Status report of KEK and KEK-CRC
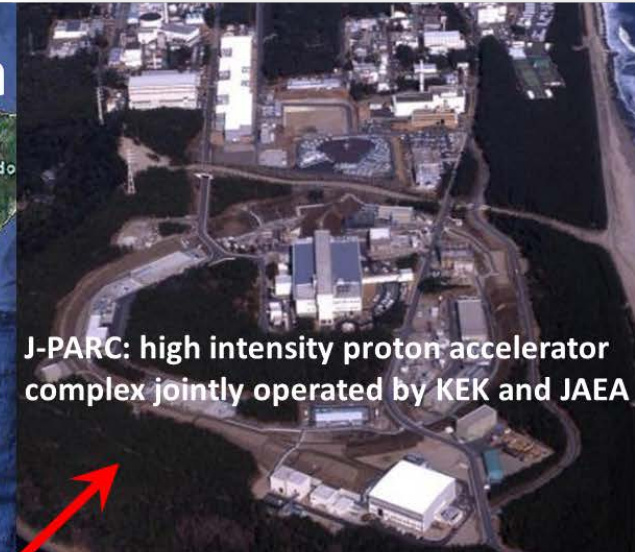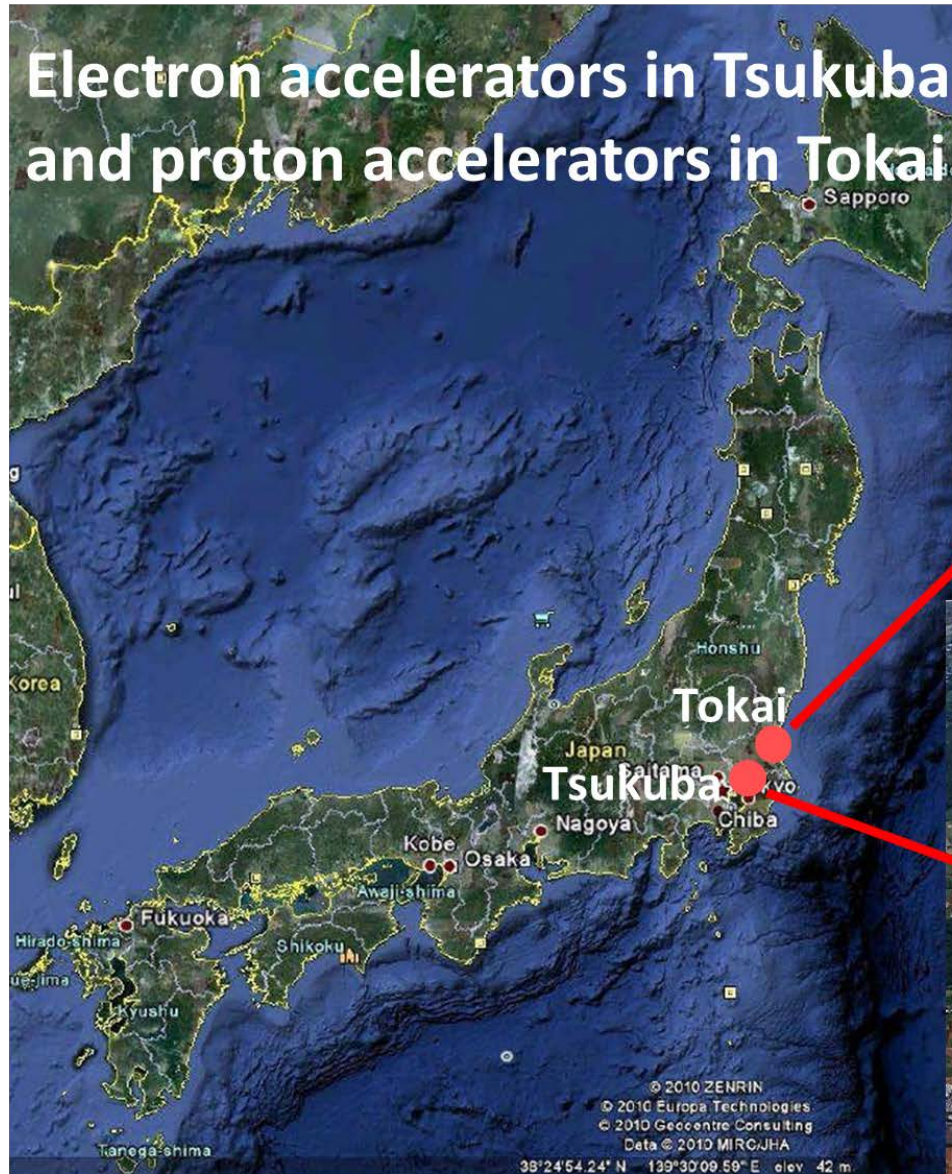
Tomoaki Nakamura

Computing Research Center
HIGH ENERGY ACCELERATOR RESEARCH ORGANIZATION, KEK

KEK
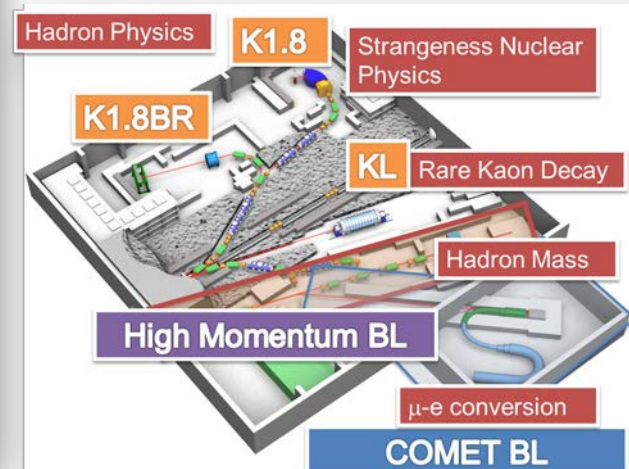Computing Research Center
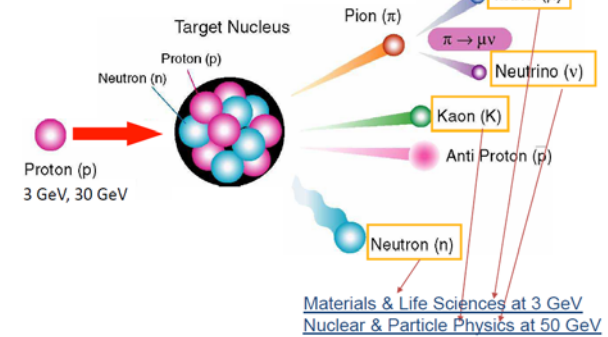
Electron accelerators in Tsukuba and proton accelerators in Tokai

J-PARC: high intensity proton accelerator complex jointly operated by KEK and JAEA

KEK Tsukuba: SuperKEKB, PF, ATF

Tokai

Tsukuba

RCS ::1 MW achieved in Jan, 2015

MR ::so far 0.36 MW for FX ; O.89 MW reachable with new PS

Renew MR PS

750 kW

RCS power
MR power

LINAC Upgrade

■ MLF one shot

● MLF achieved
（user operation）

● FX achieved
（user operation）

Beam power [MW]

