# Review of Control Resources for J-PARC Accelerators

- 1) J-PARC Overview
  - Accelerators and 6-year operation
- 2) Control Resources
  - CPU, Network, Disk
- Summary

N. Kamikubota, J-PARC/KEK

Dec. 2012, PCaPAC2012, kami, KEK/J-PARC

# J-PARC Facility

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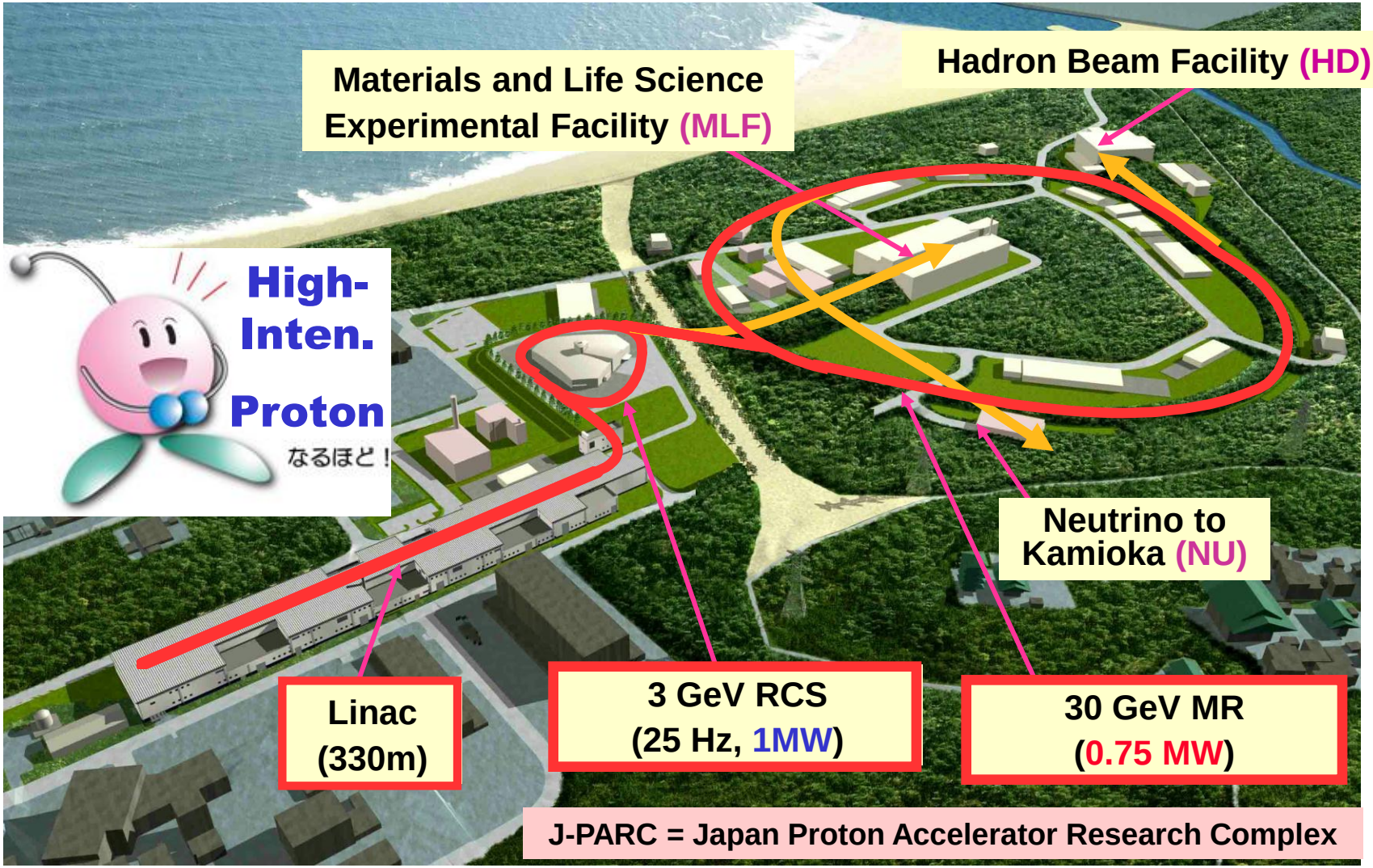
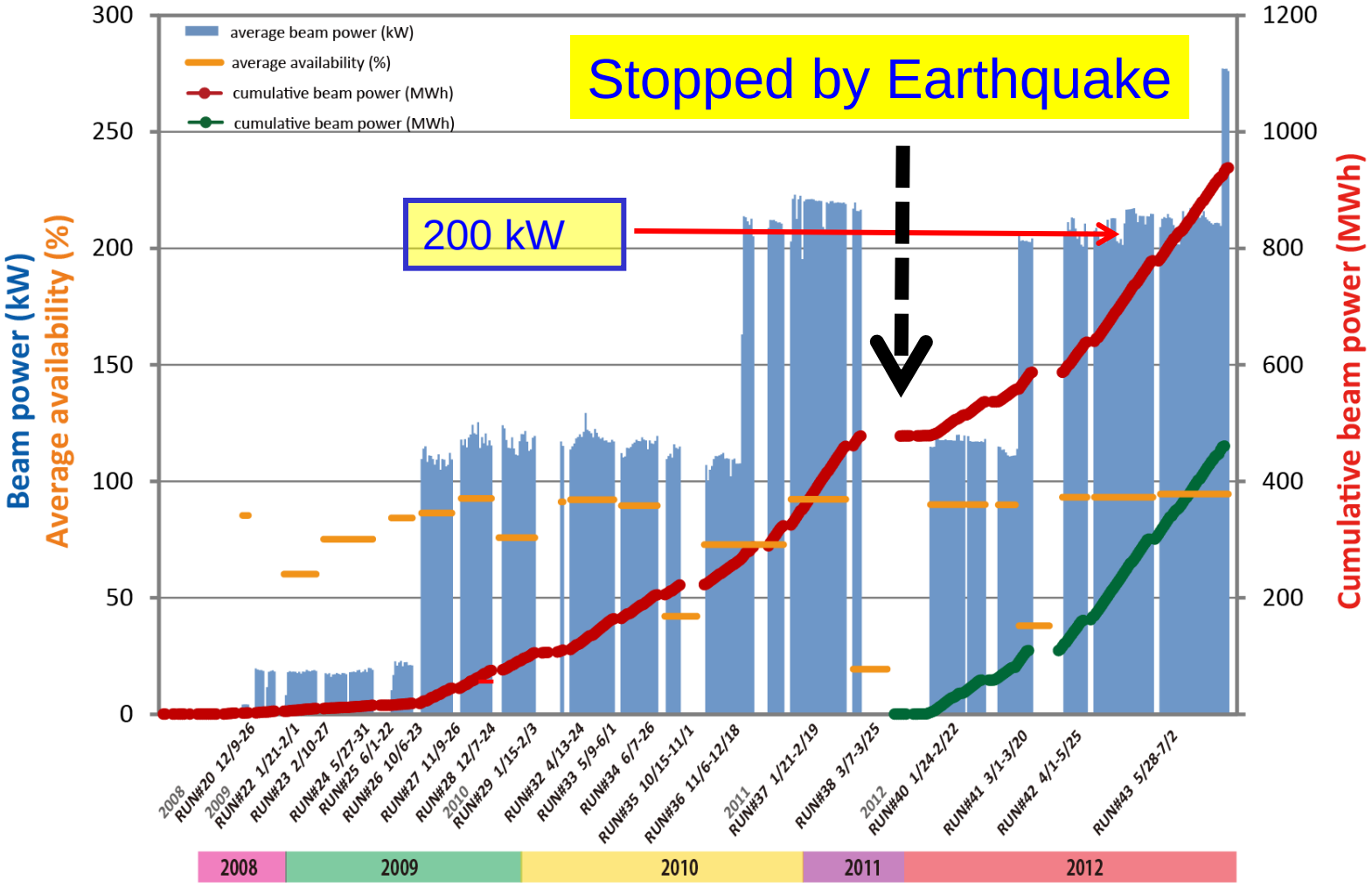
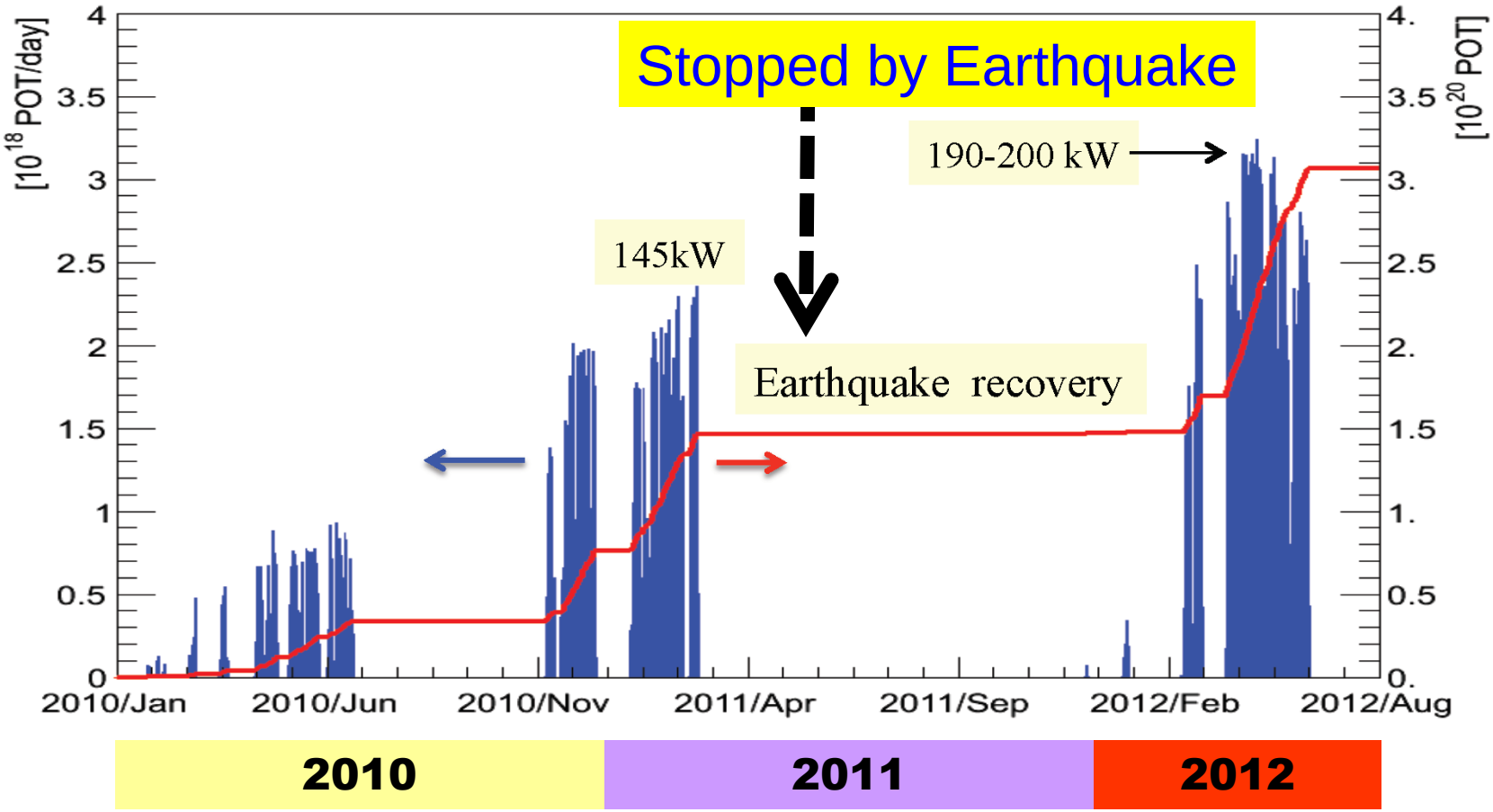


