THE FUTURE IN NETWORKING TELEMETRY SYSTEMS

Kent Yang and Cecelia Wong

Loral Instrumentation
15378 Avenue of Science
San Diego, CA, 92128-3407

Key Words: Networking, multiple network interfaces.

ABSTRACT

With the ever increasing need for faster data rates and the emergence of faster network interfaces such as Fiber Distributed Data Interface (FDDI), the task of adding new network interfaces to a telemetry system and supporting existing ones is becoming increasingly more complex. This complexity can be eliminated if the data acquisition hardware and software allows new network interfaces to be easily integrated into a telemetry system. It is the purpose of this paper to address the issues involved when dealing with multiple, heterogeneous, networking environments in telemetry systems. The paper will show how the use of flexible telemetry hardware and software will simplify the integration of new networks into an existing system, and how this flexibility can allow data acquisition applications to take advantage of a heterogeneous network.

INTRODUCTION

Picture a collection of workstations with multiple network interfaces from various vendors SUN, DEC, IBM and others, and then add to the picture the data acquisition hardware—the telemetry front end (TFE). Now the task is to develop telemetry applications that will not only work within this environment but grow as the system grows. It is not enough anymore for telemetry systems to support only the traditional homogeneous Ethernet network interface. Because of the constant emergence of new networking technologies, such as FDDI, building telemetry systems flexible enough to support multiple networks and multiple network interfaces is ever more critical and complex.

It is the purpose of this paper to discuss how a data acquisition system can support this complex network scenario. The paper will first give some background information, and then provide examples of how the integration and support of multiple networks can be accomplished. The telemetry system that will be used to illustrate the points of the paper consists of Loral instrumentation's PRO550 telemetry front end and the System 500 Data Gather Library.

BASIC TELEMETRY SYSTEM

To understand the complexity of a network of telemetry systems, it is first necessary to understand what a telemetry system consists of and the basic roles that each component plays. Todays sophisticated telemetry system typically consists of a proprietary data acquisition hardware with one or more workstations. To take advantage of this distributive processing system, a client and server model is usually implemented for communications on the network. A server process running on one workstation can handle data acquisition requests from client processes on the same workstation or on another workstation. The server then communicates the request to the TFE which in turn, spawns a task to package the real time data and send it directly to the requesting process. The telemetry application could be a data display like a stripchart, or a data storage application that stores telemetry data to high speed disks. Regardless of the type of network interface (FDDI, Ethernet, etc.), integration is trivial on a single network with one network interface. The complexity arises in heterogeneous network environments in which workstations and other hardware co-exist on various networks and each component supports one or more network interfaces. The following example illustrates the technical application of hardware and software solutions to the multiple network interface problem. The telemetry system used in the example has recently been completed by Loral Instrumentation and all functionality described has been successfully configured and tested.

EXAMPLES OF A MULTIPLE NETWORK TELEMETRY SYSTEM

In this example, two primary network problems will be addressed. The first problem involves supporting the addition of a new network interface to an existing system. The second problem involves supporting multiple network interfaces within data acquisition applications.

SUPPORTING NEW NETWORK INTERFACES

The following diagram shows a simple telemetry system supporting only one network and one network interface.