2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

JFY
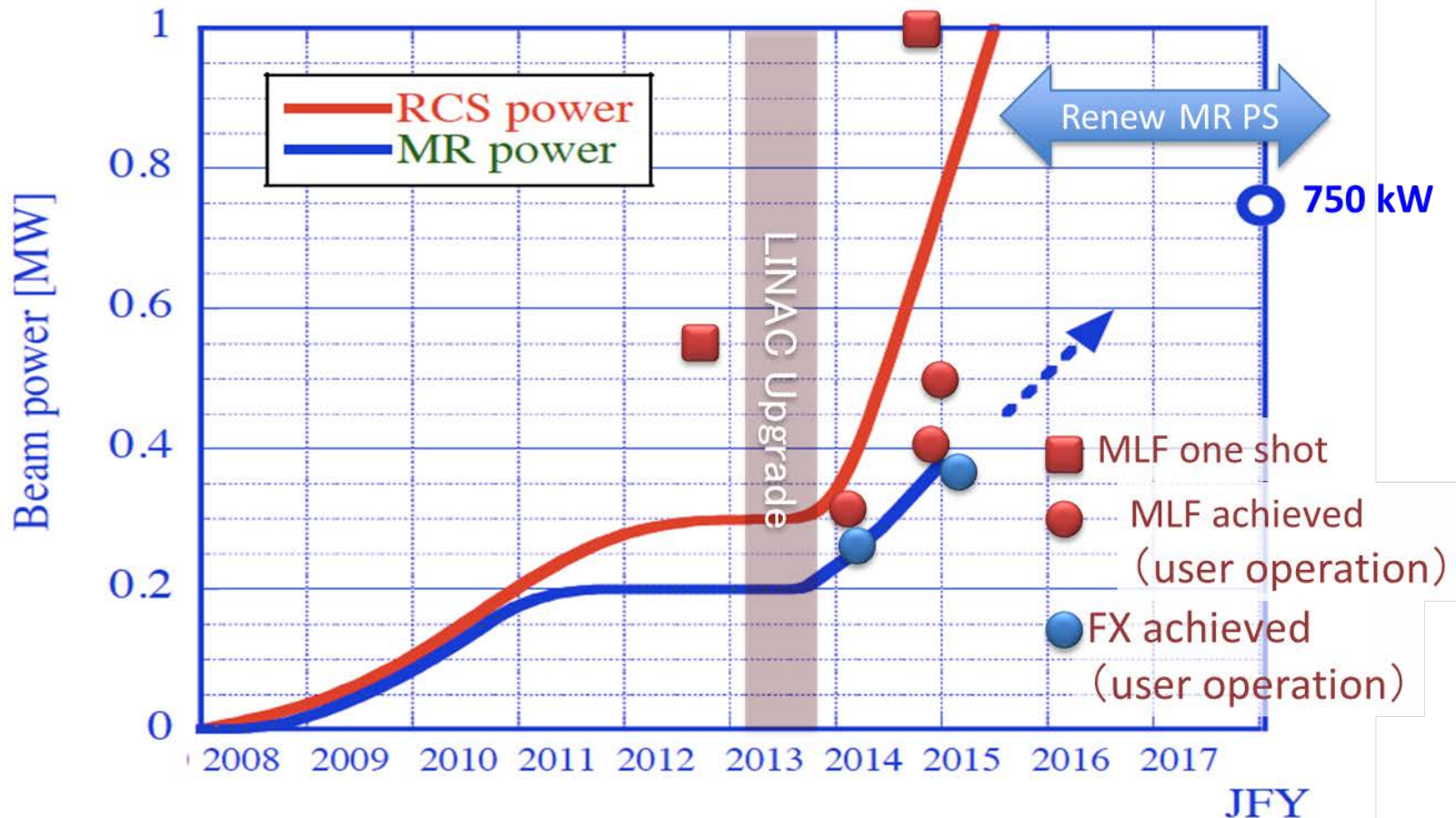
Press Release

The Belle II detector was "rolled-in" to the collision point of the SuperKEKB accelerator

April 11th, 2017 The Belle II detector was "rolled-in" to the collision point of the SuperKEKB accelerator The High Energy Accelerator Research Organization (KEK) successfully completed the "roll-in" of the Belle II detector on the afternoon of Tuesday April 11th. This is an important milestone for the international Belle II collaboration and the SuperKEKB accelerator. The Belle II experiment is an international collaboration with 23 member nations hosted by KEK in Tsukuba, Japan. Using a state-of-the-art experimental appa...
The Belle II detector precisel...
upgraded SuperKEKB acceler...
detector system, following th...
from its assembly area to the...
1400 tons. Belle II was slowl...
beam collision point.. The Be...
Belle II experiment, we will ...
positron collisions using the ...
will investigate the various ki...
will provide measurements o...
the previous Belle experimen...
much improved measuremen...
regions around the world will...
"deviation" from the Standar...
proposed new theories descr...
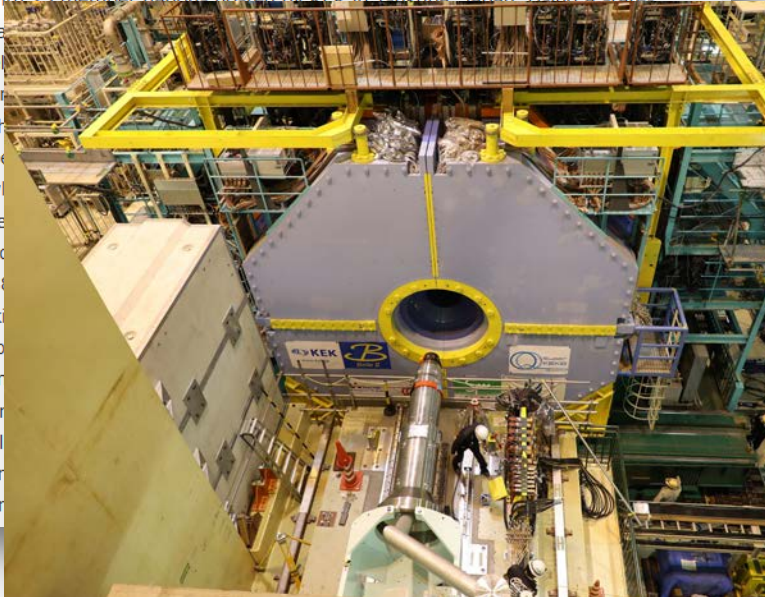
Mar. 2016: Test operation of SuperKEKB.
    Successful storage of e^+e^- beam.
Apr. 2017: Belle II detector was rolled-in.
Nov. 2017: Installation of the BEAST detector.
    Study machine induced backgrounds
Mar. 2018 : Phase II (w/o VXD) will start soon.

Apr. 11, 2017: http://www.kek.jp/en/NewsRoom/Release/20170411171500/
Nov. 18, 2017: https://www2.kek.jp/ipns/en/post/2017/11/beast-in/

France became the 24th collaborative nation of the Belle II experiment

French national flag raised by Ambassador of France to Japan and KEK Director General

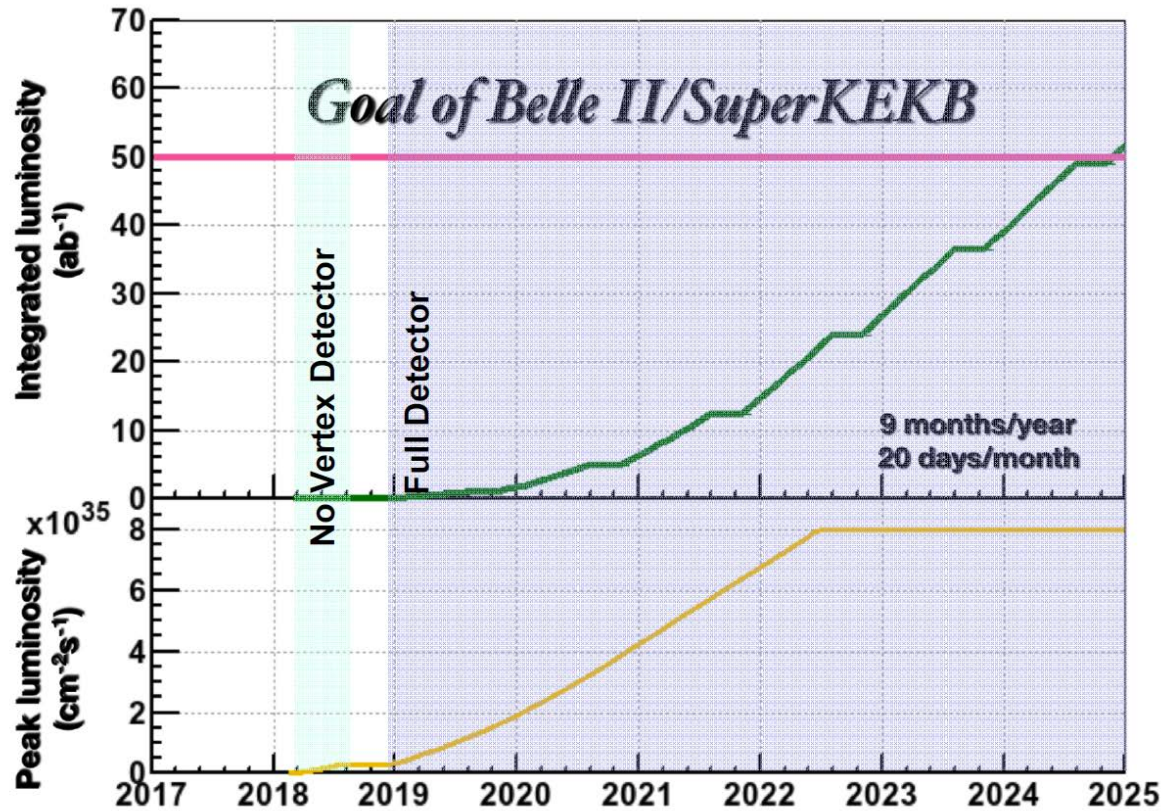https://www2.kek.jp/ipns/en/post/2017/10/french-flag/

