Enhancing computer-based I/O for test systems

With a structured architecture, you can combine current and future I/O buses into one system, preserving your software and hardware investment in the process. The key to providing this common architecture lies in software. With industry standards, such as the virtual instrument software architecture (VISA) and interchangeable virtual instruments (IVI), you can combine different I/O buses into one system and provide the abstraction layer to make the transition to new buses transparent to the user. With this architecture, you can preserve your investments and take advantage of new technologies without worrying about their low-level details.

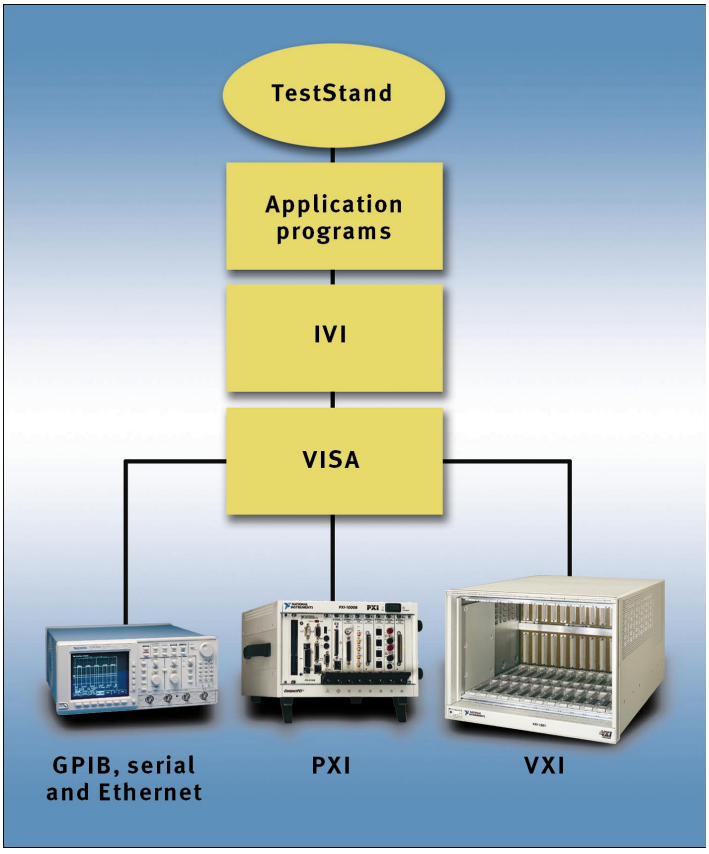

Figure 1: Preserve your software and hardware investment by using stable software architecture such as NI-VISA, which works with multi-platform systems.

Explore your connectivity options using common buses of today. The general-purpose interface bus (GPIB) and the RS-232 serial bus have been the most common I/O interfaces for many years. Instrument manufacturers have included GPIB–used specifically for instrument control applications–in thousands of instruments for more than two decades. RS-232 is a specification for serial communication, most commonly controls modems and printers, but is also very popular for instrument control applications. However, unlike GPIB, which can control up to 14 instruments per controller, you can connect and control only one device at a time with an RS-232 interface.

Benefits of emerging buses

Recently, instrument vendors began including Ethernet, USB, or IEEE 1394 as alternative communication interfaces on standalone instruments. Instrument control applications across Ethernet take advantage of unique characteristics of the bus, such as remote control of instruments and sharing among different users at different locations. Furthermore, there is a protocol (VXI-11) already designed for the control of instruments across Ethernet.

With USB, you connect peripheral devices, such as a keyboard and mouse, to PCs. USB is a plug and play bus, in which the host automatically detects and configures new devices. Today, because USB ports are a standard on PCs, you do not need to purchase a dedicated controller. Finally, because no protocol exists for instrument control with USB, you must use a proprietary implementation from the instrument manufacturer.

IEEE 1394, also known as FireWire, is a high-performance serial bus developed by Apple Computer, Inc. in the early 1990s. Although Microsoft Windows 2000/98 works with FireWire, Intel PC peripheral chipsets do not currently include it, so in most cases, you would need an IEEE 1394 controller for your PC. The IEEE 1394 Trade Association has defined a protocol to control instruments across the bus.

Using bridge products

Because of the slow adoption of new buses by instrument manufacturers, relative to PC manufacturers, bridge products are emerging as a viable alternative. Bridge products are hardware products that include two different buses arranged for conversion, facilitating the integration of new buses into traditional systems. Bridge products help preserve your investment in hardware, software and time, and act as a transparent solution for your application. For example, if you decide to replace the GPIB plug-in controller with an Ethernet-to-GPIB bridge product, you can ideally take the code written for the GPIB plug-in controller and reuse it without any modifications.

Creating a flexible software architecture

To learn the basics of VISA as a step toward industry-wide software compatibility, the VXI-plug&play Systems Alliance developed one specification for I/O software–VISA. When the alliance was founded in 1993, many non-standard commercial implementations of I/O software for VXI, GPIB and serial interfaces existed. For these buses, VISA provides a common foundation for the development, delivery and interoperability of high-level multi-vendor system software components, such as instrument drivers, soft-front panels and application software. Although the alliance defined VISA, individual vendors created different implementations of VISA.

Because VISA defines one API for instrument communication, you can preserve your software investment when you migrate to new interface buses or mixed I/O systems. The NI-VISA implementation today works with interfaces other than VXI, GPIB and serial, including PXI and Ethernet.

