# LXI-based Switching System Meets Legacy ATE System Challenge

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The signal switching subsystem is one of the most important assets in large automated test systems as it resides between precision instruments such as DMMs, oscilloscopes and signal generators and the UUT I/O. Signals that pass between the instruments and UUT cover the frequency and power spectrum and a well-designed switching subsystem utilizing a modular architecture can provide configuration flexibility that allows a variety of test instrument I/O to be available across multiple UUT test points at the general purpose interface (GPI). Since a switch acts as an extension of the test instrument, it is absolutely critical to architect the system switch, including any interface cabling, such that it is appears virtually transparent to the system thereby preserving the performance specifications of the instrument at the GPI.

Large ATE systems often require complex designs that can compromise signal integrity, and specifications on a single switch module therefore, tell only part of the story. A signal path often spans multiple switching modules through connections and cabling that add capacitance and insertion loss degrading the signal of interest. The challenges in maximizing system performance are magnified when a new test system design must also maintain backward compatibility with a legacy system as well as the multiple test program sets that have been fielded for many years. Introducing a new switch topology or design to an existing system can create conditions and path characteristics that can cause legacy tests to fail. However, if the new system must also support emerging technologies and platforms, sticking strictly with the legacy switch design can limit the potential of a system to address these new requirements.

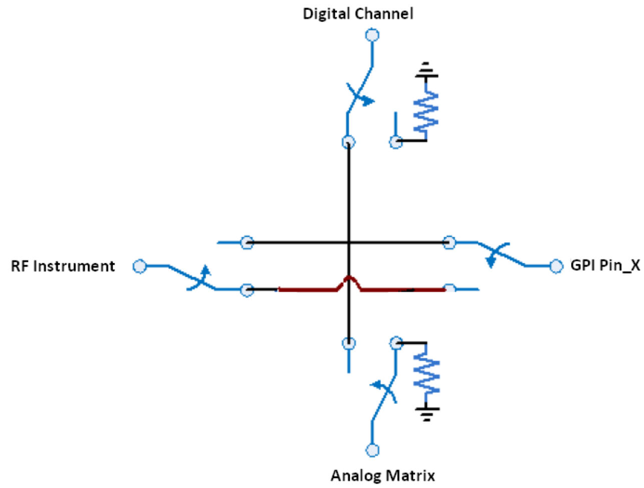
An avionics manufacturer was recently faced with the challenge of developing a forward looking test system with the stipulation that it maintain backward compatibility with a legacy system that supports in excess of 1,000 test program sets. The goals for this system were somewhat in opposition of one another, with the benchmark for success being measured against legacy test program performance, as well as the mandate to introduce enhanced capability that would provide the performance necessary to support next generation platforms. VTI Instruments' EX1200 LXI-based scalable switching series was used as the basis for this design effort. The advantages that the LXI-based architecture offered this application included:

- COTS (LXI) technology with a well-defined communications interface that takes advantage of the convenient and familiar LAN infrastructure. A low-cost, readily available Cat5e cable runs from the switch mainframe to the host controller.
- The LXI standard does not dictate a fixed form factor and offers the flexibility to implement a modular architecture that is not restricted to smaller eurocard footprints such as those defined by VXI and PXI instrumentation standards. This allowed the GPI

connectors to be integrated directly onto the switch modules with plenty of real-estate for design space that eliminated cabling between the switch I/O and the GPI.
- The larger footprint enabled a switch module design that incorporated a modified star topology creating multi-use pins at the GPI. 448 pins in seven slots of the receiver that had been dedicated to digital pattern generators can now be used to connect to other LF and high-frequency system assets, expanding the capability of what used to be a dedicated resource.
- Industry standard IVI drivers, required for all LXI devices, which simplified integration efforts.
- A web-based soft front panel, also required by all LXI devices, facilitated system maintenance and debugging by embedding a monitor and control graphical utility in the switch mainframe.

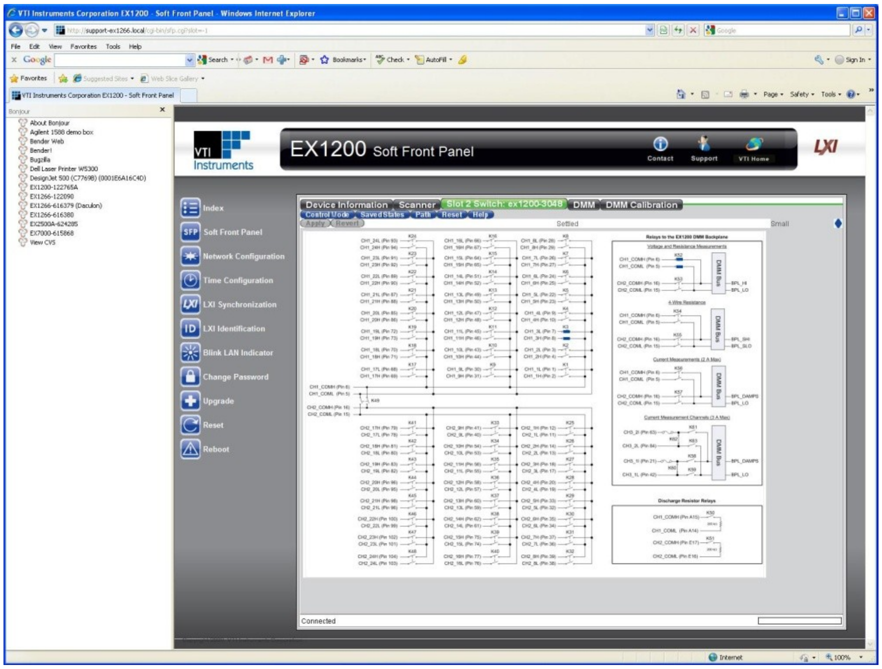
The legacy system has a defined pinmap that includes six slots of signal switching and an additional seven slots reserved for parallel digital tests out of the 19 total slots available. Experience had shown in other modernization programs that the six switching slots should be kept the same as the legacy system, otherwise the performance of legacy TPSs would be severely jeopardized. This required the elimination of any cabling between the signal switch and the general purpose interface to reduce added capacitance and propagation delays that had not been present in the legacy system and could result in TPS failure. This was achieved by mating the GPI receiver directly to the LXI-based switch mainframe and then integrating the receiver connector blocks onto the switch modules such that they could be removed/installed through the receiver.

