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Controls presentation to the External Panel on Risk

Outline

- Preamble
- The LHC Controls Infrastructure
- External Dependencies
- Redundancies
- Control Room Power Loss
- Conclusion

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Preamble

- The Controls Infrastructure is designed to **control the beams** in the accelerators

- It is **not** designed to **protect the machine** nor to **ensure personnel safety**
  - See Machine Protection or Access Infrastructures

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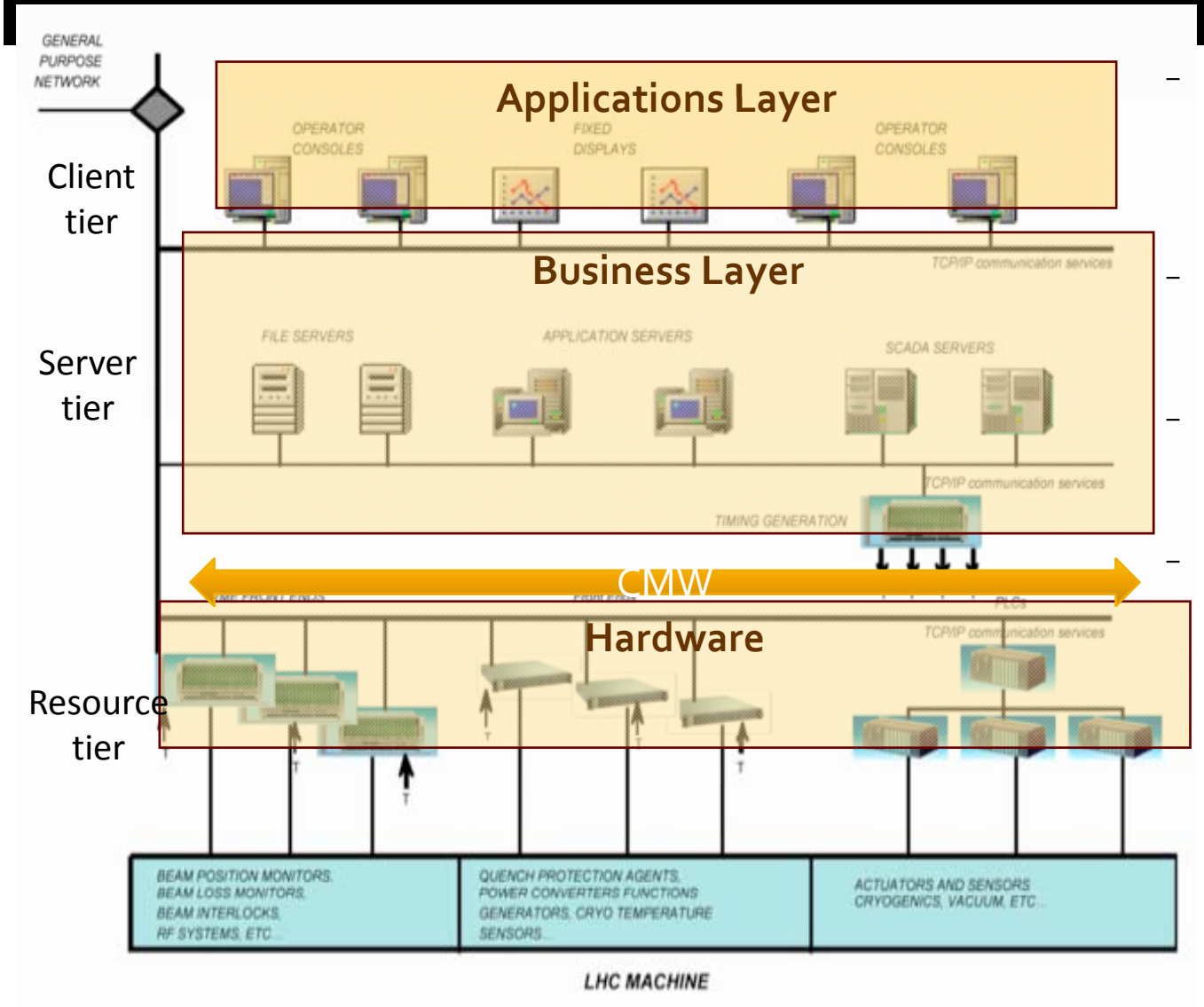
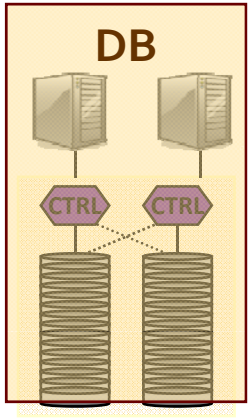
LHC Controls Infrastructure



