HIGH INTENSITY PROTON ACCELERATOR CONTROLS NETWORK UPGRADE

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Abstract

The High Intensity Proton Accelerator (HIPA) control system network is spread through a vast area in PSI and it was grown historically in an unorganized way. The miscellaneous network hardware infrastructure and the lack of the documentation and components overview could no longer guarantee the reliability of the control system and the facility operation.

Therefore, a new network, based on modern network topology, PSI standard hardware with monitoring and detailed documentation and overview was needed. We would like to present how we successfully achieved this goal and the advantages of the clean and well documented network infrastructure.

INITIAL SITUATION

The HIPA control system network components and nodes are located in about six buildings. It expanded during many years, often with ad-hoc requirements. It consisted of about 25 network switches of various manufacturers, 150 computer nodes and 20 operator consoles. Numerous problems started to arise with ever increasing frequency.

The lack of general HIPA control system network overview made the system administration difficult. Problems with performance, such as bottlenecks during data transfer between the private machine network and the PSI office network, led to the situation when no central backup and operating system update, by using the PSI standards, were possible.

Further there were problems, based on the network topology. A cascade topology rather than a star topology had evolved over the years.

Another problem we encountered, related to the maintenance of network components. In particular, switches have been installed from a multitude of suppliers and so it was almost impossible to install replacements from our emergency stock. This was a risky situation for the facility operation.

And finally the network administration was not satisfactory. Central monitoring was not possible at all, because most of the network components did not support management or monitoring.

The original situation can be seen on Fig. 1. It shows switches of various manufacturers, often connected in cascade, in six buildings. This diagram has been created after a detailed analysis of the current situation at the facility during November 2010. Fig. 2 illustrates cascaded production switches from various manufacturers used until the end of 2010.

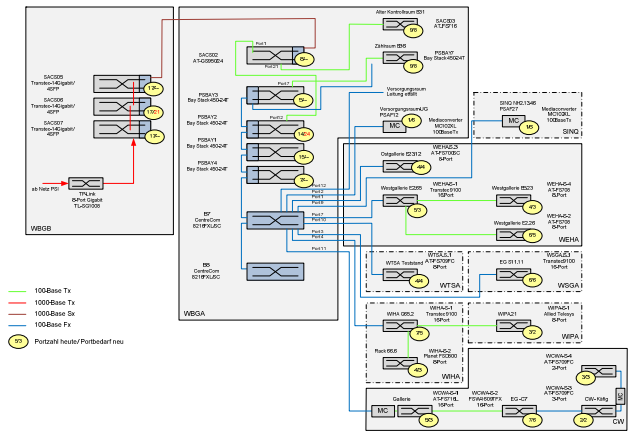

Figure 1: The HIPA network overview after the current status analysis in November, 2010.

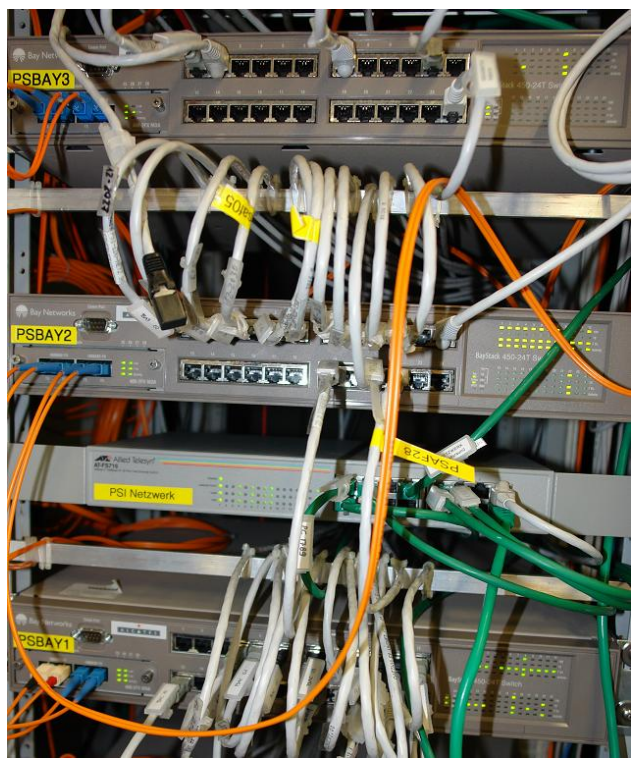

Figure 2: Different flavour of network switches running in HIPA Controls network until the end of 2010.