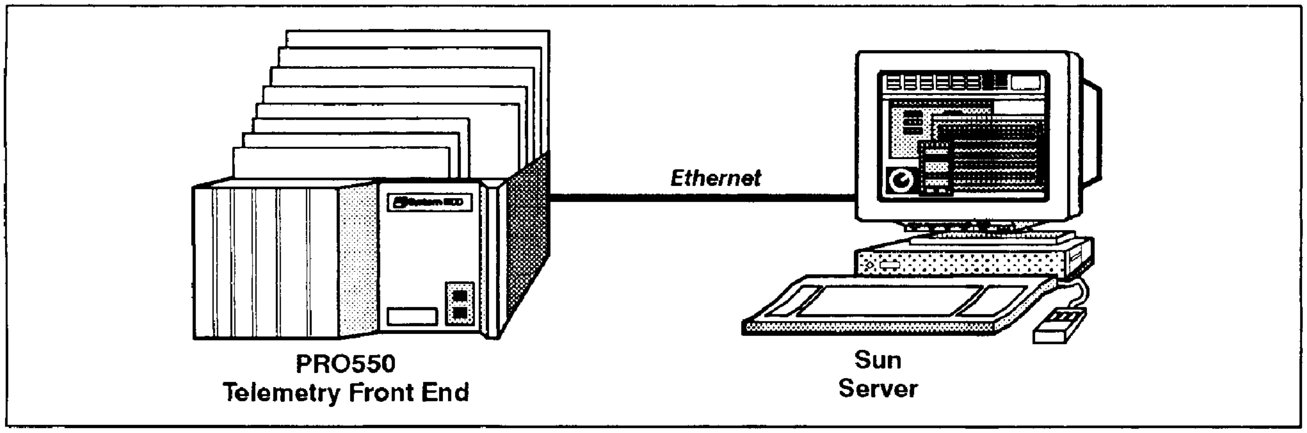

Figure 1. Single Network

In this case, the SUN workstation runs both the server and the client applications. The TFE is connected to the SUN workstation via a common Ethernet network. The client processes make requests to the server for telemetry data. The server process communicates the request to the TFE which spawns a process to package the requested data and send it directly back to client processes on the workstation. Support for this system is trivial, until a new IBM workstation with only a single FDDI network interface is added.

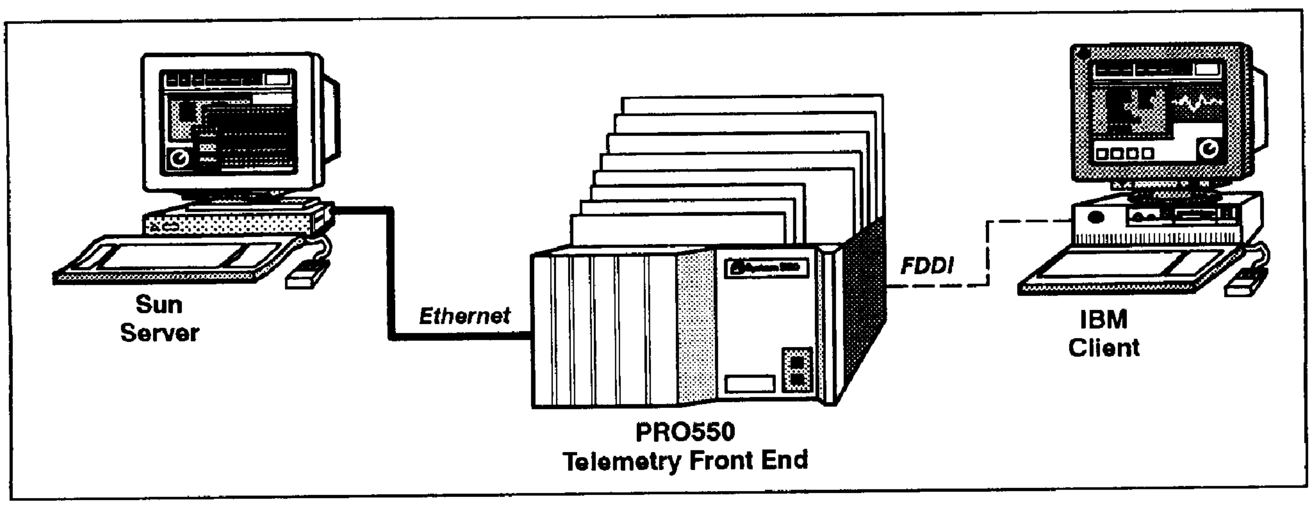

Figure 2. Adding A New Network Interface

The addition of the IBM presents the first of the two primary problems: how to support a new network interface. Two issues are involved. The first issue is how to send telemetry data to the IBM when the TFE does not have FDDI network support. The second issue is how to communicate client requests between the IBM and the SUN when they use different network interfaces and reside on different networks.

