

Status of the X-ray FEL control system at SPring-8

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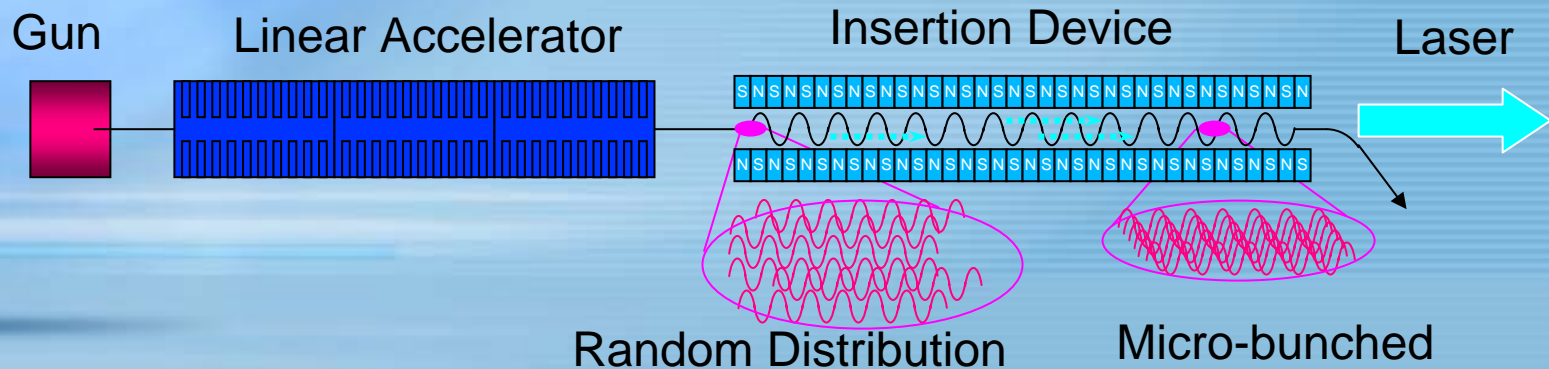
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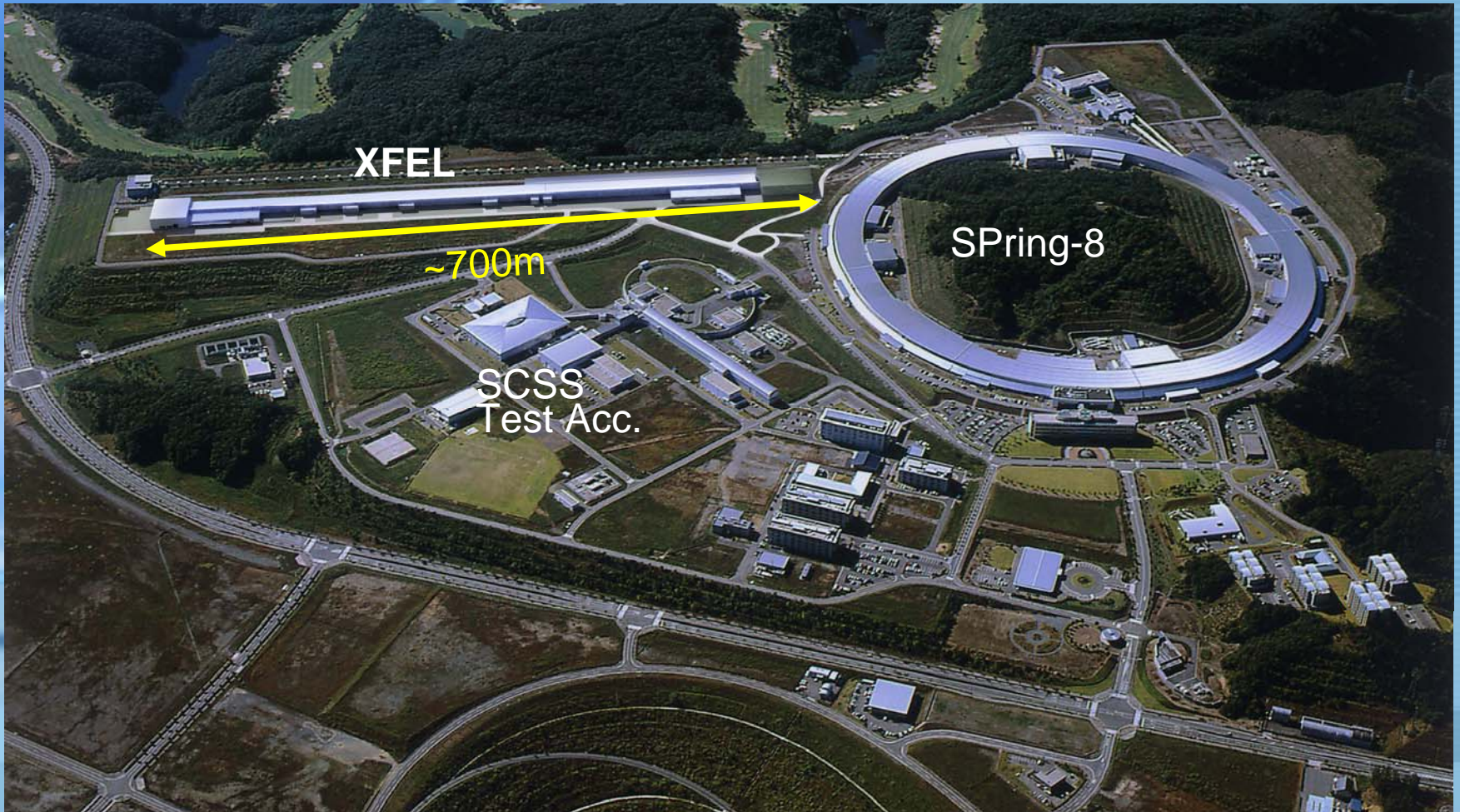
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What is X-ray FEL (XFEL) at SPring-8

