Minutes of LHC-CP Link Meeting 31

Subject : LHC Controls Project

Date : 3rd December, 2002

Place : Pavilion Conference Room, Bld 936-R-030

Participating Groups :

LHC-ACR	no representative,
LHC-ECR	no representative,
LHC-IAS	H.Milcent, C-H Sicard,
LHC-ICP	A. Hilaire,
LHC-MMS	no representative,
LHC-MTA	no representative,
LHC-VAC	R. Gavaggio, I. Laugier,
PS-CO	B. Frammery, K. Kostro,
SL-AP	no representative,
SL-BI	no representative,
SL-BT	E. Carlier,
SL-CO	A. Bland, E. Hatziangeli, R. Hopkins, C. Frisk,
SL-HRF	E. Ciapala, L. Arnaudon,
SL-MR	R. Billen,
SL-MS	no representative,
SL-OP	M. Lamont,
SL-PO	Q. King, S. Page,
ST-MA	apologies,
IT-CS	P. Anderssen, J.M. Jouanigot, D. Francart, M. Zuin.

Others : A. Daneels (Planning),
R. Lauckner (Chair),
M. E. Angoletta (Scientific Secretary),
B. Puccio, R. Schmidt (Machine Protection),
M. Tyrrell (Alarm Sub-Project),
M. Vanden Eynden (Core Team).

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Notification via: **lhc-cp-info@cern.ch**

Agenda :

1. Matters arising from Previous Meetings.
2. LHC-CP News – R. Lauckner
3. Introduction to the IT-CS Group - P. Anderssen
4. Accelerator network upgrade project - J.M. Jouanigot
5. LHC network configuration - D. Francart
6. Real Time, status report on the test bench in SM18 - M. Zuin
7. AOB.

1. Matters arising from Previous Meeting

There were no matters arising from previous meetings.

2. LHC-CP NEWS

Robin commented on the 'Outstanding Points' mentioned at the end of every LHC-CP minutes. He said that it is not clear yet how to deal with them in this transition period, and we'll have to sort that out.

3. INTRODUCTION TO IT-CS GROUP (Pal Anderssen)

Pal is the leader of the IT-CS (Communications Systems) group. Two years ago the group became responsible for the LHC communication infrastructure and the accelerator and services network. The group is more generally responsible for the planning, installation, upgrade, operation and support of CERN networking infrastructure. After describing the group mandate and organisation, Pal underlined that any network need should be expressed as soon as possible, so to give enough time to his group to plan and carry out the installation.

Claude-Henry Sicard asked whether the IT-CS group will take care of requests from the accelerator sector only or also from experiments. Pal answered that the underground electronics depends on the Tunnel Electronics Working Group (TEWG), and that there are no official channels for requests from experiments. Robin enquired about the slow controls for experiments, and Pal answered that that IT-CS will address the networking for slow control in the LHC experiments in collaboration with the IT-CO group.

Axel Daneels remarked that there were cases of requests sent but not satisfied. Pal answered that the infrastructure is not yet completely in place, (the new Technical Network was only available in the LHC service areas at this time) and that they need more time to get organised. Pierre Charrue underlined that all users as well need to get organised so to have a clear idea on who will handle the request.

4. ACCELERATOR NETWORK UPGRADE PROJECT (Jean-Michel Jouanigot)

Jean-Michel Jouanigot talked about the new Technical Network (TechNet). The new TechNet is foreseen to replace the SPS, PS and service networks. It will also integrate the LHC controls; Daniel Francart will speak about LHC network in the following talk.