SuperKEKB schedule (Feb. 2018)

Calendar year	2016	2017	2018	2019	
Japan FY	JFY2016	JFY2017	JFY2018	JFY2019	

Summer shutdown (power saving)

Summer shutdown (power saving)

Summer shutdown (power saving)

Plan as of Feb 2017

Phase 1 — w/o QCS, w/o Belle II

w/ QCS
w/ Belle II (no VXD)
Phase 2

w/ full Belle II
Phase 3

MR startup

MR renovation for phase 2, including installation of QCS and Belle II

HER start
LER start

VXD installation

DR installation & startup

DR commissioning

Phase-3 will start in Feb. 2019

Undated plan (Feb 2018)

Phase 1 — w/o QCS, w/o Belle II

w/ QCS
w/ Belle II (no VXD)
Phase 2

w/ full Belle II
Phase 3

DR beam commissioning starts this week

MR startup

MR renovation for phase 2, including installation of QCS and Belle II

HER start
LER start

VXD installation

DR installation & startup

DR commissioning

Resource requirement of Belle II

	KEKB	SuperKEKB	
Luminosity:	2.1×10^{34}	$\rightarrow$ 8×10^{35} cm^{-2}s^{-1}	(x 40)
Integrated Luminosity:	1 ab^{-1}	$\rightarrow$ 50 ab^{-1}	(x 50)
Runtime	1998 to 2010	2017 started	
Detector:	Belle	$\rightarrow$ Belle II	
Raw Data:	1 PB	100 PB (projected)	(x 100)

Goal of Belle II/SuperKEKB

No Vertex Detector

Full Detector

9 months/year
20 days/month

Year	2018	2019	2020	2021	2022
Luminosity (ab^{-1} / year)	0.21	1.67	4.67	8.60	12.03
Integrated Luminosity (ab^{-1})	0.21	1.88	6.64	15.23	27.27

Year	2018	2019	2020	2021	2022
Total tape (PB)	1.6	6.4	17.3	36.1	62.5
Total disk (PB)	3.5	13.2	22.3	23.3	43.6
Total CPU (kHEPSpec)	175	404	431	534	733

F. Bianchi

Belle II computing model

D. Jaffe

Subject: US Belle II transition
Date: Friday, August 18, 2017 at 9:07:49 AM Pacific Daylight Time
I am writing to inform you that we intend to change the DOE "host lab" for the U.S. Belle II Computing effort from its current home at Pacific Northwest National Laboratory (PNNL) to Brookhaven National Laboratory (BNL), with the transition starting around Oct 1 2017 and planned to complete by Sep 30 2018. (The rest is omitted)
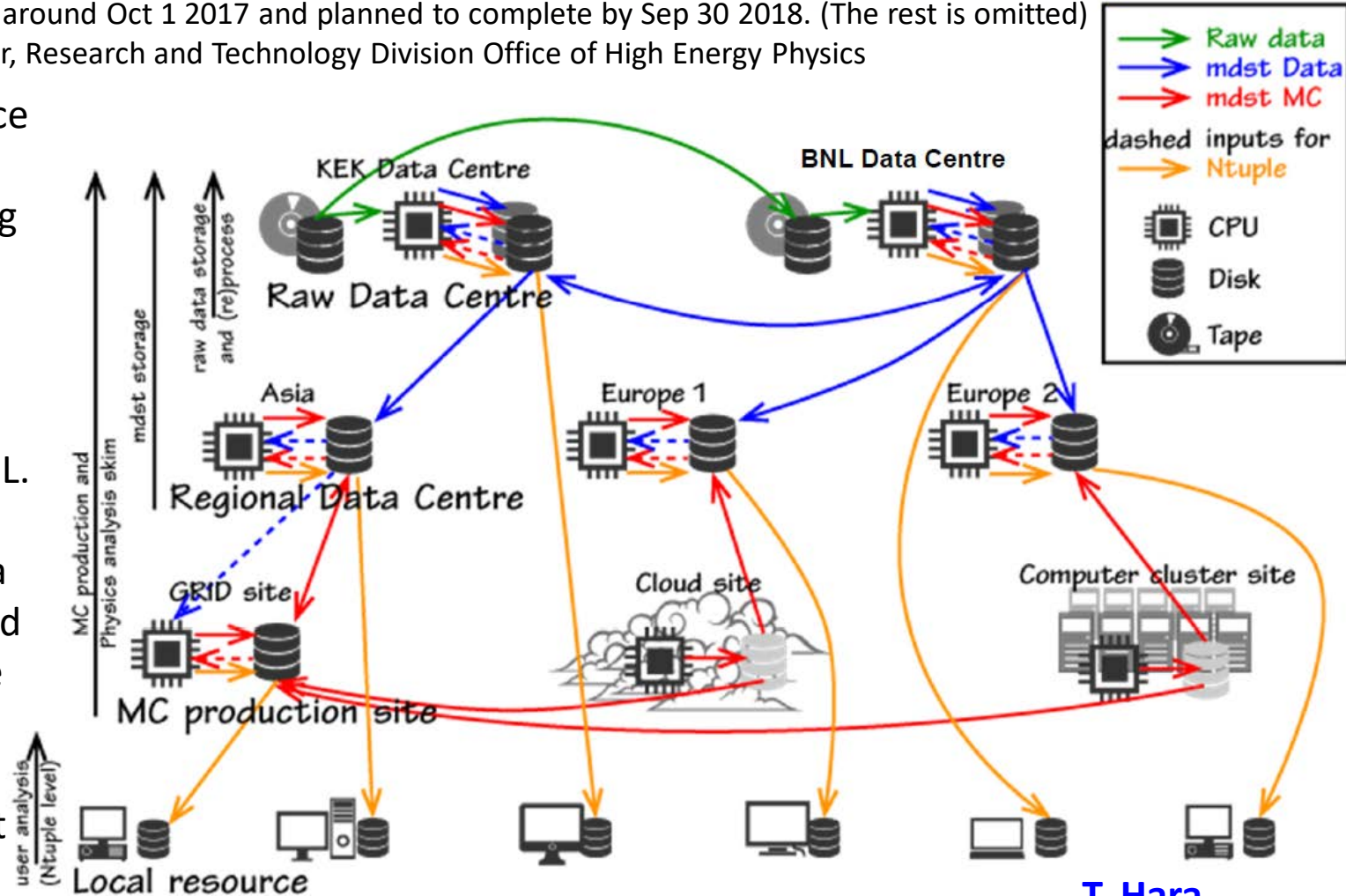Glen Crawford Director, Research and Technology Division Office of High Energy Physics

BNL signed service level MoU of the Belle II computing Grid.

Migrating Tier1 functionalities from PNNL to BNL.