# Beam Power History (RCS to MLF)




Dec. 2012, PCaPAC2012, kami, KEK/J-PARC

# Beam Power History (MR to NU)




Operation for beam delivery to the T2K experiment before summer 2012 was finished on June 9, accumulated ~3x$10^{20}$ POT

# Recovery from the Earthquake (on 09.Dec.2011)

09:30 Key was on by Nagamiya-san, the Project Leader.

Nov. 2006. The first beam was on at the Linac.

Remarkably fast recovery

14:00 Beam went throughout the Linac at 3 MeV with RFQ acceleration.

# J-PARC is still growing facility

- **Beam Performances**
  - **Started/ LI: Nov.2006, RCS: 2007, MR: 2008**
  - **Design/ LI: 400MeV, RCS: 1MW, MR: 750kW**
  - **2012.11/ LI: 181MeV, RCS: 0.3MW, MR: 200kW**
- **Re-scheduled plan for next 5 years**
  - **Reach to the design goals in 2017**
    - **2013/LI 181-> 400MeV upgrade**
    - **2013/LI IS,RFQ 20mA->50mA**
    - **2014/MR replace Magnet Power-supplies**
      - **And so on ..**
    - **(1 year delay due to the earthquake in 2011)**

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# Control System Resources

# J-PARC Control – a quick view

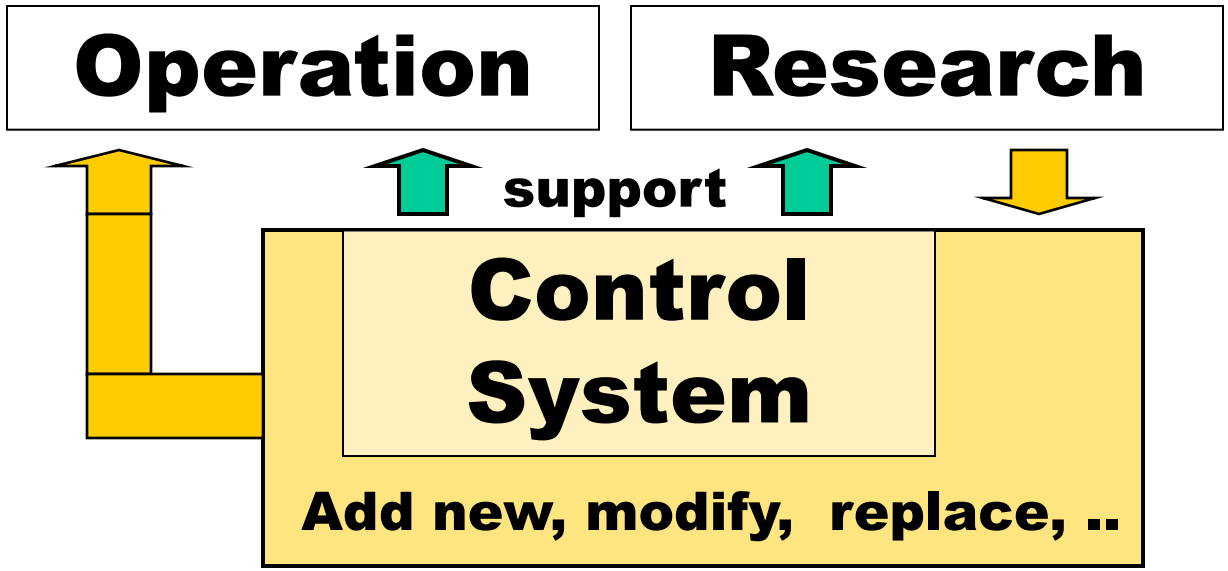
- **Control by 2 groups**
  - **JAEA and KEK : 2 control groups**
    - **JAEA is in charge of Linac and RCS, KEK is MR**
  - **Both use EPICS, single control room**

- **Scale of control system**
  - **EPICS IOCs**
    - **LI: ~120, RCS: ~30, MR: ~140**
  - **Number of Applications**
    - **~270 in the MR launcher (in 2011)**

# Control Resouces

- **Control Resources (for MR, partly for all Accl.s)**
  - **Focuses on : CPU, Network, Disk**
    - **They were introduced in 2006-2007**
    - **6-year operation**
  - **Now, good chance to review**
  - **Troubles during 6-year operation are also shown (to share experiences with you)**

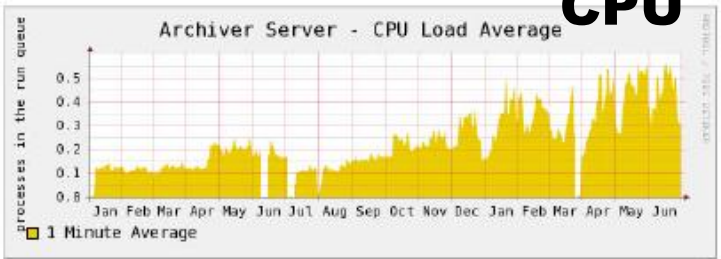
# J-PARC CS is growing everyday

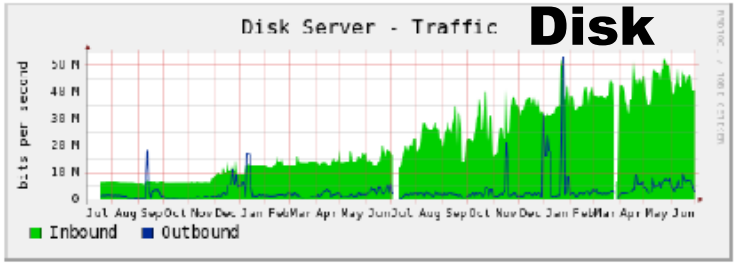



**Seeking better operation parameters by research activities**

## 1-yr trend

**MR data archive in 2009**




# CPU – Blade-type server

Blade server (8 blades in)