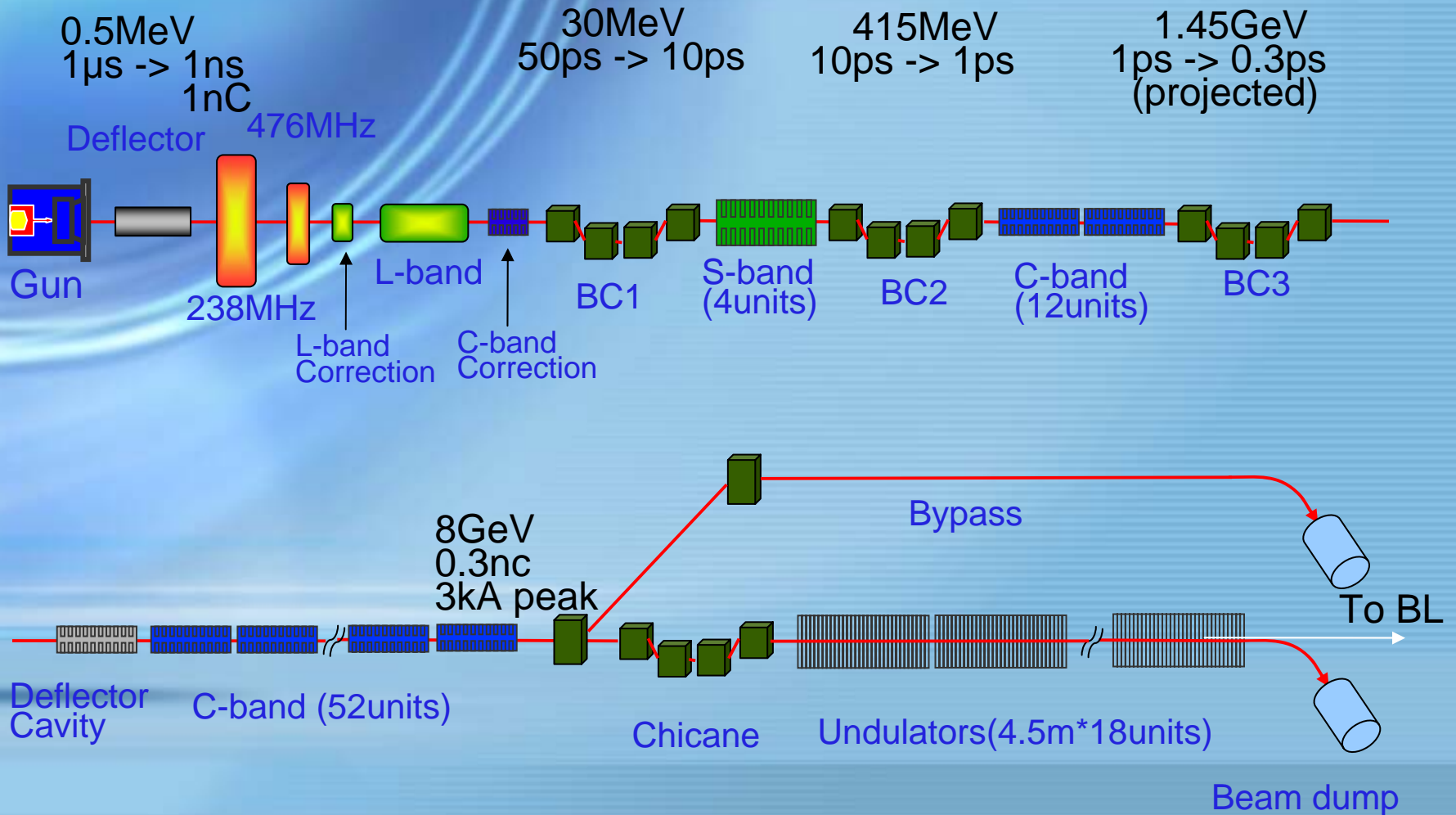
- Generate brilliant coherent X-ray with wavelength of below 0.1nm
- Consists of a low emittance electron gun, linear accelerator and in-vacuum undulators.
 - No mirror is available below 100nm



Birds-eye view of the XFEL produced with CG



Layout of the XFEL



XFEL need ...

