



HEP Computing in Korea

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Center for High Energy Physics
Kyungpook National University

International ICFA Workshop on

**HEP Networking, Grid and
Digital Divide Issues for Global e-Science**

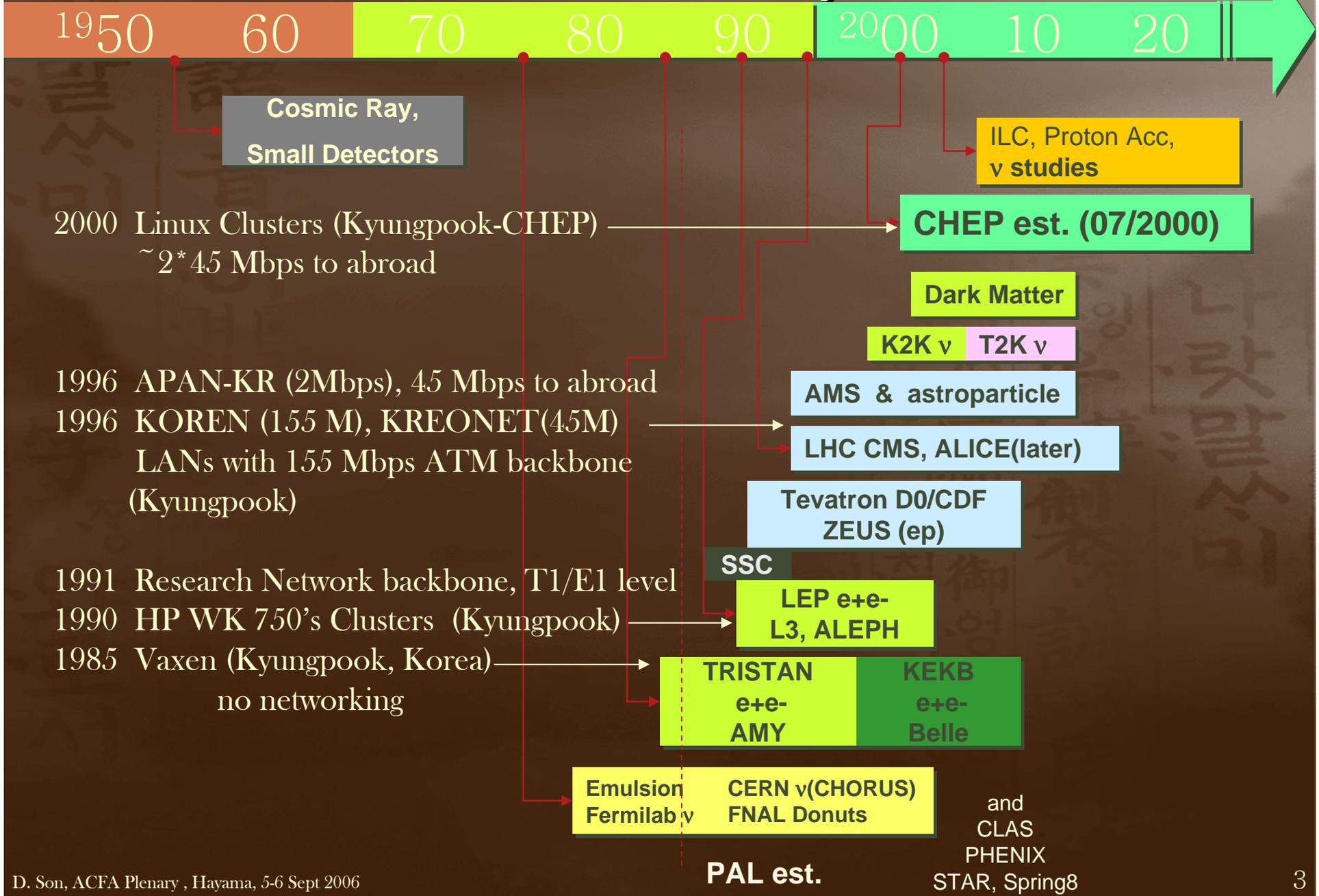
October 9-11, 2006

Cracow, Poland

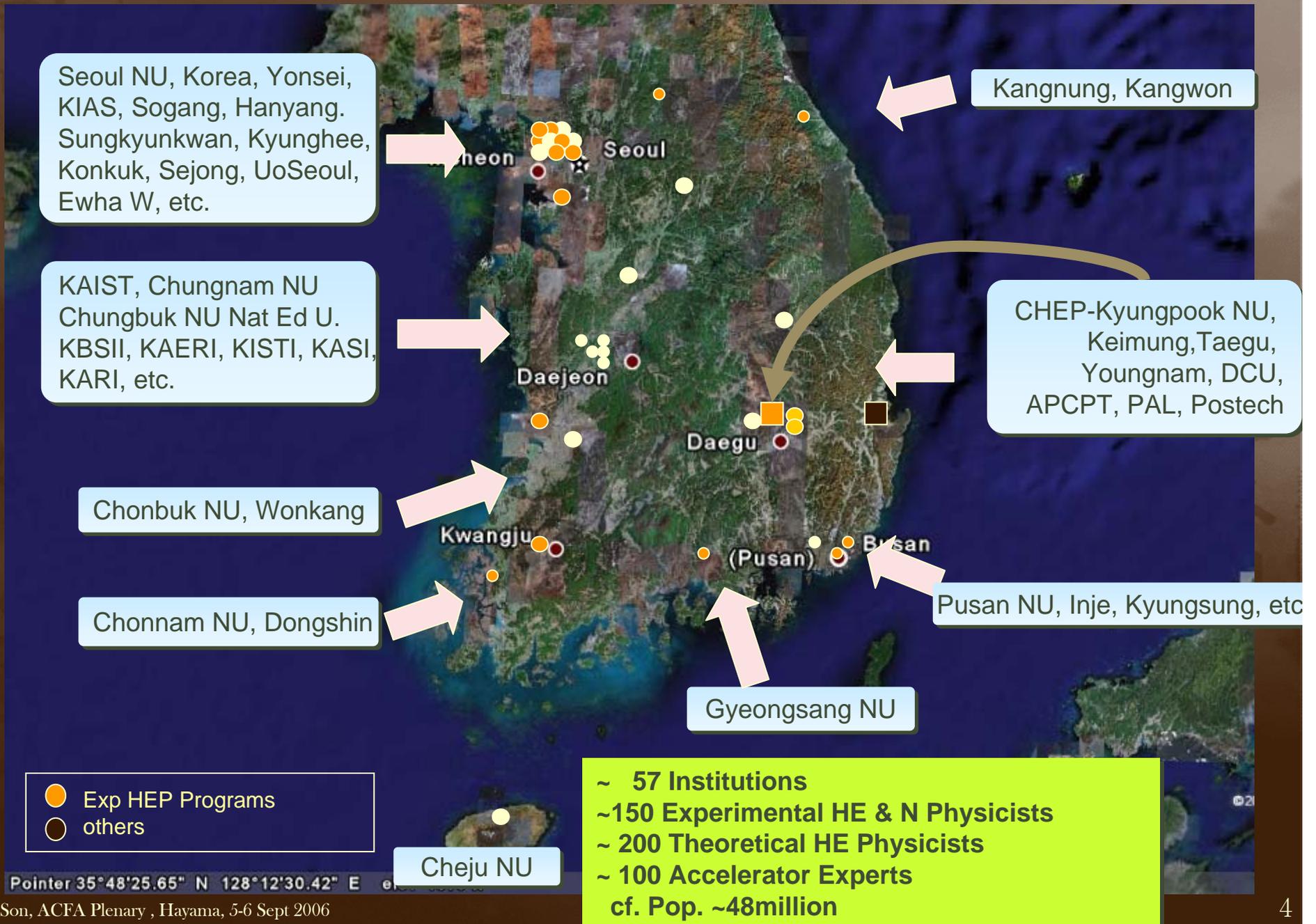
Outline

- Short Introduction to Korean HEP activities
- Networks and Computing Coordinations
- LCG Service Challenge 4 at CHEP
- Outlook
- Summary

Brief History



Institutions (HEP, HENP, Acc)



Organizations

CHEP
(2000)

Experiments
Accelerator R/D
Phenomenology
Astro-Particle Physics
HE Nuclear Physics

23 PhD's at Kyungpook
(16 Faculty, 7 Assoc.
16 exp, 4 th, 3 acc.)
>50 Faculty & Assoc.
from collaborating U.

Daegu U
Dongshin U
Donga U
Pusan NU
And others

Kyungpook NU
(host)

Seoul NU
Korea U
Yonsei U
SKKU
Chonnam NU
Konkuk U
Gyeongsang NU
Ewha WU
POSTECH
Chonbuk NU
KAIST
KIAS

And others (KAERI, etc.)

