

## Wireless Data Collection System over a Large Area

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### The Challenge

To test custom electronic equipment over a large geographical area (over 25 square miles) and wirelessly send the data to a centralized database for analysis and future storage. The system needs to employ up to forty Data Collection Units that acquire data simultaneously.

### The NTS Solution

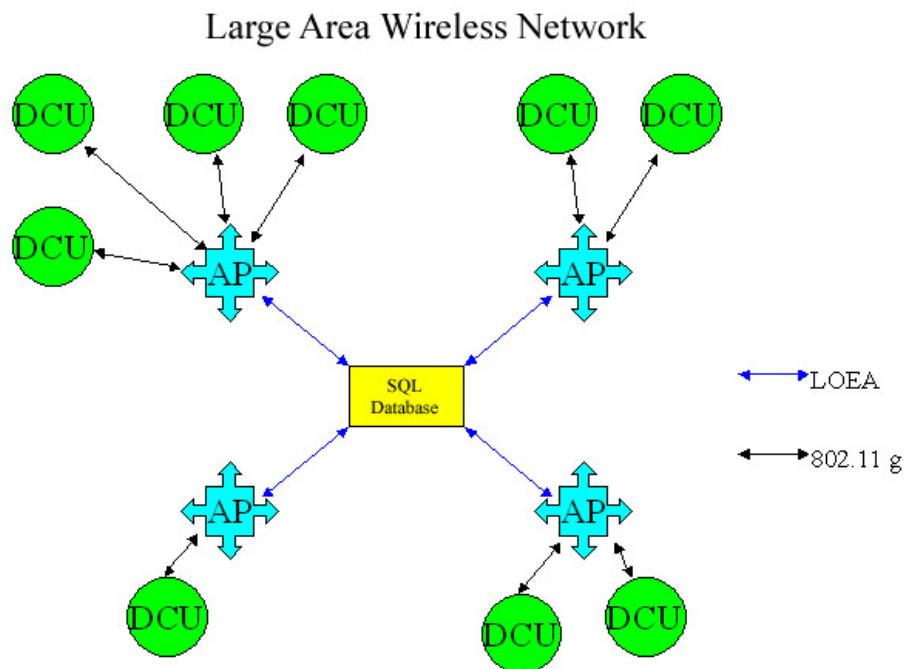
Acquire data with USB DAQPads and custom LabVIEW software, relay the data to high-speed wireless Access Points via 802.11g wireless communication and transfer the data to a centralized SQL database. A PXI chassis with NI hardware also monitors the health of each of the wireless Access Points.

### Abstract

The Data Collection Units (DCUs) are ruggedized laptops running custom LabVIEW software gathering data from USB based NI DAQPads. The DCUs can collect analog, digital, serial, and counter/timer data. The data is then sent to Access Points (APs) via 802.11g wireless communication. The APs send the data to a centralized database via wireless LOEA radios communicating at 1Gb/s. The data can then be viewed and analyzed with custom LabVIEW software. NI PXI hardware in each of the Access Points also monitors its health by reporting temperature data, critical voltages, and real-time video data from a remote control pan-tilt-zoom camera.

### Introduction

Our customer needed to perform outdoor tests of military equipment in a rugged environment over a large geographical area. The data needed to be sent simultaneously to a central database for storage and subsequent viewing. To achieve this we built portable wireless Access Points (APs) that can communicate with a network and database at the central data processing center using high-speed wireless LOEA radios communicating at 1 Gb/s. Each Access Point then also has its own local 802.11g wireless network to communicate with the numerous Data Collection Units (DCUs).

