EXPERIENCING WINDOWS NT FOR ACCELERATOR CONTROL SYSTEMS

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Abstract

At the INFN-LNS a big effort is produced to improve and upgrade the accelerators control system. The new projects and facilities under development give us the opportunity to re-design the architecture of the old control system in order to match the new technologies nowadays available. The most innovative characteristic of the new design is the use of PCs running Windows NT at any level of the architecture. It is the application software that characterizes the functional role of the machine and not the hardware configuration. Considering the relative young age of Windows NT, especially in accelerator control systems, it is important to evaluate very carefully its behavior in terms of functionality, reliability, system management, performance and security. On the other side, it is well known that a wide choice of programming languages and instruments drivers is available for this operating system. Moreover, a dedicated communication driver based on a client-server model was also developed in order to optimize the management, the reliability and the security of the data exchange over the network.

We will present the architecture including the Control Local Area Network and an evaluation about the general versatility of the architecture itself.

1 INTRODUCTION

The investigation on using new operating systems to be used as platform for accelerators control system is a very important activity that has two general reasons of interest: the design of new architectures and the upgrading of old, often obsolete, control systems. The very short mean life that nowadays affects the typical hardware and software components of a control system induces, often forces, the system manager to devote a big effort for the system upgrading. It is necessary to avoid that also the best performing and reliable architecture can be seriously compromised by the not availability of spare parts or by the incompatibility with modern and powerful software tools. Of course, also the complexity and resources requirements are quickly increasing so that not only the technical specifications but also the human resources availability have to be taken in account.

2 THE NEW LNS CONTROL SYSTEM

At the LNS, the installation of new facilities as well as the problem to upgrade those parts of the old control system not more supported were the reasons to start, few years ago, the design of a new architecture. We decided to investigate the possibility of using Windows NT starting from two simple as well as important considerations: Windows NT is the only operating system which characteristics better match the typical control system requirements, furthermore, it is the operating system best supported by the hardware and software development companies. The highest level of standardization is a strategic decision in order to improve the control system mean life and to optimize the human resources availability, typically very limited with respect the research projects dimensions.

2.1 The Architecture

This analysis on the Windows NT features is related to the control system architecture designed at the LNS, that can be considered the natural evolution of the previous one [1][2] designed more than ten years ago. We decided to save the typical three levels architecture modifying only the hardware platform and the operating system at any levels. The most important evolution was the introduction of Windows NT as operating system in the two upper levels of the architecture where Personal Computers are used to implement the console workstations and the control stations. Another important step was the upgrade of the Local Area Network (Fig.1).

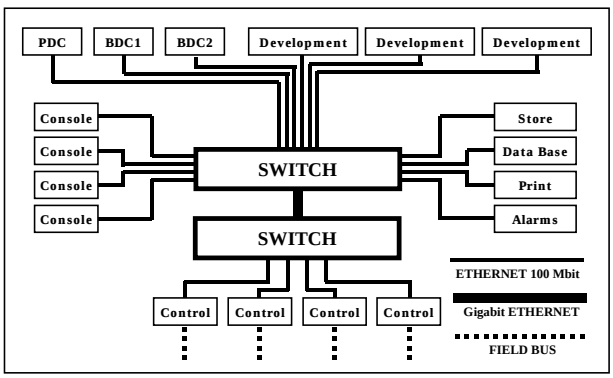

Figure 1: The LNS Computer Control Architecture.

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2.1 The Domain Administration

The administration of an accelerator control system requires several kinds of operations related to users, computers and resources management. We found very useful the use of the Windows NT administrative tools to perform those operations that are required to be executed on local as well as remote target computers.

One Windows NT Domain groups all the PCs that have to be managed. The administrative stations, one Primary Domain Controller and two Backup Domain Controllers, are located in a dedicate room together with the computers used as printers server, mass storage devices and software distribution; a separate physical location as administrative point permits an efficient management without any interference with the console operations.

