IOC Redundancy:
Redundancy Monitor Task

EPICS Meeting - Redundancy

Argonne, June 16, 2006

Matthias Clausen, DESY

XFEL Controls Demands

A user facility with high demands for 99.8% efficiency

- The control system may not fail

- Possible scenarios:

  ⇒ **Hot stand by (seamless switch of IOC's)**

  ⇒ **Cold stand by (switching 'on demand'; i.e. for maintenance)**

- Biggest problem: Find radiation hard electronics for the tunnel

  ⇒ **Distributed redundancy in cold stand by may help**

  ⇒ **Most sensors and actuators contain electronics nowadays.**

Matthias Clausen, DESY
Redundancy Monitor Task, 16-June-06

Design Goal for redundant IOC's

From the preamble of the design specification:

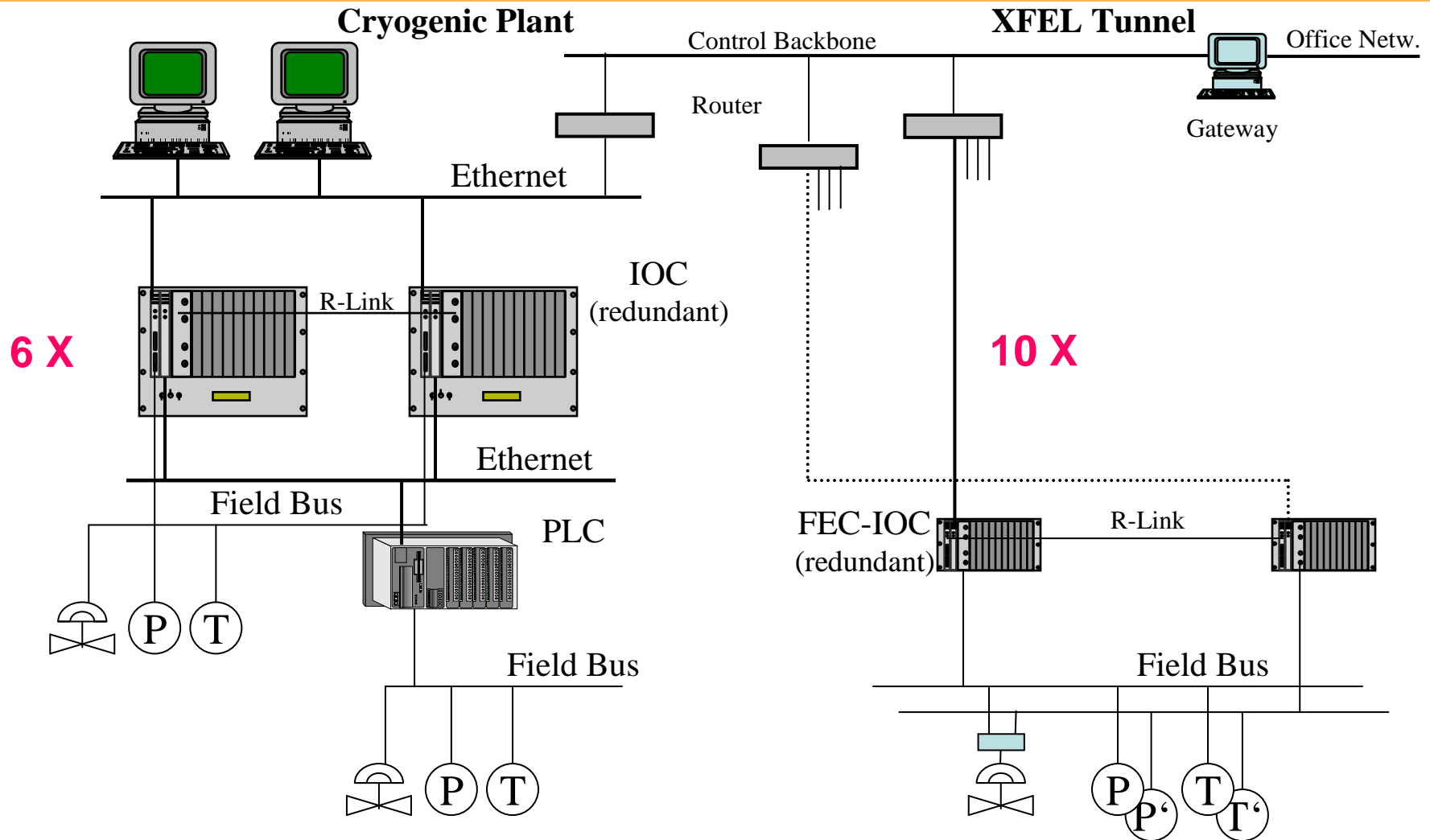… last and most importantly one major design goal must be matched:

