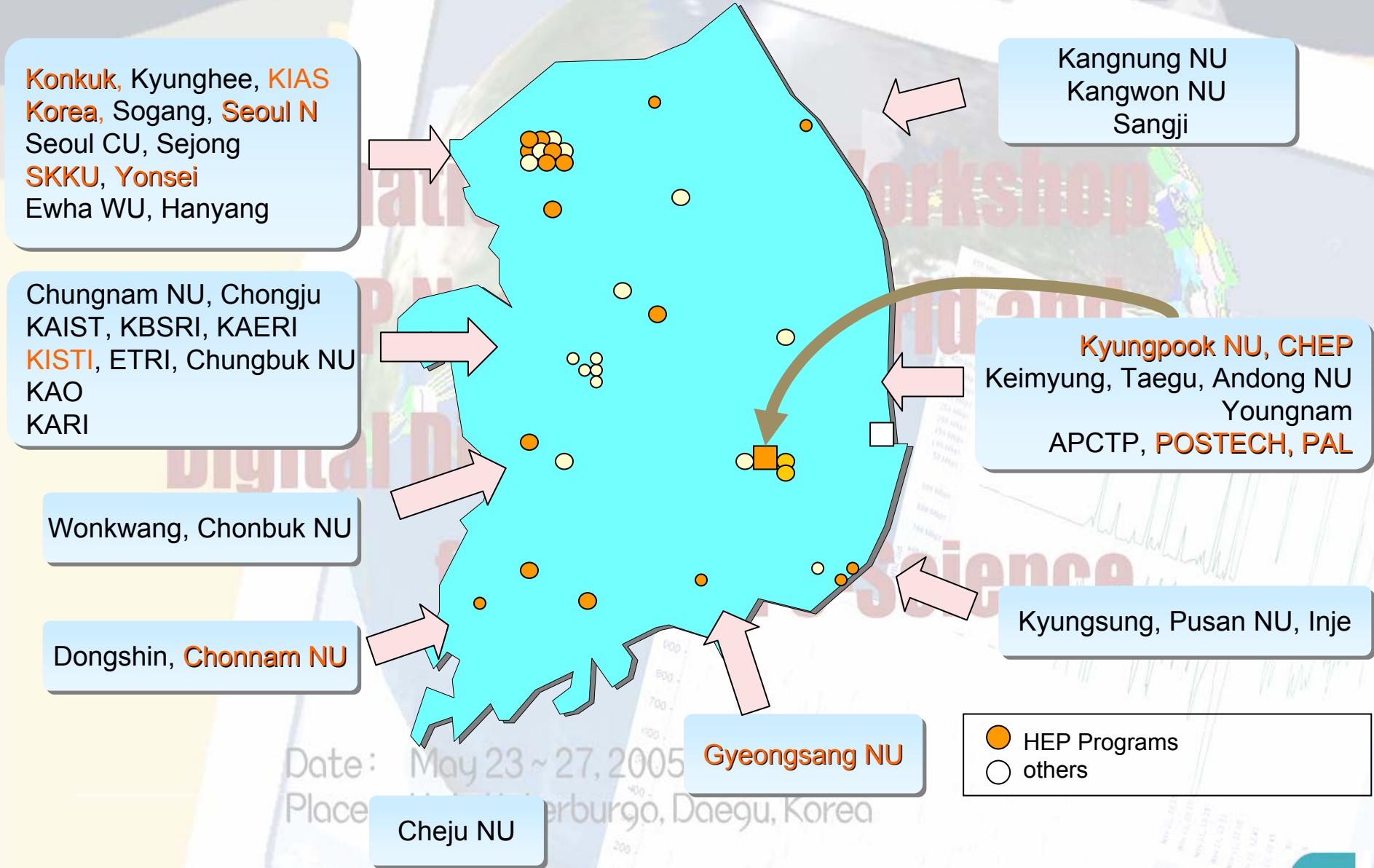Place: Hotel Interburgo, Daegu, Korea

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Korean CMS Collaborations

- Kangwon National U
- Konkuk U
- Korea U
- Seoul Nat'l Education U
- Yonsei U
- Seoul National U
- Sungkyunkwan U
- Chungbuk U
- Wonkwang U
- Chonnam National U
- Dongshin U
- Seonam U
- Kyungpook National U
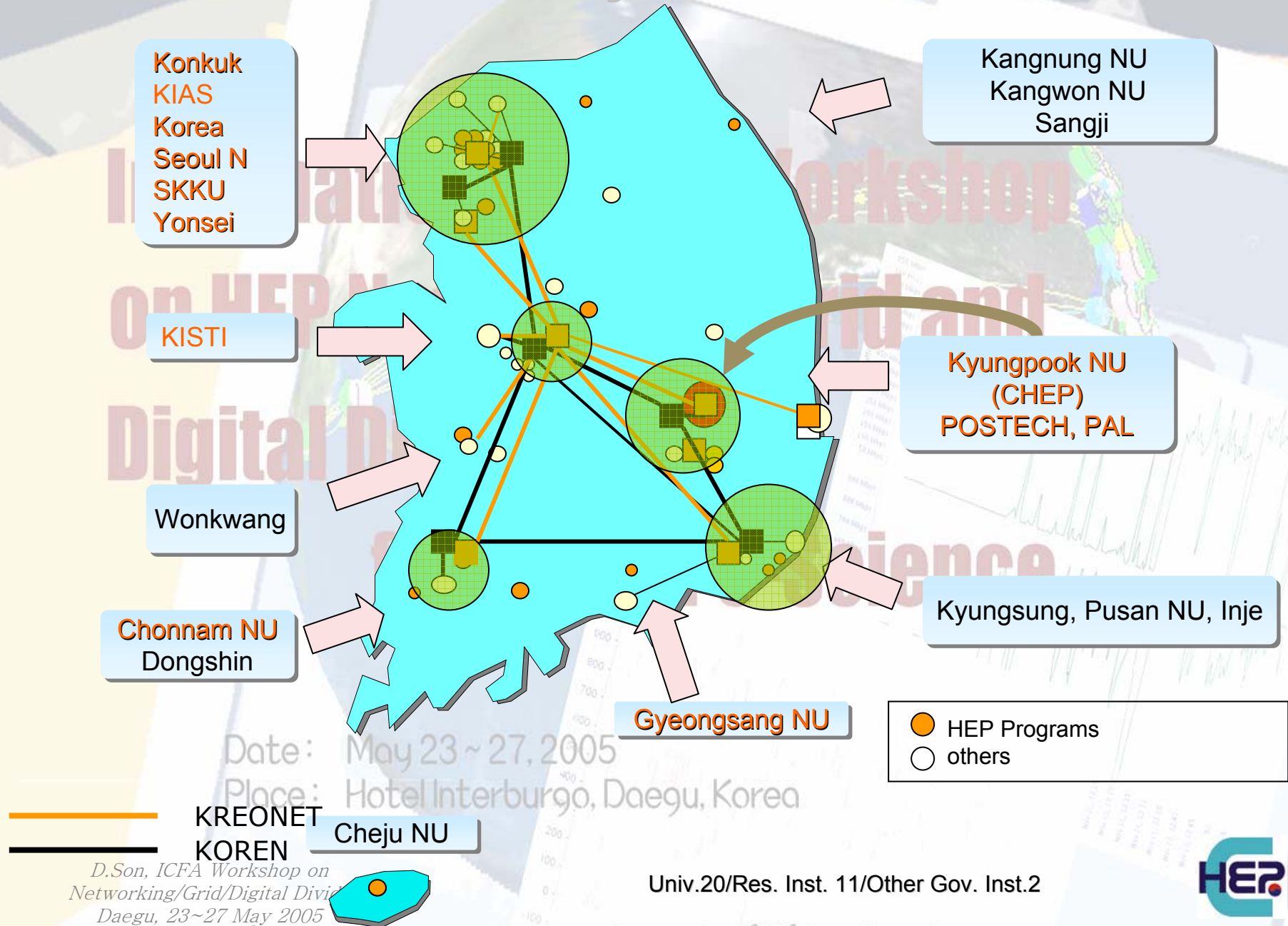- Gyeongsang National U
- Cheju National U

○ CMS

Konkuk
Korea
Seoul N
Seoul NE
Yonsei
SKK

Kangwon NU

Chungbuk NU

Kyungpook NU

Wonkwang

Gyeongsang NU

Chonnam N
Dongshin
Seonam

Cheju NU

HEP

HEP related Univ. and Institutions

Konkuk, Kyunghee, KIAS
Korea, Sogang, Seoul N
Seoul CU, Sejong
SKKU, Yonsei
Ewha WU, Hanyang

Chungnam NU, Chongju
KAIST, KBSRI, KAERI
KISTI, ETRI, Chungbuk NU
KAO
KARI

Wonkwang, Chonbuk NU

Dongshin, Chonnam NU

Kangnung NU
Kangwon NU
Sangji

Kyungpook NU, CHEP
Keimyung, Taegu, Andong NU
Youngnam
APCTP, POSTECH, PAL

Kyungsung, Pusan NU, Inje

Gyeongsang NU

Cheju NU

- HEP Programs
- others

Univ.20/Res. Inst. 11/Other Gov. Inst.2

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How are they networked?