- Software layers
- Resource Tier
  - VME crates, PC GW & PLC dealing with high performance acquisitions and real-time processing
  - Database where all the setting and configuration of all LHC device exist
- Server Tier
  - Application servers
  - Data Servers
  - File Servers
  - Central Timing
- Client Tier
  - Interactive Consoles
  - Fixed Displays
  - GUI applications
- Communication to the equipment goes through Controls Middleware CMW



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External Dependencies

HARDWARE

- Electricity
- Cooling and Ventilation
- Network
- Oracle servers in IT

SOFTWARE

- Oracle
- IT Authentication
- Technical Network/General Purpose Network

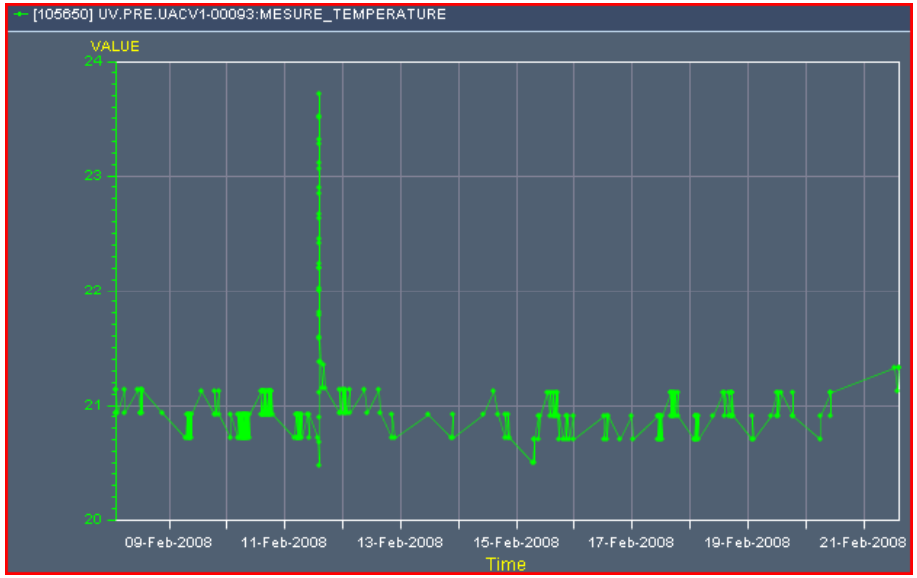
External Hardware Dependencies
Electricity

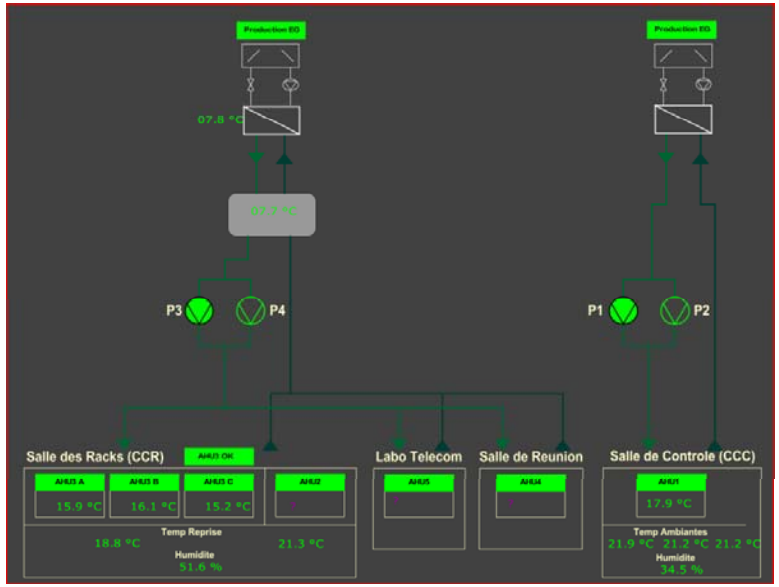
- All Linux servers are **HP Proliants** with dual power supplies
- They are cabled to **two separate** 230V UPS sources
- High power consumption will consume UPS batteries rapidly
  - **1 hour** maximum autonomy
  - Each Proliant consumes an average of 250W