While the new switching subsystem ensured legacy performance success, the requirement to add support for emerging technology also needed to be addressed. To enhance the test system with additional capability, the 448 pin digital section of the GPI was targeted for multi-purpose use. The pins on the GPI are capable of supporting signals with bandwidths in excess of 1 GHz, yet were restricted to providing access to a 25 MHz digital test instrument in the legacy system. By developing a star-type switch module within the GPI mainframe which could route a GPI pin from the digital instrument to alternate high frequency or low frequency system instruments under program control, the test system could then be extended support RF and analog I/O on the same pin (see block diagram below). The switch topology below was replicated 64 times on the switch module for each of the GPI pins.



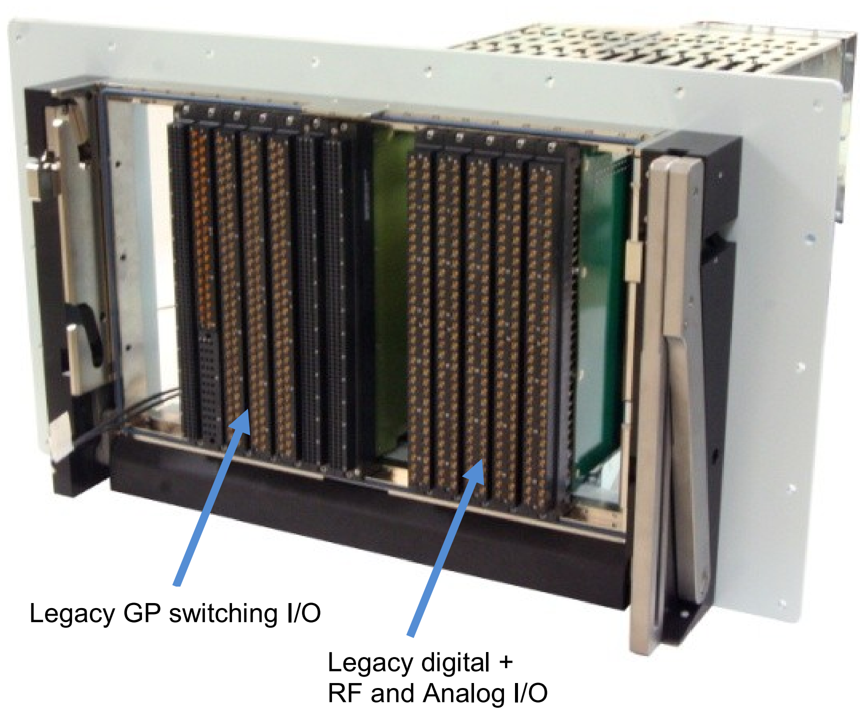

**GPI Multi-purpose Switch Topology**

The EX1200 can maintain pre-defined switch states, such that the default state directs the GPI pin to the digital test instrument to support legacy test programs on power up. Through the switch instrument's IVI driver, each pin can then be routed to either an RF instrument within the test station, or to an analog matrix bus on the backplane of the switch mainframe to support new test program development efforts. To achieve maximum performance to the RF instrument path, it was critical to create a dedicated path to the GPI and minimize any stubs, so a true star switch was not used. It was also necessary to ensure that the digital path maintained maximum performance to ensure legacy compatibility, and the traces were matched to 50 ohm, through the path to the GPI. The analog matrix connects to an analog backplane and is intended for use with low frequency measurement devices such as a counter/timer or DMM. In this way, any of the pins that had been dedicated for digital functions can now be used for RF or LF measurements. The switch mainframe has an embedded webserver that runs the soft front panel, invoked through any standard web browser (shown below), to allow for simplified debug during integration.




**Soft Front Panel for Switching Subsystem**

The integrated system, with the switch mainframe, modules and GPI is shown below. All switch modules plug into the EX1200 mainframe through the GPI and the switching states are controlled over an LXI/Ethernet communications interface. Each switch module integrates the appropriate GPI/receiver module which results in the elimination of cabling between the signal switching system and GPI creating a field maintenance environment that is considerably faster and simpler.



**GPI with Integrated LXI-based Modular Switch Mainframe**

The results of the test run on the first article were very encouraging. Bandwidths in excess of 500 MHz were achieved through the digital path ensuring legacy tests would not be impacted, and the additional RF and low-frequency analog paths were meeting their objectives approaching 1 GHz and 20 MHz respectively. Compatibility verification with legacy test program sets will proceed over the next few years.