- A machine must generate high density electron bunch with a high peak intensity and a low emittance beam.
 - A tolerance is very tight.
 - Amplitude stability $< \pm 0.01\%$
 - 238MHz phase stability $< \pm 0.01$ degree
 - 476MHz phase stability $< \pm 0.02$ degree
 - C-Band Corr. timejitter $< \pm 0.049$ psec

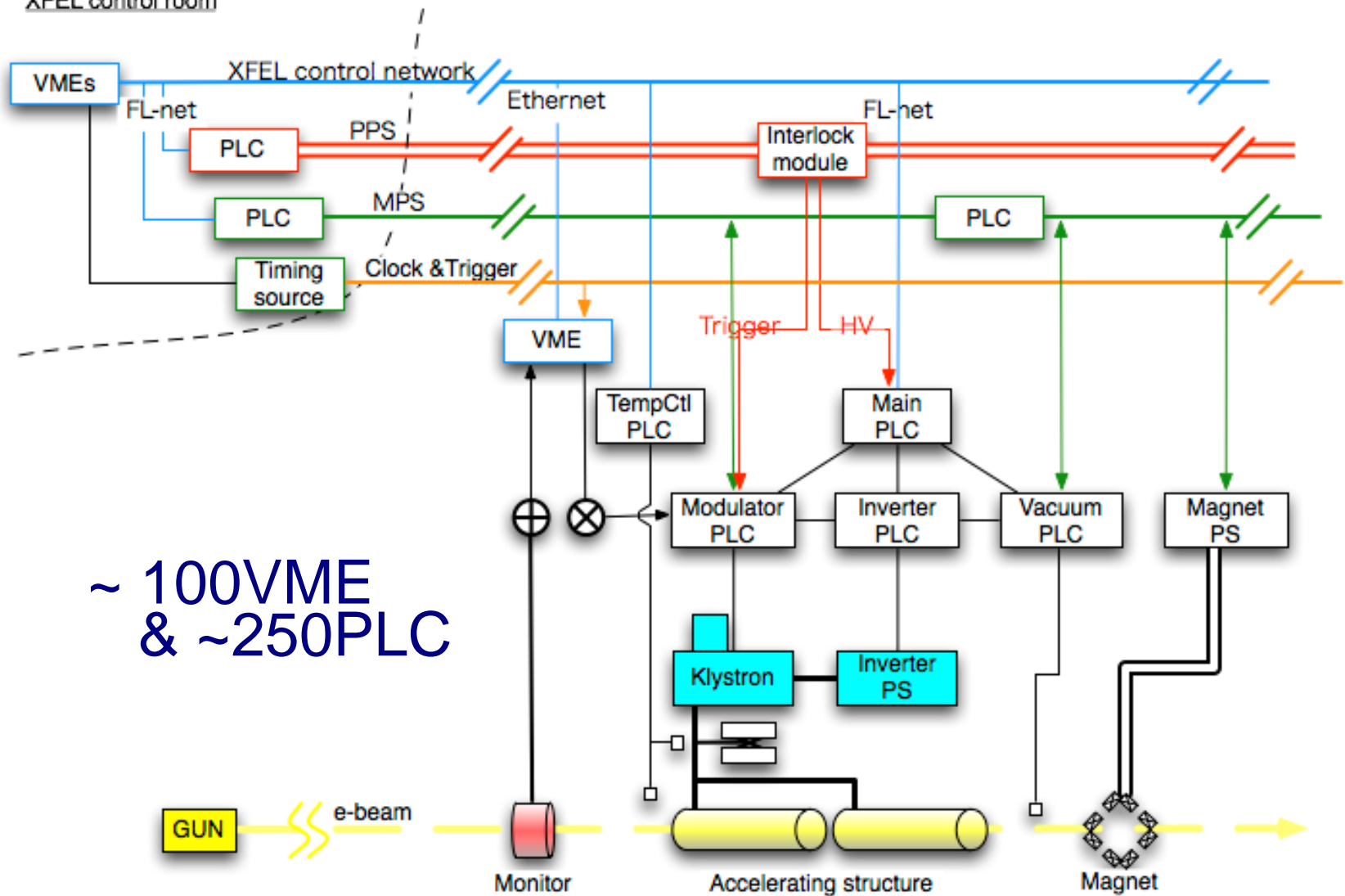
XFEL need ...

- A machine must be very stable like a storage ring.
 - It is needed to suppress a temperature change of the cavity to 0.001°C . (@238MHz $\sim 0.2^{\circ}/0.01^{\circ}\text{C}$).
 - It is important to control environmental condition.
 - A water temperature
 - An air temperature and flow
 - A power line voltage
 - It must take care a facility operation as well as accelerator control.

