

Keysight Technologies

AXIe and PXI Modular Test Solution for Multiband SATCOM Monitoring

Application Note



Introduction

Today's satellite systems are required to deliver more complex data streams to and from terrestrial stations than ever. The process of monitoring such massive multiband, multi-frequency satellite data streams becomes a multifaceted and challenging environment. Present monitoring configurations usually consist of a dedicated test set allocated to a specific band or frequency. For many satellite earth stations that means a room full of fixed hardware and the resources to support it.

Going forward, a solution that consolidates multiple pieces of hardware into a single unit, whenever possible, has the potential to reduce size, conserve resources and insure that the five-nines level of data reliability is maintained. Evolving measurement solutions should be multifunctional across multiple bands and technologies, and be integrated into as compact a footprint as possible.

In this application overview, the challenge of monitoring multiple 1.2 GHz satellite bands, from UHF through Ka, and multiple modulation schemes is addressed. The proposed solution replaces individual test units with the smaller PXIe and AXIe modular platform and the Keysight Technologies, Inc. 89601B Vector Signal Analysis (VSA) software.

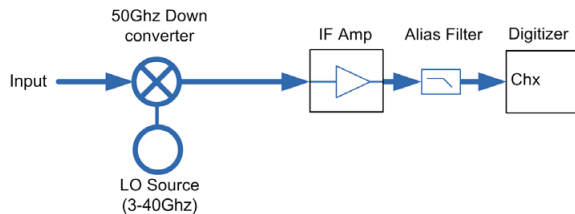


Figure 1: Key components of the solution are the M9703A AXIe high-speed digitizer, M9362A downconverter, M9352A IF amplifier and the N5183A LO source.

Solution

After review of the user requirements, it is determined that AXIe and PXIe modular instrument platforms are well suited for this application. Modular instrument attributes including excellent instrument density, expandable multichannel support and high data bus speeds are ideal for multi-band frequency monitoring. In addition, Keysight modular digitizers are designed to work with Keysight's VSA software providing the digital demodulation analysis tool required for this application.

The next step is to determine the components. The preferred choice is the Keysight M9703A AXIe high-speed digitizer. This unit provides an 8-channel, 1.6 GS/sec at 12-bit resolution with on-board Digital Down Conversion (DDC). A sampling rate of 3.2 GS/sec is also available without the DDC. Additional components included Keysight's M9362A PXI downconverter, the M9352A IF amp, the N5183A MXG microwave source as the LO source, and an alias filter.

For signal analysis, the Keysight 89601B VSA software is utilized. The 89601B is the industry's premier vector signal analysis software for evaluating complex signal spectrum, modulation and time characteristics.

This is the ideal solution set to collect multiple satellite channels for output to the VSA software. Since the LO is the most unwieldy component of this solution—it is large and heavy—a rather avant-garde approach to sharing the LO is implemented. The concept of hopping the LO across the frequency bands offered the potential to remove four redundant components from the solution, minimize the footprint as much as possible and realize the goal of increased field-portability.

Results

Issue: Address the key requirement of using Commercial Off-The-Shelf (COTS) devices, consolidating the data down converted signal streams to a single device for monitoring, and make the solution portable. Using innovative methodology, Keysight is able to present a SATCOM solution that meets these challenges. The critical components are Keysight's M9703A AXIe high-speed digitizer, with its extremely versatile Digital Down Conversion (DDC) technology that allows edge-of-the-envelope signal conversions, the fast and agile N5183A LO, and Keysight's flagship 89601B VSA software.

Results: A unique SATCOM frequency scanning and monitoring solution with standard products used in novel ways.

Solution details

A high level view of the solution is shown in Figure 2. The Antenna feed provides preselected signals of interest. The PXIe, AXIe and LXI hardware section down converts and digitizes the signals. The hardware section is under the control of the Scanning and Display software application which orchestrates a fast scan of the antenna feeds from band to band. Shown on the right of Figure 2, is the Vector Spectrum Analysis toolset which is the analysis engine used for detailed digital modulation analysis.

The Scanning and Display SW application is a, non-standard, light-weight software utility developed by a user or application engineers. For this case, the software application is designed to scan the digitized data, perform a simple FFT and then format and display the results for the operator to monitor. This allows the operator to monitor several frequency bands at once with very quick display update rates. This relieves the 89601B analysis software from needing to manage the scan.