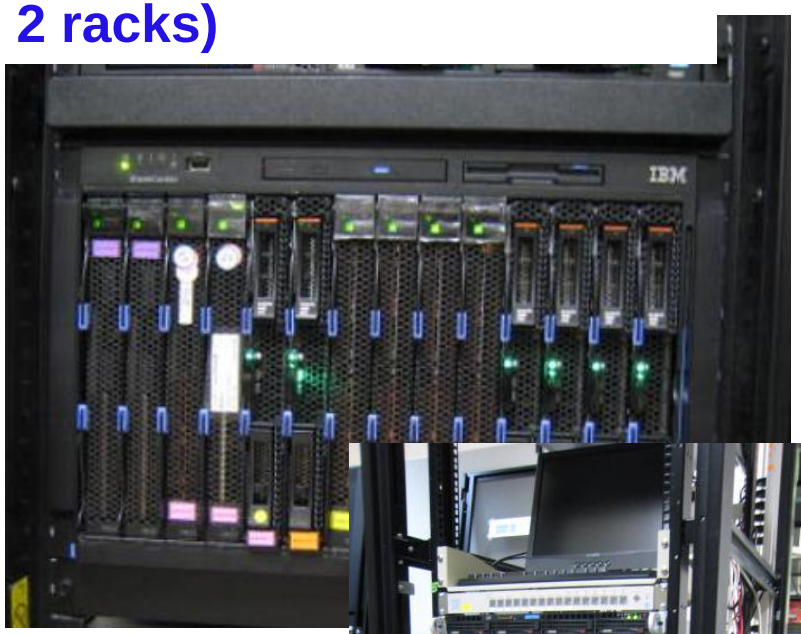
**2007**

**IBM Blade Center**

**HS20/21/22**

**Introduced for MR operation**

Blade server (29 blades in 2 racks)



**2012**

Simulation server (10 customized PCs )

# CPU - Discussion

- **Blade-type server**
  - **Increase CPU power by adding new blades => Flexible upgrade, it is suitable for us**
    - **For MR loss simulation, we needed customized spec (huge memory, so many cores, ..)**
    - **=> introduced non-blade type machines since 2010**
- **Re-organize servers with Virtual OS**
  - **In 2008, 1 server (i.e RDB, ldap, dhcp,) = 1 blade**
  - **In 2012, multiple servers = 1 blade with high spec+large memory**
    - **Using Virtual OS support (KVM) of Scientific Linux 6**
    - **Expect easier management server-hardware**

# CPU - Trouble

- **Troubles**
  - **no serious trouble**
  - **A few board stops since 2007**
  - **Rescue needed when new server rack installed**

# Network – Redundant system

- **Quick view**
  - **First install for Linac was in 2004 (MR was 2006)**
  - **Intelligent core loops to ensure high redundancy**
  - **Edge Switch/ LI: 80, RCS: 24, MR: 10, CCR: 10**
  - **Logical VLAN/ sub-networks localize traffic**
    **li(10.16), rcs(10.32), mr(10.64), ccr(10.8), ..**

- **Replace to New models**
  - **Finished/ LI: 2010-2011, MR: 2011-2012**
  - **Bandwidth/ 1Gbps -> 10Gbps**

# Network – Core Replace (2011)

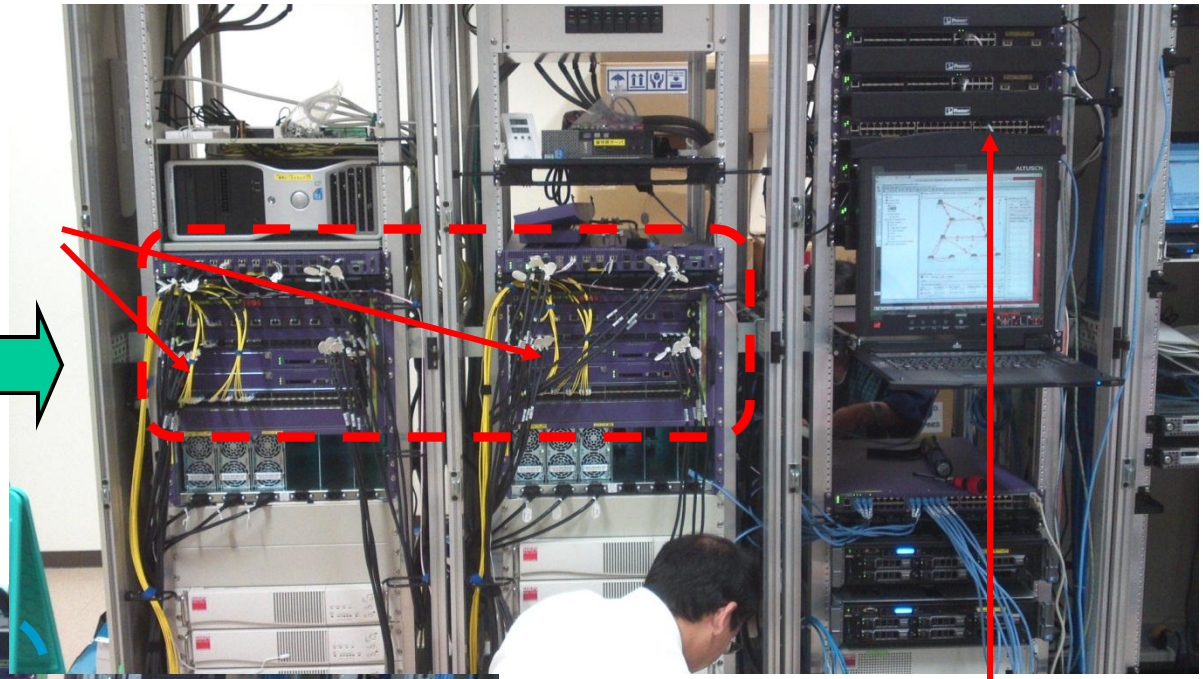
**Extreme Black-diamond and Summit**

**After**

(Core 8906)