Control System

- Most of a component are same as the SCSS test accelerator.
 - The test accelerator is operated very well.
- The control framework is similar to the SPring-8 storage ring control system.
 - We will take care a slow feedback by software. (a fast feedback by hardware)
 - It must be robust & scalable.
 - Continuous operation
 - More than 100 VMEs

XFEL control room

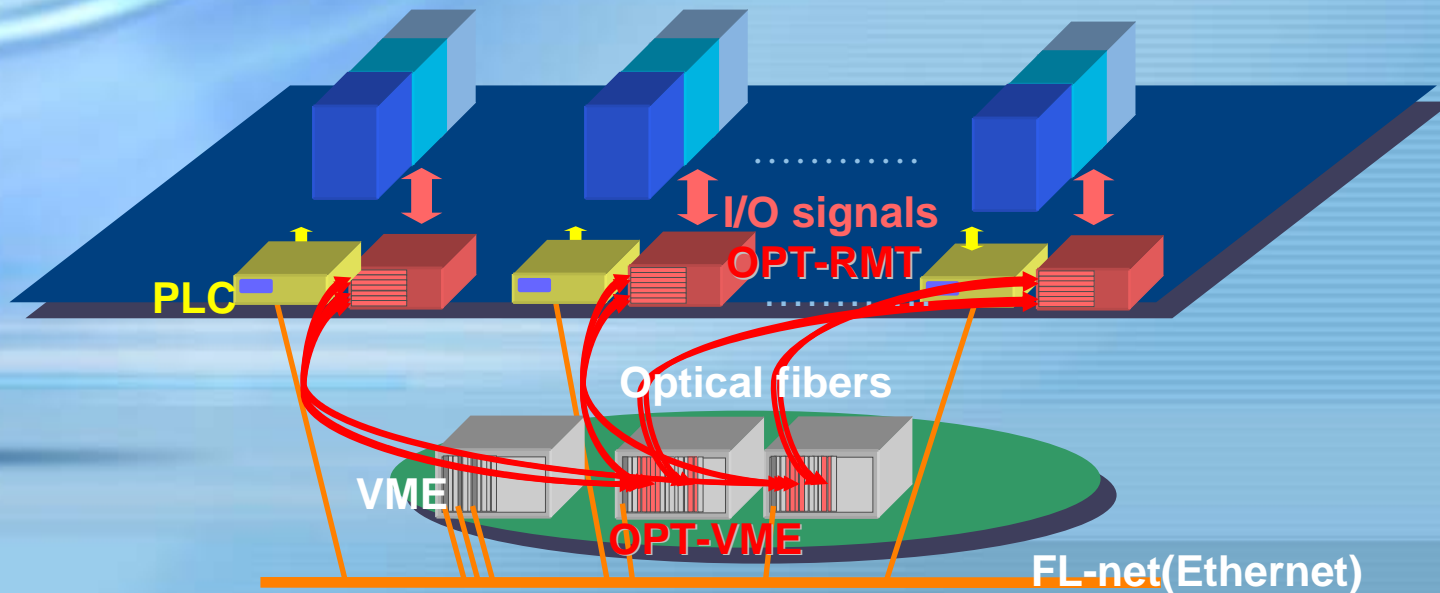


~ 100VME
& ~250PLC

Hardware Component

- We use VMEbus for an equipment controller.
 - CPU
 - IA-32 + Universe(PCI-VME Bridge) with Compact Flash boot
 - PMC or XMC for a reflective memory
- Using OPT-VME for Magnet Control
 - Same as the SPring-8 linac and the SCSS test accelerator.

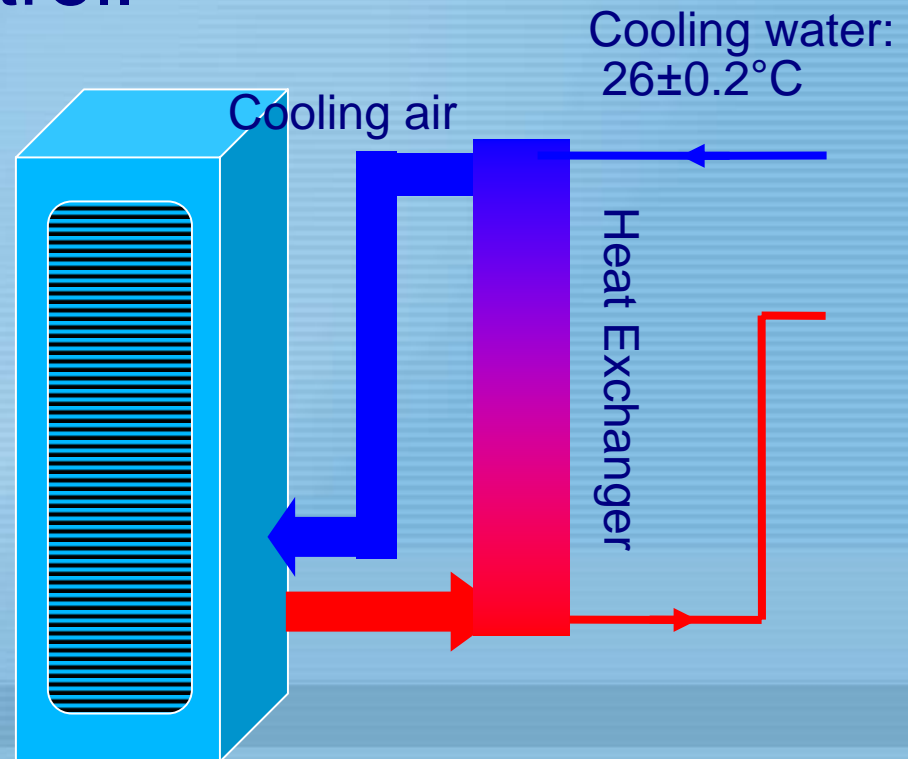
- We use PLC as remote I/O system
 - PLC for Modulator, Inverter, Vacuum, Cooling Water
 - We will select a optical fiber for a PLC link.
 - DeviceNet will be used for to reduce a wiring.
 - FL-net as a Communication between PLC and VME