CQeST
(2005)

QFT
String

20 Faculty
members

Sogang
(host)

Seoul NU
SKKU
Ewha WU
U Seoul
Kangwon NU
Kyunghee
Yonsei U
KIAS
Hanyang U
POSTECH
Chonbuk NU

DMRC
(2000)

Seoul NU (host)

MEMSTEL
(2006)

Ewha W U (host)

KODEL
(1997)

of Korea U

**Emulsion
Group**

GSNU

PAL
(1988)

POSTECH
(host)

APCTP
(1997)

POSTECH
(host)

CTP
(1990)

Seoul NU
(host)

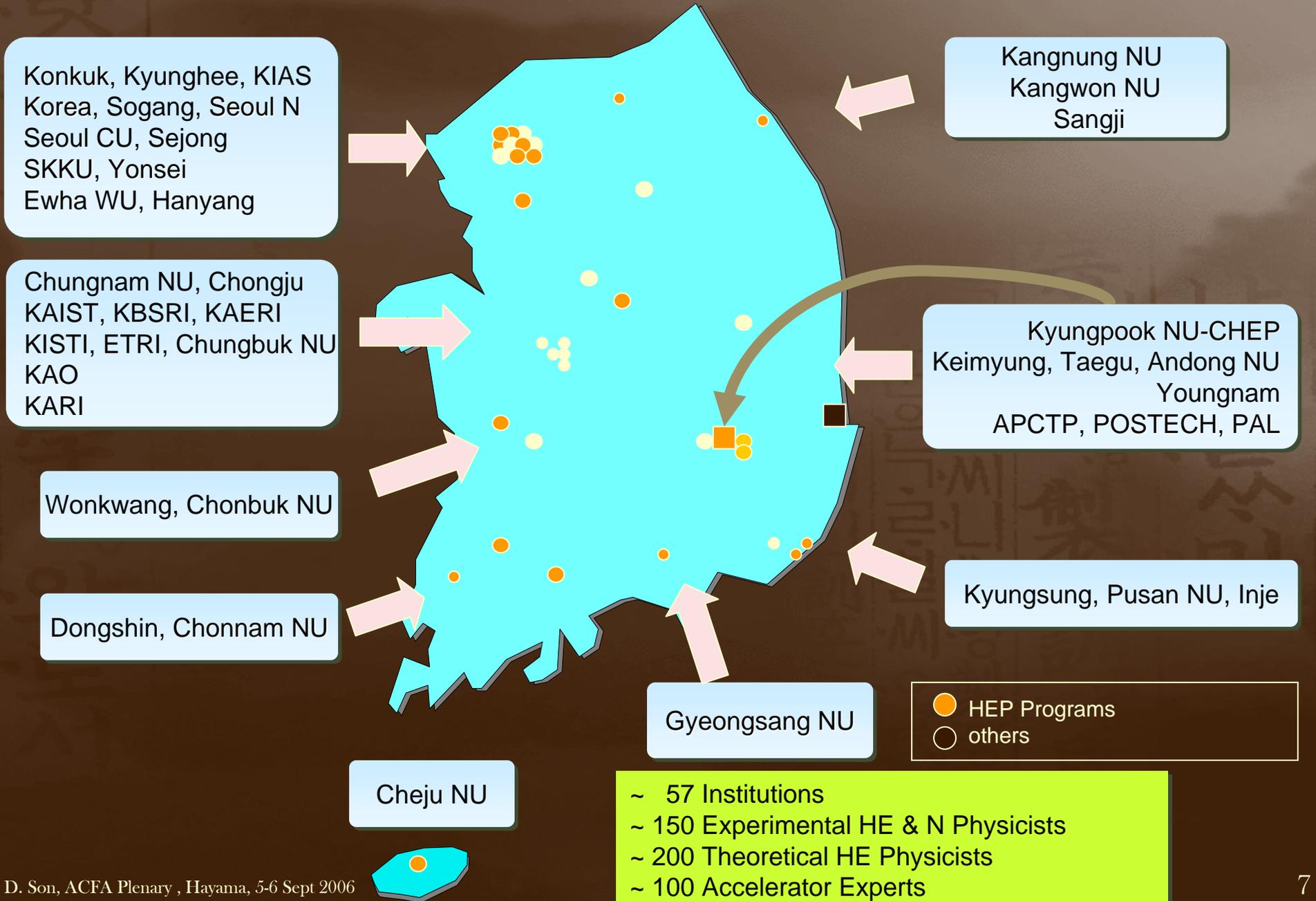
KIAS
(1996)

KAIST
(host)

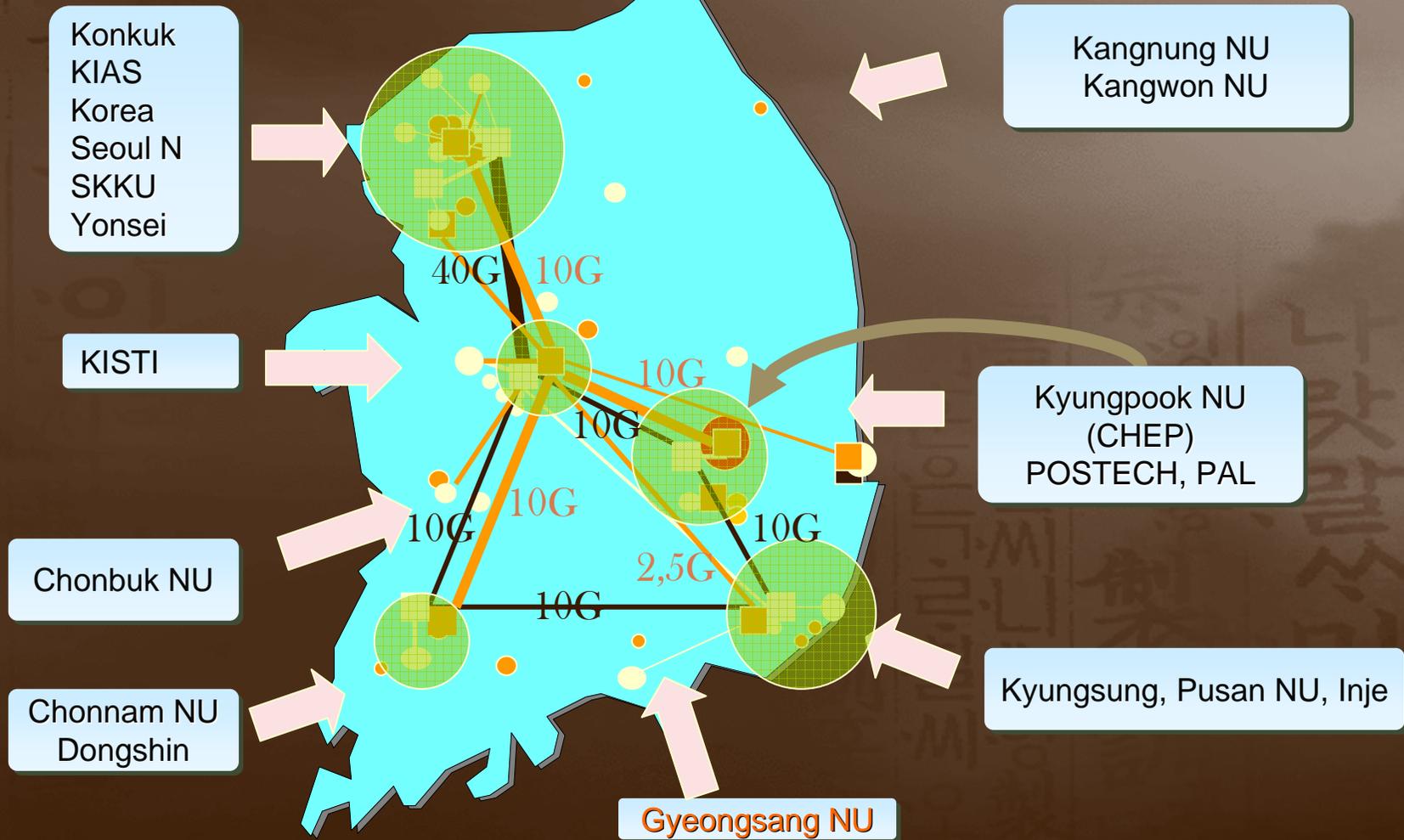
Korean HEP activities

- 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 2008(?)
 - **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 (& PHENIX) are producing a large volume of data now, which need be processed and analyzed with simulations.
- CMS & ALICE will be challenges
- ➔ These need computing facility and data storage

HEP related Univ. & Institutions



How are they networked?



— KREONET
— KOREN

10G between Backbones

Cheju NU



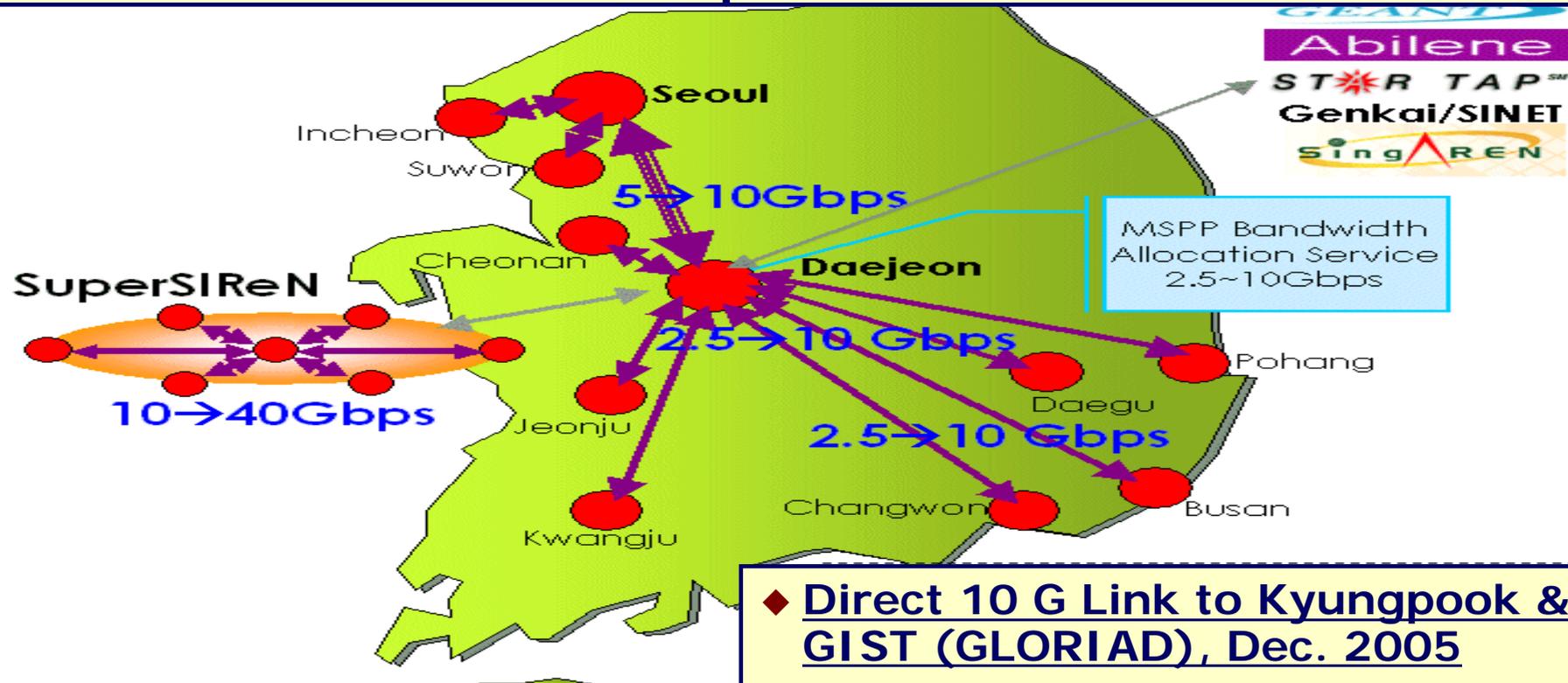
- Most major universities are connected to two Research Networks (MOST, MIC supports)
- Others use Education Network (KREN)