External Hardware Dependencies
Cooling & Ventilation

- Feb 2009: upgrade of **air flow and cooling circuits** in CCR
  - CCR vulnerability to Cooling problems has been resolved

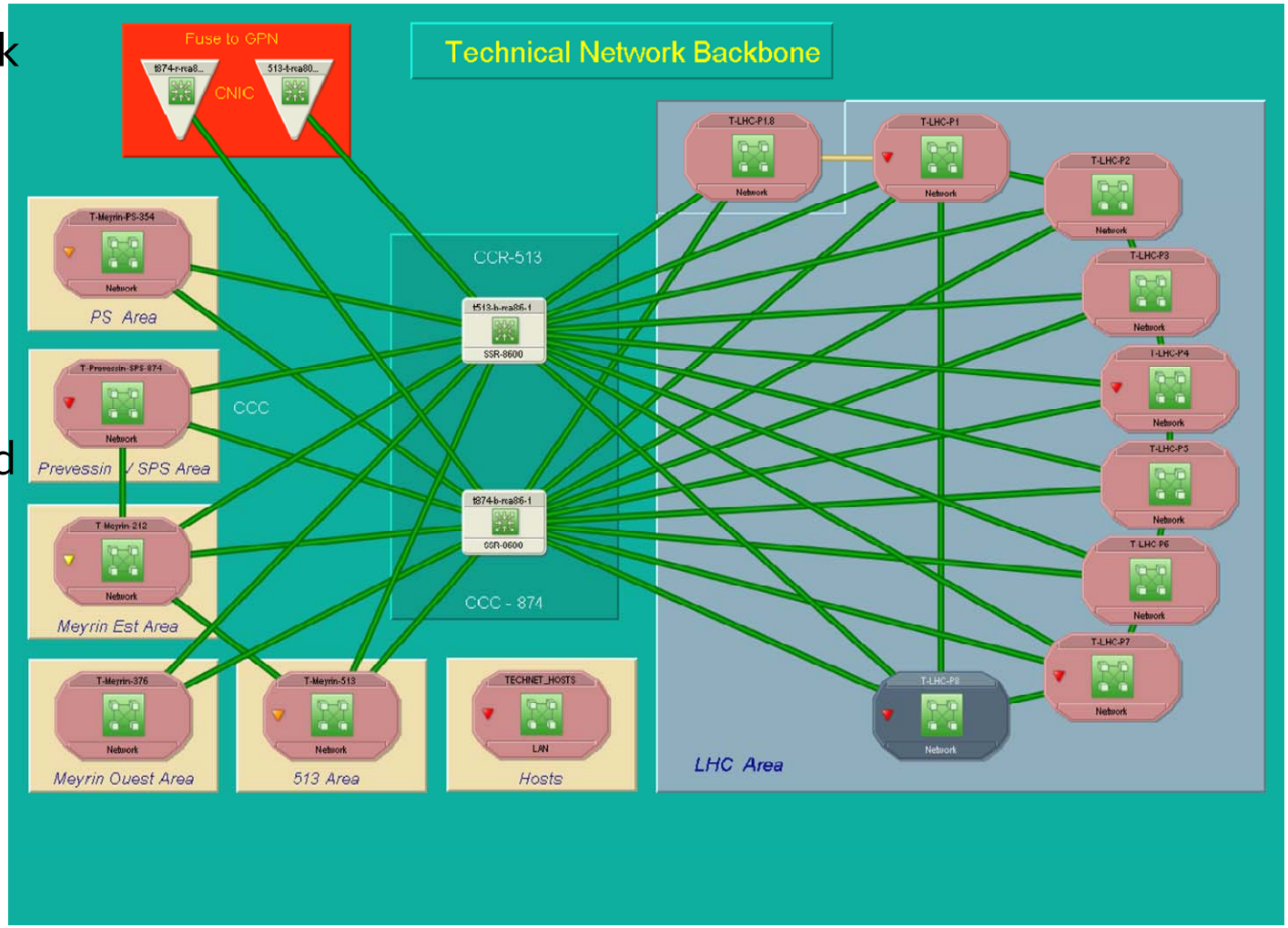
- In the event of **loss of refrigeration**, the CCR will **overheat** very quickly
  - **Monitoring** with temperature sensors and alarms in place to ensure rapid **intervention by TI operators**
  - The CCR cooling state is monitored by the Technical Infrastructure Monitoring (TIM) with views which can show **trends over the last 2 weeks**:





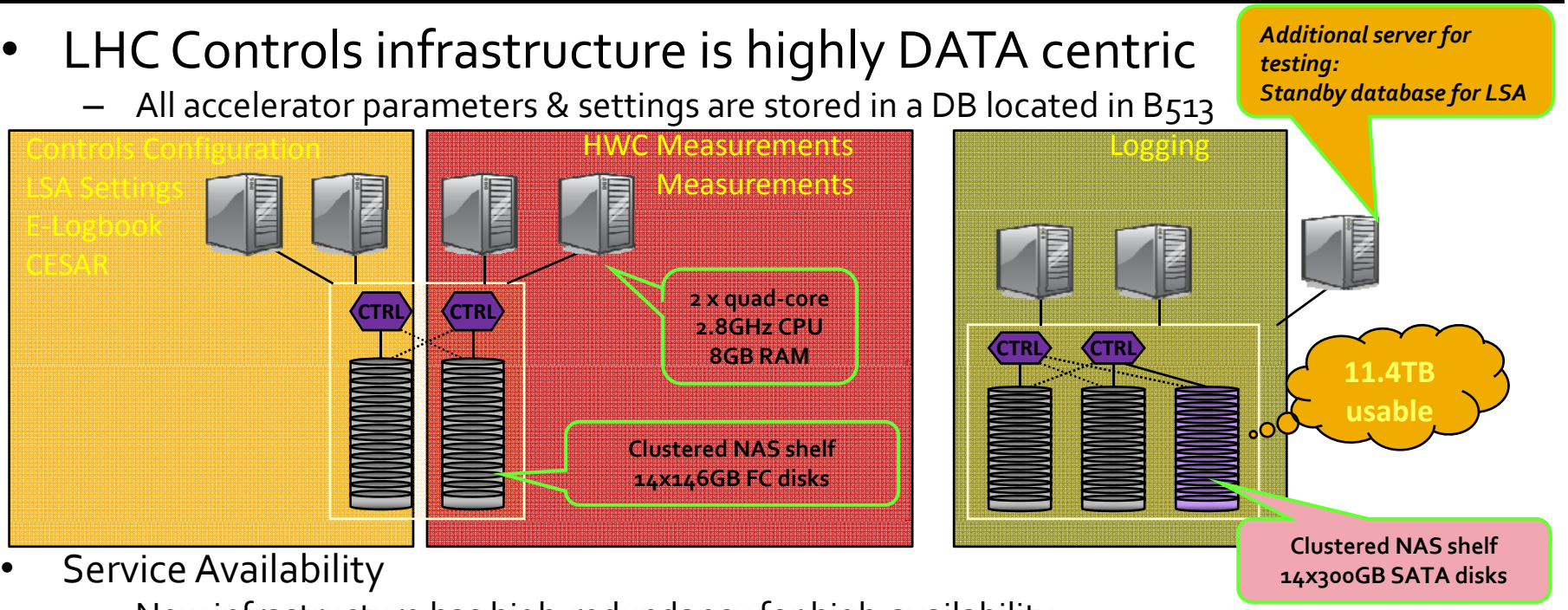
External Hardware Dependencies
Technical Network

- Very **reliable** network topology
- **Redundant** network routes
- Redundant **Power Supply** in routers and switches



External Software dependencies Online Databases

- LHC Controls infrastructure is highly DATA centric
  - All accelerator parameters & settings are stored in a DB located in B513



- Service Availability
  - New infrastructure has high-redundancy for high-availability
  - Deploy each service on a dedicated Oracle Real Application Cluster
  - The use of a standby database will be investigated
    - objective of reaching 100% uptime for LSA
  - The Logging infrastructure can sustain a 24h un-attainability of the DB
    - Keep data in local buffers
  - A 'golden' level support with intervention in 24h
  - Secure database account granting specific privileges to dedicated db accounts

External Software Dependencies
IT Authentication

- Needed online for Role Based Access Control (RBAC) and various Web Pages used by operators
- Not used for operational logins on Linux
- Windows caches recently used passwords

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Redundancies
File & Application Servers

- **Remote Reboot** and **Terminal Server** functionality built in
- Excellent power supply and fan **redundancy**, partial CPU redundancy, **ECC memory**
- Excellent **disk redundancy**
  - Automatic warnings in case of a disk failure
- Several **backup** methods :
  - ADSM towards IT backup
  - Daily or weekly rsync towards a storage place in **Meyrin**
    - Data will be recovered in case of catastrophic failure in CCR
- We are able to restore a BackEnd with destroyed disks in a few hours
- **2nd PostMortem** server installed on the **Meyrin** site