The users manager allows to implement not only the database of the authorized users, but also all the security and permission related with the users. Four general user groups were defined: administration, development, operators and guest. The user manager also implements the user roaming profile where are stored the information related to the personal desktop configuration and also to the configuration of the MMI control system. We developed a dedicated user interface allowing the navigation inside the accelerators facility and the storing of the operator personal configuration showing the interaction with the acceleration system according to his specific attitudes. We found this option very useful in order to optimize the operator operations allowing a simpler and faster execution of the procedures.

The server manager is a strategic tool allowing the remote management of all the domain computers even if they are located in controlled areas not accessible during the beam operations. The most important services that we have implemented are: the remote boot, the performance monitor and the network monitor. All these features allow an efficient monitor of the remote computer activities not only at fixed interval time but also through asynchronous messages in case of failure or malfunctioning of system components. Of course, on each computer must be installed a dedicated software that performs the system diagnosis. The remote boot capability can be used to reboot a stalled system or to initiate all the control level computers. Another important tool is the network monitor that allows the remote analysis of all the communications coming from or going to a remote computer. The detailed analysis of data packets and protocols managed by a network interface is a very useful tool for debugging and optimization procedures.

3 THE CONSOLE WORKSTATION

From the computers located in the console the operators have to perform all those operations related with the beam and control system management. In this sense, typical requirements are:

- Operator oriented interface.
- Control system maintenance capabilities.
- Efficient beam operations.

The console workstation communicates with the servers machines through the LAN interface. The data flow from the control computers to the console is managed by a dedicated application (SeaNet) [3] based on a client/server model. We also implemented a communication manager (SeaNet Communication Agent) [4] that not only manages all the communications through the LAN but also allows the dynamic reconfiguration of the server machines. An explorer like interface (Fig. 2) allows to read or change the parameter setting related with the servers functionality: add/remove servers, set the IP address, put on/off line, buffer size and the update rate.

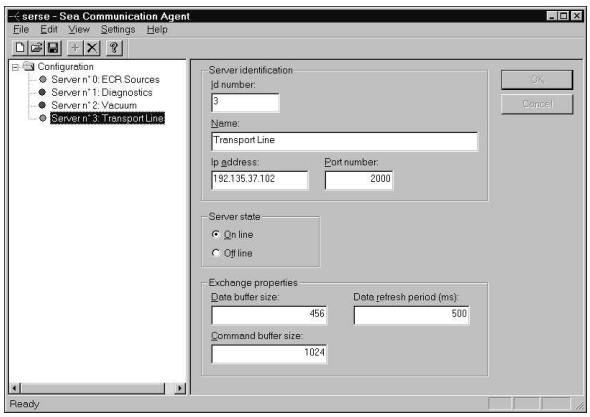

Figure 2: The Communication Agent Interface

Once the operator runs the control system interface, the communication process and the client processes, one for each active server, are automatically loaded in the workstation memory and the data exchange is started. The operator interface interacts with the communication process through the OLE methods and properties exposed by the SeaNet Communication Agent (Fig. 3).

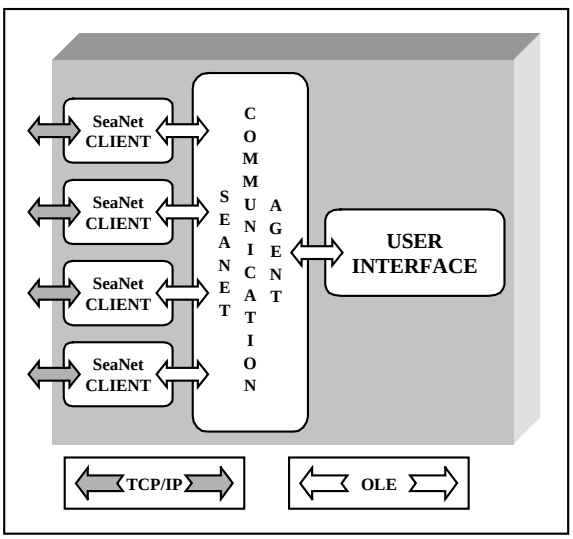

Figure 3: The Workstation Processes Architecture.