KREONET

- ◆ 11 Regions, 12 POP Centers
- ◆ Optical 2.5-10G Backbone; SONET/SDH, POS, ATM
- ◆ National IX Connection

KREONET2

- ◆ Support for Next Gen. Apps:
- ◆ IPv6, QoS, Multicast; Bandwidth Alloc. Services
- ◆ StarLight/Abilene Connection



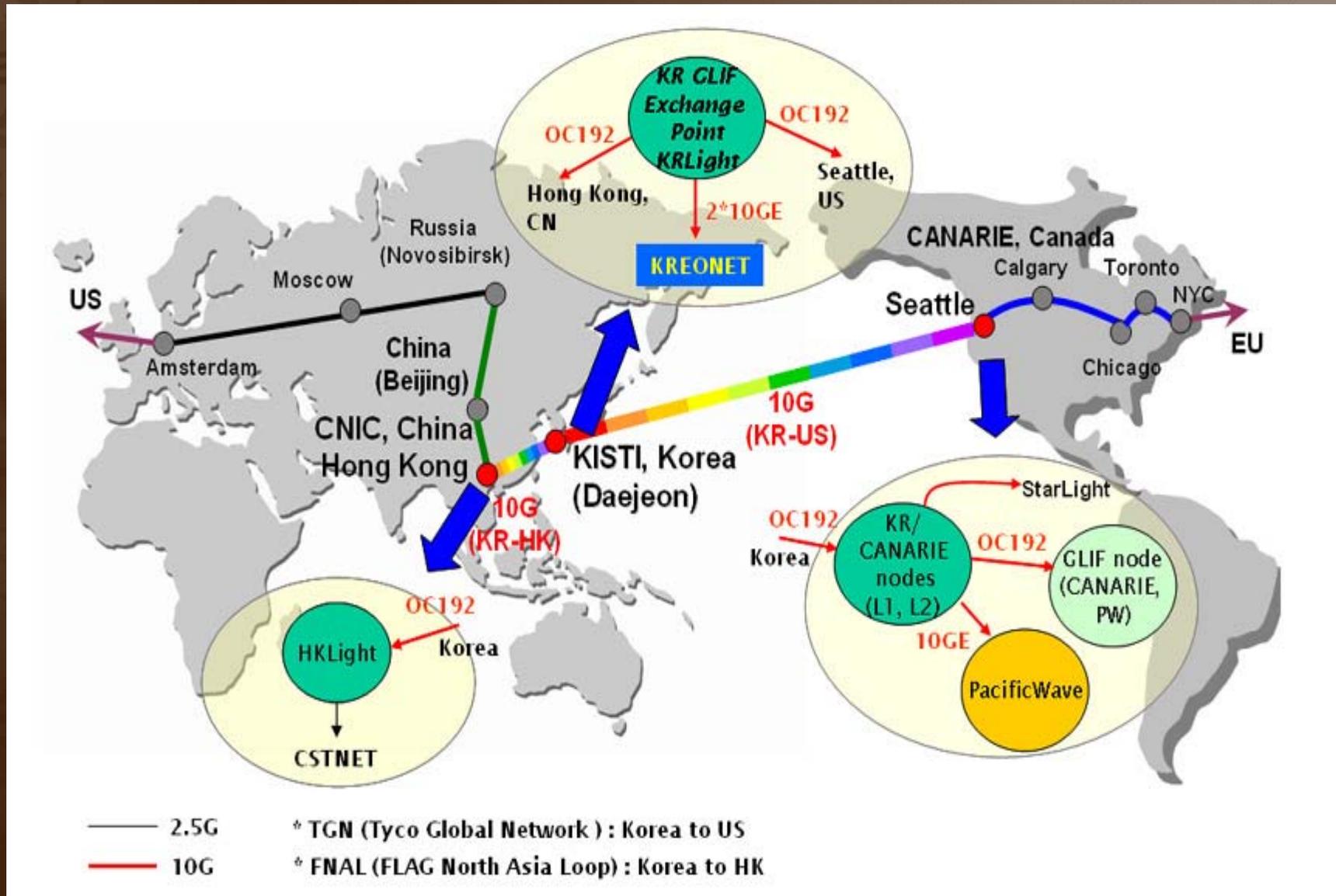
SuperSIREN (7 Res. Institutes)

- ◆ Optical 10-40G Backbone
- ◆ Collaborative Environment Support
- ◆ High Speed Wireless: 1.25 G

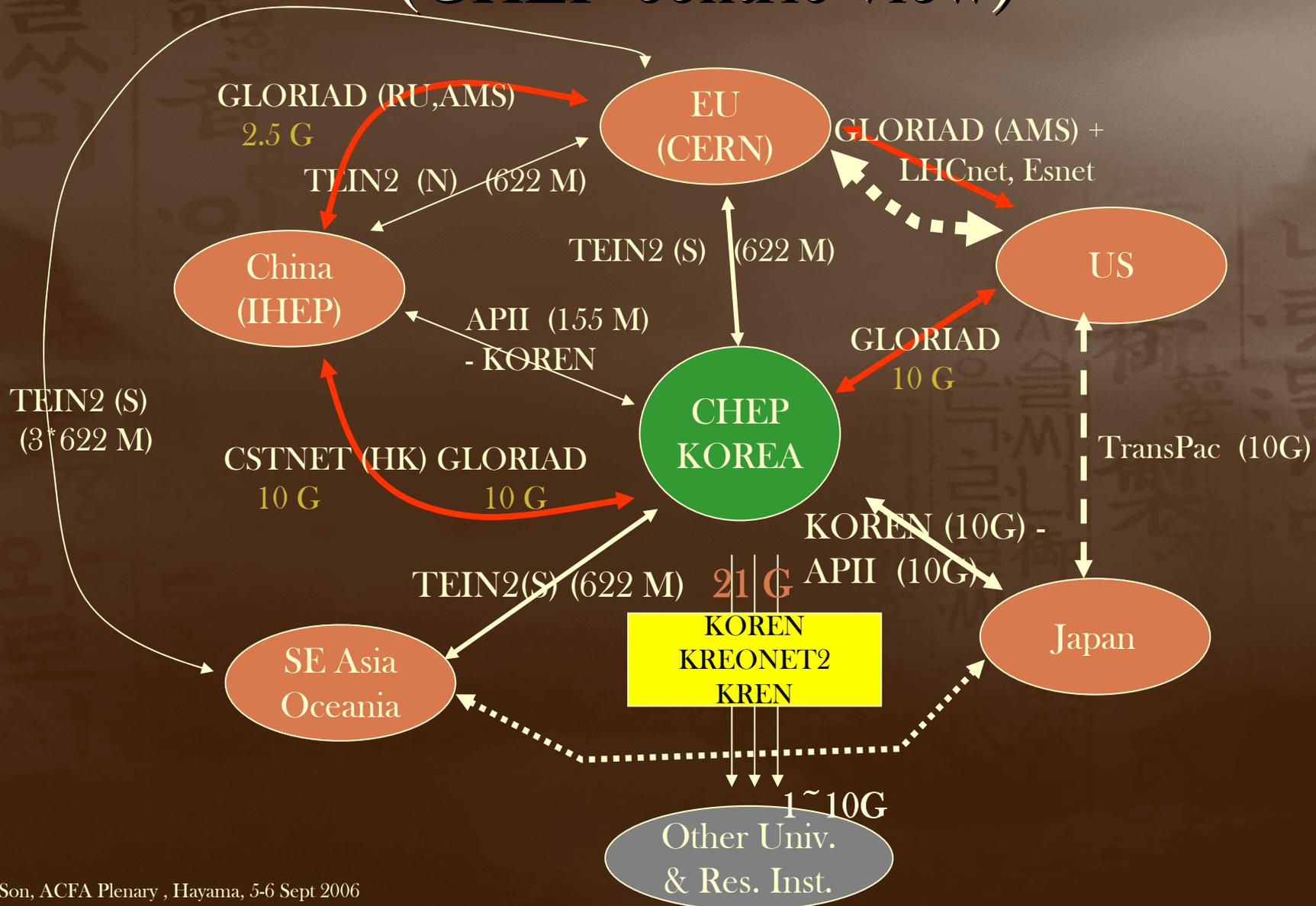
International Links

- ◆ *GLORIAD Link to 10G to Seattle since Sept. 2005*
- ◆ *With KOREN links to APII's*

GLORIAD



Summary of Networking (CHEP-centric view)



Goals of HEP Computing

- Kyungpook(KNU) has been almost the only computing resource for HEP since 1985
- The Center for High Energy Physics (CHEP) – the Only National Research Center of Excellence designated by MOST- 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. (CMS, CDF, Belle, etc..)
- Other some universities have now some computing power for HEP
 - Yonsei, SNU, Korea, SKKU, Gyeongsang, Sejong, etc.
- Since 2002, CHEP has been trying to build 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**
 - **With Grid Technology**
 - **To keep with the LHC operation**