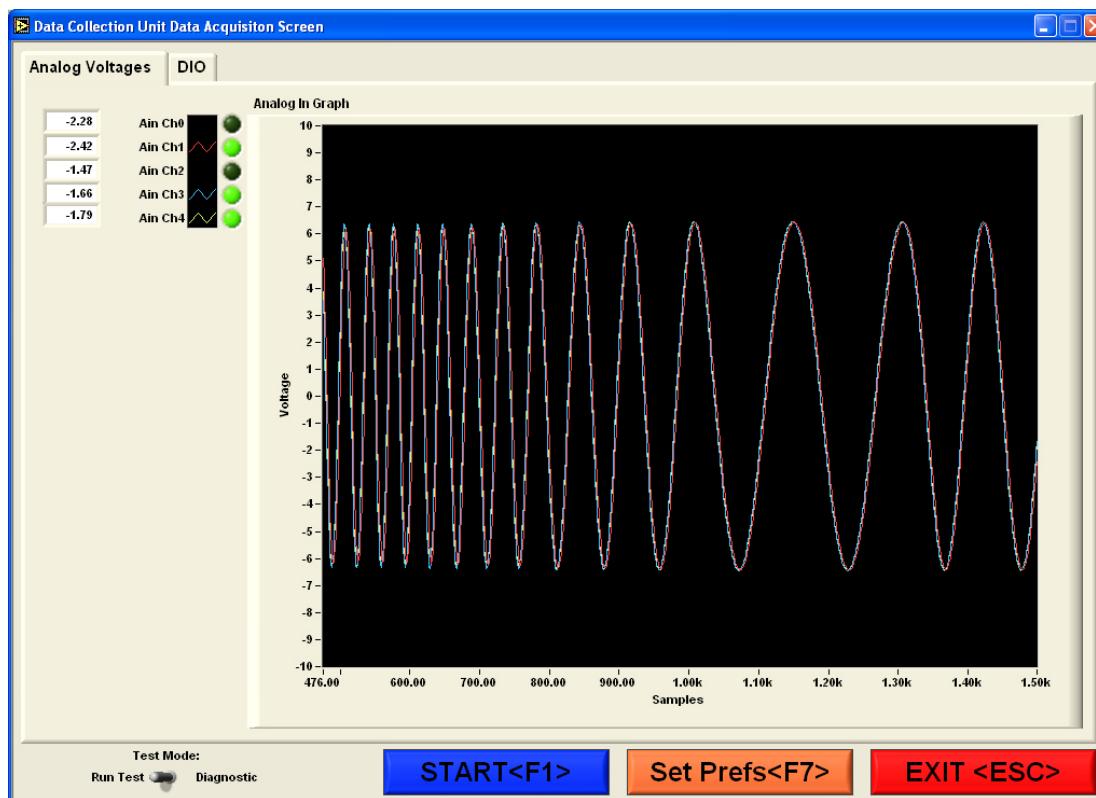


## Testing

The Data Collection Units consist of either a durable laptop or tablet PC connected to a USB DAQPad 6015 and a wireless 802.11g antenna. The DAQPad works well because of its combination of portability, variety of relatively high-speed signals, and low cost. Using LabVIEW allowed me to create flexible modular software in a small amount of time. The software can measure up to eight analog voltages, read or output to eight digital lines, implement two counter/timer channels for either event counting, frequency measurements, or pulse train output, and can read from RS-232 serial ports. Using the LabVIEW Database Connectivity Toolkit working with Microsoft's SQL Server allowed me to save data directly to the database without having to make complex network connections.

Each Access Point consists of a LOEA high-speed wireless radio, an 802.11g local network, power provided by large solar panels and a propane generator, and a health monitoring system to ensure that the Access Point is working properly. The best choice for this health monitoring system was a combination PXI/SCXI chassis due to its compactness and high density of instrumentation. Each SCXI chassis contains an 1162HV module for reading high voltage digital signals and an 1102 thermocouple module connected to a 6251 M Series MIO DAQ card to read up to 32 thermocouples.

A pan-tilt-zoom camera connected to each Access Point also allows users in the central data processing center to view each Access Point and its surroundings in real time. To implement this I used a PXI-1411 IMAQ card to capture video from the camera and a PXI 8421/4 RS-485 card to control the camera's pan-tilt-zoom functions. Using the built-in TCP connectivity functions in LabVIEW I was able to establish two-way communication between the central data center and each Access Point to send compressed live video data from the AP to the data center, as well as send camera control commands from the data center to each camera.



