

PXI Based RF Record/Playback System

Author: Lance Butler, Senior Systems Integrator, General Manager, NTS Test Systems Engineering, Albuquerque, New Mexico

The Challenge

To develop a cost effective, portable system to record RF transmissions in the field and be able to play them back in the lab for simulated RF testing.

The NTS Solution

Using the PXI platform with NI's 5660 and 5671 combined with Conduant's StreamStor technology, BBT is able to record 20 MHz wide signals at up to 2.7 GHz center frequencies for over 4 hours. These signals can then be played back in the lab at will.

Abstract

The record portion of the system is a portable PXI chassis that records RF signals through the 5660 onto the Conduant hard drive arrays. The hard drive array can then be connected to the playback system to play the signals out through the 5671. The combination of these two systems allows users to record real world signals and bring them back to lab for testing of prototype or production RF components. This gives the customer the ability to test for different ambient conditions such as weather and obstructions.

Introduction

Many of our customers face the same problem when developing RF receiving devices such as satellite radios. They need to test their radios in real world environments but there are several difficulties involved in bring their products to the field for testing.

A major problem is that the environment is constantly changing due to seasonal factors such as wind, rain or snow or even foliage on trees. The environment also changes with the construction of buildings and installation of new sources.

Another important consideration is the logistics involved with bringing large quantities of product into the field for testing. Particularly in a production environment, the thought of testing product in the field is daunting with the logistics alone.

PXI to the Rescue

Our PXI system solves all of these problems by simulating a real-world environment in the lab or on the production floor. Test personnel can now travel to any given environment just once to record a signal and then play that signal under a controlled environment in the lab to an unlimited number of units under test (UUTs).

For example, a company testing satellite radio might record a set of files in the Austin metro area periodically through the year to capture effects of various seasons, weather effects, and areas of town. They might also record under the same circumstances in other areas. These files can then be reliably played back repeatedly so that different designs can be tested with the exact same signal in order to compare the strengths and weaknesses of the designs.

PXI's Open Architecture Makes it Possible

The open architecture nature of PXI is the key to making this system a reality. The system is comprised of NI instruments that take advantage of NI's strength in RF and modular instruments married together with Conduant hardware that makes use of their specialization in extremely fast data storage and playback. PXI allows us to marry the strengths of both of these companies and create a solution that would be impractical for a single entity alone.

How it Works

RF input signals are routed through the NI-PXI5690 if needed to increase the signal levels so that they are suitable for recording. The signal is then run through the NI-PXI5600 for down conversion to an appropriate frequency. The NI-PXI5122 then digitizes the signal and routes the digital data through a DMA channel. The Conduant StreamStor card then funnels the data onto four hard drives simultaneously.

This combination allows data to be recorded for over 4 hours without interruption. While additional drive arrays can be purchased for additional record time, we have found that this time is sufficient for most applications.

For the playback process, signals are essentially routed in the reverse order through playback hardware. The StreamStor card feeds data from the drives to the DMA channel on the NI-PXI5671. The data is then played through a digital to analog converter (DAC), upconverted to the recorded frequency, and sent to the UUT.



Playback controls work like a VCR

A utility is provided to further extend the capabilities of this system by allowing files to be moved to or from the drives. In the former case this allows files to be ported into any analysis package where they can be analyzed or modified. The latter case allows for synthesized signals to be played in order to simulate various effects. As an example a user may record a given signal and then modify it to simulate periodic signal strength loss. This new file can then be played in order to test the effects of the change versus the original file.



Portable version of a combination record and playback system with GPS

The Flexibility of PXI Allows for Many Options

The most common systems involve a record system in a portable configuration that typically includes a shock resistant shippable container and a rack mount playback system for the lab. However, thanks to the modular nature of PXI and the power of LabVIEW, other configurations have been developed for various needs.

When the source signal is readily available at the lab, but the requirement for testing multiple UUTs with the same signal still exists the two systems can be combined in one chassis. This version uses an 18-slot PXI chassis to house components of both the record and playback system and uses the same LabVIEW software as the other systems.

If two channels are required to be synchronously recorded, additional hardware can be added. In this case the RTSI bus inherent in PXI allows very tight synchronization of the two channels. The two channels can come from different sources for diversity testing, or they can be set for different frequencies. The two-channel playback version of this system maintains the synchronicity throughout the process.

PXI also allows for the integration of GPS position data into the recording. This can be useful when terrain features are of particular interest.

Efficiencies of LabVIEW and PXI Development Reduce Costs

Because LabVIEW already has many of the necessary tools built in or available as toolkits and PXI drivers are very easy to develop with, this system represents a significant cost savings over any other method. The cost of the initial system including development is considerably lower than the cost of other products which have less functionality.

Products used in this Program

- NI PXI-5600 2.7 GHz Downconverter
- NI PXI-5122 100 MS/s 14-bit Digitizer
- NI PXI-5671 2.7 GHz RF Vector Signal Generator with Digital Up-conversion
- NI PXI-5690 RF Preamp
- NI PXI-1045 18 Slot PXI Chassis
- NI PXI-8196 2 GHz Pentium M Controller with Windows XP
- LabVIEW 7.1.1
- RFSA 1.5
- RFSG
- Spectral Measurements Toolkit
- NI FGGEN
- NI Scope

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.