100% of raw data will be transferred for the first three years.
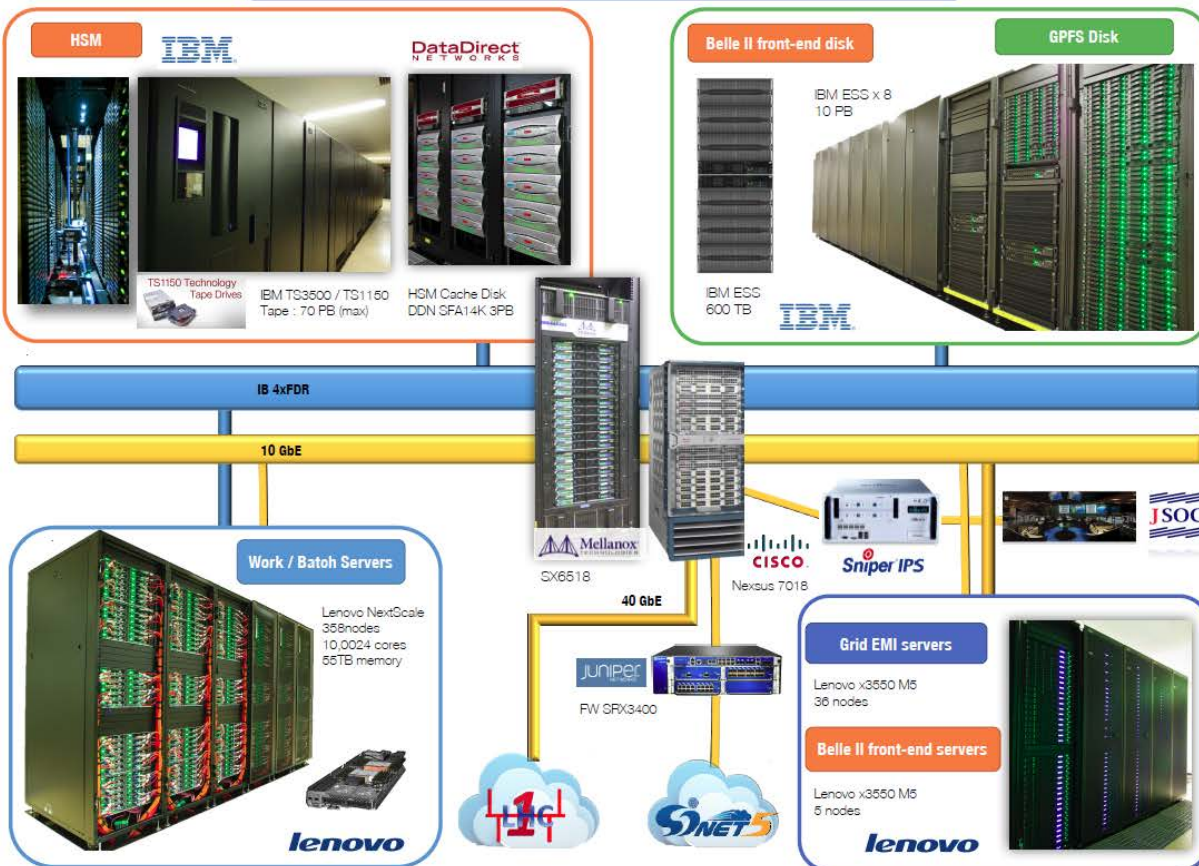
Data transfer test is on going.

T. Hara

KEK Central Computer System (KEKCC)

System has already been in production mode since September 2016.
A lot of improvements, optimizations, performance tuning based on the
requirement from experiments.
Procurement process for the next system (2020~) will be started this year.

SYSTEM RESOURCES

CPU : 10,024 cores
- Intel Xeon E5-2697v3 (2.6GHz, 14cores) x 2
  358 nodes
- 4GB/core (8,000 cores) /
  8GB/core (2,000 cores) (for app. use)
- 236 kHS06 / site

Disk : 10PB (GPFS) + 3PB (HSM cache)

Interconnect : IB 4xFDR

Tape : 70 PB (max cap.)
HSM data : 8.5 PB data, 170 M files,
5,000 tapes

Total throughput : 100 GB/s (Disk, GPFS),
50 GB/s (HSM, GHI)

JOB scheduler : Platfrom LSF v9

K. Murakami (CHEP2016)

CPU usage breakdown

Compute node

CPU: Intel Xeon E5-2697v3 (2.6GHz, 14cores) x 2
358 nodes, 10,024 cores, 236kHS06/site
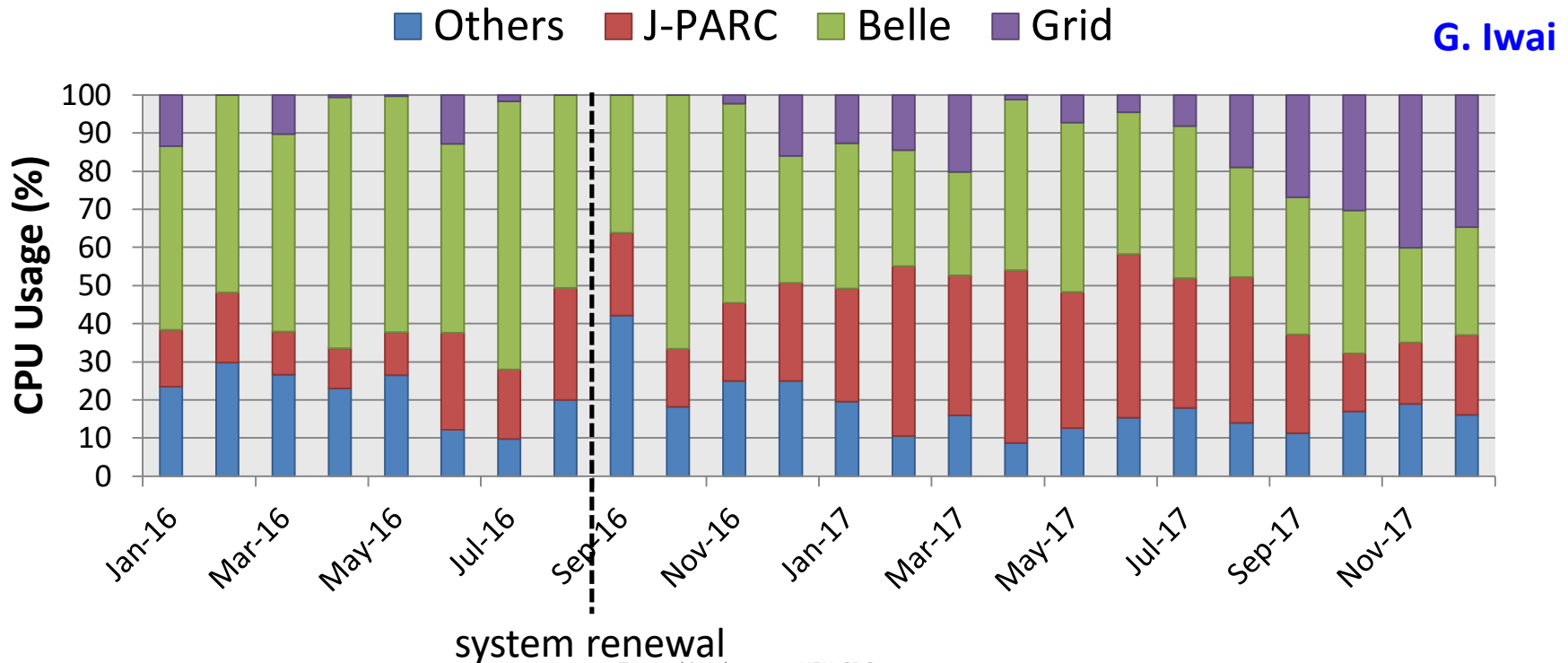
Memory: 4GB/core (8,000 cores)
8GB/core (2,000 cores)