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PROJECT GOALS

The main goal for the HIPA network migration was to build a highly available, stable and scalable network with low complexity and dependencies. This should mainly lead to the improvement of network performance. Furthermore, network administration and hardware maintenance should be more simple and effective. Network design topology should be according the PSI standards with network monitoring. The project should be well documented in order to supply overview and useful information for the facility operation or for people on the on-call service.

PROJECT PLAN AND REALISATION

Three teams collaborated intensively during the project preparation and realisation: At PSI these were the Controls and AIT Network groups and the external company KeyNet Consulting GmbH [1].

Based on the analysis of the current situation, a new design based on the star topology was created, see Fig.3.

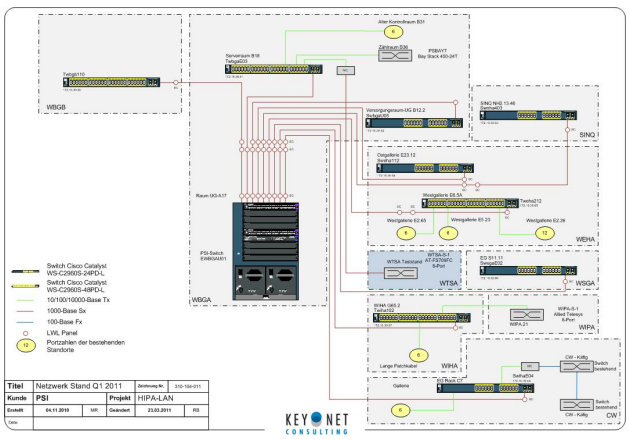

Figure 3: The new network design based on the star topology, PSI standard.

Afterwards, a more detailed project plan was elaborated. This included a schedule for ordering and purchasing of switches and other components; and cabling specification for the Electrical engineering division.

The cleanup of nodes in the new and old server rooms and control rooms has been done. The configuration of operator consoles, servers, and other computing components has been unified. Redundant computers have been removed.

One of the biggest challenges of the network realisation was the tight time scheduling during the HIPA shutdown period. An important part of the project was the cabling realisation. Because of minimal resources, it was difficult to schedule the network recabling to the electrical shutdown plan. All the activities had to be independent of other shutdown activities, such as components and machine tests. And finally, the successful operation start-up schedule had to be guaranteed. Another challenge was the fact that we could enter some locations only for a very short period because of high radiation. This was for example, the building in which the ion source and the Cockcroft-Walton accelerator are located.

RESULTS AND ACHIEVEMENTS

The HIPA proton accelerator control system runs now on a modern scalable and stable PSI standard network.

Network Homogeneity

The number of active components has been reduced from 25 to 9 Cisco Catalyst 24- or 48-port switches. They are the same type as other PSI switches, thus a replacement emergency stock is not an issue anymore.

Performance

We could observe performance improvement, thus the computers can receive the PSI updates and servers are connected to the PSI central backup system.

DHCP and DNS

DHCP and DNS administration has been reorganized by using the PSI standard infrastructure.

Cabling

Cabling and patching work has been done meticulously. Many unused connections have been unplugged and hundreds of meters of cables removed. This led to a better physical overview.

Monitoring

The HIPA network is now monitored by using the PSI standard tool, NeDi (Network Discovery) [2] and the information is visible to the Controls section on the intranet, see Fig. 4.

