**Industry:** Aerospace

**Products Used:** LabVIEW™ • LabVIEW Real-Time • FieldPoint™ • Lookout™ • NI PXI/SCXI™ hardware

# Real-Time, Mission-Critical Control and Acquisition of a High-Channel-Count Distributed and Networked System

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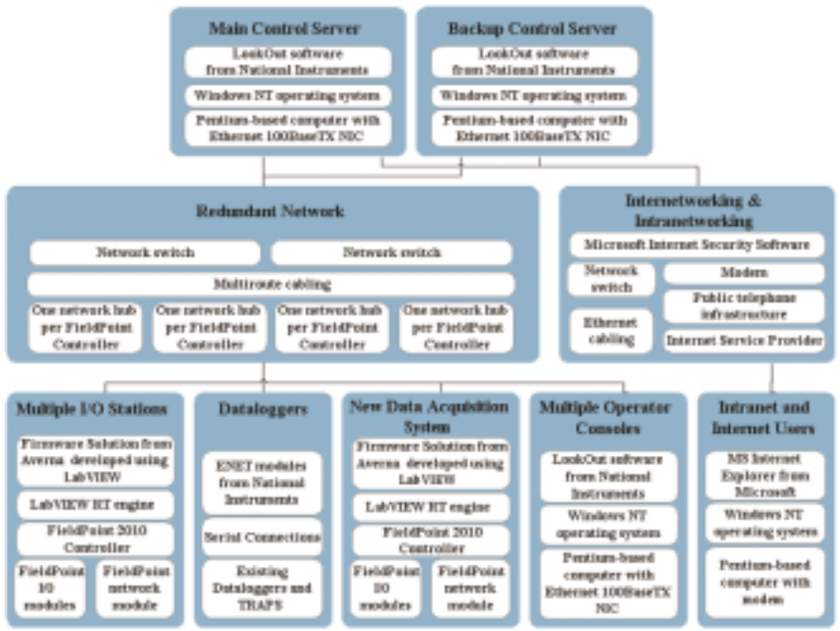
**The Challenge:** **Implementing a distributed and mission-critical data acquisition and supervisory control system that integrates thousands of transducers, actuators, and third-party data loggers with secure system access, configurable data logging, data extraction, and display features in a short delivery time.**

**The Solution:** **Using off-the-shelf hardware from National Instruments, including FieldPoint real-time controllers, I/O modules, PXI-based switching, and ENET modules combined with powerful software tools, such as LabVIEW and Lookout, to implement the fully integrated solution in a cost-competitive and time saving architecture.**




*Schematic View of Data Acquisition and Control System*

## A Quick Upgrade

Our customer's test facilities used several different technologies to control chamber environment variables and measure a multitude of physical quantities. They needed a system that incorporated thousands of single measurement points including thermocouples, voltage and current transducers, relays, and digital I/O. The technologies that the facilities used in the past were controlled by applications that were limited in flexibility, ease of use, and speed. In addition, they relied on custom, obsolete signal conditioning hardware. The high-channel-count system had to operate with stable, redundant hardware. Our customer needed networked, distributed operation along with real-time control and flexible configuration capabilities. They considered replacement of the existing transducers and data logger units, but this option proved too timely and cost prohibitive. Our customer needed to upgrade the system in the short timeframe of three months.

***Working in collaboration with NI support engineers, we realized that we could address all of the system requirements with cost-effective and flexible technologies.***

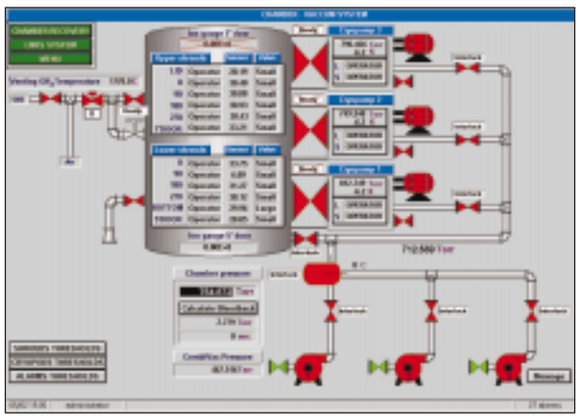
## Flexible Technologies

Working in collaboration with NI support engineers, we realized that we could address all of the system requirements with cost-effective and flexible technologies including:

- FieldPoint 2010 modules with real-time acquisition and control;
- FieldPoint I/O modules for distributed signal conditioning and acquisition of a variety of analog and digital signals;
- ENET modules to integrate serial interface devices in the system without distance limitations;
- PXI-based switching hardware for implementing hardware redundancy;
- Lookout for supervisory control and data logging supported by Citadel;
- LabVIEW Real-Time to build an embedded, yet easy-to-design control and data acquisition engine;
- LabVIEW for implementing a flexible user interface for system configuration, data viewing, and to glue other sub applications together;
- Support technologies, such as DataSocket, VI Server, and ActiveX delivered ease of integration and information exchange between several different sub-applications running real-time or on Windows platforms in a networked environment.

We implemented main and backup control servers using National Instruments Lookout. These applications rely on the Windows NT operating system running on personal computers to provide a redundant execution. We built the redundant network using switches, multiroute cabling, hubs, and implementation of best network topology practices.

We designed Internetworking and intranetworking using Microsoft Security



*One of the Lookout Control Panels for a Test Facility*

software to manage user access at the operating system level. The built-in user manager features in Lookout also help with user access issues. We implemented I/O stations using firmware that runs with the LabVIEW Real-Time engine on the FieldPoint controller module. The FieldPoint controllers interact locally with I/O modules and with the control servers to achieve the integration of all required system inputs and outputs. Data loggers and other control hardware with serial interfaces integrate using LabVIEW drivers running on control servers. ENET modules from National Instruments interface the serial hardware to the Ethernet infrastructure while providing transparent and remote connectivity to the equipment. We built multiple operator consoles using Lookout. Our customer can deploy the consoles anywhere on the local network. These applications run on Windows NT installed on personal computers. Internet and intranet users gain access to the client and server applications by using a Web browser and built-in Web server features of Lookout and LabVIEW.

***Overall, we saved several hundred thousand dollars in implementation costs.***

## Implementing Hardware Redundancy

FieldPoint I/O devices, grouped in banks of three to eight modules, acquire all of the current and voltage signals. A FieldPoint 2000 module running LabVIEW Real-Time supervises each bank. The system implements a three-to-one hardware redundancy by routing the I/O signals to FieldPoint modules through PXI switches. Using the redundant local area network, all of the FieldPoint controllers connect to the main and backup servers.

## Intuitive and Hierarchical Access

With a LabVIEW application, the system can build disk resident configuration sets with intuitive and hierarchical access to system hardware. Configuration changes dynamically load to PXI and FieldPoint controllers and become effective in real time.

Real-time code in the FieldPoint 2000 modules handles deterministic system control. The code also provides the transducer data to an acquisition demon running on the server machine. The server collects data from serial devices and feeds it all to Lookout data logging panels. Data logs to a citadel database with a typical logging rate of 100 Kbytes/sec. Alarming, dead band for logging, and defining computed data values are some of the features available to the user through the data acquisition and logging part of the system. Through LabVIEW VIs, the user can take advantage of configurable data extraction and viewing with historical, real-time trend graphs, and with tabular data display.

We designed the system control in sub-categories. PID loops running on FieldPoint controllers provide a deterministic control of sensitive system parameters. Users can optimize the PID parameters and monitor loop performance through VIs running on remote networked machines. The supervisory control and human machine interface (HMI) commands propagate through Lookout panels to FieldPoint controllers across the network.

## Mission-Critical System

The main and backup servers rely on Lookout redundancy features to realize a mission-critical system that parallels the hardware redundancy while minimizing the data and control loss due to hardware or software failure on a single system element. The system operates in distributed networked modules where users have password protection and hierarchical access to single test facilities for all of the control and data viewing operations. ■

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