CPU usage: breakdown by groups,
normalized by the total CPU usage per month

CPU usage has been reached 80 - 90 % of total resource

Storage

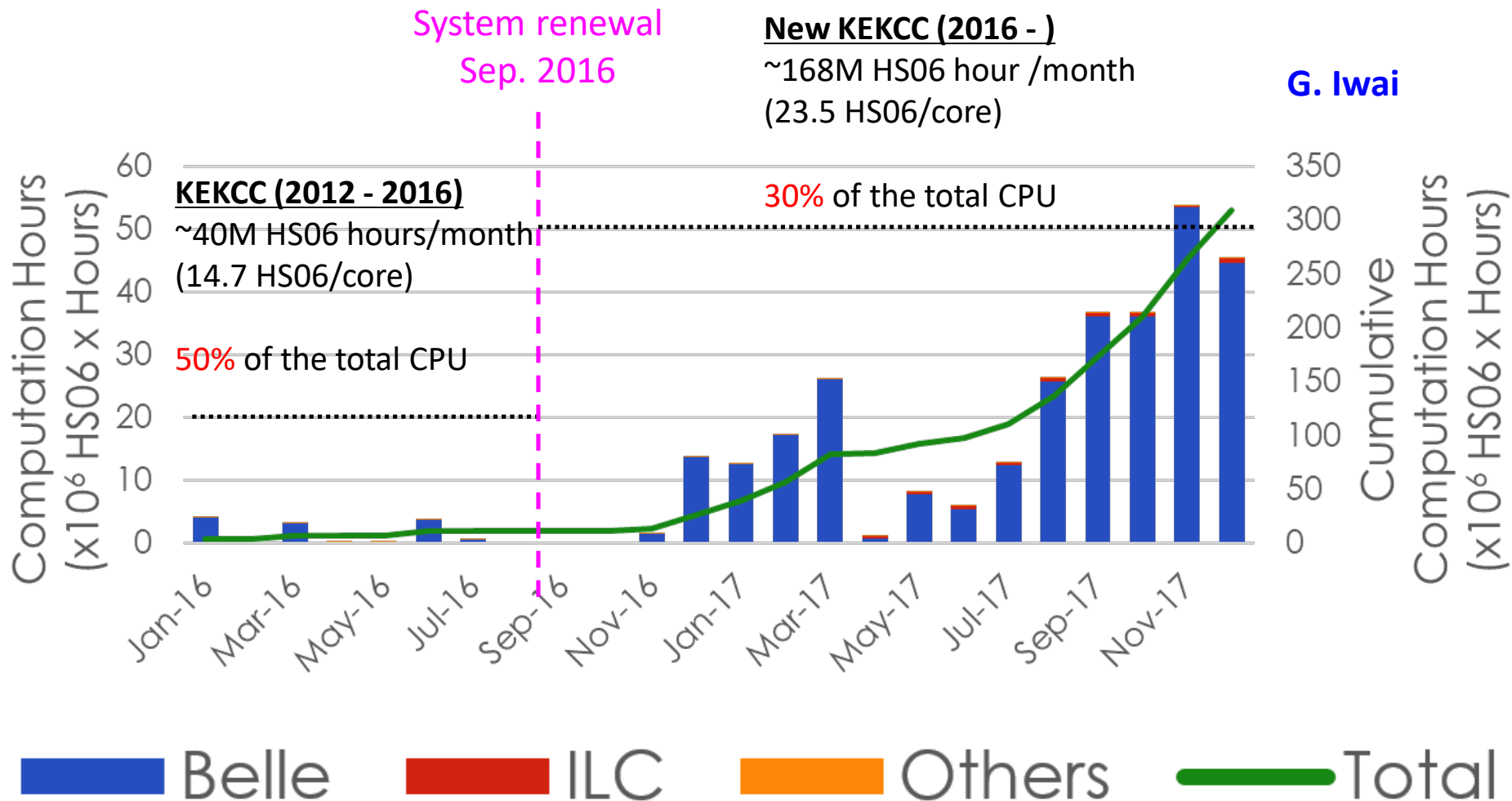Disk: 10PB (GPFS, IBM ESS x8 racks)
3PB (HSM cache)

Interconnect: InfiniBand 4xFDR (56 Gbps)
Tape: 70 PB (max cap.)

Throughput

100 GB/s (Disk, GPFS), 50 GB/s (HSM, GHI)

G. Iwai

CPU Consumption by Grid jobs

System renewal
Sep. 2016

New KEKCC (2016 -)
~168M HS06 hour /month
(23.5 HS06/core)

G. Iwai

KEKCC (2012 - 2016)
~40M HS06 hours/month
(14.7 HS06/core)

30% of the total CPU

50% of the total CPU

Legend: ■ Belle ■ ILC ■ Others —— Total

Data transfer capability

Belle II raw data — StoRM
4x10 Gbps, 4x10 Gbps — Grid FTP, Grid FTP — 4xFDR

Belle II analysis — StoRM
2x10 Gbps — Grid FTP — 4xFDR

Other VOs — StoRM
2x10 Gbps, 2x10 Gbps — Grid FTP, Grid FTP — 4xFDR, 4xFDR

Online storage

~3GB/s

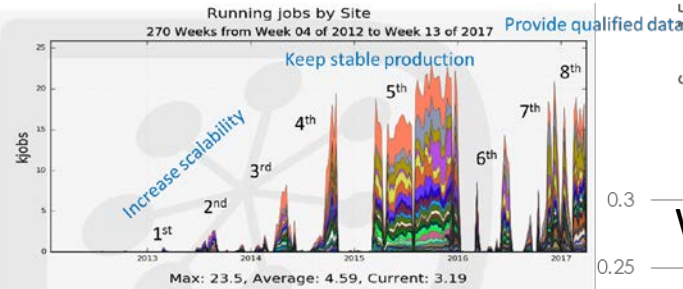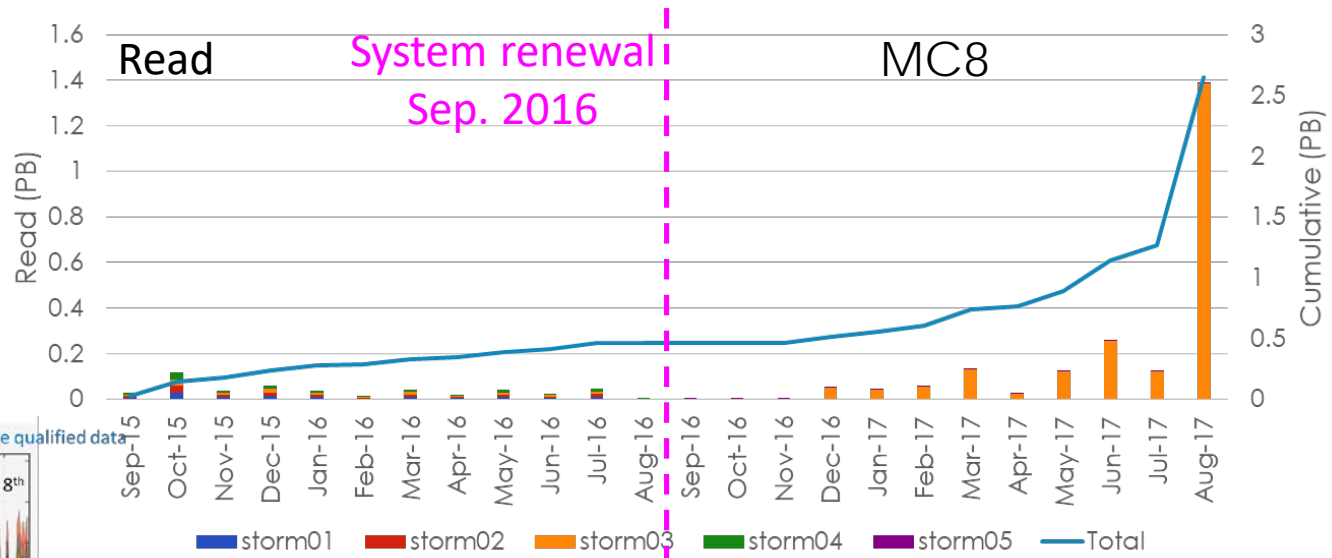Disk — HSM
2x10 Gbps
2x56 Gbps (IPoIB)

