ICS ELECTRONICS
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APPLICATION BULLETIN

ADDING VXI-11 AND 8065 CAPABILITY TO GPIB-UTILS
(GPIB for Linux using Ethernet)

INTRODUCTION

The gpib-utils project is a project on SourceForge that is a collection of linux command line utilities for various electronic test instruments. The project was originally developed with conventional GPIB controllers such as a PCI-GPIB card and a USB-GPIB Controller module. This Application Note describes the addition of Ethernet support to the gpib-utils package using the VXI-11 protocol.

BACKGROUND

Gpib-utils (see <http://gpib-utils.sourceforge.net/>http://gpib-utils.sourceforge.net/) is an open source project to provide Linux support for configuration save/restore, print screen, and light automated test applications for several GPIB-enabled instruments. It was initially started to support the HP 1631A Logic Analyzer/Oscilloscope, which had become an attractive instrument for the DIY electronics community, but which lacked any Linux support from HP/Agilent. Gpib-utils, brought to the Linux/DIY community the ability to save and restore configurations set up using the front panel, and to capture screen dumps for offline analysis or publication. Support for other instruments was added over time.

One of the problems that every user of gpib-utils had to tackle was installing the linux-gpib package and getting it to work with their Linux distribution and GPIB interface card. This package has improved in recent years, but for various reasons it has always been difficult to get working reliably. The advent of VXI-11 Ethernet - GPIB gateways has opened another avenue for Linux that is much more portable and stable than linux-gpib. VXI-11 provides a functional interface very similar to the National Instruments compatible API in linux-gpib, so porting gpib-utils to it was a straightforward task.
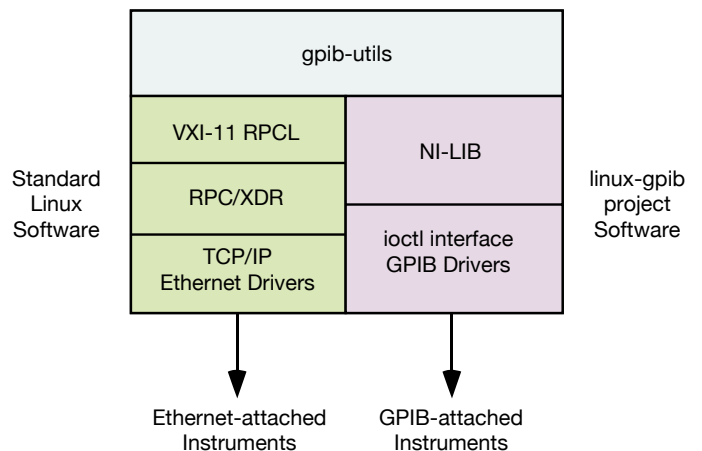
ADDING VXI-11 SUPPORT TO GPIB-UTILS

The VXI-11 Specification defines a protocol based on ONC RPC for communicating with devices and test equipment over a TCP/IP

network. VXI-11.3 is the sub-specification for communication with instruments, either natively to a LAN jack on the back of an instrument, or via an Ethernet-to-GPIB gateway. ICS's Model 8065 is a VXI-11.2 and VXI-11.3 compliant Ethernet-to-GPIB Gateway.

VXI-11 eliminates one step in the process of establishing instrument connectivity to Linux: no GPIB driver. For GPIB boards or USB GPIB adapters, linux-gpib provides kernel drivers and National Instruments library compatibility. Although linux-gpib is a well maintained project, linux-gpib kernel drivers do not seem to be on track for inclusion into the Linux kernel any time soon. There are also a number of popular GPIB Controllers that are not included in the current version of linux-gpib. Furthermore linux-gpib is not part of most major Linux distributions (with the exception of Debian). Thus, for many users, linux-gpib must be recompiled and reinstalled every time the kernel is updated.

With VXI-11, kernel drivers are **not** needed and instrument connectivity software like gpib-utils is much easier to install and use. Further, it becomes possible to build gpib-utils as a standalone package which could be adopted by a Linux distribution without the kernel baggage. The following figure depicts gpib-utils relationship to the VXI-11 software stack versus GPIB:

Software Diagram

Adding VXI-11 support to gpib-utils was a matter of including the VXI-11.x ONC RPC definitions from the VXI-11 spec (pulled from the Agilent application note examples referenced below), adding Makefile targets to generate the stubs for the VXI-11 services with rpcgen, and adding VXI-11 function calls to gpib.c, where all gpib-utils's I/O functions are wrapped. Because the gpib.c wrappers were already there, it was possible to add VXI-11 support without modifying the instrument utilities themselves, although in some cases it was necessary to alter error handling code to more gracefully exit, shutting down RPC services to avoid leaving the other end of the connection to time out.

Each utility takes an --address command line argument, used to specify the instrument address which is passed to the gpib.c wrapper initialization function. If the address contains a colon, the initialization function now interprets it to be a VXI-11 hostname: logical_device, otherwise it is assumed to be a numeric GPIB primary address. For example, a native VXI-11 instrument might be called meter:inst0, an instrument at GPIB address 9 behind an Ethernet-to-GPIB controller such as the ICS 8065 might be addressed as gpibgw:gpib0,9, and the same instrument directly attached to a GPIB card would simply be addressed as 9. For convenience, a configuration file /etc/gpib-utils.conf has been added so that default addresses can be entered there for each instrument and the --address argument does not have to be used every time. In earlier releases of gpib-utils, each instrument was expected to be present in /etc/gpib.conf. This is no longer necessary, and indeed RPM packages for gpib-utils 1.3 are available compiled with and without linux-gpib. In the latter case, specifying a GPIB instrument address results in an initialization error.

Since gpib-utils is rather unsophisticated in its use of GPIB facilities, only the core VXI-11 channel was used. The abort and intr (SRQ) channels were not implemented. VXI-11 device locking is not used. VXI-11 device discovery (broadcast to portmapper port 111) was not implemented

SUMMARY

This Application Note has described how the VXI-11 protocol and support for the 8065 were added to the gpib-utils project to control GPIB instruments.

CREDITS

Special thanks to Jim Garlick for the material for this Application Note and for his feedback which has helped to improve the 8065 Ethernet to GPIB Gateway.

References:

The following references were used in the course of adding VXI-11 support to gpib-utils:

* Model 8065 Ethernet <-> GPIB Controller Instruction Manual, ICS Electronics.
* Frequently Asked Questions (FAQ) For The ICS Model 8065 Ethernet-To-GPIB Controller, Application Note AB80-1, ICS Electronics.
* VXI-11 RPC Programming Guide for the 8065: An Introduction to RPC Programming, Application Note AB80-3, ICS Electronics.
* SRQ Handling With a VXI-11 Interrupt Channel On ICS's Model 8065 Ethernet-To-GPIB Controller, Application Note AB80-4, ICS Electronics.
* VMEbus Extensions for Instrumentation: TCP/IP Instrument Protocol Specification VXI-11, Revision 1.0, July 17, 1995.
* Using Linux to Control LXI Instruments Through VXI-11, Application Note 1465-28, Agilent Technologies.
* Example code from Agilent application note.
* Power Programming with RPC, John Bloomer, O'Reilly & Associates, Inc., 1992.