Konkuk
KIAS
Korea
Seoul N
SKKU
Yonsei

Kangnung NU
Kangwon NU
Sangji

KISTI

Kyungpook NU
(CHEP)
POSTECH, PAL

Wonkwang

Chonnam NU
Dongshin

Kyungsung, Pusan NU, Inje

Gyeongsang NU

- ● HEP Programs
- ○ others

Date: May 23 ~ 27, 2005
Place: Hotel Interburgo, Daegu, Korea

KREONET
KOREN

Cheju NU

D.Son, ICFA Workshop on Networking/Grid/Digital Divide, Daegu, 23~27 May 2005

Univ.20/Res. Inst. 11/Other Gov. Inst.2

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KREONET

KOREN

Seoul
Suwon
Daejon
Taegu
Kwangju
Busan

DWDM/OADM

ATM Switch

Router

Gigabit Switch

35 Gbps

155Mbps*8

155Mbps

2.5Gbps

To be upgraded to 10 Gbps
In 2006

CERNET(China)

International Connection (as of May 2005)

APII-Testbed
155Mbps

TEIN
155Mbps

APII-Testbed
1.2Gbps

APII-Testbed
6Mbps

APII-Testbed
1Gbps
+ 1Gbps

disconnected

SingaREN
Singapore
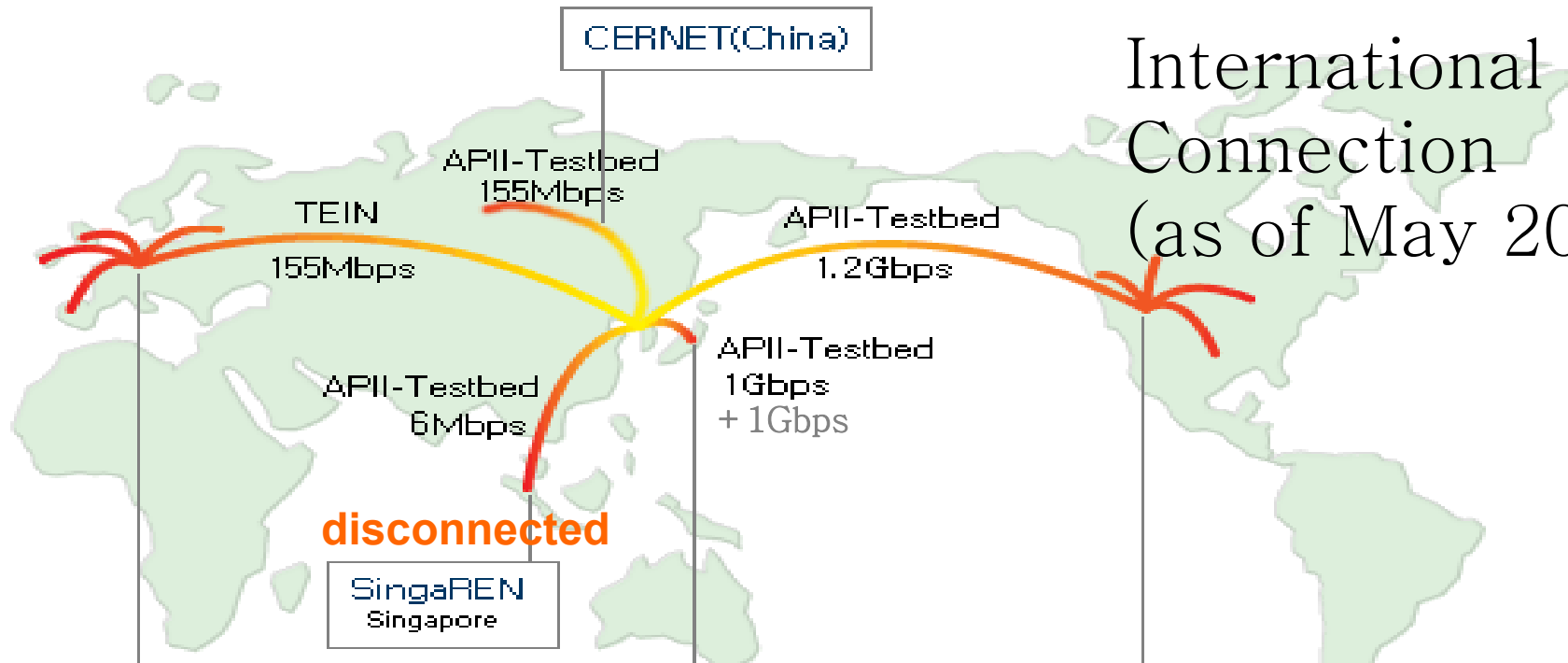
GEANT (EU)
  RENATER2 (France)
  JANET (United Kingdom)
  SURF net (Netherlands)
  CERN (Switzerland)
  HERnet (Ireland)
  IUCC (Island)
  NORDUnet (Nordic Countries)
  BELNET (Belgium)
  DFN (Germany)
  GARR (Italy)
  ...etc