Data Grid R/D & Collaborations

- Domestic Collaboration (Grid WG) since 2001 and HEP/Physics Network Working Group since 2002
- Have operated LCG Grid Testbeds at KNU& SNU in 2002
- Many Large File Transfer Tests btw KR – USA/Japan/CERN
- Running IPv6 tests, etc.
- iVDGL (since 2002) & Open Science Grid (2005)
 - serving researchers in HEP, Astronomy, Bio-Chemistry, etc, providing CPU resources (84 CPUs once, later moved to LCG2)
- LCG2: up and running since 2005 – ready to join WLCG
- SRB (Storage Resource Broker) Running Experience
 - For Belle, fed. (Taiwan, Japan, Australia, China, Poland,)
For domestic usage (KISTI, KBSI)
- Partner of UltraLight
- Participated in SC04/SC05
- Joined EGEE (KISTI & Others)

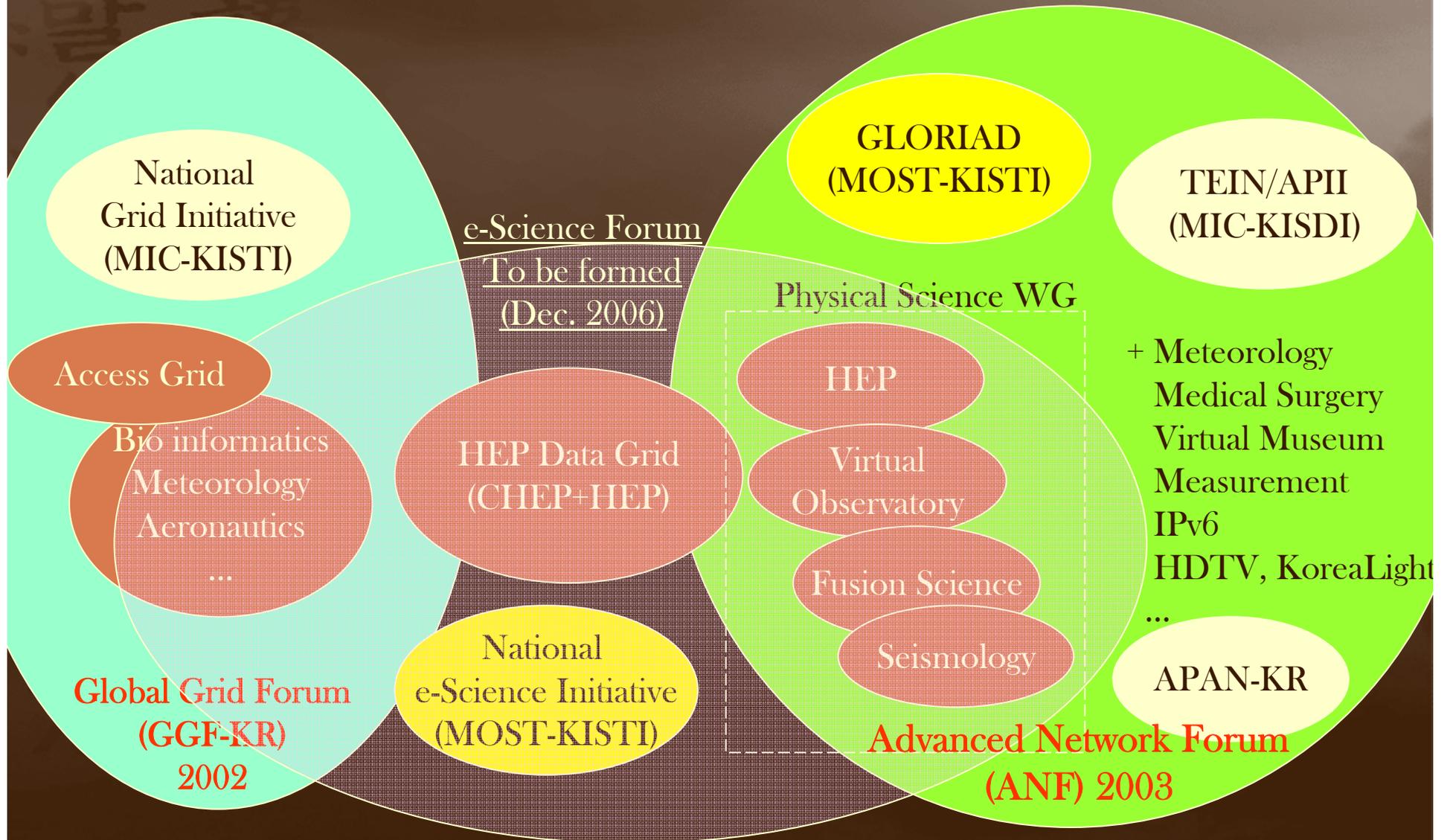
Acknowledgment:

Harvey and his Caltech team, Paul and OSG, Karita/KEK,
CERN LCG team and Lin/Taiwan, and many Korean Colleagues

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)

Communities and National Initiatives



Korean CMS Institutions

- 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



LCG Service Challenge 4 at KNU

- Tier-2 configuration
- Working for
- SC4: 2006.6.1-9.30
 - Service Challenge 4: Successful completion of service phase
- Ready for CSA06: 2006.9.15-11.15
 - “Computing, Software, & Analysis Challenge 2006”
 - **“Receive” from HLT (previously run) events with online tag (HLT decision)**

CHEP System Overview (CPU)

Exp. Group	CPU	Node	kSI2K
CMS	46(55)	29(35)	40.3(48.7)
CDF/DCAF	73(85)	44(51)	82.2(93.5)
Belle	24(46)	24(35)	31.8(23.9)
AMS	24(35)	15(22)	22.7(29)
Grid Testbed	0(22)	0(21)	0(13.8)
Network Test	4(14)	2(6)	3.7(10.4)
ETC	0(14)	0(8)	0(12.1)
Total	171(269)	114(178)	180(231.7)

※ Number of available device for SC4 (total CPU)

System Overview (Hard Disk)

	HDD[GB]	# of HDD	Total Size [TB]	SC4
Cluster116	250	15	3.75	O
Cluster119	250	15	3.75	X
Cluster120	250	7	1.75	X
Cluster121	250	8	2.00	X
Cluster133	300	15	4.50	X
Cluster134	300	15	4.50	O
Cluster136	300	15	4.50	X
Cluster140	320	24	7.68	O
Cluster141	320	24	7.68	O
Cluster142	320	24	7.68	O
sul	250	15	3.75	X
Total			51.54	31.29 TB

System Overview (MSS)

- MSS(Mass Storage System)
 - IBM 3494 Tape Lib : 45.6TB
 - IBM FAStT200 (Buffer Disk): 740GB
 - IBM 3494A : 21.8TB
 - IBM 3494B : 23.8TB

Resources

+ CHEP computers at collb. Inst. eg. Konkuk, Yonsei, SKKU, SNU, KOREN-NOC, KEK, Fermilab, CERN