Any redundant implementation must make the system more reliable than the non redundant one. Precaution must be taken especially for the detection of errors which shall initiate the failover. This operation should only be activated if there is no doubt that keeping the actual mastership will definitely cause more damage to the controlled system than an automatic failover.

Fulfilling XFEL Control Demands

Redundant Process Controllers will help to provide the required MTBR. The following actions can be performed without interrupting cryogenic operations:

- **XFEL Cryogenic Plant:** *Main objective: Maintenance (permanent operation for more than one year)*
  - Hardware maintenance
  - Software maintenance
  - Installing new system-/ application- Software

- **XFEL Tunnel Installation:** *Main objective: Survive radiation damage (MTBR > 1 month)*
  - … same like cryogenic plant
  - Seamless switch over of:
    - ⇒ **Process Controller (IOC)**
    - ⇒ **I/O sensor/ -actor**
    - ⇒ **Power supplies**

4

Principle Layout of the XFEL Cryogenic Control System

Cryogenic Plant

XFEL Tunnel

Control Backbone

Office Netw.

Router

Gateway

Ethernet

IOC
(redundant)

R-Link

6 X

10 X

Ethernet

Field Bus

PLC

P T

Field Bus

FEC-IOC
(redundant)

R-Link

Field Bus

P T

Field Bus

P P' T T'