QGPOP / Tokyo XP (Japan)
  SINET (Japan)
  CERNET (China)
  TANet2 (Taiwan)
  UniNet (Thailand)
  ...etc

StarTAP(USA)
  USA : Abilene, vBNS, DREN,
        Esnet, NISN, NREN,
  CANADA : CA*net3
  AUSTRALIA : AARNet
  Brazil : ANSP, RNP
  MEXICO : CUDI
  Argentina : RETINA
  Chile : REUNA
  ... etc

HEP

Demands and Directions

- CMS is certainly the most outstanding challenge in near future
- And there are other demanding experiments even before the LHC era.

- Koreans have been proposing a Tier-1 Center for CMS in Korea with three Tier-2 domestic centers with additional facilities which can be concurrently shared by other experiments since 2001
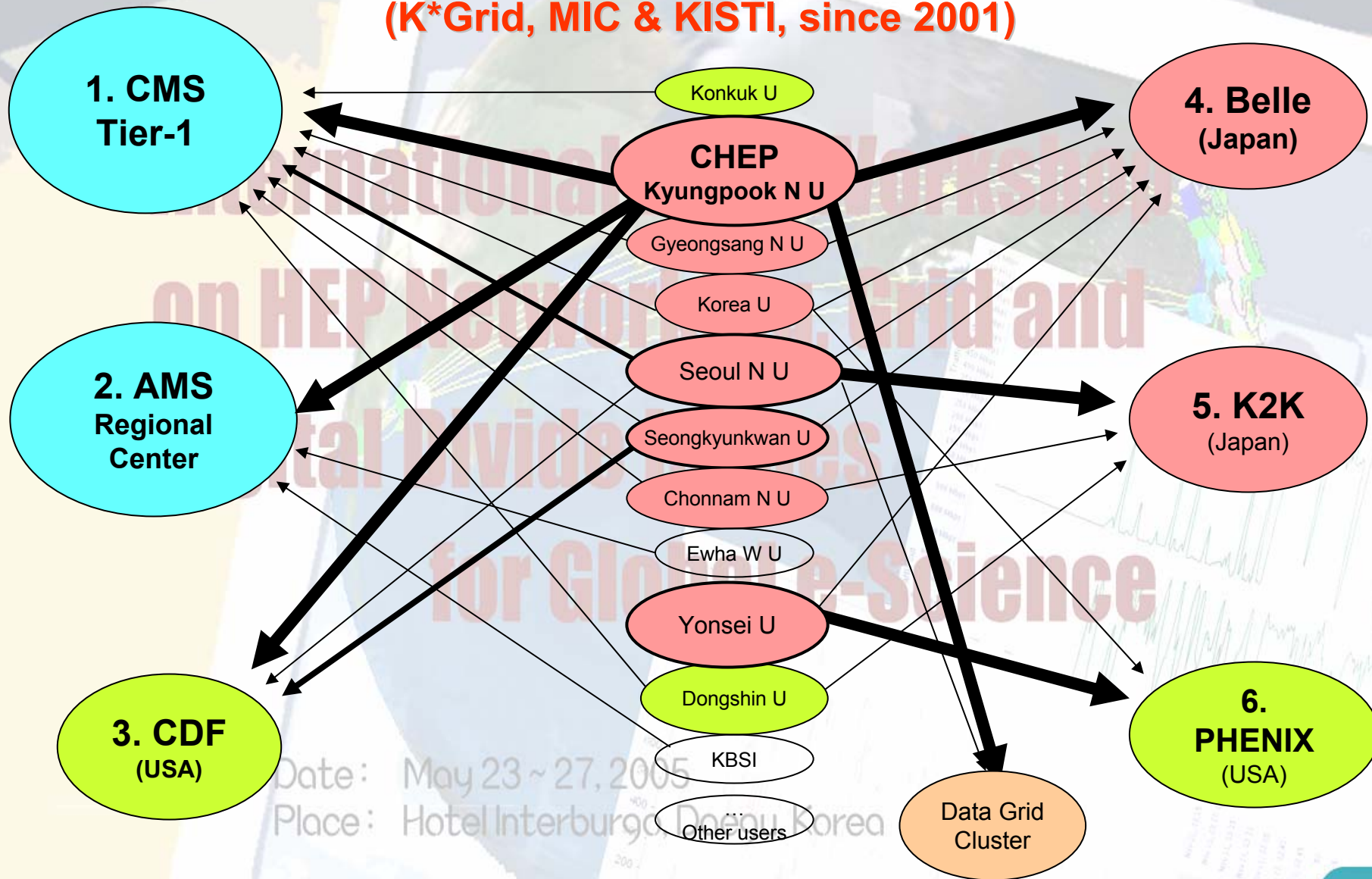
Goals of HEP Computing