Documentation

Even the documentation has been written during the each process of the HIPA Network Upgrade, we realized on-line documentation generated directly from the Oracle database. All the information was updated in the Controls Database Inventory [3]. The tool generates various reports in the form of maps and diagrams working directly with the data stored in the database. They can be displayed on the PSI intranet Web, see Fig. 5.

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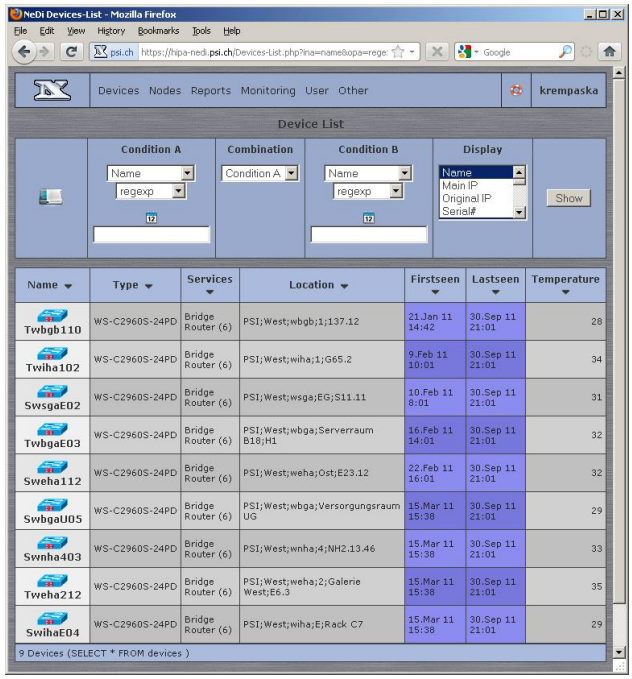

Figure 4: HIPA switches and nodes are monitored by a PSI Network monitoring Web tool NeDi.

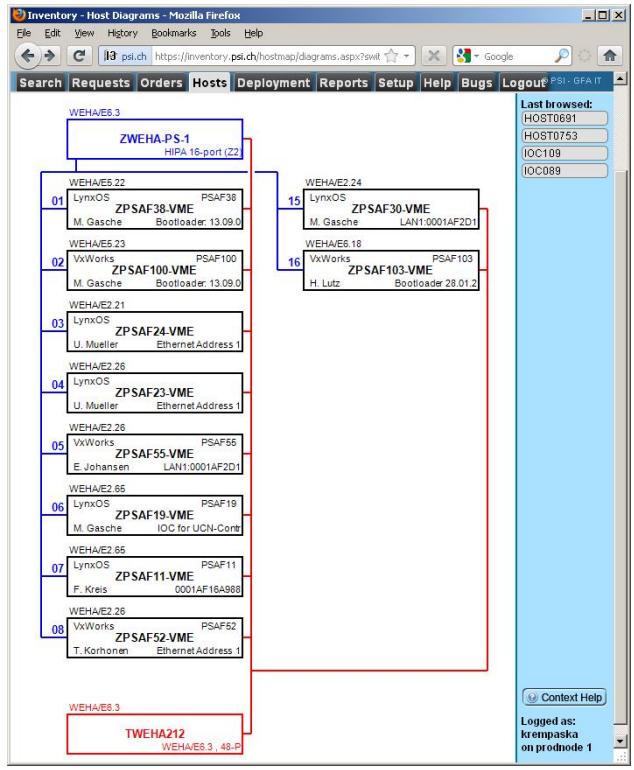

Figure 5: The diagram shows a switch and the nodes connected to it (red lines). These VME IOCs have serial connections to a port server (blue lines).

ACKNOWLEDGMENTS

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[1] R.Krempaska, H. Lutz, F.Lendzian, PSI, Villigen, M.Rutz, R. Boesch, KeyNet Consulting GmbH, Projektabschlussbericht Redesign HIPA-Network
[2] http://www.nedi.ch/
[3] http://gfa-it.web.psi.ch/invent_help/

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