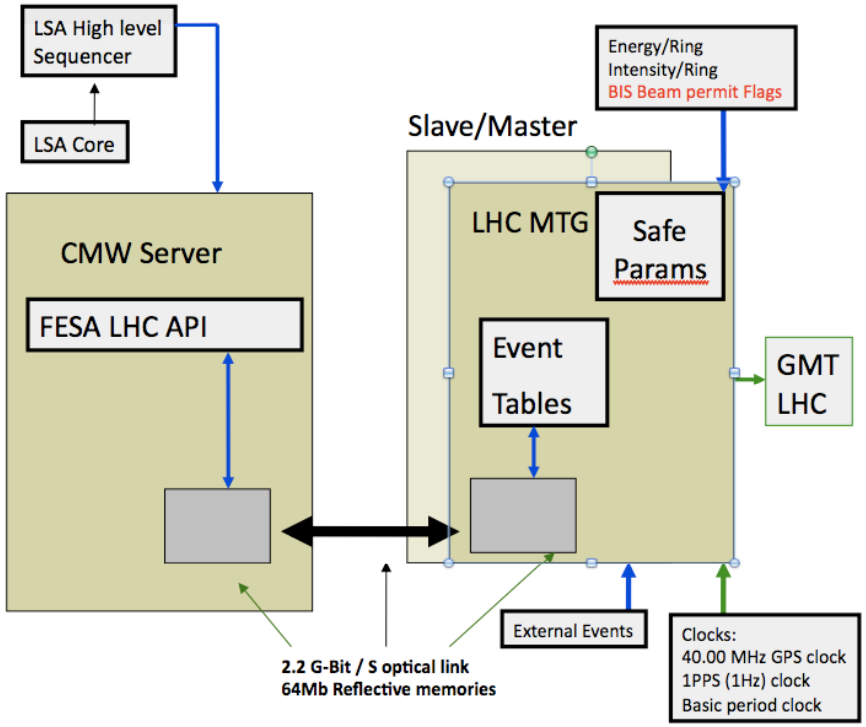
Redundancies
Front Ends

- **VMEs**
  - Can survive limited fan failure
  - Some VME systems with redundant power supplies
  - Otherwise no additional redundancy
  - **Remote reboot and terminal server vital**

- **PLCs**
  - Generally **very reliable**
  - Rarely have remote reboot because of previous point
    - some LHC Alcove PLCs have a remote reboot

Redundancy
Timing distribution

- **LHC central timing**
  - Master, Slave, Gateway using reflective memory, and hot standby switch