- The Center for High Energy Physics (CHEP), Center of Excellence, at KNU is the place where most of these experimental activities are centered. Naturally the computing resources and R/D activities are based on the CHEP activities.

- CHEP is building a Supercomputing Center for HEP to be equipped with
  - **CPU: > 1,000**
  - **Disk cache: 1,000 TB**
  - **Tape Storage: 3,000 TB**
  - **Networking: > 20 Gbps**
  - **In Grid Technology**
  - **Before 2007**

HEP Data Grid Working Group
(K*Grid, MIC & KISTI, since 2001)

1. CMS Tier-1

4. Belle (Japan)

Konkuk U

CHEP Kyungpook N U

Gyeongsang N U

Korea U

Seoul N U

2. AMS Regional Center

5. K2K (Japan)

Seongkyunkwan U

Chonnam N U

Ewha W U

Yonsei U

Dongshin U

3. CDF (USA)

KBSI

…
Other users

6. PHENIX (USA)

Data Grid Cluster

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Data Grid R/D and Collaborations

- EUDG testbeds (2002~3, now closed) -- learned about Globus
- Grid3 and iVDGL for CMS
  - Running now since 2002
  - serving 100 researchers in HEP, Astronomy, Bio-Chemistry, etc, providing more than 2,000 CPUs with US sites (Korea: 84 CPUs)
  - NOW part of OSG (2005)
- LCG2: up and running and will be officially approved soon. completed in 2005
- SRB (Storage Resource Broker)
  - For Belle, federation of Taiwan, Japan, Australia, China, Poland, Korea SRB sites
  - and for domestic usage (KISTI, KBSI)

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Data Grid R/D and Collaborations

- CMS MC productions and analyses
- Decentralized Analysis Farm (DeCAF) for CDF
  - Running and serving 800 researchers around the World for CDF experiment
- Belle Gridification Works
  - CA and SRB, MC production
- AMS: MC production but not in the Grid mode
- And other works
  - CA (Server installed, almost ready for operation)

Korean HEP Data Grid Activities

Traffic Monitoring

HEP Data Grid Homepage

Cluster Monitoring

HEP Data Grid R/D

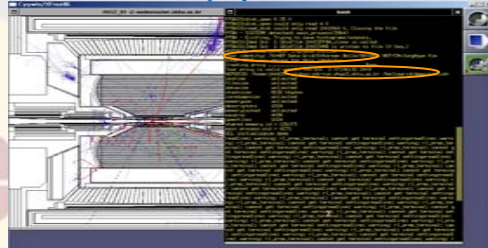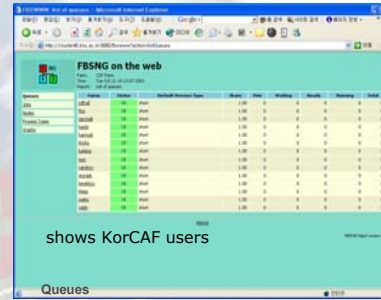## Belle