5

Redundancy: New developments

The implementation of the key redundancy tasks on an IOC has been subcontracted to two companies:
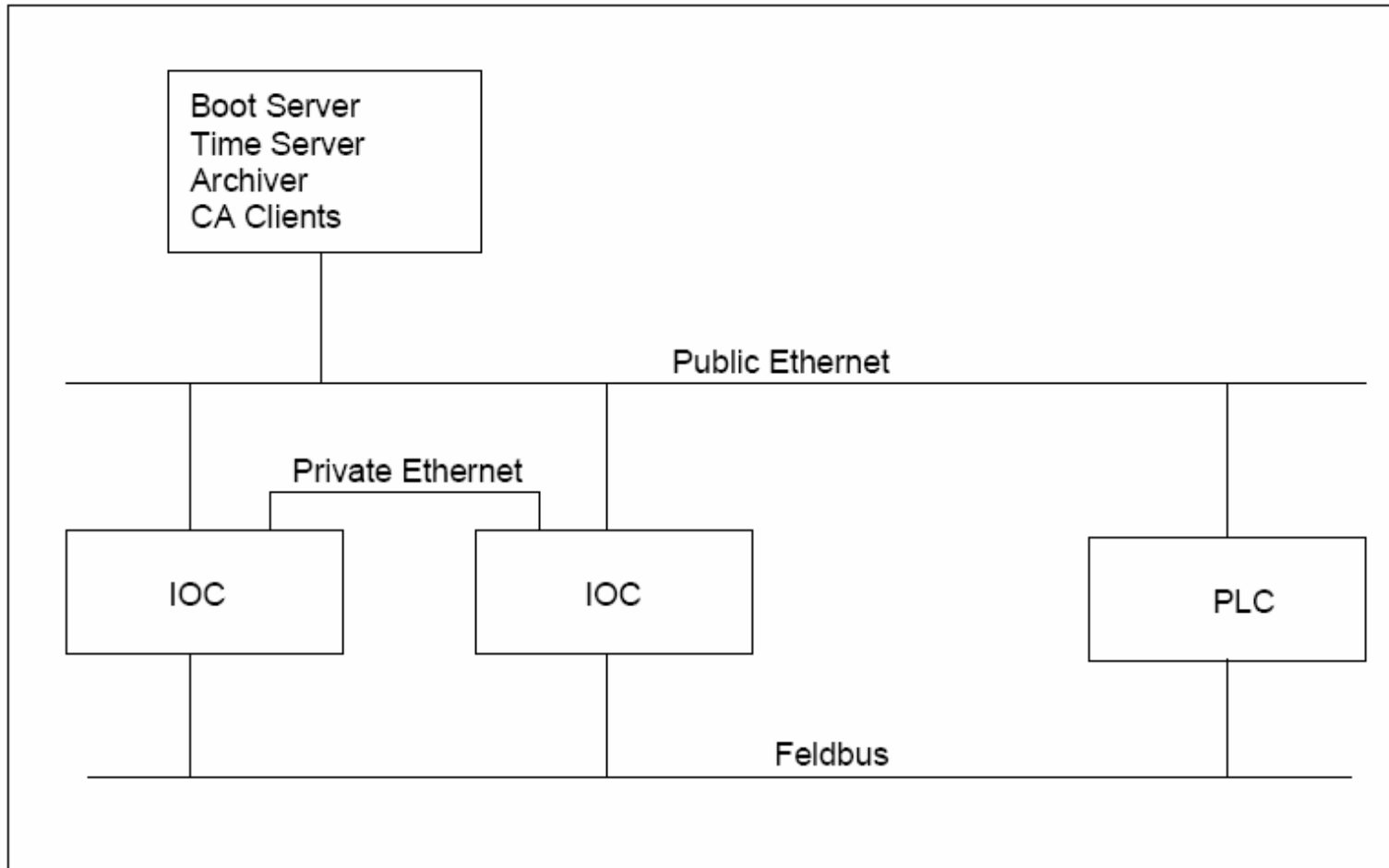
- **Redundancy Monitor Task**
  - Supervision of the tasks running on an IOC
  - Switching IOC's in case of serious problems on one IOC

- **Continuous Control Executive Task**
  - Synchronizing the continuous control processing on two IOC's
  - Permanent monitoring of all changes in record processing on an IOC

Core and main objective of any failover:

The resulting status of an IOC after a failover must be a more stable state than the status before the failover.