**Before**

(Core 6808)



**After**

(edge X480-48t x 6)

**Before**

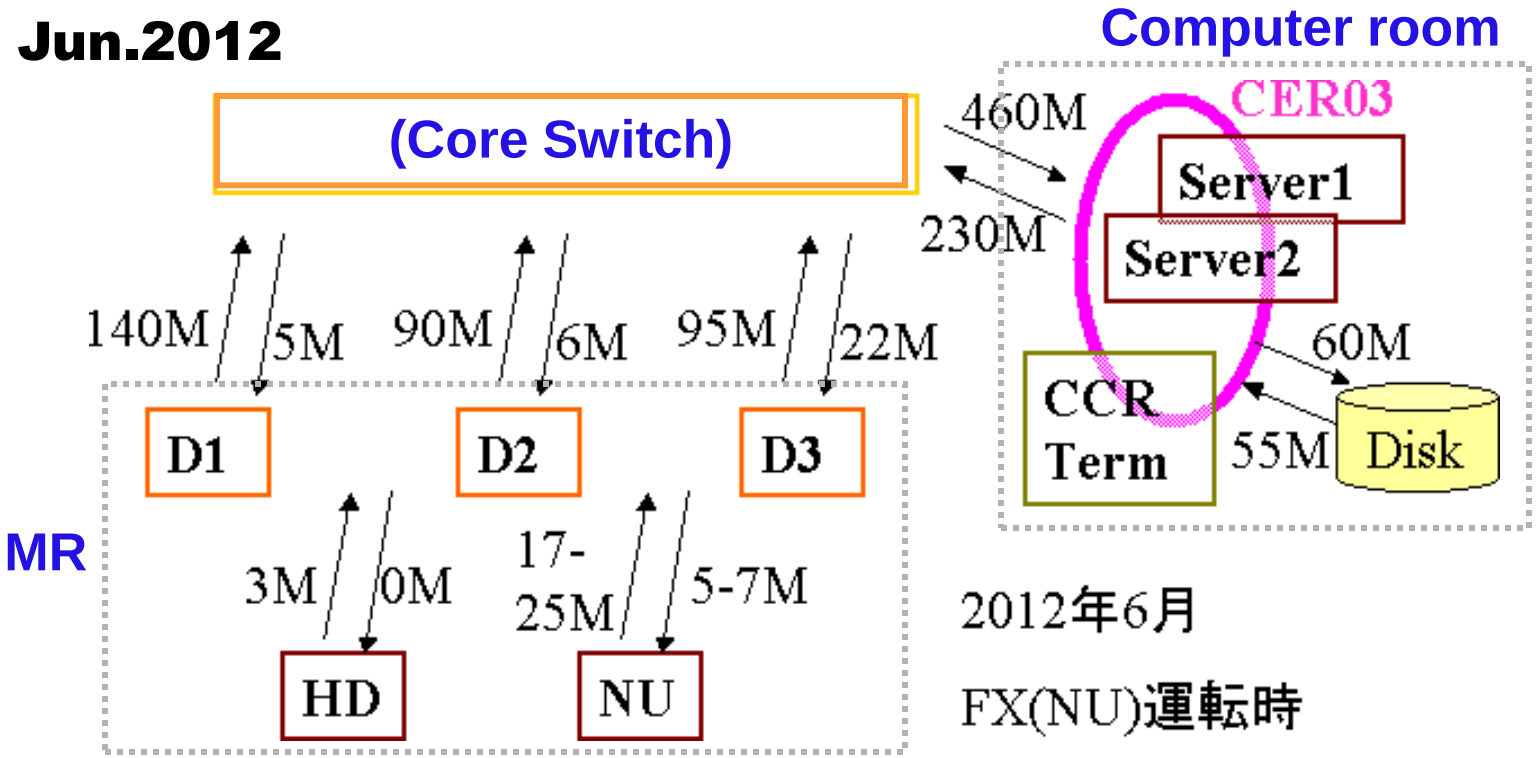
(edge 6804)

# Network – Traffic during Beam-run

**Observed network traffic**

**between MR buildings and CER (Computer room)**

**Jun.2012**




**Bandwidth are occupied by**

**many (20-30) waveform data (100ks/s x (2-5) seconds)**

# Network - Troubles

- **Edge Switch faults**
  - **Switch in NU/ 5 times during 20010-2012**
    - **=> Check power-line quality – no fault after 2012.4**
  - **Switch for CPU&Disk/ once in 2011.10**
    - **=> Replaced to a new model (2011.11)**
- **Trouble by miss-maintenance**
  - **A network camera sent broadcast storm (2012.5)**
    - **Radiation damage in accelerator tunnel**
    - **=> auto port-disable function against abnormal broadcast (2012,summer)**
  - **Air-cooling unit fault caused network stop (2011.11)**
    - **One of two units stopped -> room temperature rise -> network switches stopped (redundancy didn't work)**
    - **=> add third cooling unit (not yet)**