This architecture is strictly related with the Windows NT features. The configuration is stored in the local client registry as well as in the remote server registry; all the dynamic data collected by the Communication Agent are available to any Windows application running on the same workstation and using the same OLE model for data exchange. We adopted this model in order to access the control system dynamic data base from any custom or commercial software (Word, Excel, Access, Outlook, etc.) able to display, analyze or transmit the informations. Several tools are available in order to assist both the developer and the operator work:

- Operator profile configuration.
- Process and thread management.
- Policy manager (Audit, Security, Registry).
- OLE & ActiveX.
- Remote system management.
- Intelligent manageability.

The system configuration that we adopted is based on the experience gained during many years of work developing accelerator control systems. In this sense we implemented a development platform able to guarantee:

- System reliability.
- System versatility.
- High performances.

4 THE CONTROL STATION

The server computers are the remote machines that connect the instrumentation through acquisition boards or field bus interfaces. They are distributed along the accelerator facility according to their functional role (power supply, beam diagnostics, sources, etc.).

The stations were designed taking into account both the general choices of the control design and their critical role from the point of view of the instrumentation management. The operating system must guarantee the maximum performances in terms of:

- Easy interface (ISA, PCI) configuration.
- Efficient data exchange (LAN and field bus).
- Configuration versatility (local/remote).

The control station communicates with the clients located in the remote console and with the field level. When the control application is active a server process (SeaNet Server), configured by the Communication Agent, is loaded into the local memory and it acts as a bridge between the commands coming from the console and the data coming from the instrumentation (Fig. 4). For each control station we developed a dedicated control application that manages the communication with the instrumentation through the field bus. Considering the importance of its role the system has to show the highest performances in terms of

- Process and thread management.
- OLE and ActiveX components.
- Remote system management.

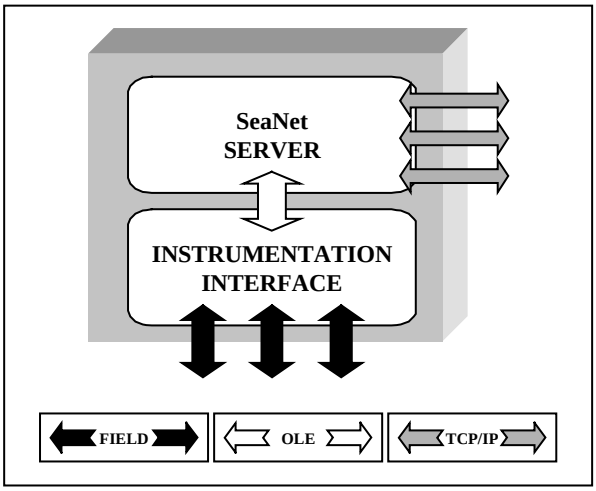

Figure 4: The Control Processes Architecture.

5 GENERAL REMARKS

We like to conclude this paper with few general remarks about our feeling experiencing the Windows NT OS. The main advantage is the availability of many tools for the system functionality management. The interaction and, consequently, the optimization of the local and remote resources is fundamental in order to obtain the highest performances in terms of:

- Friendly system interaction.
- Dynamic resources management.
- System configuration versatility.
- System and network monitor.

Of course, several problems have to be taken in account. The first difficulty that we have found was the complexity of this OS. It is necessary a lot of work to get confident with all its functionality and, sometime, it is impossible to understand some aspects that strongly affect its performances. Also the availability of Service Packs and Resource Kits often is not sufficient to correct many well known problems that typically produce a lot of waste time during the system configuration. In this sense we found the following problems:

- OS complexity.
- Difficult system reconfiguration.
- Difficult registry functionality maintenance.

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