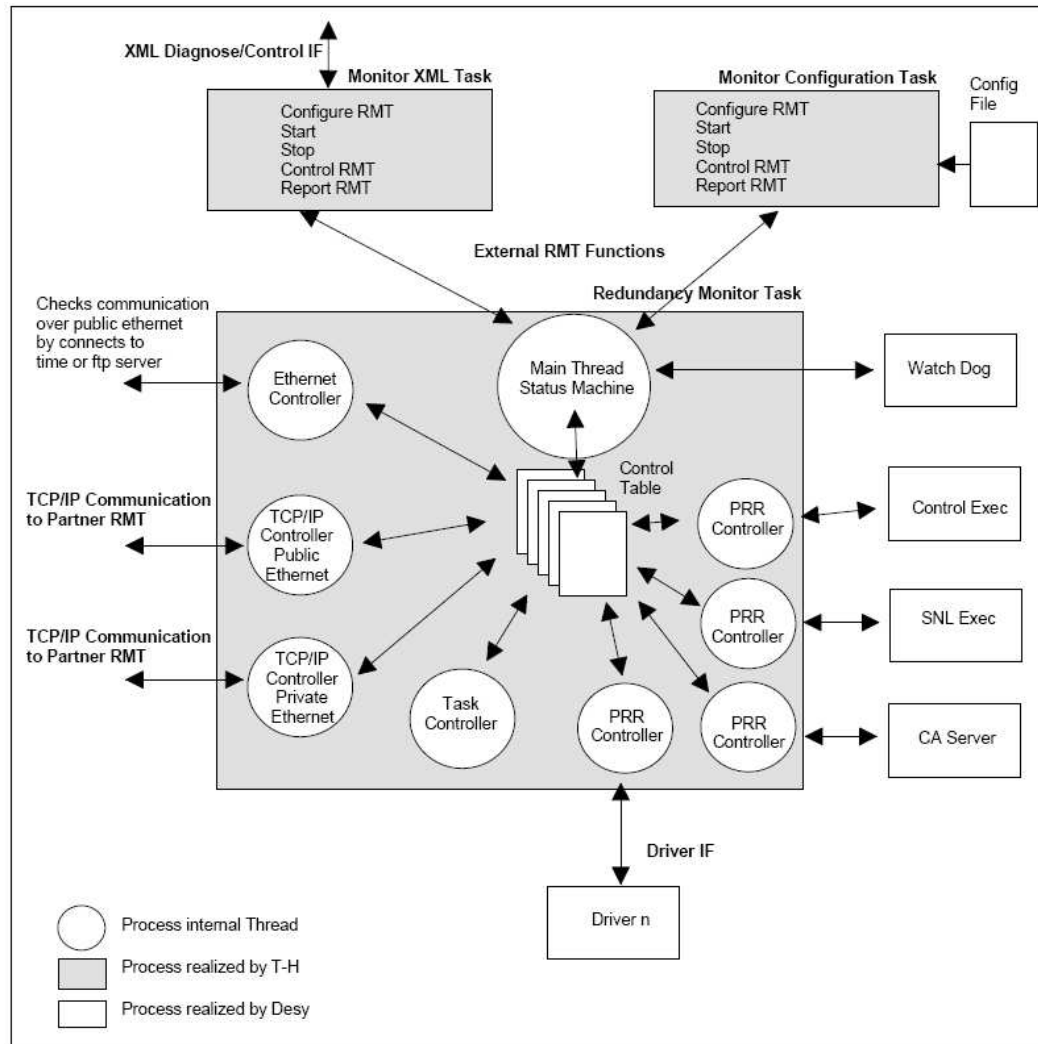 - Diagnostic analysis programs must be activated to ensure this.