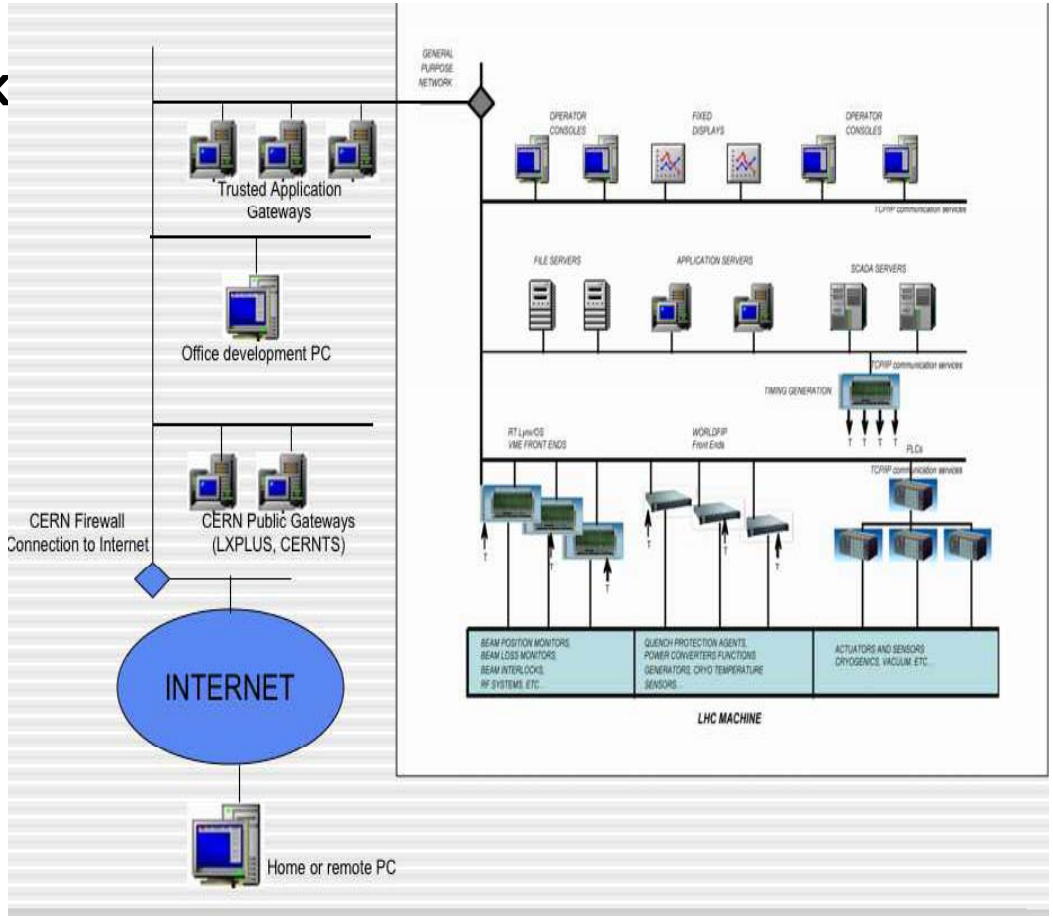


- Timing is distributed over dedicated network to timing receivers CTRx in front ends