4th Floor



Supercomputing Center
at CHEP

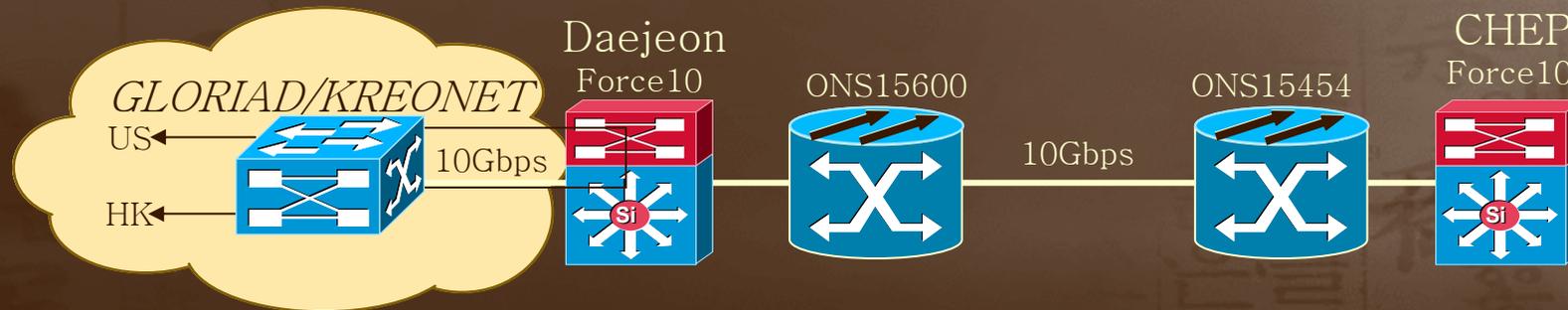


Linux Cluster System



Tape Library System

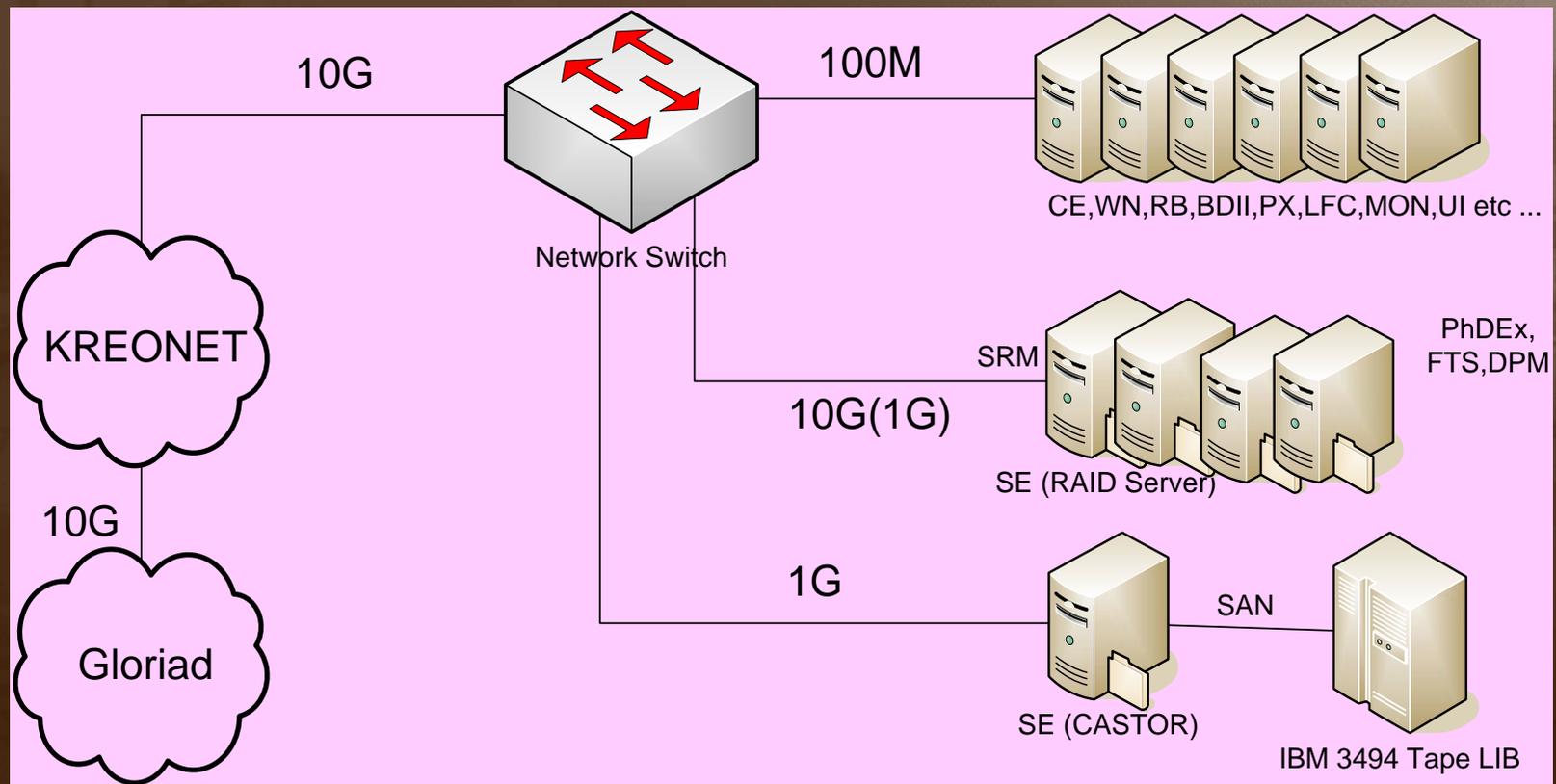
CHEP 10G Network



CHEP Interface

1. 10G Ethernet 3Port(MM Type)
2. Gigabit Interface Fiber 8Port(MM Type)
3. 10/100/1000 Interface 11Port(UTP Type)

KNU System Diagram for LCG SC4



CMS SC4 Transfer State

PhEDEx SC4 Status Transfer State 2006-08-25 01:47:56 GMT

Database: Production | SC4 | Dev | Testbed | Validation

Last Change	Node	Destined		On Site		In Transfer	
		N	Size	N	Size	N	Size
86d16h48	T1_ASGC_Buffer	-	-	106	12.5 GB	-	-
Current	T1_ASGC_Load	1223	2.1 TB	101	179.1 GB	267	472.8 GB
71d1h06	T1_ASGC_MSS	106	12.5 GB	106	12.5 GB	-	-
17d12h37	T1_CERN_Buffer	-	-	1593	2.8 TB	-	-
Current	T1_CERN_Load	1407	2.4 TB	1696	3.1 TB	353	619.1 GB
56d13h41	T1_CERN_MSS	106	12.5 GB	1571	2.7 TB	-	-
79d8h55	T1_CNAF_Buffer	-	-	106	12.5 GB	-	-
1d20h54	T1_CNAF_Load	2688	4.8 TB	387	685.4 GB	-	-
71d1h06	T1_CNAF_MSS	106	12.5 GB	106	12.5 GB	-	-
27d5h19	T1_FNAL_Buffer	-	-	125	46.7 GB	-	-
9h48	T1_FNAL_Load	2776	5.0 TB	696	990.6 GB	-	-
100d10h12	T1_FNAL_MSS	-	-	106	12.5 GB	-	-
63d11h27	T1_FZK_Buffer	106	12.5 GB	106	12.5 GB	-	-
Current	T1_FZK_Load	1175	2.0 TB	86	150.5 GB	413	742.2 GB
71d1h06	T1_FZK_MSS	106	12.5 GB	-	-	-	-
52d9h30	T1_IN2P3_Buffer	-	-	306	392.2 GB	-	-
Current	T1_IN2P3_Load	1175	2.0 TB	48	84.2 GB	148	259.5 GB
63d14h59	T1_IN2P3_MSS	106	12.5 GB	106	12.5 GB	-	-
2d5h37	T2_KNU_Buffer	106	12.5 GB	107	14.2 GB	-	-
Current	T2_KNU_Load	307	538.4 GB	83	145.2 GB	79	138.3 GB

CMS SC4 Transfer Details

PhEDEx SC4 Status
Transfer State Details
2006-08-25 01:55:20 GMT

Database: Production | SC4 | Dev | Testbed | Validation

Update

Transfer State Details								
Age	To		or	From		Files		Detail
	Node	State		Node	State	N	Size	
	<input type="text" value="KNU"/>		<input type="text" value="KNU"/>					
Current	T1_ASGC_Load	requested		T2_KNU_Load	ready	48	84.2 GB	(Files)
Current	T1_CERN_Load	requested		T2_KNU_Load	pending	7	11.8 GB	(Files)
Current	T1_CERN_Load	requested		T2_KNU_Load	ready	1	1.7 GB	(Files)
Current	T1_CERN_Load	transferring		T2_KNU_Load	ready	25	44.1 GB	(Files)
Current	T1_FZK_Load	requested		T2_KNU_Load	ready	40	70.1 GB	(Files)
Current	T1_FZK_Load	transferring		T2_KNU_Load	ready	8	14.1 GB	(Files)
Current	T1_IN2P3_Load	pending		T2_KNU_Load	pending	39	68.3 GB	(Files)
Current	T1_RAL_Load	requested		T2_KNU_Load	pending	14	25.1 GB	(Files)
Current	T1_RAL_Load	requested		T2_KNU_Load	ready	1	1.7 GB	(Files)
Current	T1_RAL_Load	transferring		T2_KNU_Load	ready	1	1.9 GB	(Files)
Current	T1_RAL_Load	error		T2_KNU_Load	ready	12	20.4 GB	(Files)
Current	T2_KNU_Load	transferring		T1_CERN_Load	ready	6	10.2 GB	(Files)
Current	T2_KNU_Load	transferring		T1_FZK_Load	ready	32	56.0 GB	(Files)
Current	T2_KNU_Load	requested		T1_IN2P3_Load	pending	1	1.9 GB	(Files)
Current	T2_KNU_Load	transferring		T1_RAL_Load	ready	29	51.0 GB	(Files)
Total		pending		pending		39	68.3 GB	
		requested		pending		22	38.8 GB	
		requested		ready		90	157.7 GB	
		error		ready		12	20.4 GB	
		transferring		ready		101	177.3 GB	
		All		All		264	462.5 GB	