# Disk – Dedicated storage system

Storage disk (9TB)

IBM N3600 (NetApp)

2008

Storage disk (28TB)

IBM N3600 (NetApp)

2012

+Storage disk (30TB)

IBM X3630 (x2)

+Storage disk (11TB)

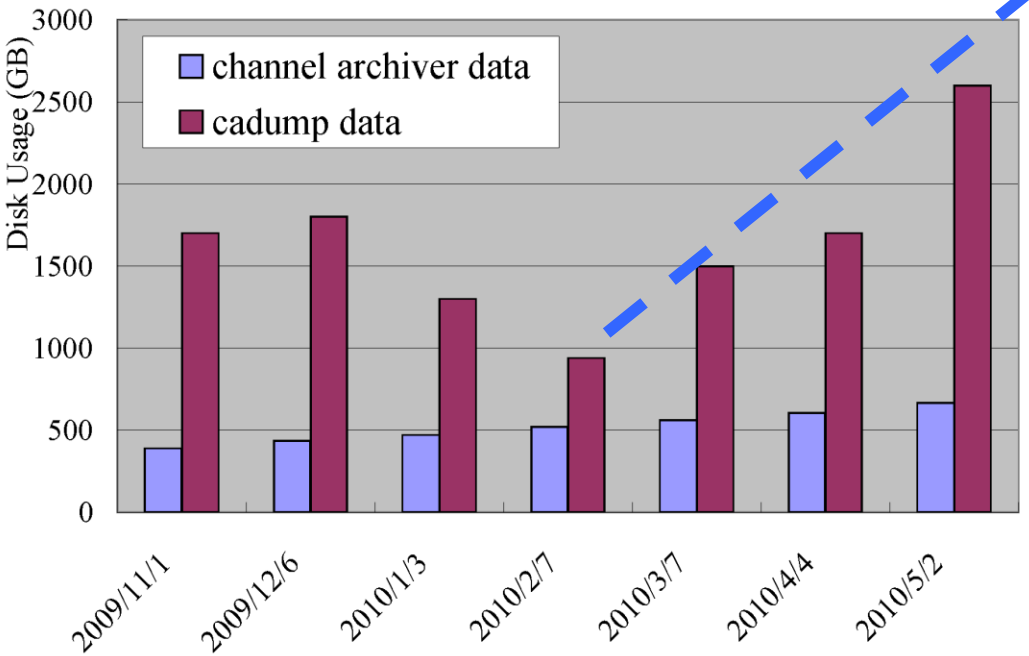
StoreNext (for LI,RCS)

# Disk - Discussion

- **Statistics**
  - **NFS client**
    - **40 servers, 150 IOCs, 30 terminals**
  - **Stored data amount**
    - **~50GB/day in Neutrino-mode operation**
    - **~110GB/day in Hadron-mode operation**
    - **Roughly agrees observed network traffic**