Hardware Component

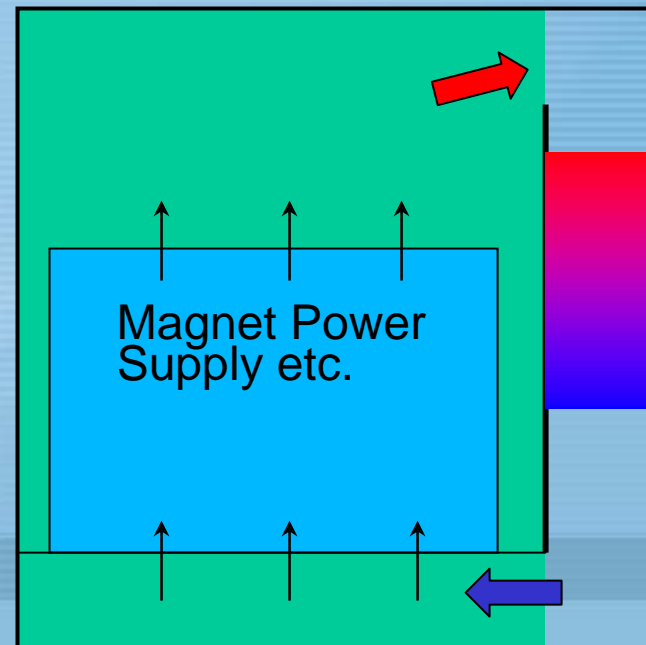
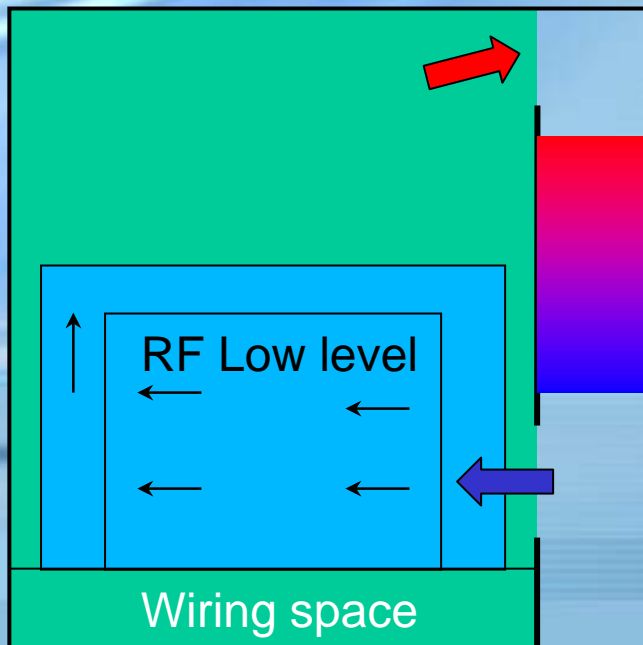
- RF low level components will be installed in a water-cooled ($26\pm 0.2^\circ\text{C}$) 19inch racks for temperature control.

- IQ modulator & demodulator
- High-speed A/D
and D/A VME boards
- Clock & trigger distribution unit
- Trigger delay VME board



Hardware Component

- We use VME enclosure with a horizontal installation of boards
 - Avoid a vibration cause by the air to shake the cable.