HSM or Disk

HSM — Disk
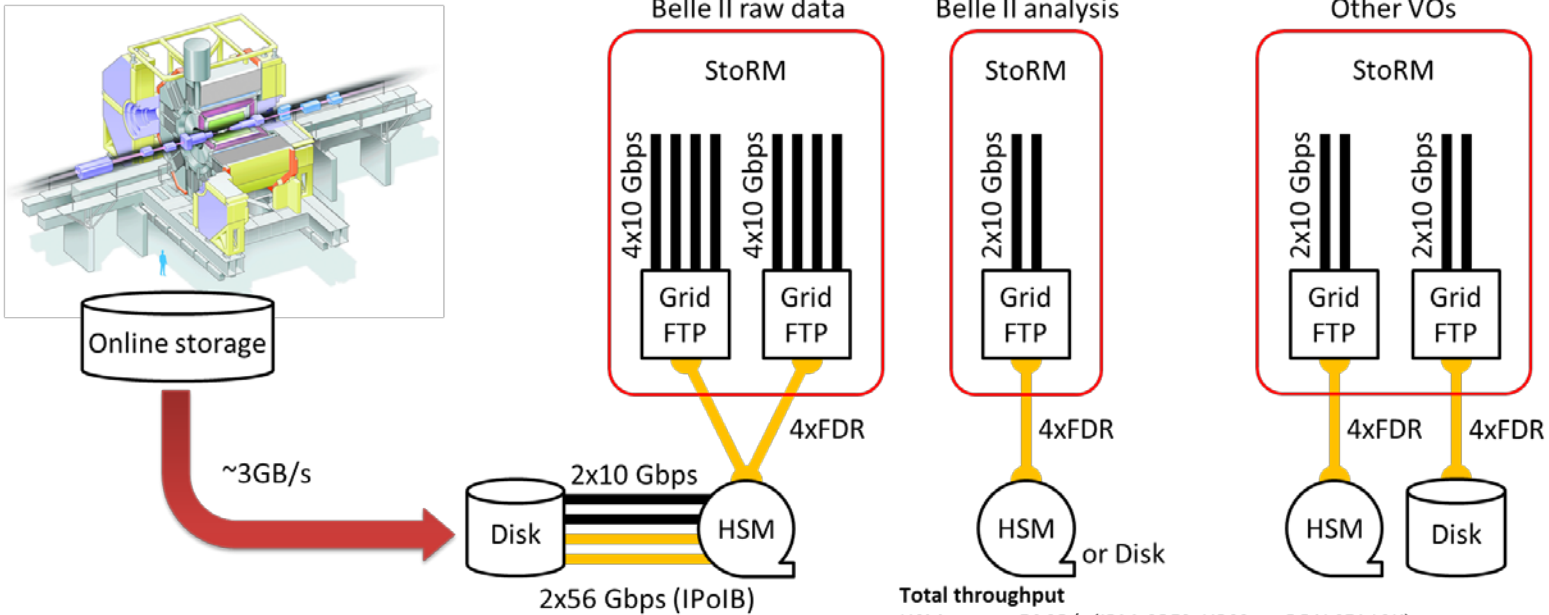
Complete separation of Belle II raw data transferring path from analysis and the other VOs activity.

Total throughput
HSM: 50GB/s (IBM GPFS+HPSS on DDN SFA12K)
Disk: 100GB/s (IBM GPFS on IBM ESS)

Online

Belle II Detector 50x1G → **HLT Farm 10x10G**

Offline (KEKCC)

Front End Server 5x[2x10G] → **Grid FTP 2x[4x10G]** → **Grid sites**
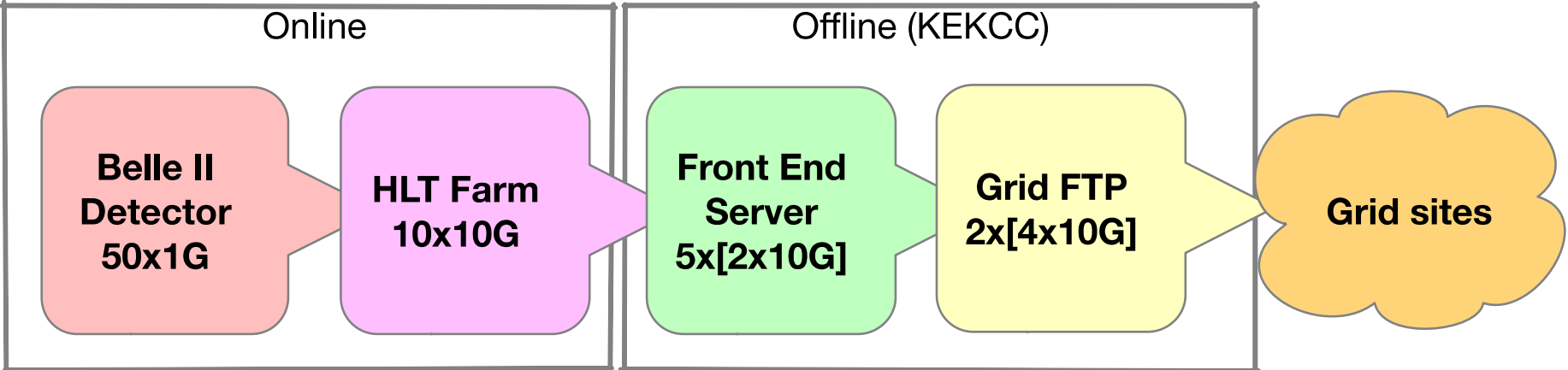
Grid data transfer from/to external sites