CMS SC4 Transfer Rate

PhEDEx SC4 Status

Transfer Rate

2006-08-25 02:01:08 GMT

Database: Production

SC4

Dev

Testbed

Validation

Time span

Last day

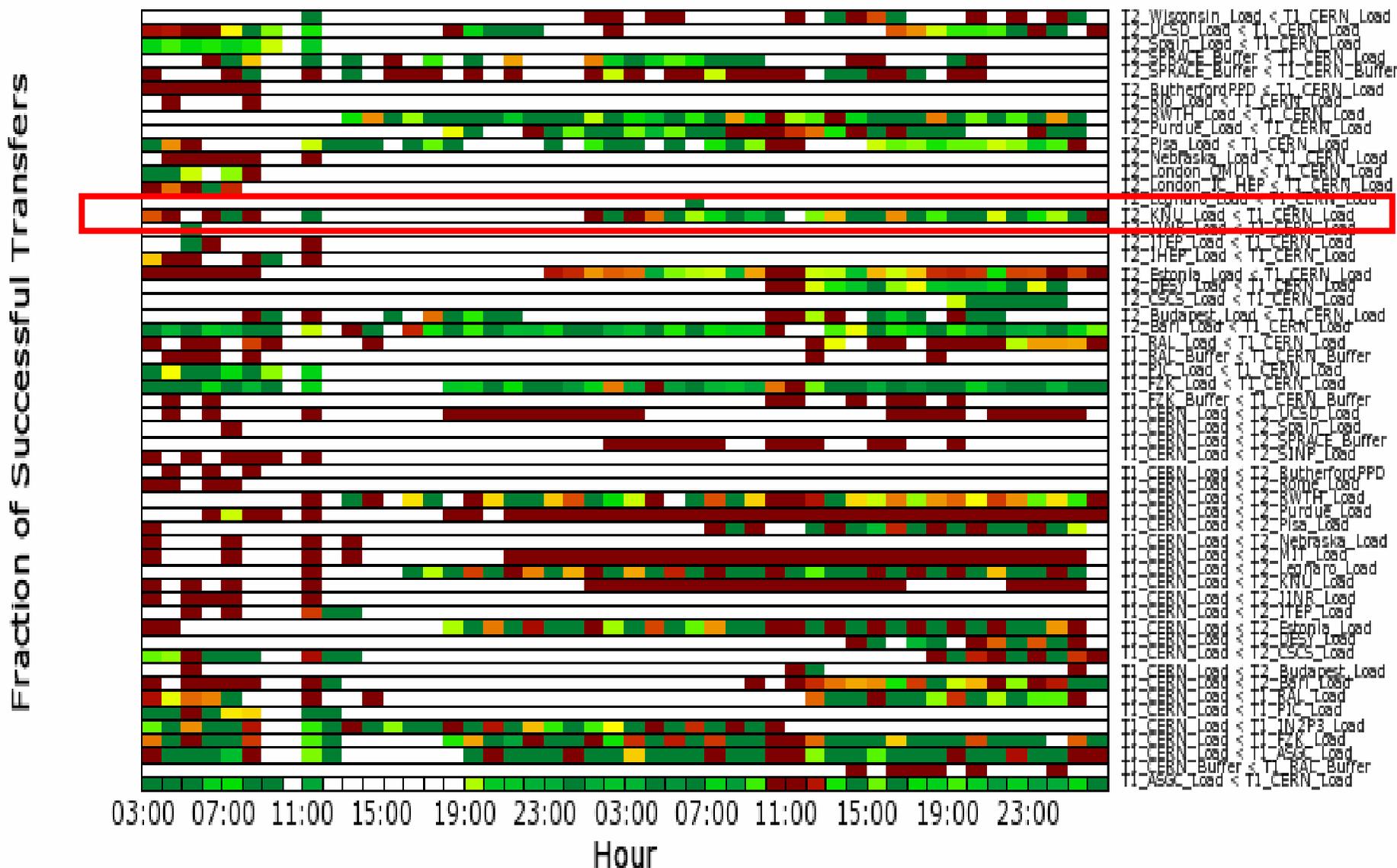
Include links with nothing but errors

Update

Last day									
To		From	Files	Total Size	Rate	Errors	Expired	Avg. Est. Rate	Avg. Est. Latency
KNU	or	KNU							
T2_KNU_Load		T1_FZK_Load	785	1.3 TB	16.3 MB/s	-	-	16.1 MB/s	2h52
T2_KNU_Load		T1_CERN_Load	298	517.3 GB	6.1 MB/s	-	-	6.0 MB/s	14h15
T2_KNU_Load		T1_RAL_Load	146	254.8 GB	3.0 MB/s	-	4	5.4 MB/s	16h31
Total			1229	2.1 TB	25.4 MB/s	-	4	-/s	0h00

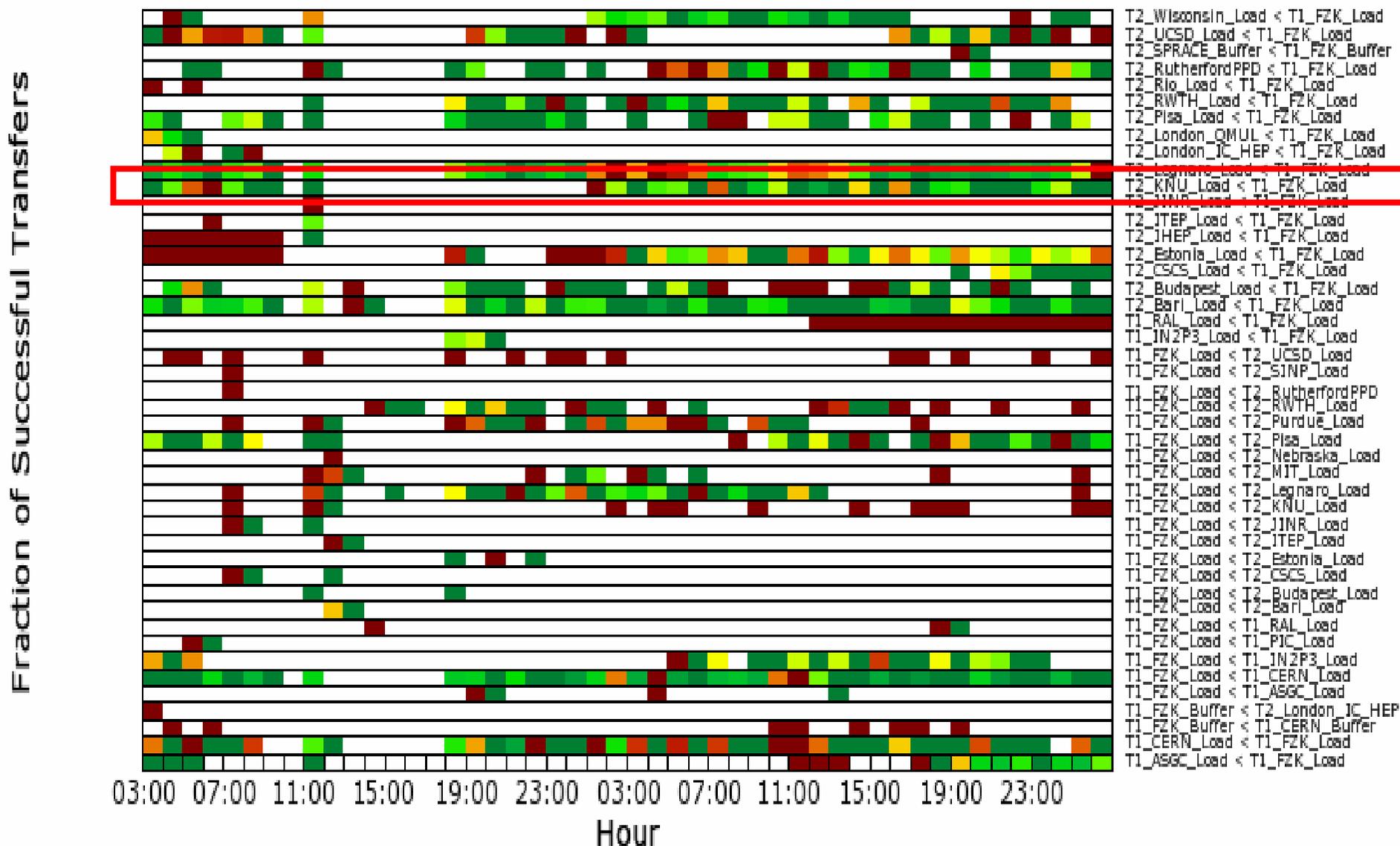
PhEDEx SC4 Transfer Quality By Links matching 'CERN'

Last 48 Hours at 2006-08-25 02:23, last entry 2006-08-25 02:00 GMT



PhEDEx SC4 Transfer Quality By Links matching 'FZK'

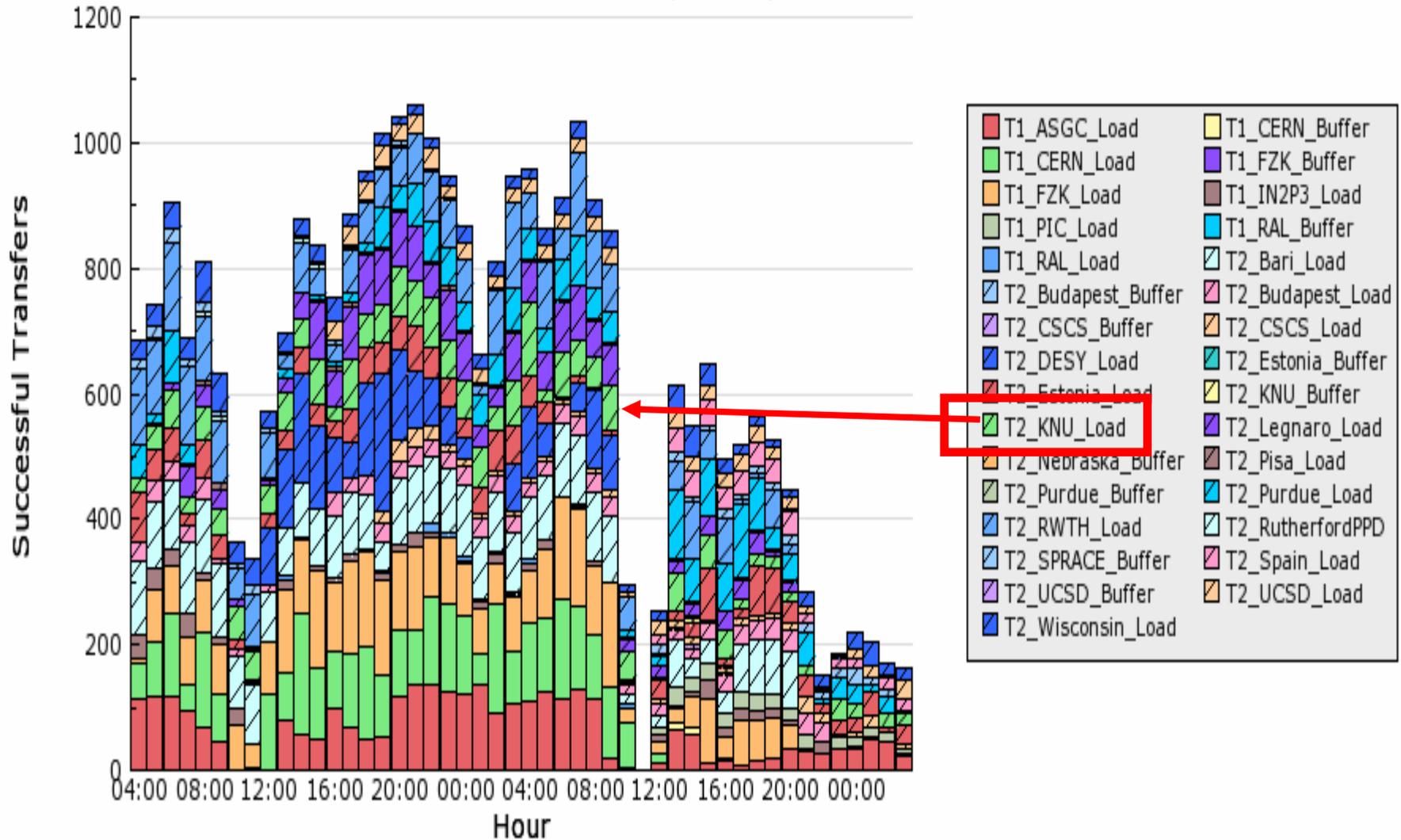
Last 48 Hours at 2006-08-25 02:32, last entry 2006-08-25 02:00 GMT