KorBelle (Korean Belle) Home page

* GSIM event Display in GT environment

Globus Environment

Grid Computing Research Group

CE

QQ (EvtGe) → QQConfig → QQProcess

GEANT (DetSim)

Skim

Analysis

RUNConfig

RUNProcess

Belle-lib server (BASF)

Batch Job System

Node0 Node02 Node03 Node04 ● ●

KNU Data Storage (Real/MC data)

CDF

FBSNG on the web

shows KorCAF users

Queues

Jobs

users
KCHEP(DCAF)   Fermilab (CAF)
SAM Grid
users

FBSNG on the web

current status of work node

Nodes
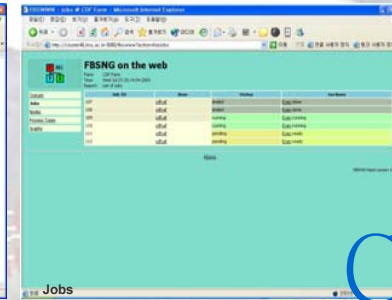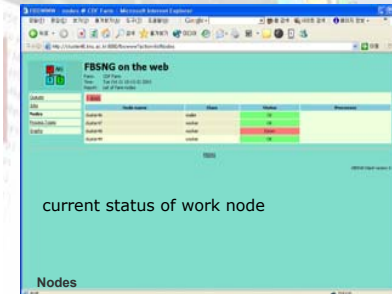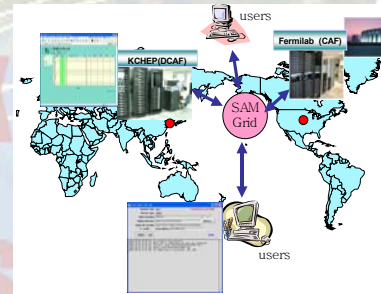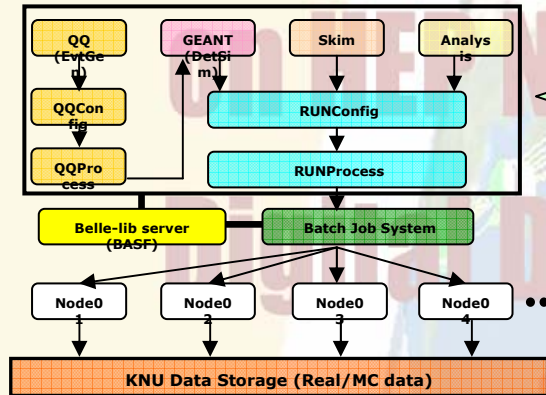
●**DEMO at SC2003**
- Fermilab/SLAC booth
  - ❑Grid3
- KISTI Booth
  - ❑DCAF
  - ❑KorBelle

CMS

Grid3
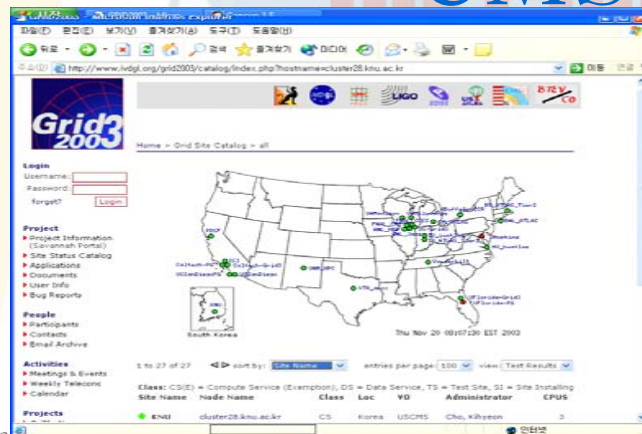
DCAF
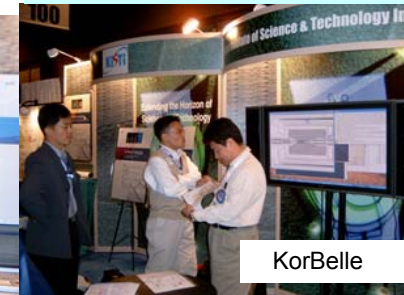
KorBelle

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- Linux cluster: ~200 CPUs
- RAID disk: ~10 TB
- Tape: ~45 TB