The key to solving the first issue rests in the design of the TFE. The PRO550 TFE is built on a two bus architecture: a proprietary MUXbus and the industry standard VMEbus. The Muxbus is essential in providing high speed real time data transfer between telemetry modules in the front end. The VMEbus creates an open system by allowing off-the-shelf cards to be added to the front end. Due to the open architecture and modular design of the TFE, readily available network interface cards are easily added to the system. By adding an FDDI card, the TFE is able to send telemetry data via an FDDI network interface. Because of the design of the TFE, the solution to a complex problem becomes trivial. In addition, the system is able to grow with the advances in networking technology and new network interfaces can be added by simply adding a new card.

The second issue is that of communicating requests between the IBM and the SUN. In order to receive telemetry data from the TFE, data acquisition processes on the IBM client workstation must be able to communicate requests to the server process running on the SUN. Since the IBM workstation does not have an Ethernet interface, a gateway must be created to allow packets on one network to reach the other network. By adding the FDDI network card to the TFE, the basis for this gateway is also established. Since the TFE provides access to both networks, a software gateway on the TFE can be created using static route tables.

Once the gateway is setup, data acquisition processes running on the IBM client can send requests through the gateway to the SUN.

The gateway receives packets from the IBM through the FDDI interface and routes them to the SUN server through the Ethernet interface. When the request reaches the server, the server communicates the request to the TFE. The TFE then spawns a task to package the telemetry data and transmits the data directly to the requesting process on the IBM workstation using the FDDI network interface.

There are several benefits to using a software gateway through the TFE. Not only is a software gateway easily configurable and uses industry-standard routing utilities, but it also reduces the cost and complexity of a system by eliminating the need to purchase a separate hardware gateway. In addition, once the system is configured, the existence of multiple networks becomes transparent to the user. To the user, the whole system operates as if it is on a single network. The only clue that might give away the system's true configuration would be the higher data rates for telemetry applications on the IBM's FDDI interface.

Because of the open architecture in the telemetry system used, supporting a new interface on a network is a simple and painless process. Workstations with a different network interface can be added to a system and a new network interface can be added to the TFE quickly and easily. In addition, the telemetry system is able to serve two crucial needs. Not only is the telemetry system able to accommodate data acquisition through various network interfaces, but it is also able to serve as the gateway between two different networks.

SUPPORTING MULTIPLE NETWORK INTERFACES

In the previous section, a workstation with a single new network interface was added to an existing telemetry system. In this section, the addition of a workstation capable of supporting various network interfaces presents another interesting challenge.

The following diagram shows same telemetry system previously defined but with the addition of a DEC workstation that supports two network interfaces, Ethernet and FDDI.