The TechNet will carry security information and, for security reasons, no direct access from Internet will be allowed. The electronics parts of it will be new, while it will share cables and infrastructure with the non technical network. The TechNet infrastructure is geographic and the network is divided into four areas, namely LHC area, SPS and Prevessin area, PS area and Meyrin area excluding PS. The technical network will interface with the general one via only two cables, provided with two security fuses aimed at keeping hackers out. Such fuses should not interfere, in principle, with TechNet's internal work. Robin pointed out that it is difficult to know all the technical interdependencies that may exist, at any time, between the two networks. As a consequence, periodic fuse openings should be scheduled with the aim to ascertain a) the existence of such interdependencies and b) the effects of the fuses on TechNet's internal operation. These openings would also allow the fuses efficiency to be tested.

Jean-Michel continued by giving an overview of the TechNet in the PS and SPS areas. A considerable amount of work is being carried out as a part of the TechNet Rejuvenation project, such as updating the cabling infrastructure and installing new equipment. The current network prefix 128.142 will be replaced by 172.18, and this will call for the intervention of the person-in-charge of each and any device on the network. The presence of the security fuse between Technical and GPN networks also implies that IT-CS will have to develop independent services such as DNS and TS to allow the TechNet to work even with an open fuse.

Robin asked whether the TechNet will carry any Alarm Level 3 information. Jean-Michel answered that Alarm Level 3 information will use both general and technical networks, while Access Interlocks will use their own fieldbuses and Surveillance will use the technical network. A possible problem is then to conceive applications that can connect to both networks and react well when one of the networks goes down.

Rudiger Schmidt asked about the use of UPS in case of power cuts. Jean-Michel answered that this is a big problem for the whole of CERN. However, by next year a solution might be in place for LHC, by using the ST/EL network.

In reply to Bertrand Frammery's question, Jean-Michel pointed out that it will be possible to have the fuses open when the LHC beam is circulating. However, not all services required by the Control Room will be available.

Claude-Henry asked about the maintenance window, in particular what type of intervention (software and/or hardware) and how much time was foreseen. Jean-Michel answered that maintenance interventions will be needed about twice a year and services will be interrupted for a few minutes each time. To that type of interruption one has to add any breakdown and failure. In addition, there will be "Tests of emergency stops", that will involve the TechNet only. Finally, the network will not be more reliable than the electricity network.

5. LHC NETWORK CONFIGURATION (Daniel Francart)

Daniel started by giving an overview of TechNet main hardware, namely the Router (Enterasys X-Pedition 8600) and the Switch (3Com SuperStack 3 Switch 4400). He then described the LHC TechNet Fibre Topology, stressing the fact that the redundant topology allowed each point in the network to be accessed by the Computing Control Room (CCR), the MCR and the PCR by 2 independent routes.

Daniel concluded his talk by giving an overview of the TechNet Gigabit backbone structure (which includes an active redundancy whereby each point has a 2 Gbit/s capacity towards the two routers) and of the peripheral LHC topology.

Answering a question by Philippe Gayet, Daniel said that redundancy will be provided in every location with a difficult physical access.

Marc Vanden Eynden asked whether commissioning facilities such as mobile consoles will be available in the tunnel. Daniel answered that there will be very few such facilities, since they will be sort of "throwaway" equipment, since they will have to be thrown away as soon as they become irradiated by the beam.

Quentin King asked whether Ethernet ports will be available in the tunnel, and the answer to that was negative. Rudiger then asked whether they will be allowed to pull cables. Quentin added that the Power Supply group was already thinking about a serial interface to use during the commissioning period. It is clear, anyhow, that a more powerful interface was needed in case one wants to connect for instance to the database. Robin then underlined that other systems, such as quench protection and vacuum, will have similar requirements.

6. REAL TIME, STATUS REPORT ON THE TEST BENCH IN SM18 (M. Zuin)

Marianna reported the results of several measurements carried out on a pilot network installation deployed in the SM18 test facility. The network devices tested were two kind of Switches and one router. The measurements carried out included device latency and kilometric distance measurements. Finally, a small network including several routers linked by different link length was tested.

The results for all tests agreed with the foreseen behaviour. It was also shown that the delay due to transmission and travelling time is more relevant than that due to network devices, in the network latency calculation.