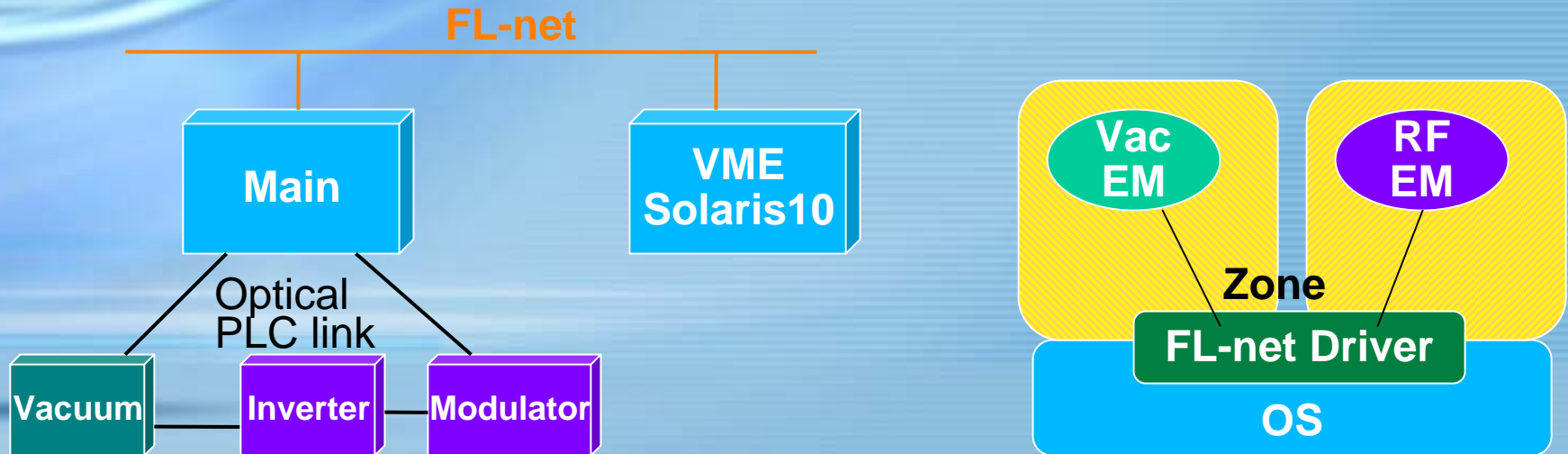


Software

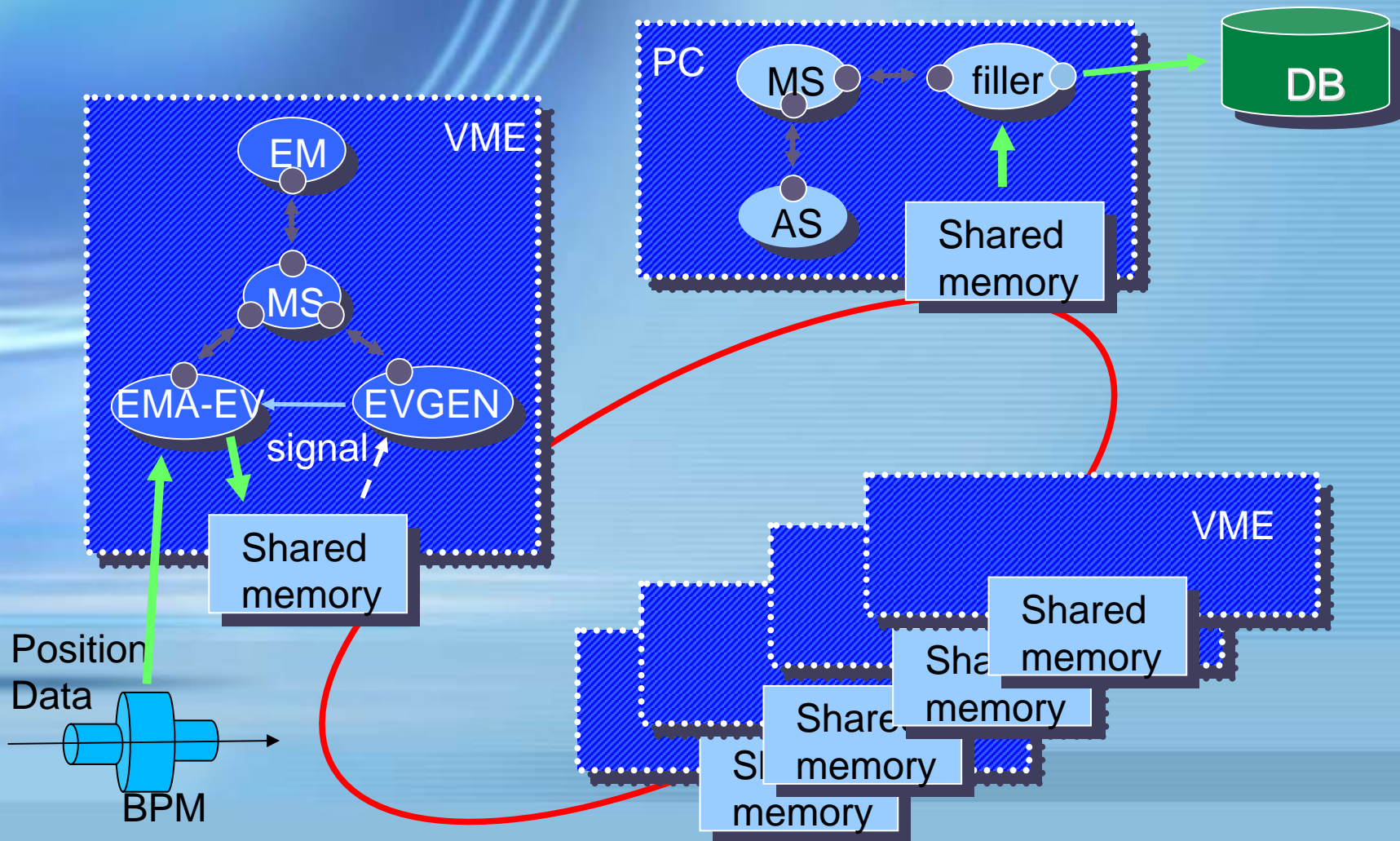
- The MADOCA is used for the XFEL control framework.
 - Same as the test accelerator.
 - The RDBMS is a key for stable operation.
 - Logging data is used to find unstable parts.
- LINUX as a operating system for a operator console.
 - X-Mate as a GUI builder
 - Purify will be used for memory corruption detection and memory leak detection.
 - For HP-UX, Purify help us to stable operation.