**Long-term maintenance of large data**

**is an open issue**




**Cadump = waveform_data**

**Started at 2009-end**

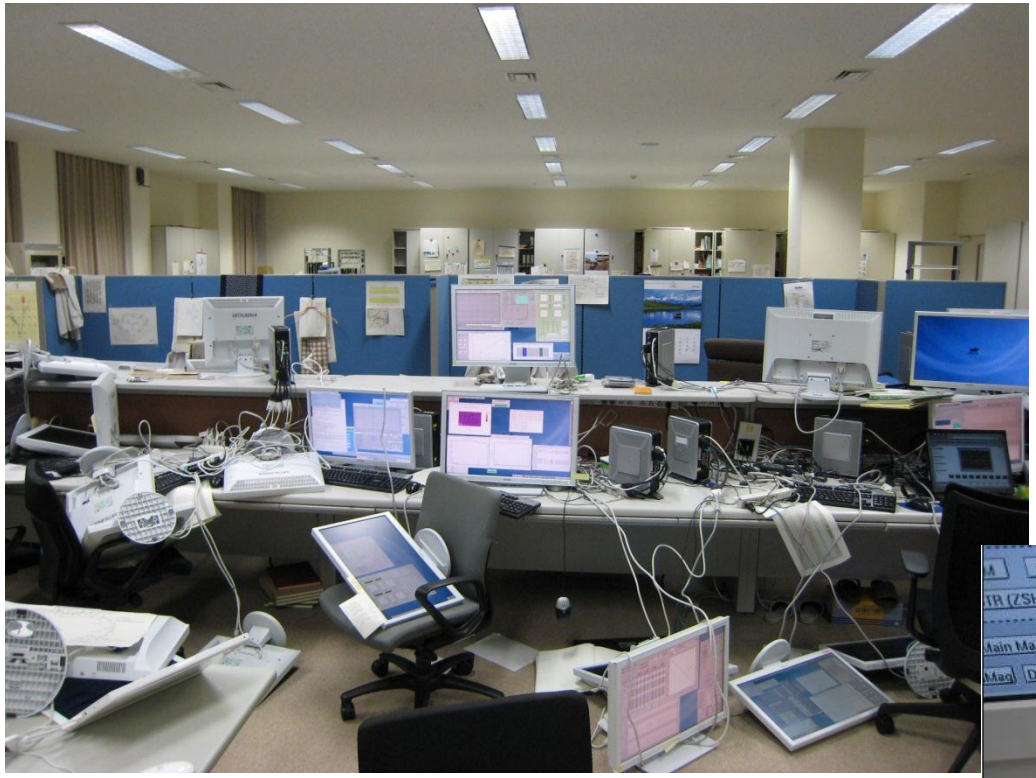
# Disk - Trouble

- **Disk unit fault**
  - **a few times in a year (recovered by RAID system)**
  - **Fault rate seems increasing year by year**

- **In 2012.02, a big trouble**
  - **Maintenance during beam operation caused system hang-up**
    - **Maintenance = remove old data-files (~TB order)**
    - **removing large files made internal CPU very busy**
  - **=> discuss new disk for large data (in 2013)**

# One more before Summary

# Improve after the 2011 Earthquake

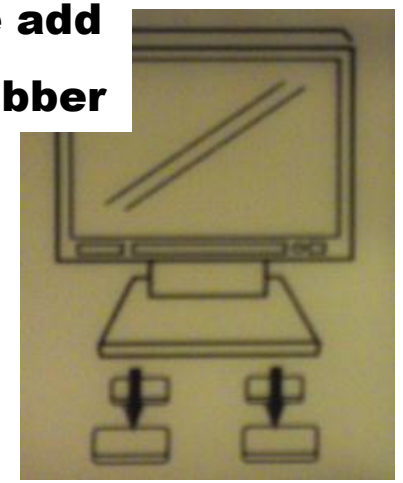


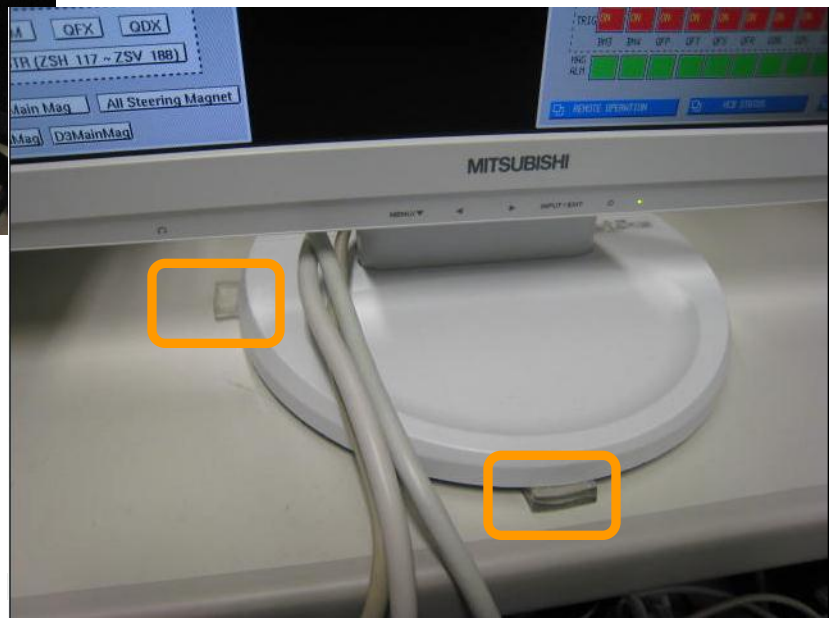
**On 2011.03.11**

**J-PARC Control Room**

**Mid-2011 we add**

**Anti-vibration rubber**





# Summary

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- J-PARC Accelerator Facility
  - Still growing toward the design goal
  - Recovery from the earthquake was made within 1-year

- Control Resources are reviewed
  - CPU – blade-type servers
    - Blade-type enabled us flexible upgrade
  - Network – a redundant system
    - Replaced in 2011-2012
    - Trobles by switch fault and miss-maintenance
  - Disk – dedicated disk system
    - In 2012 ~70TB
    - Looking for an idea for long-term large-data storage