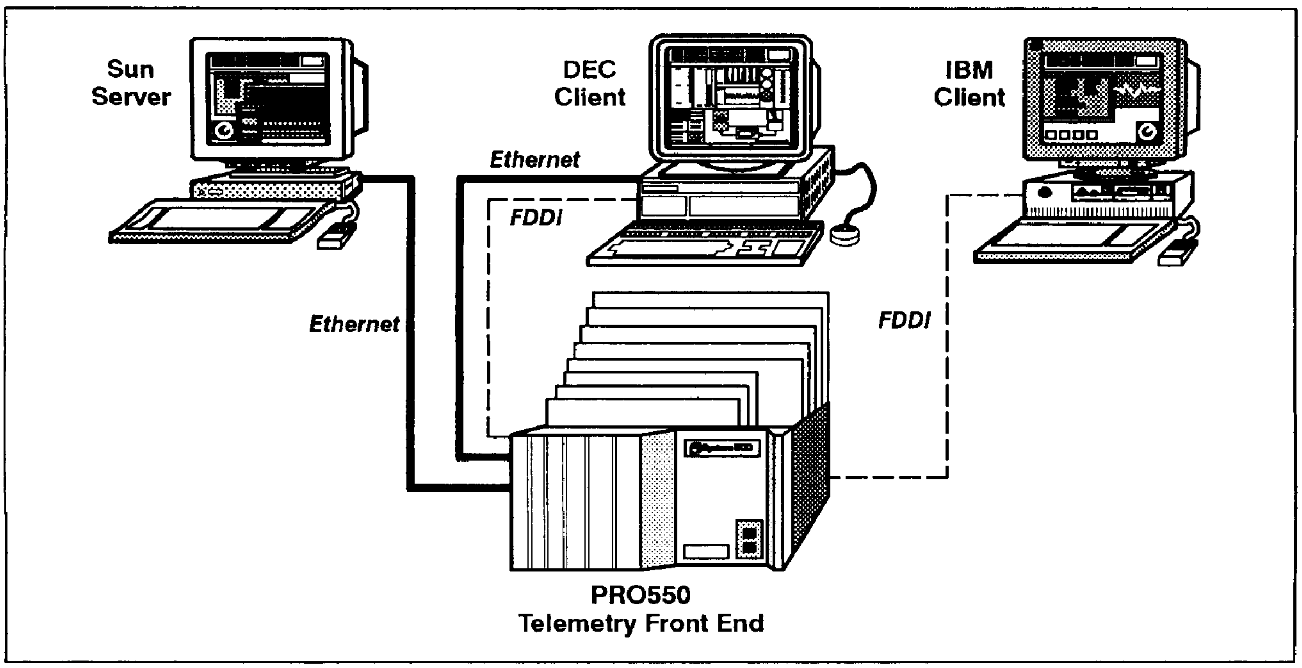

Figure 3. Adding Support for Multiple Network Interface

Because the DEC workstation supports two types of network interface, it is desirable to provide data acquisition applications the ability to take full advantage of both networking capabilities. To accomplish this requires that each application has the option to specify its desired network interface. However, accommodating all the various network interfaces in an application can greatly increase the time spent in coding and can result in programs that are not extensible to future networking needs. The solution to this problem is to provide a level of abstraction to the application which hides the underlying complexity of the network.

The Data Gather Library is a library of C language function calls that can be used to gather telemetry data from the PRO550 TFE. From this library, application programmers can develop custom telemetry applications such as real time displays or data archiving applications. By designing this library to provide a level of abstraction to the network, applications can use library calls to display or store data from any available network interface.

One advantage of providing a level of abstraction to support multiple network interfaces is that it allows the application developer to concentrate solely on the design of the application. In addition, the application developer would not have to be concerned about changing the application code to support new network interfaces. This would be taken care of in the Data Gather Library. Once a new interface is configured into the telemetry system, the application can specify the interface in its calls to library routines and can expect the data to arrive using the specified interface.

Another advantage of this design is the flexibility it provides the application in choosing its desired network interface. For example, there are two network interfaces—Ethernet and FDDI—available on the DEC workstation. The application programmer can choose to design his application strictly using the faster FDDI network interface or give the application user the option to decide at run time which interface to use. In addition, multiple applications can be running on the DEC workstation with each application using a different network interface. A real time display process can be using the slower Ethernet network interface and the data archiving process can be using the faster FDDI interface. This flexibility can also be used to help alleviate high network traffic and setup dedicated telemetry networks.

Now back to the example. Depending on the system configuration, data acquisition applications running on the DEC workstation can send requests to the SUN server via either the Ethernet or the FDDI interface. Requests to gather data are made through calls to the library. When making a request, the application can specify the network interface on which the TFE is to transmit the data. Once the server receives the request it sends the request to the TFE. The TFE then packages and transmit the data back to the requesting process on the client workstation using the specified network interface.

CONCLUSION

The configurations possible for multiple network environments seem almost endless and networking telemetry systems is difficult enough without having to deal with multiple networks and new network interfaces. However, with newer network technology like ISDN and ATM on the horizon, the networking environment is only going to become more complex. Telemetry systems must be able to support the future of networking as well as accommodate the present networking needs. By providing flexibility in network configuration at both the telemetry hardware and software levels, a telemetry system will not only be able to support a multiple heterogeneous networking environment but also, with minimum effort, new network interfaces can be added to existing systems. In the end, all of this aids the application programmer in developing better data acquisition applications and allows application users to take full advantage of new networking technologies.