Software

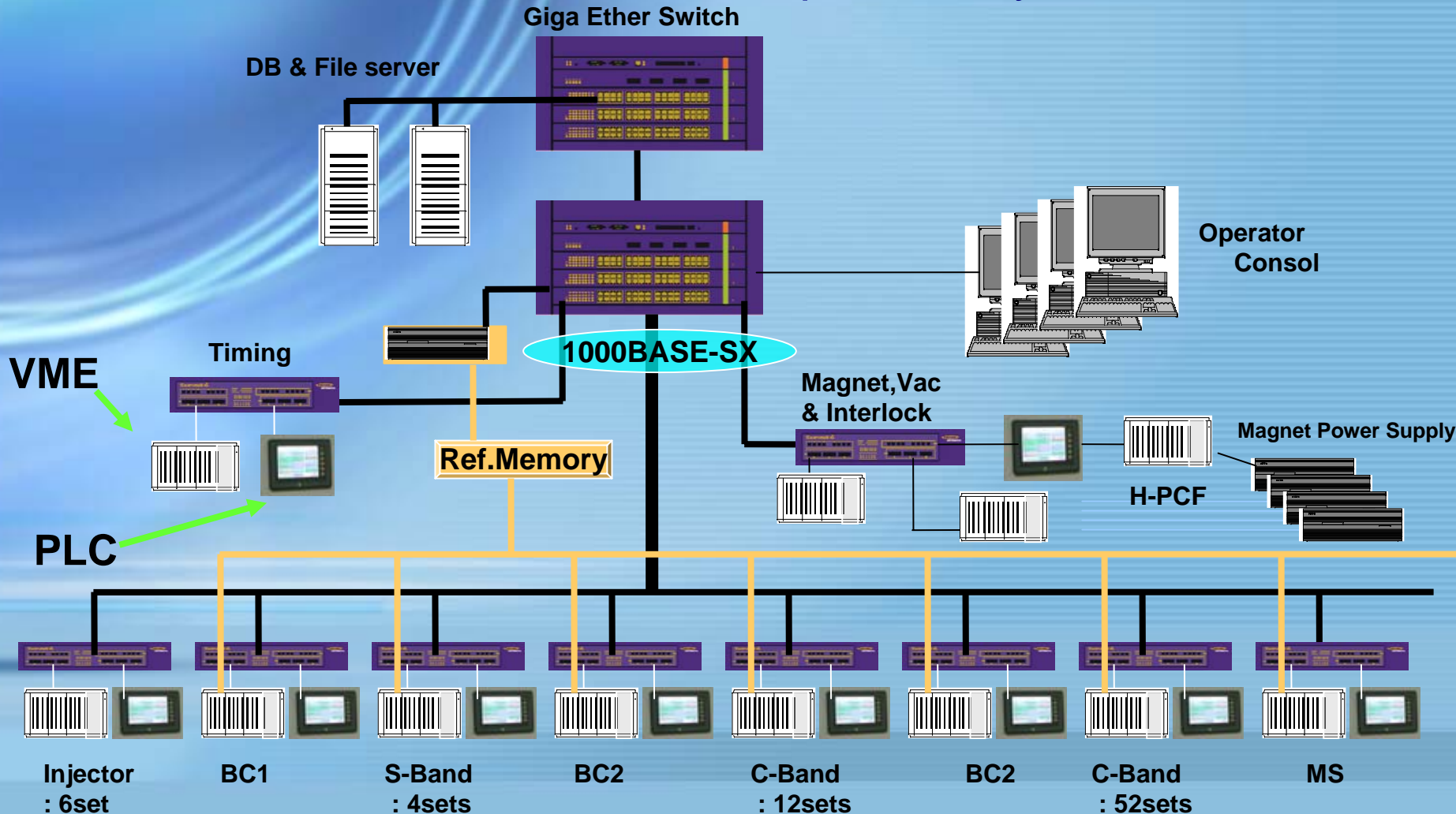
- Solaris 10 x86 as a operating system for a VME CPU.
 - It is possible to use Solaris Container.