Ease VISA with passport models

One problem with the previous model was that each vendor designed its VISA implementation to work with that vendor's controllers, and you could not use it with those from other vendors. In addition, to work with new interfaces, you have to install a complete VISA library. Sometimes, it comes from a different vendor and does not guarantee the preservation of existing interfaces.

To solve such problems, National Instruments has redesigned their VISA implementation using a "Passport" plug-in model, which defines a distinct communication port, or passport, for each different bus. The NI Passport model separates the specific communication mechanisms for connectivity buses from the core VISA library, which contains the popular high-level VISA API. With this model, each different bus requires a passport to connect to the core VISA engine, so you can add compatibility with new buses easily without disturbing the existing interfaces.

With this model, you can truly have multi-vendor and multi-interface systems. Unlike other solutions that rely on technologies such as component object model (COM), multi-platform ANSI-C technology is still the basis of the passport model. In addition to the interfaces with which VISA works today, National Instruments is committed to adding

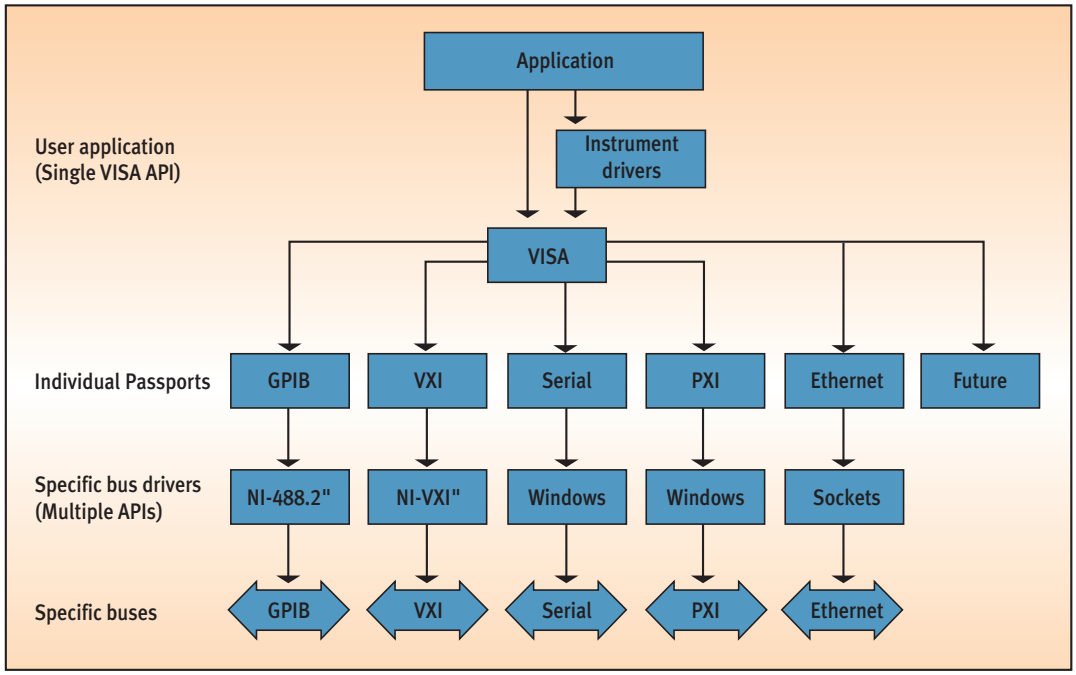

Figure 2: VISA is a software layer for configuring, programming and troubleshooting instrumentation systems comprised of VXI, VME, GPIB and Ethernet.

compatibility within VISA for any bus interface that becomes popular in test and measurement applications.

Find versatility with IVI

The IVI Foundation is defining a standard for instrument drivers–software modules that abstract low-level communication details–that builds on VISA to provide a robust, high-performance and easy-to-use instrument communication protocol. These instrument drivers, created according to the foundation standards, contain high-level functions, such as Configure Measurement or Read Waveform, which internally contain the low-level VISA read and write functions. Combined with VISA, IVI provides a great mechanism to deliver multi-vendor, multi-platform, mixed I/O test systems.

Software architecture provides benefits

Because multi-vendor, multi-interface systems are becoming increasingly prevalent, you need to have a software architecture in place that can handle those systems with minimal effort and with maximum software reuse. The software architecture based on VISA can provide such compatibility, as well as the following benefits:

a. Gain compatibility with multiple connectivity buses. Develop a system that mixes traditional interface buses with newer buses. In addition, a plug-in model provides an easy migration path to future buses, which might include Bluetooth.
b. Preserve your hardware investment. Use bridge products to incorporate existing hardware into systems. And use a multi-interface architecture, so you can slowly migrate to newer bus technology without replacing all instruments or waiting for them to become available with the new bus.
c. Preserve your software investment, the most costly part of a system. When migrating to a new control bus, use bridge products to control traditional equipment without code modification. For instruments that only work with newer buses, a system written with VISA continues to work.
d. Eliminate the learning curve. Although programming instruments across new buses can require you to learn a completely new API, the same familiar API continues to work with the VISA Passport model.
e. Gain compatibility with the most popular and emerging instrumentation platforms. The VISA API currently works with Windows, Linux, Macintosh, Solaris, and more.

The future of test systems is one that comprises instrumentation hardware with mixed I/O connectivity. The best way you can maintain the investment in software and hardware throughout the life of the system is to use a stable software architecture capable of working with multi-vendor, multi-interface, and multi-platform systems.

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