Read

System renewal
Sep. 2016

MC8

load balancing by 4 servers

Write

Belle II Raw data transfer
Belle II Grid jobs
Other VOs

storm01　storm02　storm03　storm04　storm05　Total

Running jobs by Site
270 Weeks from Week 04 of 2012 to Week 13 of 2017

Provide qualified data

Keep stable production

Increase scalability

Max: 23.5, Average: 4.59, Current: 3.19

H. Miyake
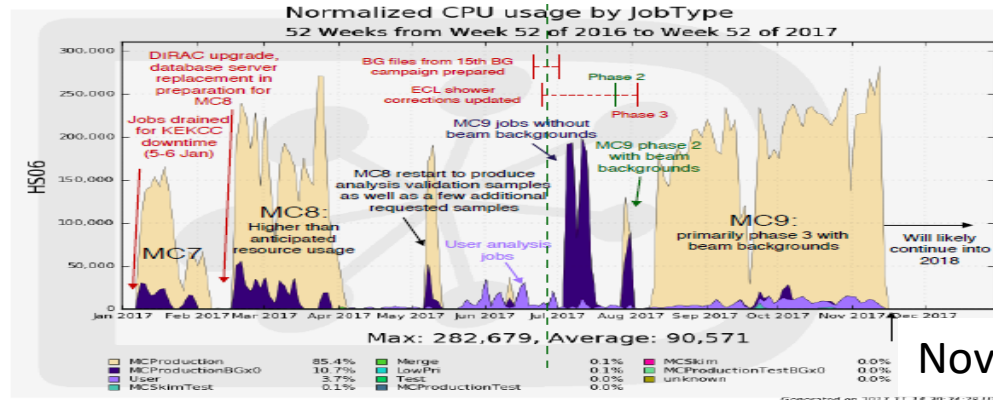
G. Iwai

J. Bennett

Nov. 2017
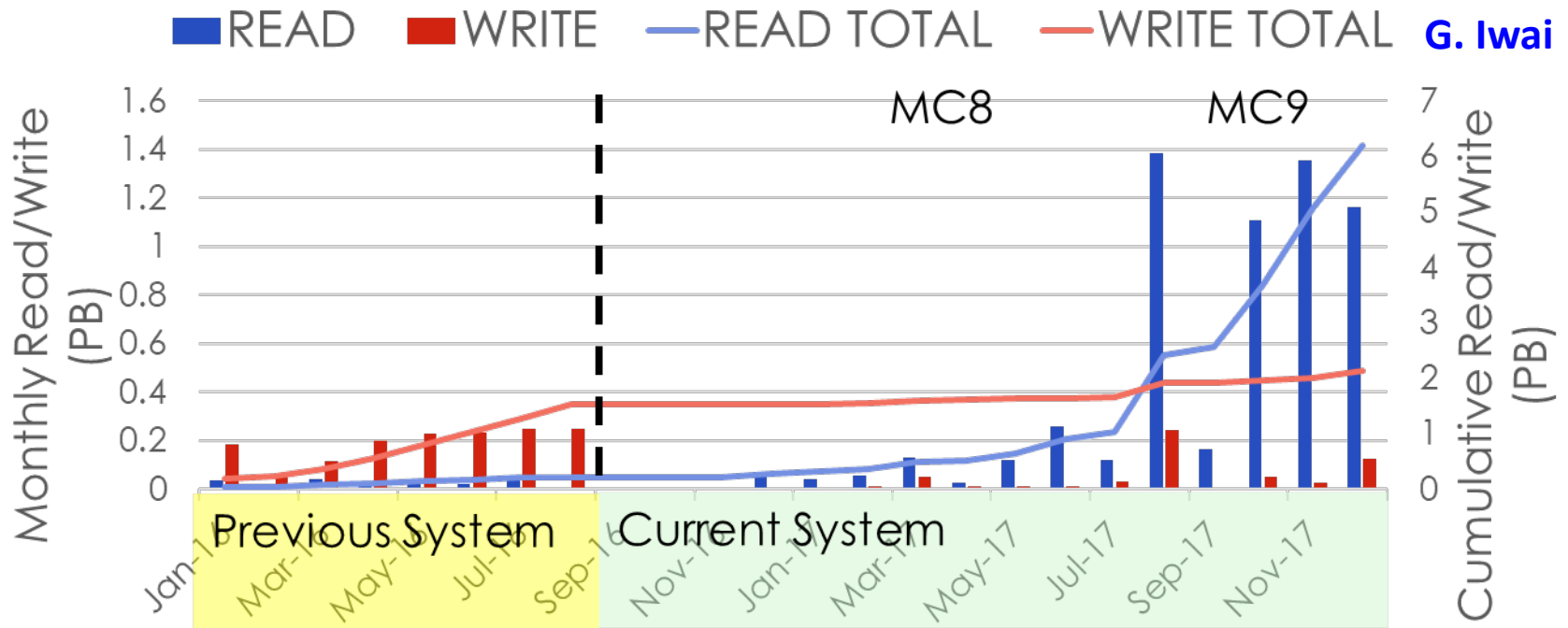
G. Iwai
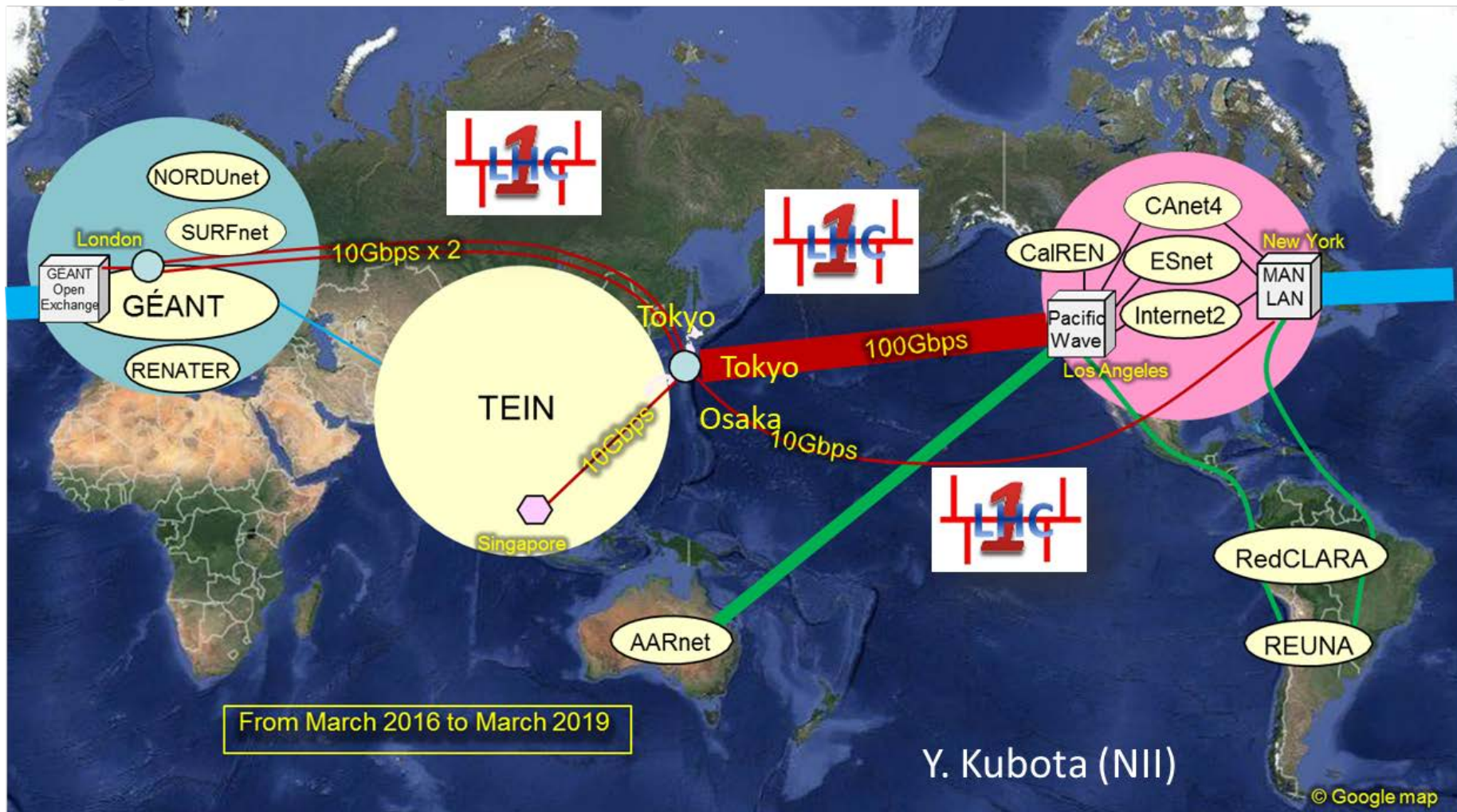
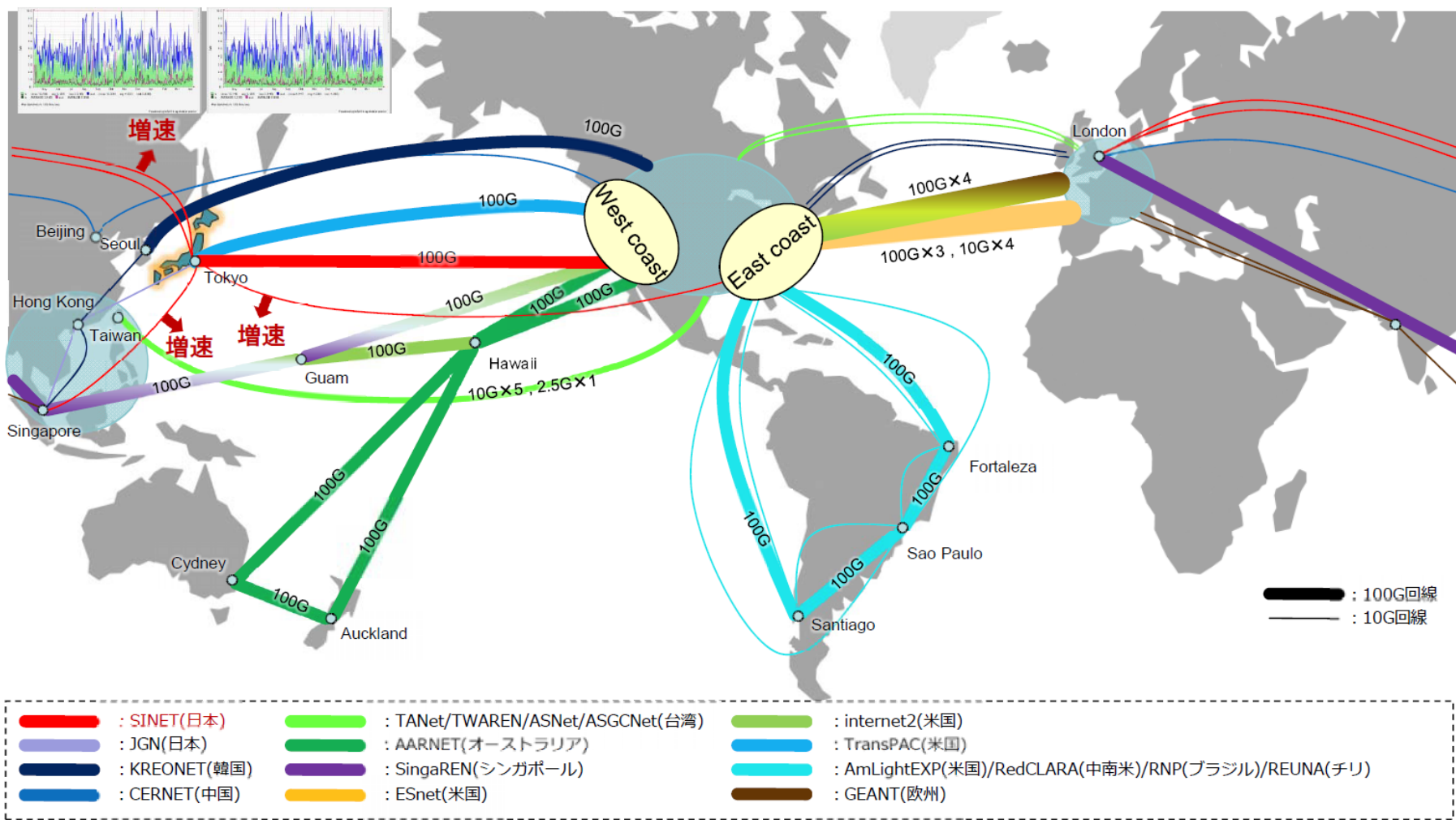6 PB of readout and 600 TB of writing to the SRM has been achieved in 2017