SC4 Transfer Quality Plot- Successes

PhEDEx SC4 Transfer Quality By Destination

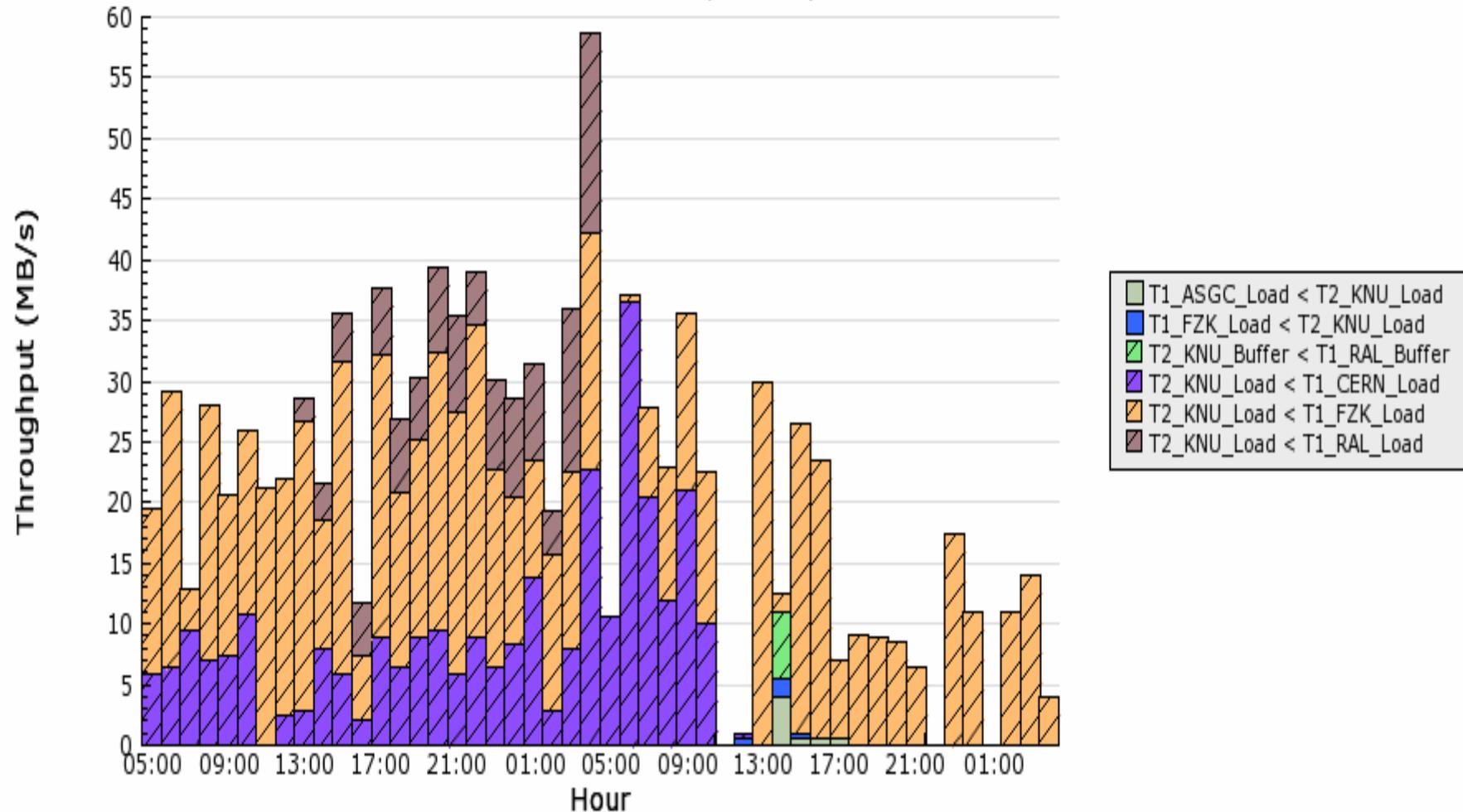
Last 48 Hours at 2006-08-26 03:42, last entry 2006-08-26 03:00 GMT



SC4 Transfer Rate Plots-Rate

PhEDEx SC4 Data Transfers By Links matching 'KNU'

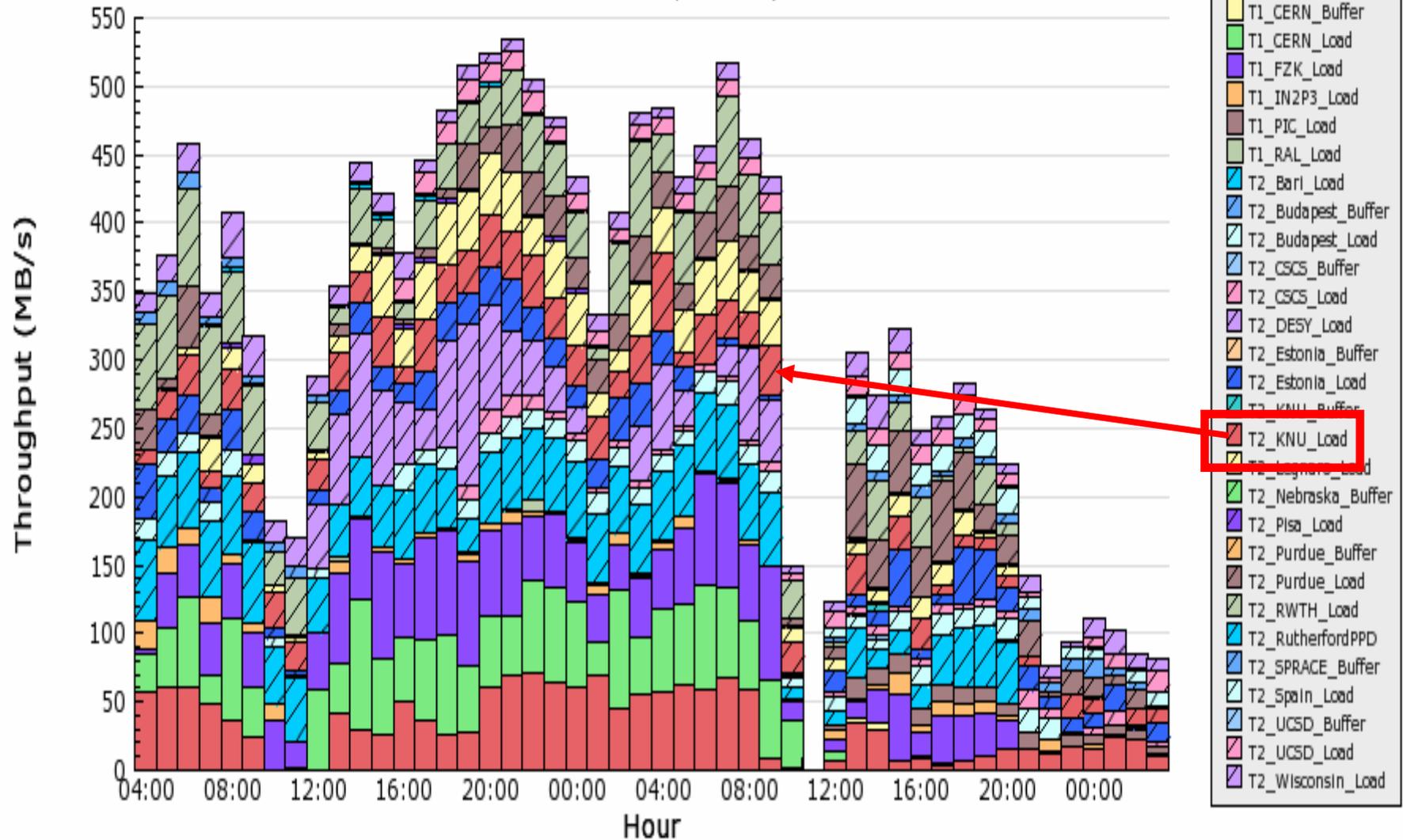
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SC4 Transfer Rate Plots - Rate

PhEDEx SC4 Data Transfers By Destination

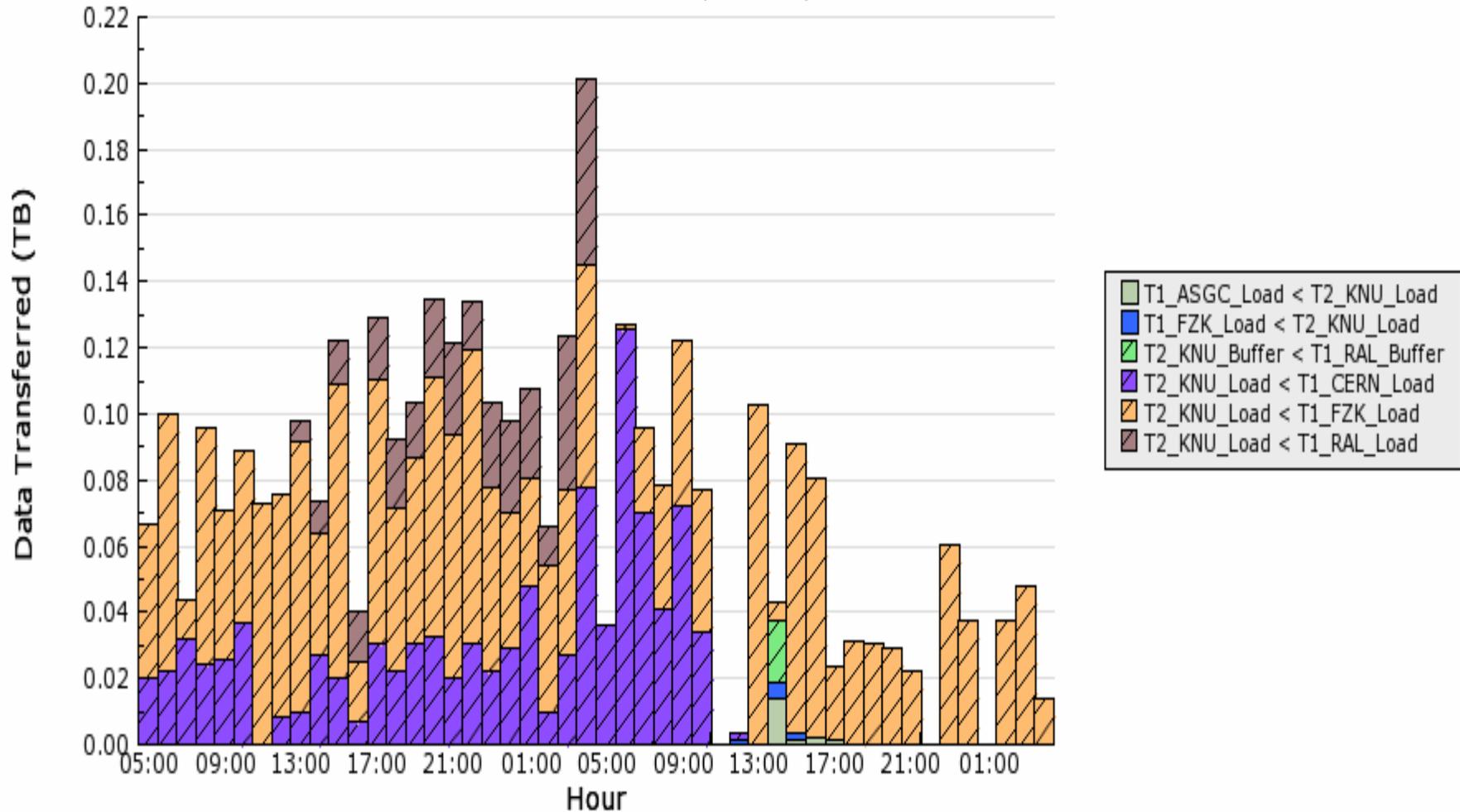
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SC4 Transfer Rate Plots - Volume