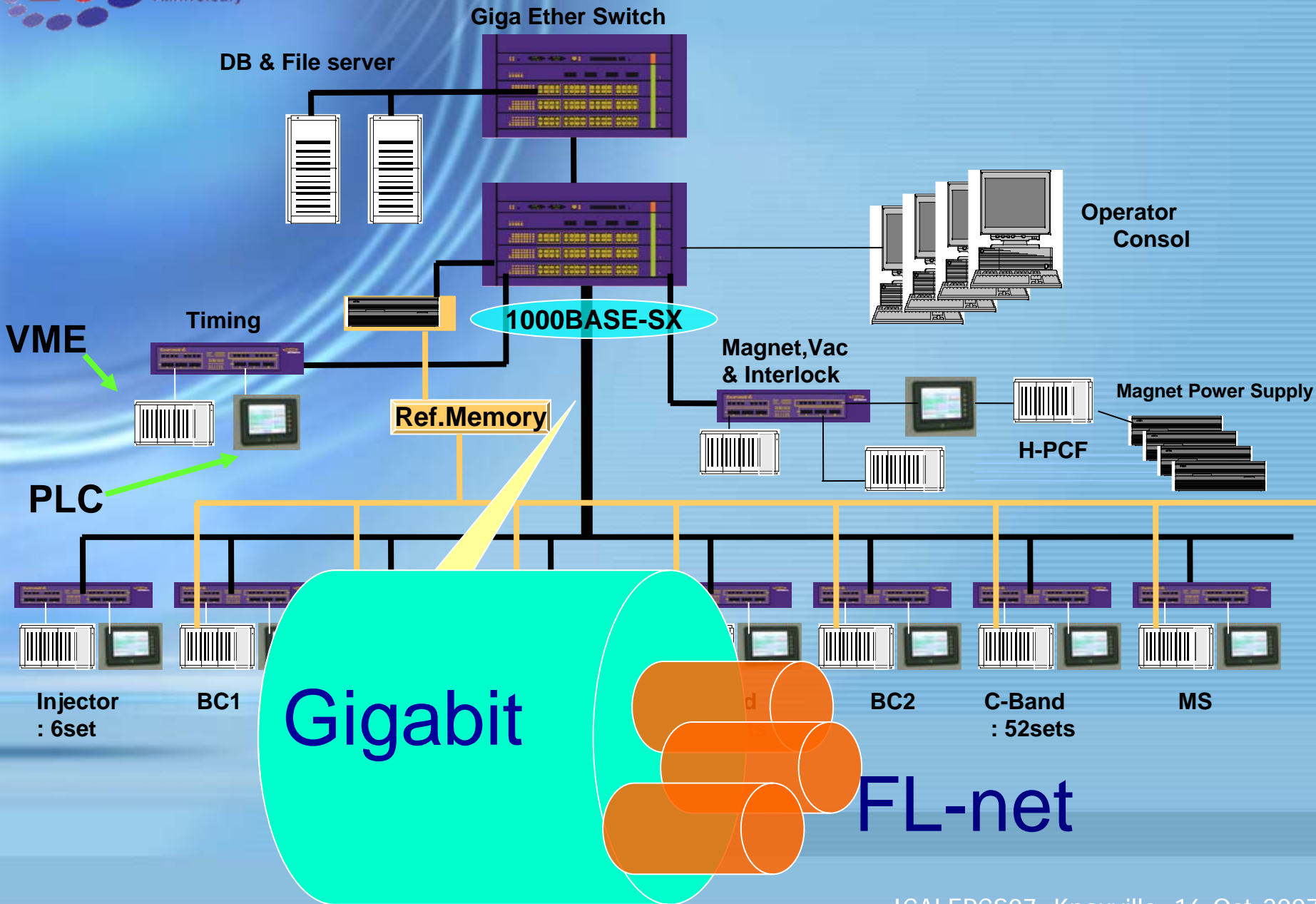


Event driven data acquisition system



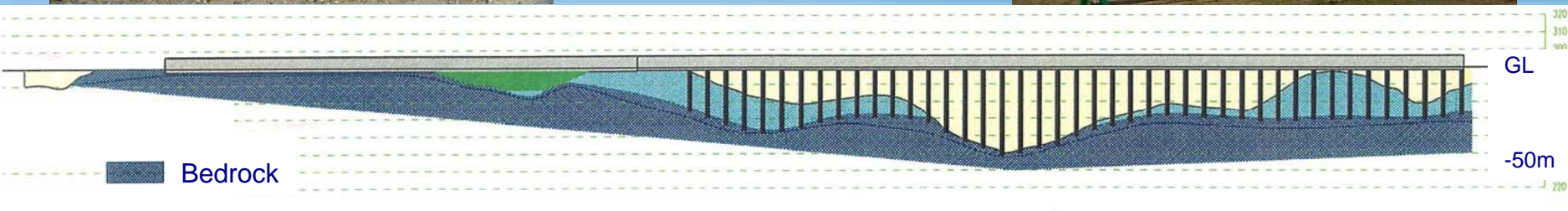
- Gigabit Ethernet is used for a backbone of network.
 - Each FL-net is separated by VLAN





Project Schedule

- The XFEL machine construction already started and the machine tunnel will be completed at March 2008.
 - ~ 150 piles



Project Schedule

- Live Camera @ 10-Oct-2007



Project Schedule

- The RF aging will start in October 2010 and the commissioning will start in February 2011.
- The test accelerator is successfully operated to generate laser pulse about 30uJ/pulse
- We will start to serve as a EUV-FEL users facility in next week.

Summary

- Most of the component was tested at the SCSS test accelerator.
 - The SCSS test accelerator is successfully operated
- Some of a component has to be improved.
- A commissioning of the XFEL start in February 2011.