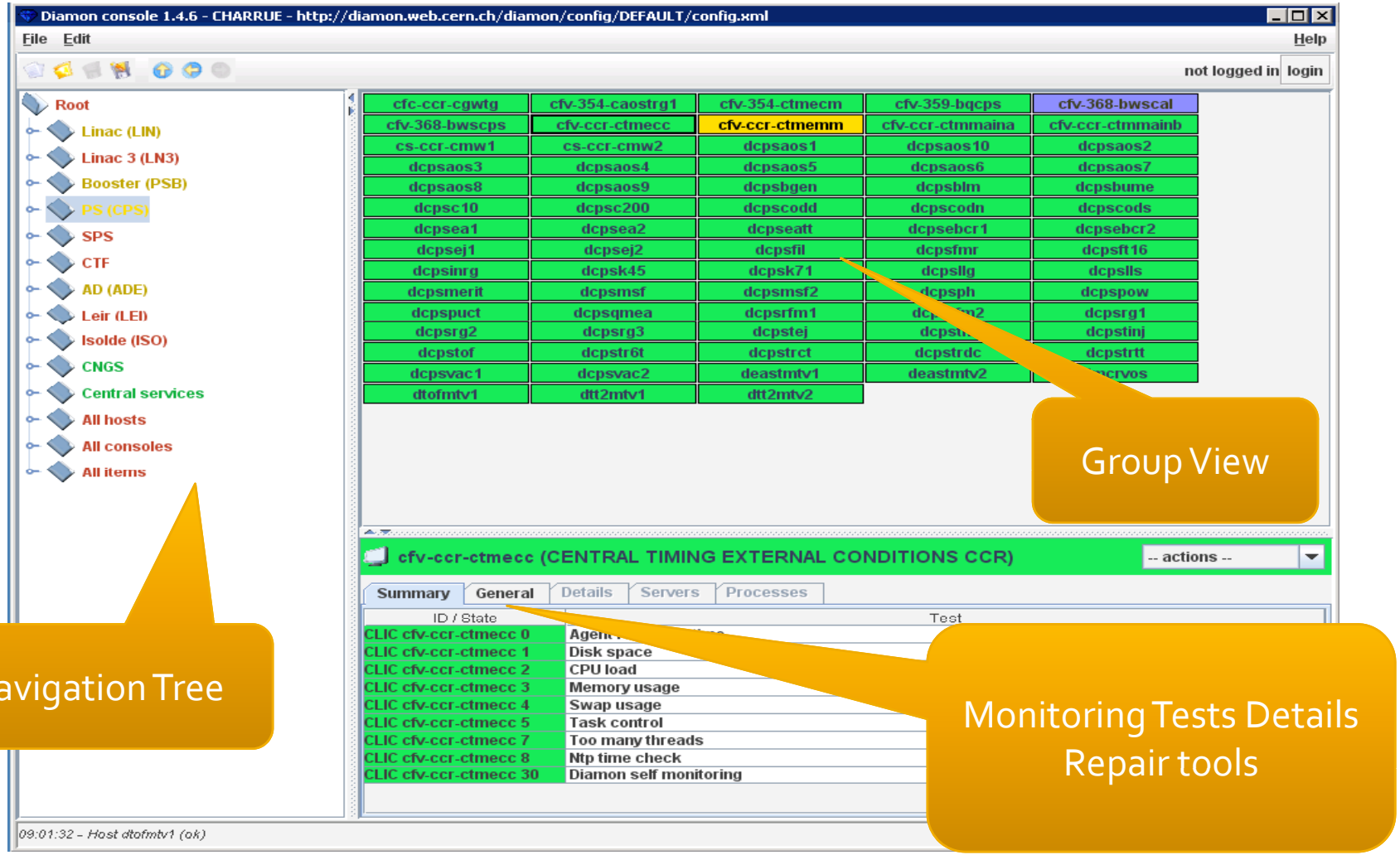
Network Security

Isolation of Technical Network from external access

- **CNIC** initiative to separate the General Purpose Network from the Technical Network
- **NO dependences of resources** from the GPN for operating the machines
- **Very few hosts** from the GPN allowed to access the TN
- **Regular** Technical Network **security scans**



Software Safety and Reliability



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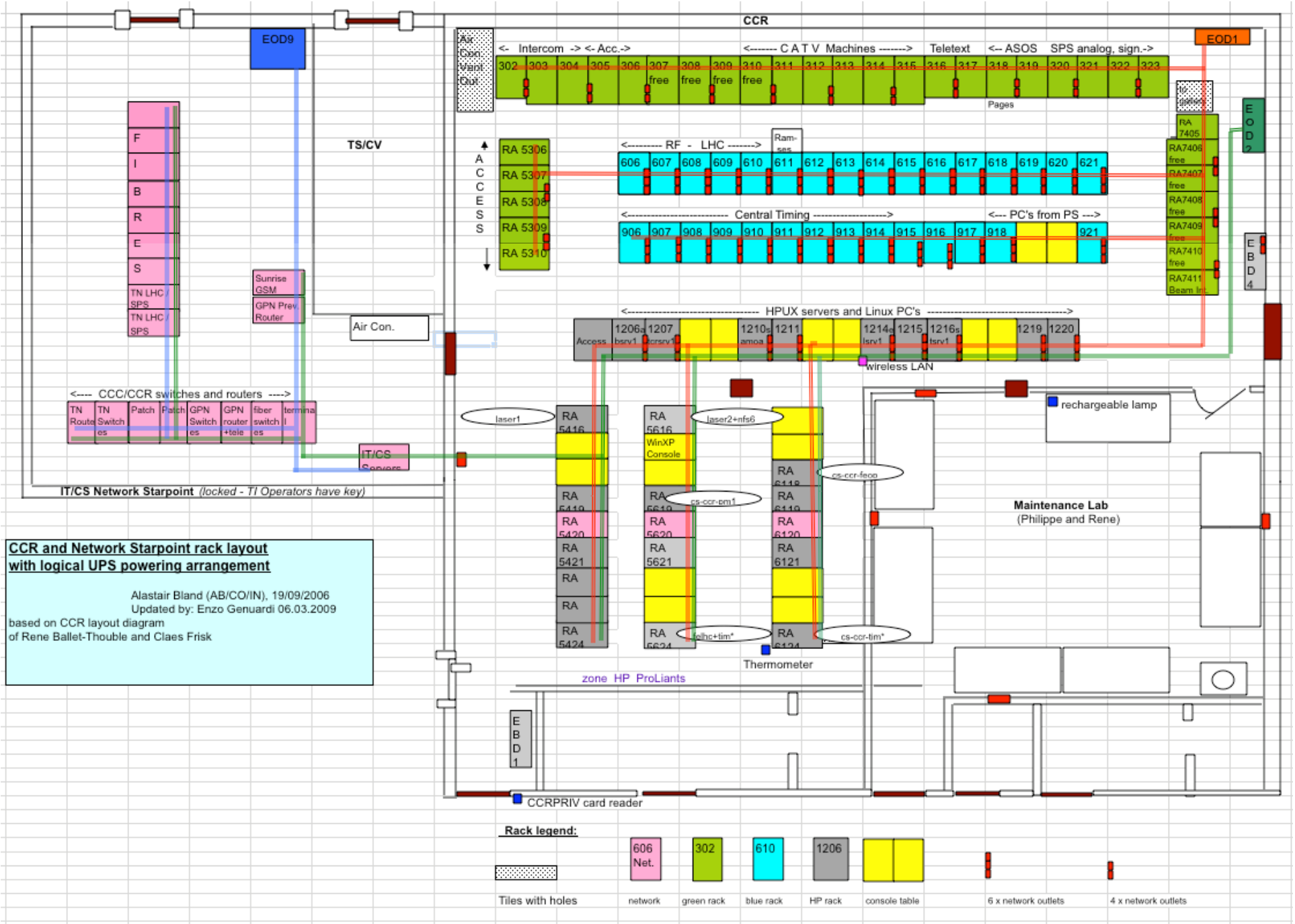
Power Loss