Resources

4th Floor

Supercomputing Center at CHEP

Linux Cluster System

Tape Library System

CHEP Clusters around the world
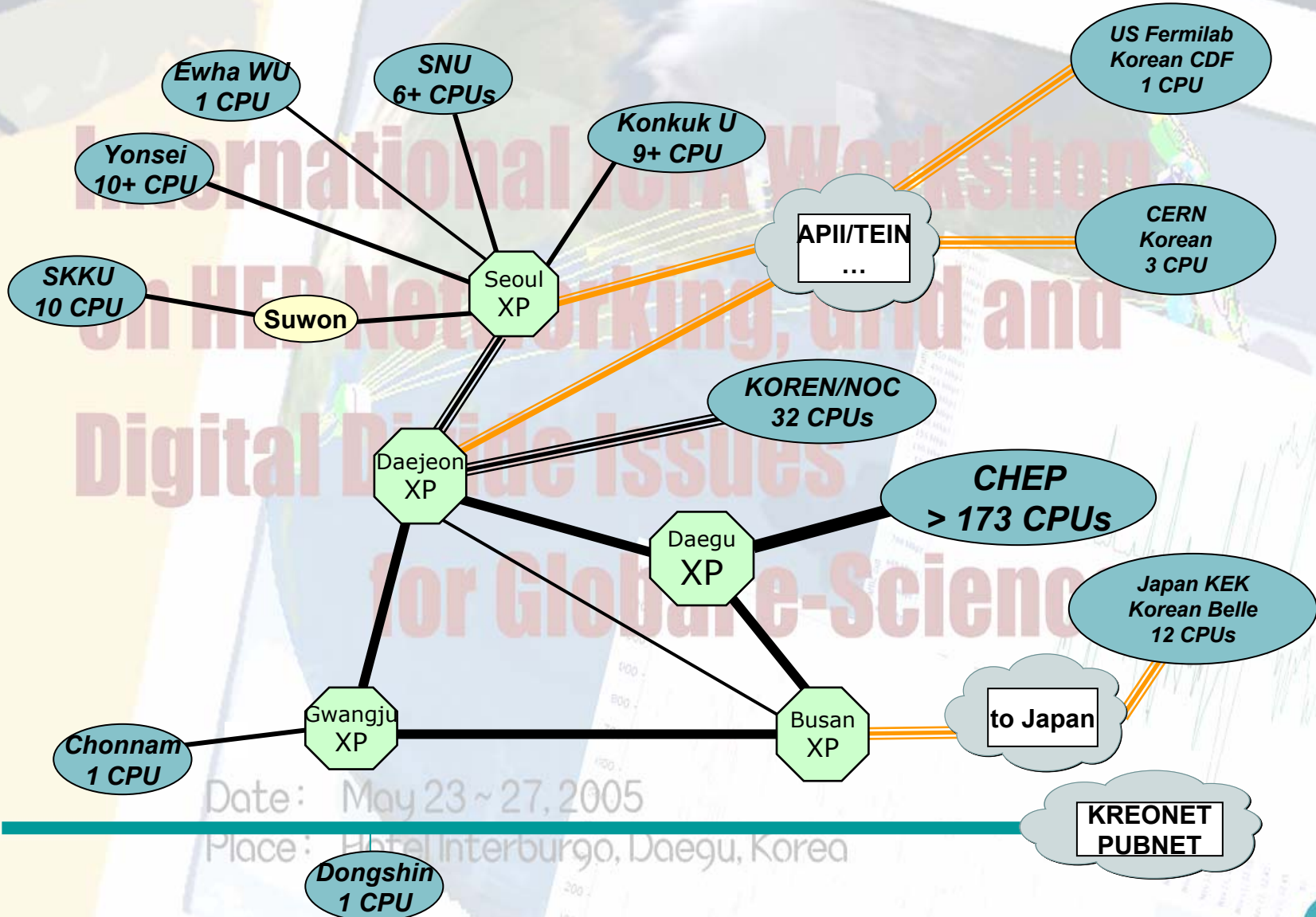
(not complete)

Ewha WU
1 CPU

SNU
6+ CPUs

Konkuk U
9+ CPU

US Fermilab
Korean CDF
1 CPU

Yonsei
10+ CPU

APII/TEIN
...