The meeting ended with some general questions concerning all presentations.

Bruno Puccio asked whether the Network Time Protocol (NTP) will be provided. The answer was that IT/CS will provide NTP servers.

Quentin asked about the lifetime of the network hardware. Jean-Michel answered that the manufactures are committed to support the hardware until 2008. In any case, the IT/CS job is to put the infrastructure in place. If the job is well done and if there is the need to change some network component, it will be likely that only single boxes will have to be changed, and nothing else.

Outstanding Points

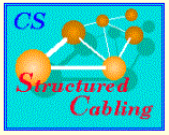
1. Requests for network connections and feedback is not working

2. A temporary network infrastructure is needed in the tunnel during hardware commissioning

Long-Term Actions	**People**
Common power circuit database requirements	R. Schmidt
Underground Control Rooms requested	R. Lauckner
Establish Post-mortem sub-project	R. Lauckner
Clarify Middleware Services to be used by LHC-CP	AB-CO TC

Reported by M. E. Angoletta

Communication Systems



Technical Networking Support

IT-CS Interfaces and Internals

LHC Controls Project Meeting

3 December 2002

Pål S. Anderssen

Jean-Michel Jouanigot

Daniel Francart

Marianna Zuin

IT-CS

IT-CS

Network Support Organization

- Three activity lines in IT-CS:
  - The infrastructure team
    - Collects site requirements
    - Installs the passive and active infrastructure
      - Cabling is executed by ST-EL
    - Verifies and tests the installation
  - The network first line team (SLA)
    - Receives connection requests (from e-form)
    - Enables the port and provides the cable
  - NETOPS
    - Receives requests for network extensions (example: outlet too far away from network device)
    - Feeds request back to infrastructure team

IT-CS

Installation Sites

- In the LHC underground areas
  - The LHC-TEWG will coordinate equipment space requirements
  - The Infrastructure team will work with TEWG and the groups involved to ensure that sufficient network outlets are available where needed
- In the LHC surface buildings
  - There is no central space management
  - Need to work with each equipment group

  and
  - The space coordinator when such a person exists

IT-CS

Nota

- Installation planning and execution takes more time than you may think;
- Unexpected and unfavorable circumstances will always pop up;
- Hence, make your needs known as soon as possible

I thank you for the attention -

The new Technical Network

Jean-Michel Jouanigot IT/CS

- The new Technical Network; general overview
- Technical Network Rejuvenation project

- Daniel will present the TechNet in LHC in more details

New Technical Network General Overview

The new Technical Network will replace the SPS, PS and "service" networks and Integrate LHC controls

All merged into ONE single infrastructure

The New technical Network

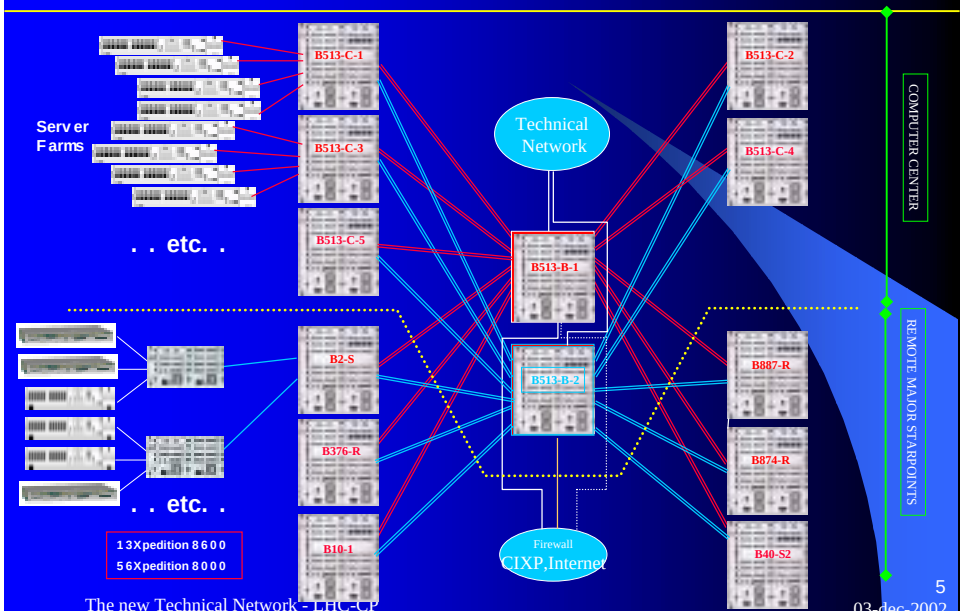
- One global infrastructure but two (sub)projects
  - For LHC
    - Redundant infrastructure
    - Surface topology ready by end 2002 (no full redundancy)
  - For SPS, PS, Meyrin, Prevessin
    - Rejuvenation plan without redundancy and 100 Megabit/s backbone
- Integrated, with the GPN, into one single 24x24, 365x365 support schema
  - One database
  - One helpdesk
  - Same tools and procedures
- Taking care of some specificities