In the next 3 years.
M. Nakamura (NII)

JP-EU link will be upgraded to 100G (Russia route)
JP-NY link will be upgraded to 100G hopefully
JP-SG link may be upgraded to 100G

Improvement of connectivity in Asia

LHCONE routing

Sep. 2016
GEANT at London (20G)
GEANT at NY (10G, backup)
ESnet, CANARIE at LA (100G)

All connections are on LHCONE

Sep. 29th 2017
ASGC, KOREONET, TEIN
at Hong Kong (100G)
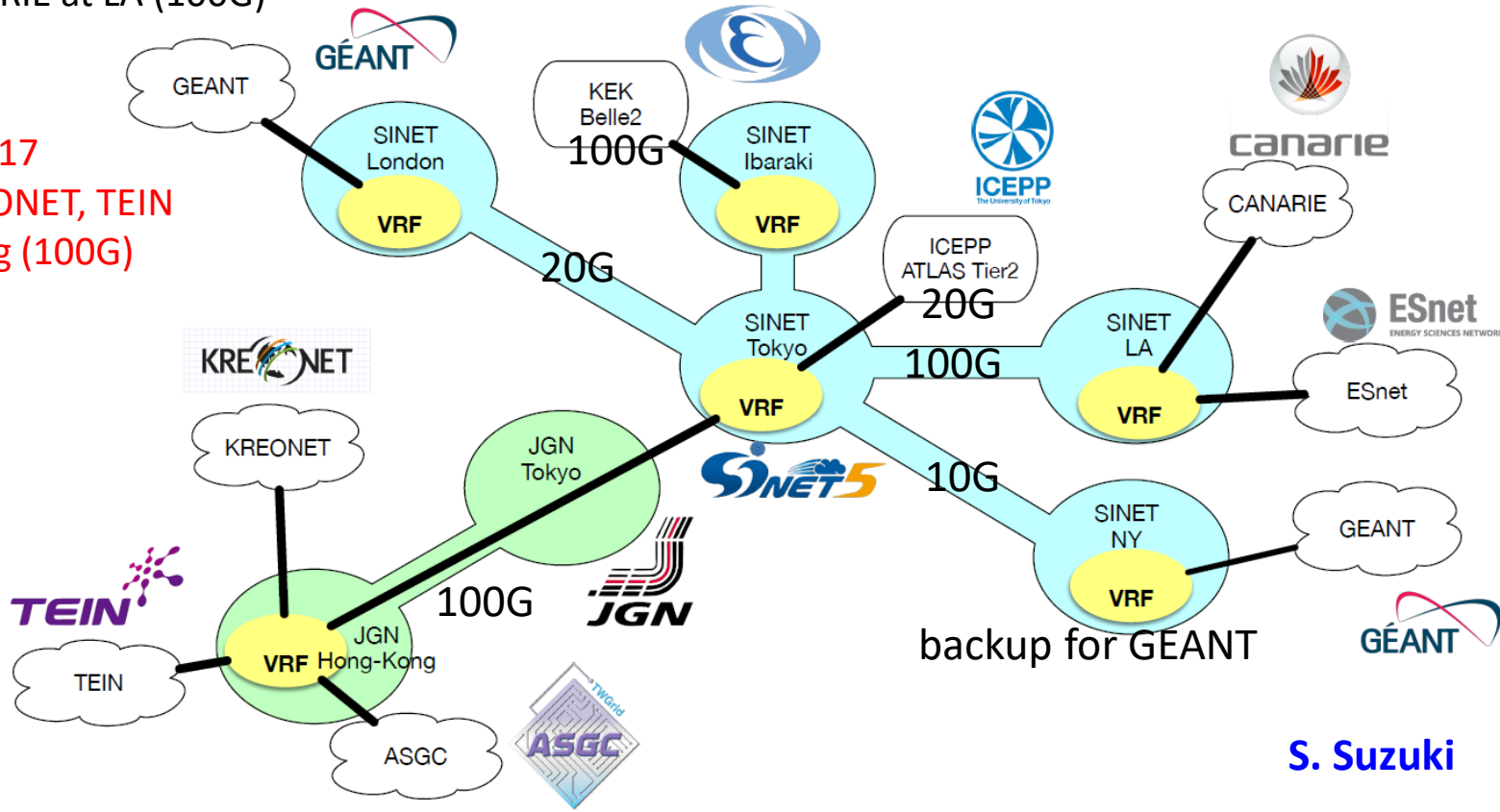
S. Suzuki

SINET (National Institute of Informatics): Ministry of Education, Culture, Sports, Science and Technology
JGN (National Institute of Information and Communications Technology): Ministry of Internal Affairs and Communications

HEPiX Fall 2017 and HUF2017

October 16 - 20, 2017 at KEK

Three events were collocated in the same week.
(HEPiX, LHCOPN-LHCONE, HUF)
All events were the first time hosted in Japan.
More than 190 participants in total.
8 attendee and 4 talks from CC-IN2P3.

We really thank for your contributions!

The KEK Technology Prize 2018

Wataru won the KEK Technology Prize 2018 by the development of OwnHome (an Kibana plugin for the secure monitoring system in multi-user environment)

The first prototype was introduced at CC-IN2P3 and demonstrated its functionality.

Finally, it is adopted as a component of CERN integrated monitoring system.

Covered subjects for review:
Accelerators, Detectors, Radiations, Superconductor, Laser, Vacuum, Machining and so on, i.e. any of technologies for the accelerator based science.
The first time from Computing technology (KEK-CRC).

https://github.com/wtakase/kibana-own-home

Summary
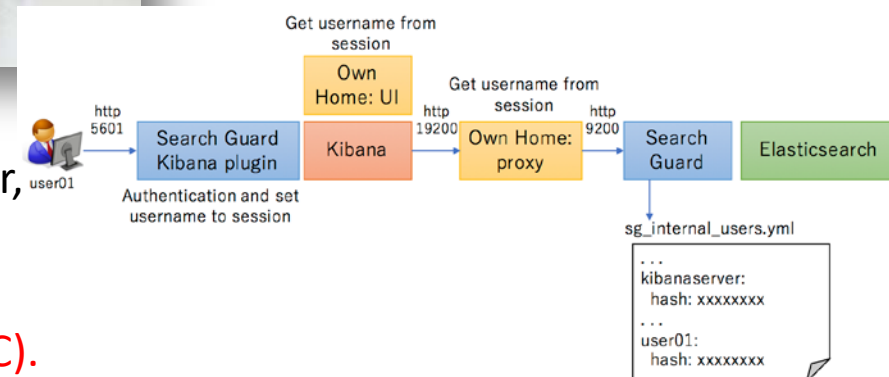
SuperKEKB/Belle II:
- **Physics data taking (phase 2 run) will start soon (Mar. 2018).**
- **US raw data center will be migrated from PNNL to BNL by the end of September 2018 completely.**
- **France became the 24th collaborative nation of the Belle II experiment.**

KEK-CRC:
- **Current KEKCC is in the 2nd year operation since Sep 2016.**
- **The Procurement process for the next system will be started in 2018.**
- **International network connectivity including inside Asian countries is expected to improve furthermore with the aid of LHCONE.**
- **A lot of R&D for the private/commercial cloud deployment is actively ongoing at KEK. It will be presented by Wataru.**