CERN
Korean
3 CPU

SKKU
10 CPU

Suwon

Seoul
XP

KOREN/NOC
32 CPUs

Daejeon
XP

CHEP
> 173 CPUs

Daegu
XP

Japan KEK
Korean Belle
12 CPUs

Gwangju
XP

Busan
XP

to Japan

Chonnam
1 CPU

KREONET
PUBNET

Dongshin
1 CPU

D.Son, ICFA Workshop on Networking/Grid/Digital Divide Daegu, 23~27 May 2005

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Networking(from 2000 to now)

- Domestic Links
  - KREONET, KOREN
    - 155 Mbps at best BEFORE 2002
    - **1~2.5 Gbps NOW**
- International Links
  - **APII**
    - **Japan: (2 M → 2*1 G → 10 G this year)**
    - **US: (30 M → 1.2 G)**
  - **TEIN**
    - **CERN (EU) (New Direct link 155 Mbps)**
  - **GLORIAD**
    - **US-Korea-Hong Kong: (10 G this summer)**
- Technology
  - ATM (before 2002) → Optical (Lambda)
- These achievements were made possible, DRIVEN by applications demands (HEP played the leading role)

Network Activities

- Working with Advanced Network Forum in Korea
  - HEP and Physics Working Group
- Working in collaboration with Caltech and Lambda networking Groups, Gloriad, etc. in the world

- Iperf tests
  - Domestic tests on research networks
  - International tests (USA, Europe)
- Real File Transfer Tests using bbFTP
  - Domestic tests
  - International tests (Europe)
- IPv6 performance tests domestically

- Participated in SC2004 Bandwidth Challenge with international HEP partners

Real File Transfer (1TB) Test

200GB each

A

1G

B

1G

C

1G

D

1G

1G

E

KOREN

1G

KNU File Server

(Tuned RAID 0, Read 197MB/s with Iozone, Write 178MB/s)

machines at KOREN-NOC in Daejon


```
TGP GbE 2/2.19 In/Out
1000 M
500 M
0
        18:00    00:00    06:00
In traffic  51.211456k   Out traffic  4.211326k
```
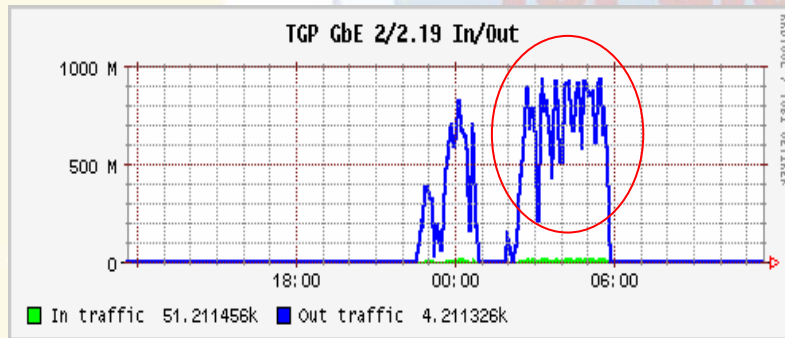
A: 3 hr. 13 min. 20

B: 3 hr. 13 min. 31

C: 3 hr. 14 min. 36

D: 3 hr. 14 min. 46

E: 3 hr. 11 min. 22

Throughput: 701Mbps

Outlook

- Now in the phase from base configuration to more intensified system (Tier-1 like)

- e-Science program started this year (MOST)
  - proposed eHEP to the MOST as working application
- Networks (GLORIAD, APII-Japan: at least 20 Gbps) coming in and ready soon

- Continue R/D for Data Grid Technology and Networking for improvement

- A national strategic plan for ILC (including LHC and all other HEP activities, roadmaps, and e-HEP) is in preparation

Summary

- Demands in Korean HEP formed HEP Data Grid Collaboration and HEP Working Groups for Networks, being supported by governments (MIC, MOST) and various groups of experts

- HEP Data Grid R/D and Network tests having been performed in collaboration with international and domestic partners

- Korean HEP is proposing a Tier-1 regional center for CMS and other experiment and hope to be ready

- Enough bandwidth with new technology such as GLORIAD will be up and ready

- HEP is an excellent promising example of truly global e-Science, with widely dispersed resources all over the world and with excellent collaboration

Acknowledgment

- **Many thanks to**
  - MOST and KOSEF for supporting CHEP
  - Especially MOST for supporting e-Science(eHEP)/GLORIAD
  - MIC for supporting HEP in many ways
  - KISTI for supporting HEP Data Grid
  - NCA for supporting the Networking and HEP (APII, TEIN)
  - KISDI for supporting the HEP/Physics Group for APII, TEIN
  - KT/KOREN-NOC for supporting the Network services
  - IBM-Korea and CIES for supporting the Storage system
  - ANF, APAN, KREONET for supporting networking
  - HEP Community for participation
  - And many others