Data Collection Unit software measuring analog voltages

## Data Storage and Viewing

A LOEA radio in the central data processing center connects the SQL database to the high-speed wireless network. The database consists of two Terabyte servers connected to a domain controller running Microsoft's SQL Server. The overall storage of the system is approximately 6 Terabytes of data. I used LabVIEW and the Database Connectivity Toolkit to create an application to allow the user to read the data from the database, reassemble the data, and view the data. With the power of SQL queries I can store large amounts of data and find the data the user needs fairly quickly.

## Additional Utilities

The application also includes several additional utilities including the camera controller utility, a network pinging utility, and the AP health monitoring utility. The camera controller allows the user to view live camera data from any of the connected Access Points and to remotely control the camera's pan, tilt, and zoom functions. The network pinging utility allows the user to send a network "ping" to devices on the network, verifying that devices are connected to the network. This utility proves to be quite useful when trying to diagnose potential problems with network connectivity. The AP health monitoring utility allows the user to view live data transmitted from the Access Points to the central database. From here the user can monitor AP input and output voltages, power consumption, and temperatures.

## Software Configurability

The power of the database also allows the user to independently configure settings for each Data Collection Unit and store them in the central database. These settings include which types of measurements to take, the settings of each data acquisition channel, and the speed of data acquisition. Since the DCU retrieves its settings from the database each time it is powered on, users in the central data center can change settings locally so that users out in the field in difficult environments do not need to make any adjustments while testing.



The Camera Controller software

## ***Advantages of LabVIEW and National Instruments Hardware***

The fact that National Instruments hardware is integrated so well with LabVIEW was a huge advantage while integrating the hardware with the software. Using NI-DAQ's instrument drivers made it quick and easy to configure and use the hardware. The modularity of NI-DAQ also made it possible to use the same software in my DCUs and APs despite the fact that the Data Collection Units use USB based DAQPads while the Access Points use PXI based hardware. The only instrument driver that I needed to write was for camera, which is really impressive considering how much different hardware I had.

### ***Products used in this Program***

- 4 PXI 1010 PXI/SCXI Combo Chassis (8PXI-4SCXI)
- 4 PXI-8187 Embedded Controllers 2.5 GHZ
- 4 PXI-6251 M-Series DAQ Cards
- 4 PXI-1411 IMAQ, Single channel, Analog, Color Video Cards
- 4 PXI-8421/4 RS-485 Cards
- 4 SCXI-1102 32 Channel Thermocouple modules
- 4 SCXI-1303 32Ch Isothermal Terminal Blocks
- 4 SCXI-1162HV 32 Ch. Digital input Modules
- 4 SCXI-1326 High Voltage Terminal Block
- 4 DAQPad 6015 USB Analog Input Multifunction DAQ Modules
- LabVIEW 7.1.1
- NI-Vision 7.1
- NI LabVIEW Database Connectivity Toolset 1.0.1
- NI-DAQ 7.4

## **About NTS Test Systems Engineering**

NTS TSE, located in Albuquerque, NM, designs and integrates test, measurement, automation, data acquisition and control systems utilizing diverse hardware platforms, operating systems, and instrumentation standards. Our expertise involves projects ranging from LabVIEW instrument drivers to full-blown automated turnkey systems. The dedicated staff of electrical and mechanical engineers, project managers and technicians of NTS are well versed in designing, integrating and programming real world solutions for industrial applications for a diverse set of operating systems and standards.

### **Test & Automation Services Include**

- Requirements Analysis & Development
- Hardware Design
- Software Design & Architecture
- Instrument Drivers
- Test System Management (TestStand)
- Software Development (LabVIEW)
- Data Management & Analysis (DIADEM)
- Enterprise Solutions
- Fabrication
- Integration
- Installation & Training
- Maintenance & Support



### **Contact**

To discuss how NTS can help you solve your next test system engineering challenge, contact Tim Brooks at 505-345-9499 or email [tim.brooks@ntscorp.com](mailto:tim.brooks@ntscorp.com).