TechNet specificities

- Maintenance windows agreed with Technical and Accelerator sectors
- Priority in case of failure
- Carries security information ("alarmes de niveau 3")
- No Direct Access from Internet (security)

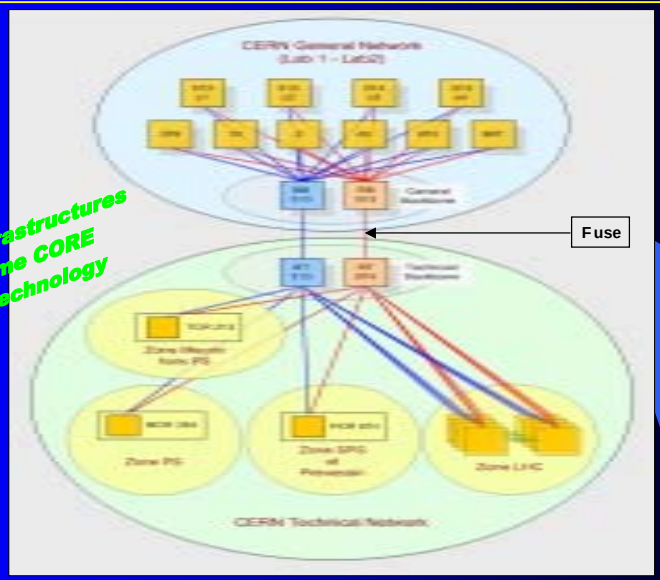
- ➔ Dedicated active infrastructure

CERN MULTI-GIGABIT BACKBONE REDUNDANT STRUCTURE OVERVIEW

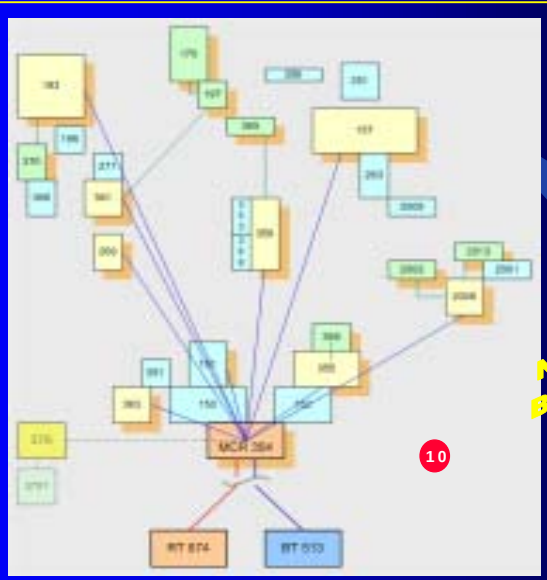


The Global view

Two Active Infrastructures using the same CORE redundancy technology

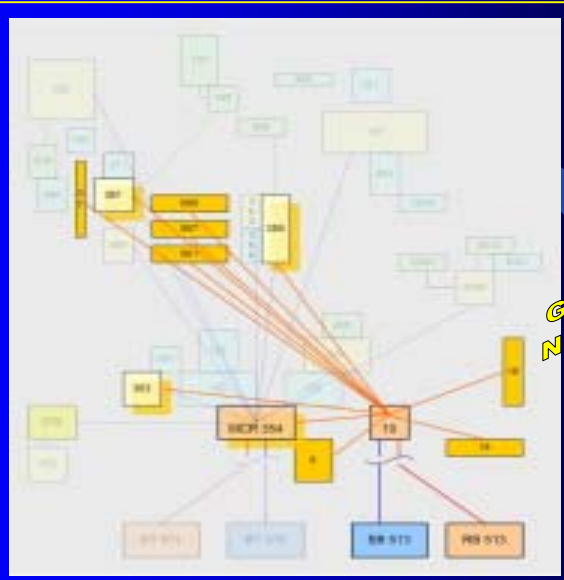


TechNet in PS area



No redundancy
Not INB compliant
Being implemented

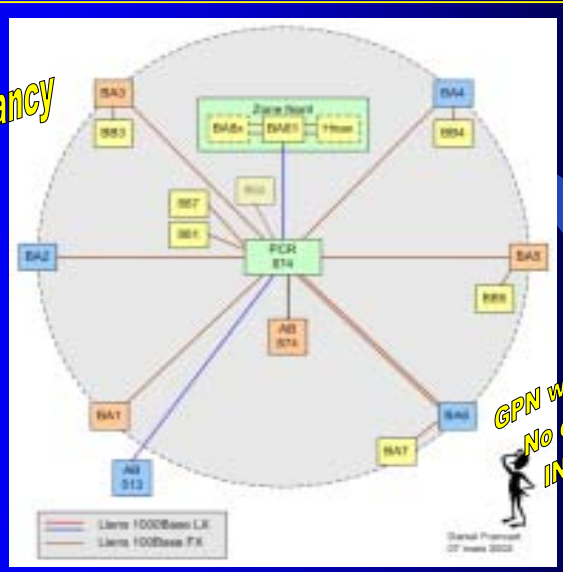
TechNet and GPN in PS area



GPN also present
No common mode
INB compliant

TechNet in SPS area

No redundancy



GPN will also be present
No common mode?
INB compliant?

What we will do / are doing

- Update the cabling infrastructure
  - Change sockets (UTP5e)
  - Replace some cables (shielded when required)
  - Reorganize/change racks
  - Lock racks (➔ move some systems out!)
  - Create new starpoints
  - Reinforce power system (dual power source)
  - Adapt/reinforce the fiber cabling infrastructure
  - Enter the new infrastructure in our databases
- Install new Equipment
  - Routers SSR-8600 for Backbone & control rooms
  - 3COM switches 4400 in all starpoints where power hubs or Catalyst were present