6

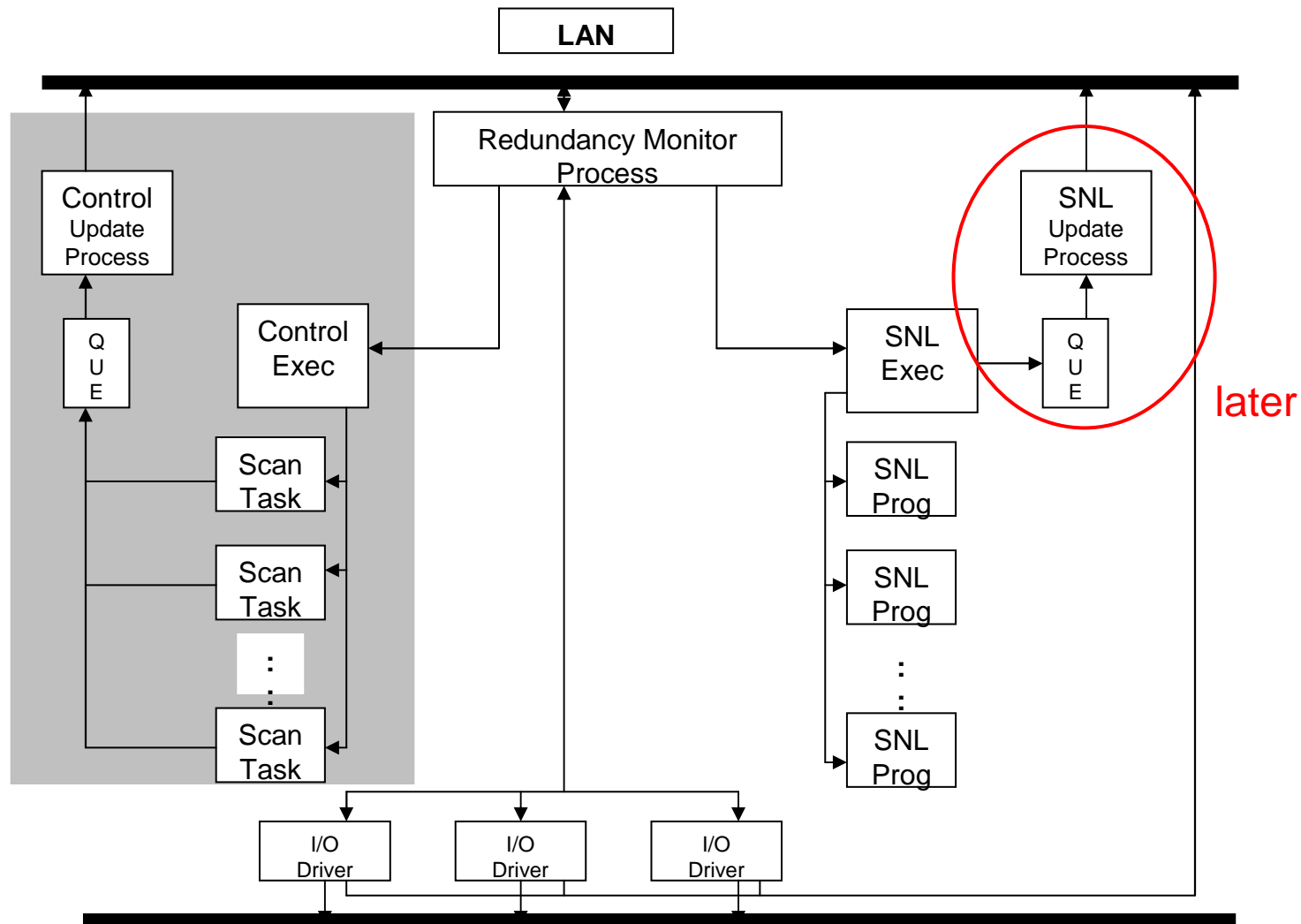# Redundancy Monitor Task (RMT)
Hardware Layout

Redundancy Monitor Task

- **Controlling Primary Redundancy Resources (PRR)**
  - Drivers
  - Tasks
  - Watchdog
  - Ethernet ports