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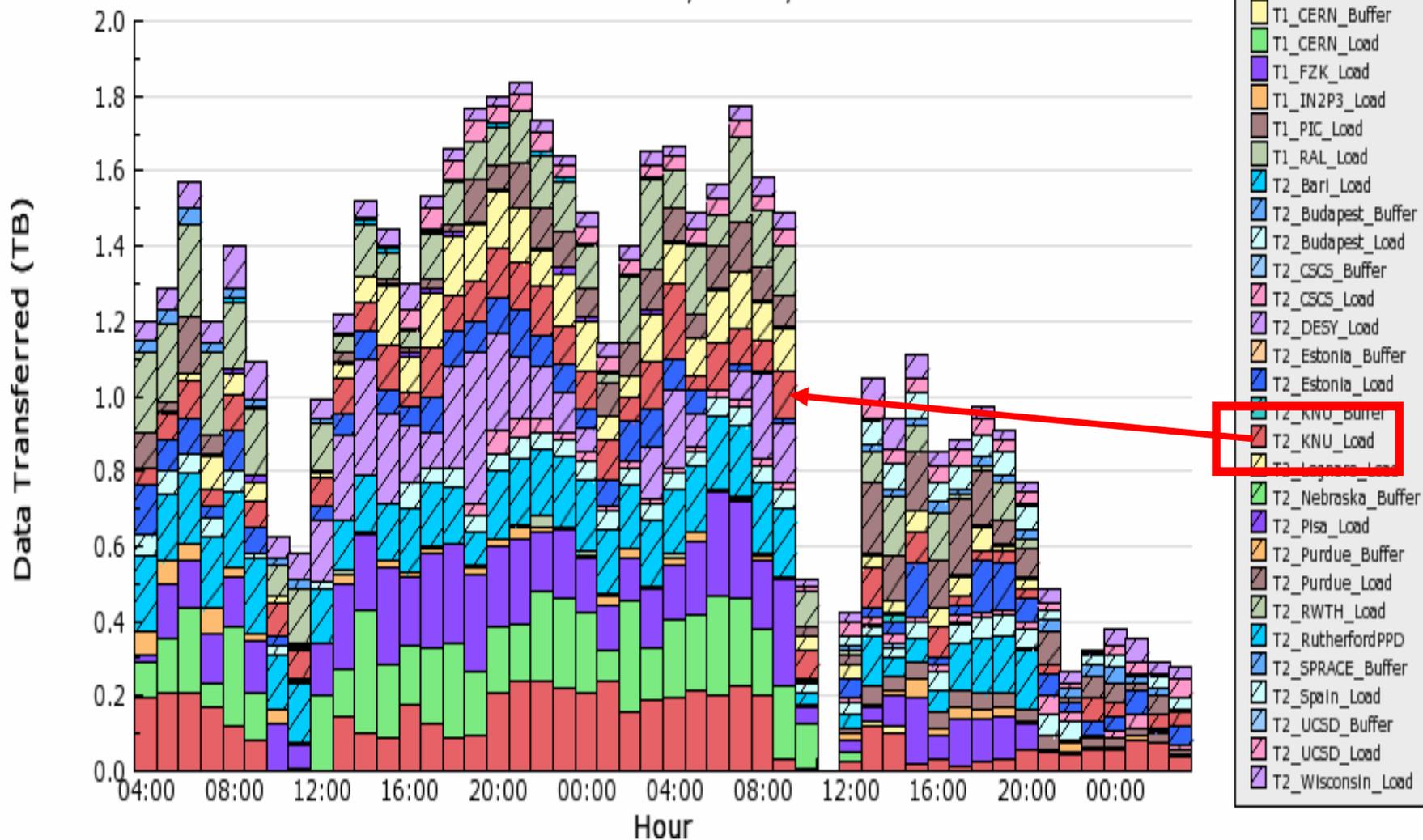
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SC4 Transfer Rate Plots- Volume

PhEDEx SC4 Data Transfers By Destination

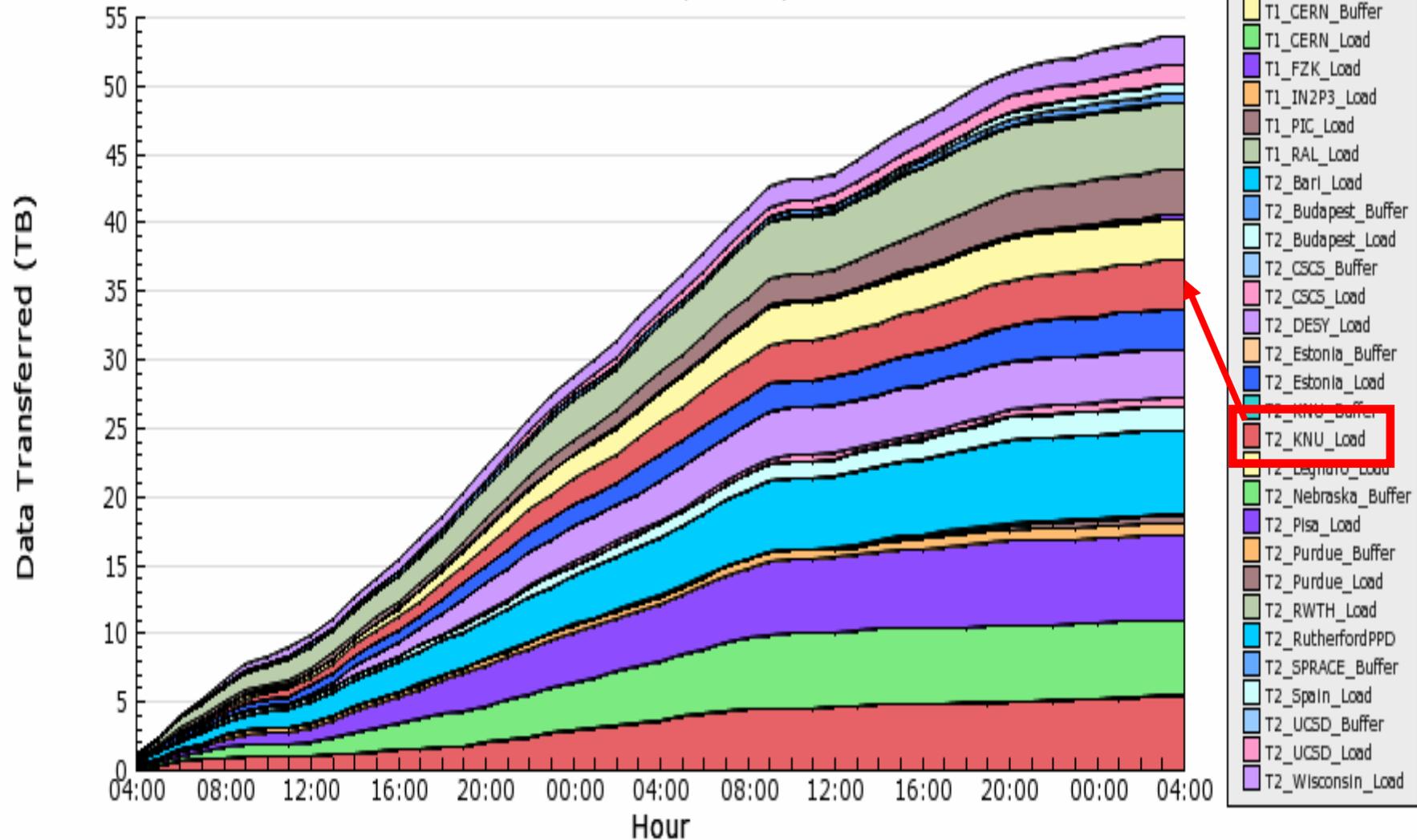
Last 48 Hours at 2006-08-26 03:44, last entry 2006-08-26 03:00 GMT



SC4 Transfer Rate Plots - Cumulative

PhEDEx SC4 Data Transfers By Destination

Last 49 Hours at 2006-08-26 04:10, last entry 2006-08-26 04:00 GMT



Outlook

- Now in the phase from base configuration to more intensified system (Tier-1 like)
- Networks (GLORIAD & APII + TEIN2: more than 20 Gbps) and 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) has been discussed there: We need to implement it.
- MOST will support Tier-2's for CMS and ALICE from next year, possibly for a Tier-1 for CMS later.

Summary

- Demands in Korean HEP established 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
- Enough bandwidth with new technology such as GLORIAD 10Gbps are ready and will be up 40Gbps
- Korean HEP is proposing a regional center for CMS and other experiment and is in preparation and a Tier-2 Center is working properly.