  - Keep most of the Ethernet hubs

In practice…

- **A LOT of work**
  - ~2'000 plugs to adapt, hundreds of equipment to install
- Planning
  - LHC area: Backbone ready, connections starting
  - PS area: 4Q2002-1Q2003: IN PROGRESS
  - TCR, Meyrin, LHC surface: 2Q2003-3Q2003
  - SPS: 4Q2003-1Q2004
- A new network prefix
  - 128.142 replaced by 172.18
- Fuse between the Technical network and the GPN
  - Independent DNS, TS, etc managed by CS
- Tools adaptations
  - Network monitoring (Spectrum will replace OpenView)
  - Database adaptations (SL network database integrated)
  - End node monitoring

In practice… The result

- Starpoints are not dedicated anylonger
  - The passive infrastructure (UTP, fibers, starpoints) is common
  - The active equipment is either Technical network or GPN; both can coexists in the same starpoint
  - The new technical network has a geographical topology (as the GPN)
- Starpoints
  - Locked, managed by CS
- Routers and switches
  - Enterasys & 3COM
  - Current terminal servers are included
- Same service definition as the GPN (IP, PB)
  - Very small subnets, at least one service per starpoint, subnets are not shared across starpoints
- Connections to this infrastructure are controlled
  - New WEB interface will implement a mechanism

The new Technical Network

Questions?