- **Answering and/ or forwarding XML diagnostic and – management requests**
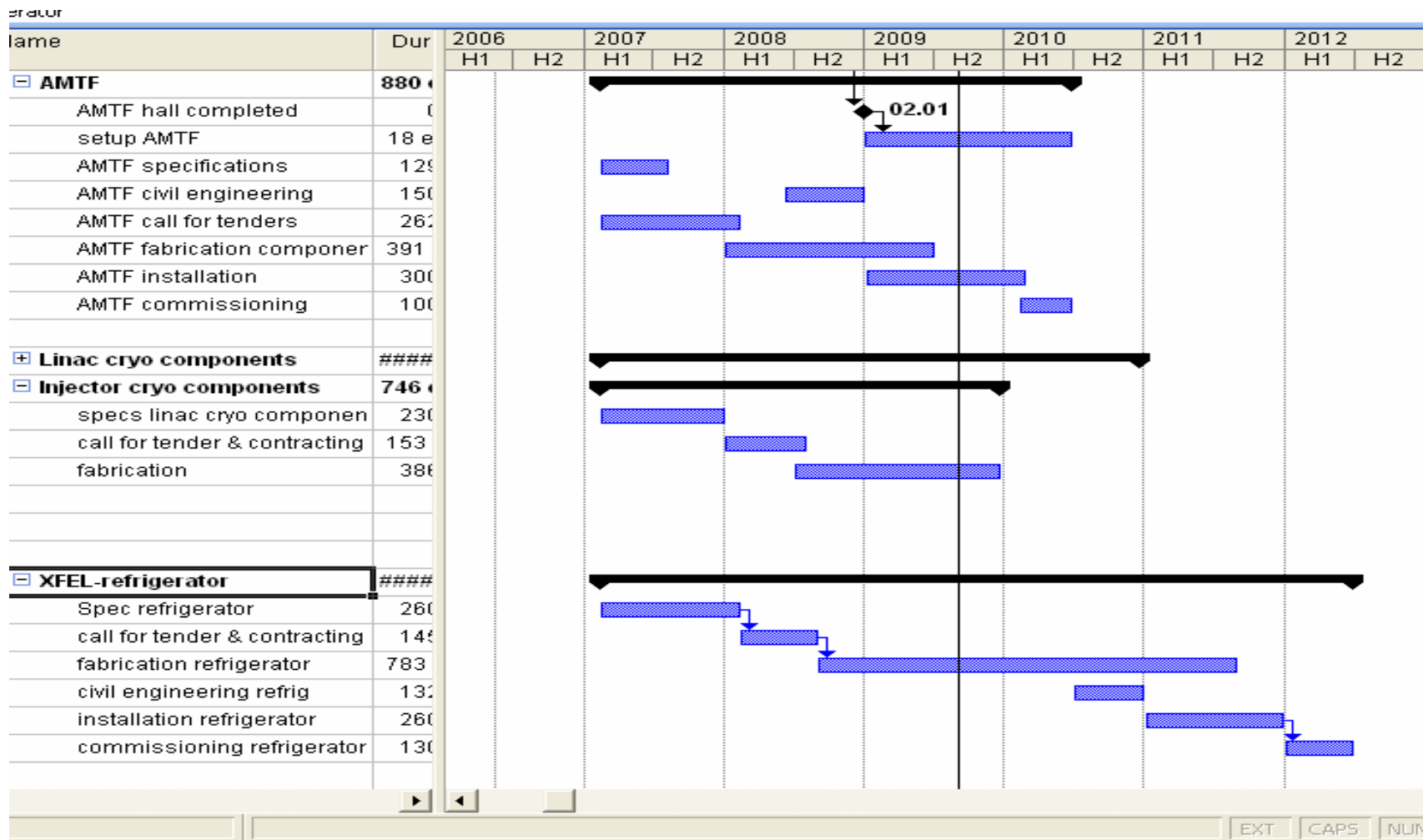
Redundancy Monitor Task (RMT)
Process and Interface Design

Redundancy:
Control Executive -> Bob's talk

LAN

Redundancy Monitor Process

Control Update Process

Control Exec

Q U E

Scan Task

Scan Task

⋮

Scan Task

SNL Exec

SNL Update Process

Q U E

later

SNL Prog

SNL Prog

⋮

SNL Prog

I/O Driver

I/O Driver

I/O Driver

Matthias Clausen, DESY
Redundancy Monitor Task, 16-June-06

XFEL Schedule (for Cryogenic Installations)

Matthias Clausen, DESY
Redundancy Monitor Task, 16-June-06

Outlook

Individual tests by the end of June '2006

Integrated test in July 2006

Intensive testing until end of 2006

- Redundant hardware
  - ⇒ **CompactPCI backplane/ CPU**
  - ⇒ **Redundant PS**
  - ⇒ **Remote reset for PS**
- Beta testing 2007

Production for Accelerator Module Test Facility (AMTF)

- 2009

SNL Redundancy:

- Basic functionality implemented by Mike Laznovsky (SLAC)
- Redundancy implementation starting middle 2006

12