- Power Loss in **any LHC site**:
  - **No access** to equipment from this site
    - **Machine protection** or OP will take action
- Power Loss in the **CCC/CCR**
  - CCC can sustain **1 hour on UPS**
  - **CCR Cooling** will be a problem
  - Some CCR servers will still be up if the **2nd power source** is not affected
  - **10 minutes** on UPS for **EOD1**
  - **1 hour** on UPS for **EOD2** and **EOD9**


CCR
EOD9
EOD1
TS/CV
Air Con.
Intercom -> <- Acc.->
<------- C A T V Machines ------->
Teletext
<-- ASOS SPS analog, sign.->
Pages
ACCESS
RA 5306
RA 5307
RA 5308
RA 5309
RA 5310
<--------- RF - LHC ------->
<---------- Central Timing ---------->
<--- PC's from PS --->
RA 7405
RA7406 free
RA7407 free
RA7408 free
RA7409 free
RA7410 free
RA7411 Beam Int
EOD2
EBD4
F
I
B
R
E
S
TN LHC / SPS
TN LHC / SPS
Sunrise GSM
GPN Prev. Router
<---- CCC/CCR switches and routers ---->
TN Router
TN Switches
Patch
Patch
GPN Switches
GPN router +tele
fiber switches
IT/CS Servers
IT/CS Network Starpoint (locked - TI Operators have key)
<---------- HPUX servers and Linux PC's ---------->
Access
1206a lsrv1
1207 dcrsrv1
1210s amoa
1211
1214a lsrv1
1215 lsrv1
1216s lsrv1
Wireless LAN
laser1
laser2+nfs6
WinXP Console
cs-ccr-feop
cs-ccr-pm1
cs-ccr-tim*
lcolhc+tim*
Thermometer
rechargeable lamp
Maintenance Lab
(Philippe and Rene)
zone HP ProLiants
EBD1
CCRPRIV card reader
CCR and Network Starpoint rack layout
with logical UPS powering arrangement
Alastair Bland (AB/CO/IN), 19/09/2006
Updated by: Enzo Genuardi 06.03.2009
based on CCR layout diagram
of Rene Ballet-Thouble and Claes Frisk
Rack legend:
606 Net.
302
610
1206
Tiles with holes
network
green rack
blue rack
HP rack
console table
6 x network outlets
4 x network outlets

Machine Protection

- The LHC machine itself is protected via a complete Machine Protection System, mainly based of hardware :
  - Beam Interlock System
  - Safe Machine Parameters system
  - Fast Magnet current Change Monitors
  - Powering Interlock System
  - Warm Magnet Interlock System
  - Software Interlock System
- All devices in the PostMortem chain are protected for at least 15 minutes
  - In addition, the source FrontEnds can hold the data locally in case the network is the cause
  - The CCR servers for PostMortem are on UPS for one hour
  - A 2nd PostMortem mirror server is located on the Meyrin site
  - The archives are stored on RAID servers, with 2 levels of backups, one on a backup server maintained by BE/CO on the Meyrin site, and one ADSM backup server maintained by IT in building 513.

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Conclusion

- **High dependence** on electricity distribution, network, cooling and ventilation, databases
- **Emphasis** on the Controls Infrastructure on
  - **Redundancy**
  - **Remote** monitoring and diagnostic
  - Remote reset
  - Quick **recovery** in case of major problem
- The controls infrastructure can **sustain Power loss between 10' and 60'**
  - Special care is taken to secure PostMortem data (collection and archives)