TECHNICAL NETWORK
LHC TOPOLOGIE

MATERIAL OVERVIEW

LHC FIBER TOPOLOGIE OVERVIEW

GIGABIT BACKBONE REDUNDANT STRUCTURE OVERVIEW

PERIPHERAL LHC TOPOLOGIE OVERVIEW

QUESTIONS

TECHNICAL NETWORK MATERIAL OVERVIEW

Enterasys X-Pedition 8600 Router

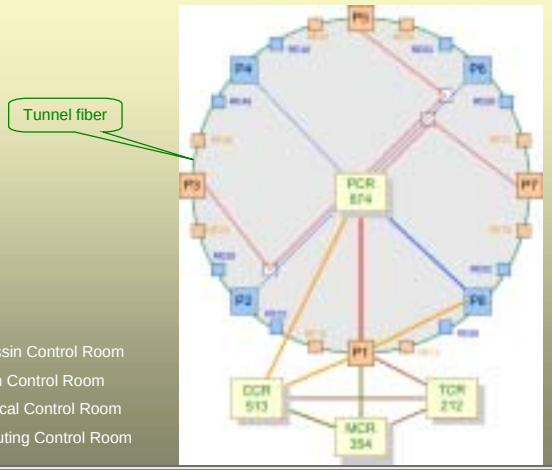
- 32 Gbps non-blocking switching fabric
- 30 Mpps routing throughput
- Hardware ports routing
- Up to 240 10/100 Mbps ports
- Up to 60 Gigabit Ethernet ports
- Hot-swappable interface modules
- Redundancy 2 power supply (220V AC - 48V DC)
  2 Control modules
  2 Switch fabric
- QoS based on Layer 2, 3 and Layer 4 information
  4 queues = 4 profiles

TECHNICAL NETWORK MATERIAL OVERVIEW

3Com SuperStack 3 Switch 4400

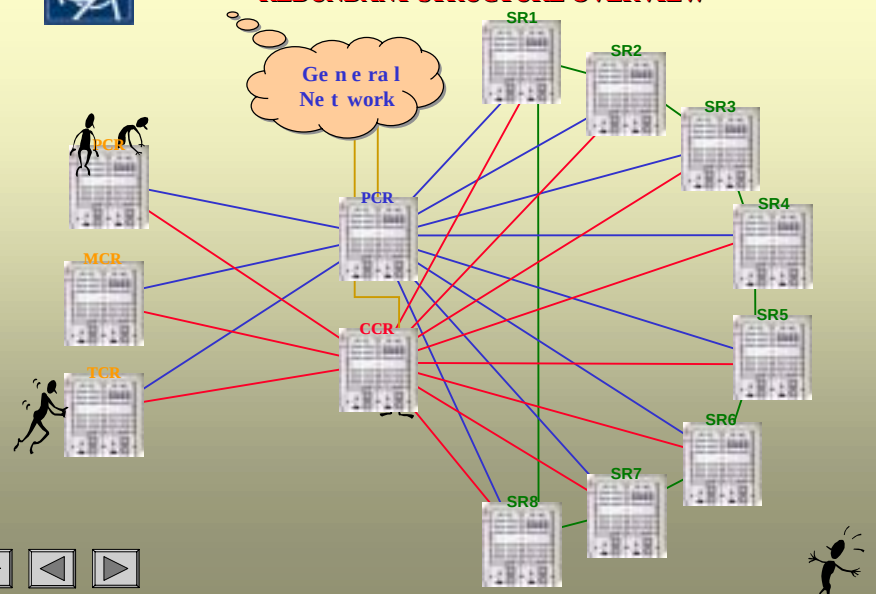
- 8.8 Gbps non-blocking switching fabric
- 6.6 Mpps switching throughput
- 24 10/100 Mbps ports
- 2 Modules uplink 100B FX / 1000B T SX LX
- QOS Priority level and traffic type
  - 8 Levels of priority
  - Classifier by transport protocols (tcp udp)
  - Classifier by application protocols (http snmp)
  - Classifier by IP address
  - Classifier by identification packets (dscp)
  - Classifier by ports (all packets)
  - 4 queues = 4 profiles

