Design and Status of the SuperKEKB Accelerator Control Network

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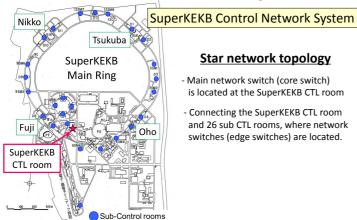
1. SuperKEKB project

SuperKEKB : Upgrade plan of the KEKB B-factory project

Target luminosity
8×10^{35} cm^{-2}s^{-1} **x40 of KEKB**

- KEKB operation finished in 2010 June.
- SuperKEKB operation starts from 2015 Jan.
  Currently under construction

We have upgraded the accelerator control network system for SuperKEKB

2. SuperKEKB Control Network Design

SuperKEKB Control Network System

Nikko / Tsukuba / SuperKEKB Main Ring / Fuji / Oho / SuperKEKB CTL room / Sub-Control rooms
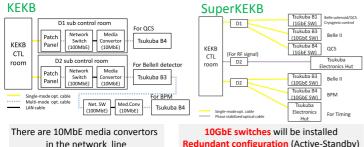
Star network topology

- Main network switch (core switch) is located at the SuperKEKB CTL room

- Connecting the SuperKEKB CTL room and 26 sub CTL rooms, where network switches (edge switches) are located.

Network connections and Network bandwidth

Network connection btw KEKB and Tsukuba

KEKB

- KEKB CTL room
- D1 sub control room: Patch Panel, Network Switch (100MbE), Media Convertor (10MbE) — For QCS — Tsukuba B4
- D2 sub control room: Patch Panel, Network Switch (100MbE), Media Convertor (10MbE) — For BelleII detector — Tsukuba B3
- Net. SW (100MbE), Med.Conv (10MbE) — For BPM — Tsukuba B4

Single-mode opt. cable
Multi-mode opt. cable
LAN cable

SuperKEKB

- KEKB CTL room
- D1 — Tsukuba B1 (1GbE SW) — Belle solenoid/QCS Cryogenic control
- Tsukuba B3 (10GbE SW) — Belle II
- Tsukuba B4 (1GbE SW) — QCS
- (For RF signal) D2 — Tsukuba Electronics Hut — Belle II
- D2 — Tsukuba B3 (10GbE SW) — Belle II
- Tsukuba B4 (10GbE SW) — BPM
- Tsukuba Electronics Hut — For Timing

Single-mode opt. cable
Phase stabilized optical cable

There are 10MbE media convertors in the network line

10GbE switches will be installed
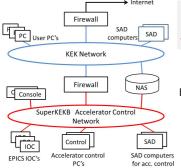**Redundant configuration** (Active-Standby)

VLAN segmentation for the SuperKEKB Control Network

EPICS : Main software tools to control SuperKEKB
EPICS uses UDP broadcast → Many UDP broadcast packets in the network.
Accelerator components with Ethernet interface also receive these.
We prepare VLANs for the accelerator components.

Network reconfiguration to connect with the KEK network

Internet / Firewall / SAD computers / SAD / PC User PC's / KEK Network / Firewall / NAS / Console / SuperKEKB Accelerator Control Network / IOC / Control / SAD / EPICS IOC's / Accelerator control PC's / SAD computers for acc. control

We changed the network configuration this summer, to enhance the network security

KEKB : Many computers connect to both KEK and KEKB control networks

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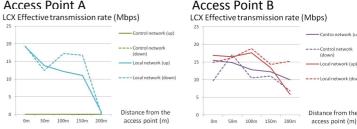Computers in acc. control network don't connect to KEK network

3. WiressLAN installation into the beamline

For SuperKEKB beamline construction, we install the Wiress LAN system into the whole tunnel area

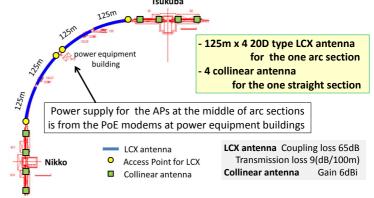### Measured network speed with a Leaky Coaxial (LCX) cable antenna

LCX cable parameters
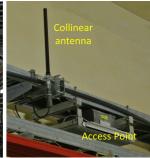200m length, 20D type, Coupling loss 70dB, Transmission loss 7(dB/100m)

Access Point A — LCX Effective transmission rate (Mbps)
Access Point B — LCX Effective transmission rate (Mbps)

Control network (up) / Control network (down) / Local network (up) / Local network (down)

Distance from the access point (m)

Based on this measurement, we chose access point B

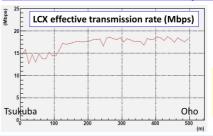### Layout of the installed wireless LAN components in SuperKEKB

Tsukuba / Nikko / 125m / power equipment building

- **125m x 4 20D type LCX antenna** for the one arc section
- **4 collinear antenna** for the one straight section

Power supply for the APs at the middle of arc sections is from the PoE modems at power equipment buildings

LCX antenna
Access Point for LCX
Collinear antenna

LCX antenna Coupling loss 65dB Transmission loss 9(dB/100m)
Collinear antenna Gain 6dBi

Installed LCX and Collinear antenna in SuperKEKB

Access Point / LCX antenna / Collinear antenna / Access Point

We select LCX and Collinear antennas with good radiation hardness >1MGy. The all AP and PoE in the tunnel are installed within lead boxes.

Measured WiressLAN Network Speed at SuperKEKB tunnnel

LCX effective transmission rate (Mbps)

Tsukuba / Oho / (m)

Good network speed performance of ~18Mbps in the whole tunnel area

4. Summary

We have upgraded the accelerator control network system for SuperKEKB.

The designed network system has the higher performance : the wider bandwidth data transfer and redundant configuration. We have installed the new wireless network system into the 3 km circumference accelerator tunnel.