Satellite pre-selection is user-provided to remove out-of-band signals. The four frequency bands (C, Ku, K, and Ka) are fed to the M9362A-DO-F50 quad downconverter. These signals are downconverted by the frequency hopping LO, processed, digitized and converted to the frequencies of interest (see Figure 2). The UHF band does not need to be downconverted and thus can be captured directly with the M9703A.

The requirement is to observe, record and analyze, in detail, SATCOM signal anomalies. For this solution, the apparatus of choice is the Keysight M9703A digitizer. This unit's diverse feature set fits the requirements directly.

When an anomaly is noted in the monitored signal and the operator instructs the device to capture a signal of interest, the digitizer configures the DDC to increase the segment's record size and take a high-resolution snapshot of the narrow segment of the band containing the signal. This is done at the hardware level by the advanced technology of the DDC integrated into the digitizer. This is accomplished in the hardware by the DDC, which is used to down convert this large record file and reduce it to a very manageable size, yet keep the required resolution bandwidth required for digital demodulation.

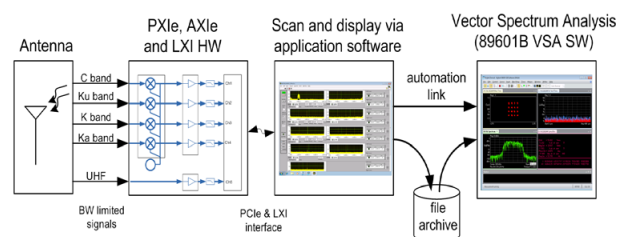


Figure 2. Block diagram of the signal flow process.

Once captured and demodulated, the application software will use an automation link that will retrieve the digitally demodulated data and display it on the VSA software. Another capability of this approach is to archive captures and file them for analysis at a future time. Archived files can be date and time stamped and have descriptions attached to them.

One issue to be addressed is that sampling theory dictates when sampling a 1.2 GHz signal with only a 1.6 Gs/S bandwidth device, the possibility of producing images is highly likely. Keysight's approach is a two-pass down conversion on both the low and high side. One caution is that very sharp cutoff filters are required to prevent aliasing and insure no spurious energy leaks into the signal being sampled (see Figure 3). In this case, preselection is provided at the antenna; however, in cases where the signal is not preselected, then a preselection filter is required.

Finally, what makes this solution viable for SATCOM application is the VSA software's ability to allow user corrections for input paths. Because the front end down converter has the potential to produce conversion loss, correction for input path losses is required. The 89601B series includes methods to correct for such losses, which insures that the displayed data is accurate. The process used to characterize and generate the correction data needs to be done by the user. To assist in this effort, measurement support can be included in the application software utility for the path loss characterization.

Together with knowledgeable staff, a unique SATCOM frequency scanning and monitoring solution has been developed with standard products used in novel ways.

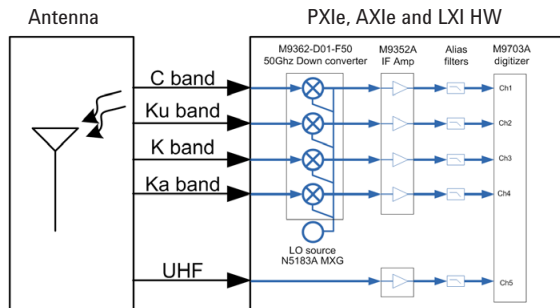


Figure 3. Signal processing components.

Ordering information

Model	Description
89601B	89600 VSA software, transportable license
M9502A	AXIe chassis
M9018A	PXIe chassis
M9021A	Cable card (for cascade connect PXIe to AXIe chassis)
M9703A	AXIe 12-bit digitizer
M9703A-SR2	1.6 GS/s sampling rate
M9703A-DDC	Digital down-conversion firmware
M9703A-M40	4 GB (256 MS/ch) acquisition memory
M9036A	PXIe controller
M9036A-M08	Memory option
M9036A-W76	Windows 7-64 bit OS
M9352A	IF amplifier (order 2)
M9362A-DO-F5	Quad downconverter
M9536A	Embedded AXIe controller
N5183A	MXG (CW only)
N5183A-540 W	40 GHz BW
N5183A-UNZ	Fast frequency range
Y1202A	PCIe cable x 8, 2M (for cascade connect PXIe to AXIe chassis)
Alias filters	Standard alias filters (need 4-8)

Software information

Supported operating systems	Microsoft Windows XP (32-bit) Microsoft Windows 7 (32/64-bit) Microsoft Windows Vista (32/64-bit) Linux
Keysight IO Libraries	Includes: VISA Libraries, Keysight Connection Expert, IO Monitor

Want to know more?

Product information

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