TECHNICAL NETWORK
LHC FIBER TOPOLOGIE OVERVIEW

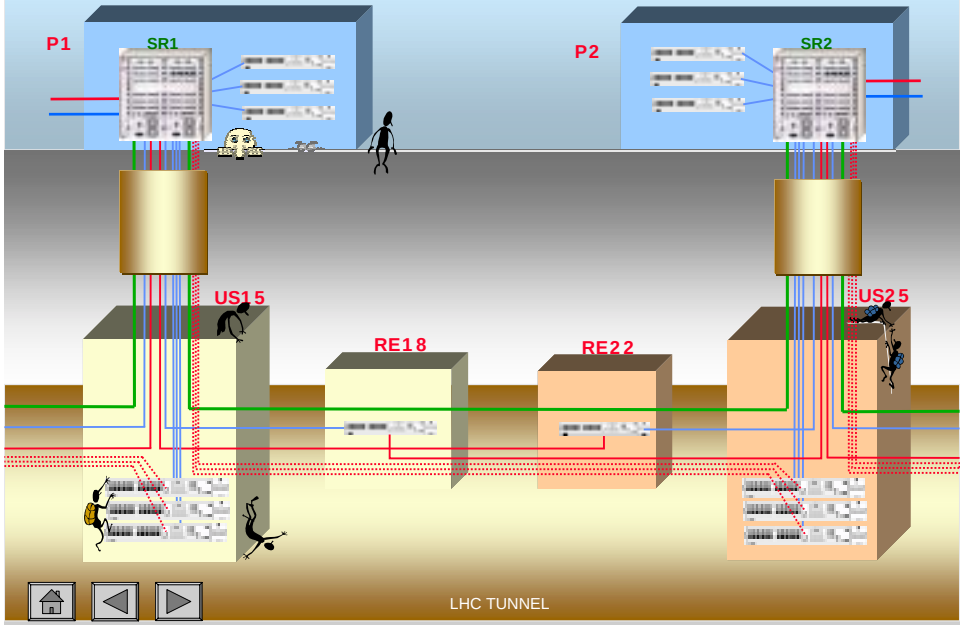


PCR Prevessin Control Room
MCR Meyrin Control Room
TCR Technical Control Room
CCR Computing Control Room

TECHNICAL NETWORK GIGABIT BACKBONE REDUNDANT STRUCTURE OVERVIEW



TECHNICAL NETWORK – P ERIP HERALLHC TOP OLOGIE OVERVIEW



TECHNICAL NETWORK LHC TOP OLOGIE

QUESTIONS

SM18 Pilot Installation Measurement Results

Daniel Francart
Jean-Michel Jouanigot
Marianna Zuin

CERN IT/CS

Technology Features

- Fast Ethernet = 100 Mbps
- Gigabit Ethernet = 1000 Mbps
- In fiber links:
  signal speed = 2/3 slower than light speed

0.2 km/us

Fiber traveling time = 1 km /5 us

Network Devices Tested

- 3Com®
  SuperStack® 3 Switch 4400

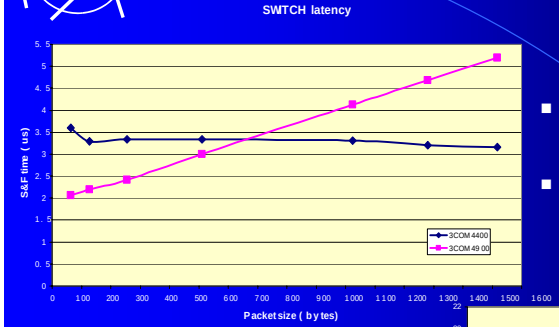
- 3Com®
  SuperStack® 3 Switch 4900

- Enterasys Networks™
  X-Pedition Switch Routers

Measurements Carried Out

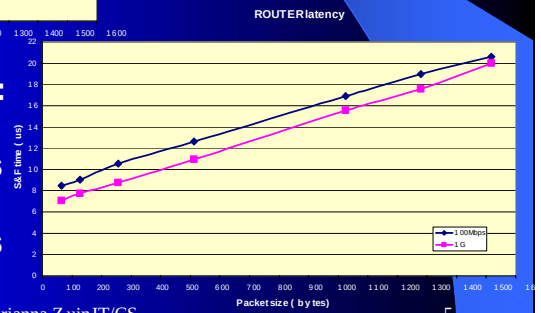
- Single network device latency tests
  - 3Com switches
  - Enterasys routers
- Kilometric distance tests
  - Two routers connected by a fiber link of different lengths (1, 2.5, 5, 10 km)
- Small network tests
  - Networks with three and four routers
  - Different link lengths between the routers

Single Device Results

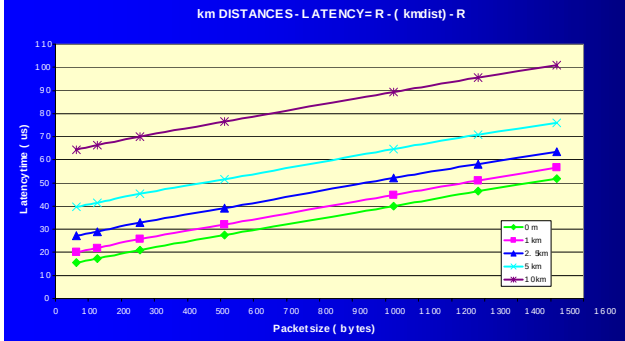


- 3Com 4400 (100Mbps):
  - ~3.3 us
- 3Com 4900 (1000Mbps):
  - ~2 us TO ~5 us

- Enterasys 8000 & 8600:
  - 100Mbps
    ~8.5 us TO ~20.5 us
  - 1000Mbps
    ~7.0 us TO ~20.0 us



Kilometric Distance Results



Fiber traveling time:
1.0 km = ~ 5.0 us
2.5 km = ~ 12.5 us
5.0 km = ~ 25.0 us
10.0 km = ~ 50.0 us

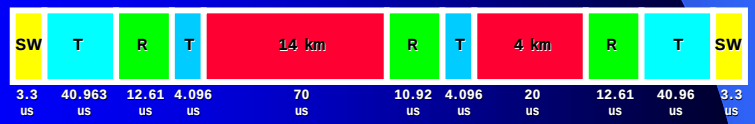
Approximations (Confirmed by Tests)

- Possible path: ***Point 5 towards Control Room***

0 m (100Mbps) — 14 km (1000Mbps) — 4 km (1000Mbps) — 0 m (100Mbps)

SW - R(SR5) —— R(CCR) —— R(PCR) - SW

- Total Time: 222.85 us (512 byte packet)



20% Network devices

80% Transmission time

Conclusions

- All test results are
  - Not surprising
  - Consistent
  - Coherent

- Major result:
  - In a whole network latency calculation, the delay due to the transmission time and to the traveling time is much more relevant than the delay due to the network devices under test.

Future Tests

- Latency and jitter under high traffic load
- Efficiency of Quality of Service