

# Automating MAP-200 Instruments in LabVIEW

## Introduction

This application note provides guidance on communicating between the MAP-200 and associated modules in LabVIEW (LV). MAP-200 is an optical test and measurement platform optimized for cost-effective development and manufacturing of optical transmission networked elements. LabVIEW from National Instrument provides a graphical programming environment that engineers and scientists commonly use to develop sophisticated measurement, test, and control systems using intuitive graphical icons and wires resembling a flowchart.

## MAP-200 Hardware Interfaces

As with any programmable instrument, one or more hardware (HW) interfaces are available that allow communication between the instrument, the test PC, and test software. The MAP-200 is equipped with an Ethernet port and a General Purpose Interface Bus (GPIB) port. The MAP-200 is LXI (LAN Extension for Instrumentation)-compliant and falls under a LXI Class C instrument. Figure 1 highlights the communication architecture of the MAP-200.

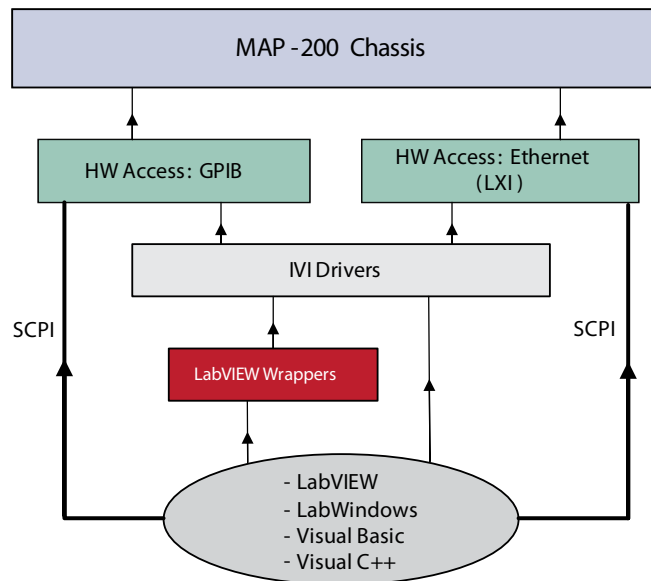


Figure 1: MAP-200 Communication Architecture

## Choosing the Right Hardware Interface

Deciding which of the two available hardware interfaces to use for automation requires an understanding of LXI. Be sure to review Appendix A for more information about LXI and GPIB so you can make a more informed decision on the appropriate hardware communication platform. The latest industry standards and trends recommend LXI (Ethernet) for hardware interface.

## Establishing Communication and Saving Instrument Resources

The following sections indicate how to add the MAP-200 as a resource in National Instruments Measurement and Automation Explorer (NI MAX). To bypass the resource setup in NI MAX, refer to the subsection on Creating Instrument Resources Directly.

### GPIB

The default GPIB address on the MAP-200 is 13. After connecting the chassis to the GPIB bus of a computer that supports GPIB communication, add the instrument by following these steps:

1. Expand the **Devices and Interfaces** section.
2. Right click **GPIB0** and select **Scan for Instruments**.
3. Expand **GPIB0** and the MAP-200 will show up as **Instrument [N]**.

Communication with the MAP-200 is also possible from this interface by right clicking on the MAP-200 instrument and selecting **Communicate with Instrument**. The resource appears as shown in Figure 2.

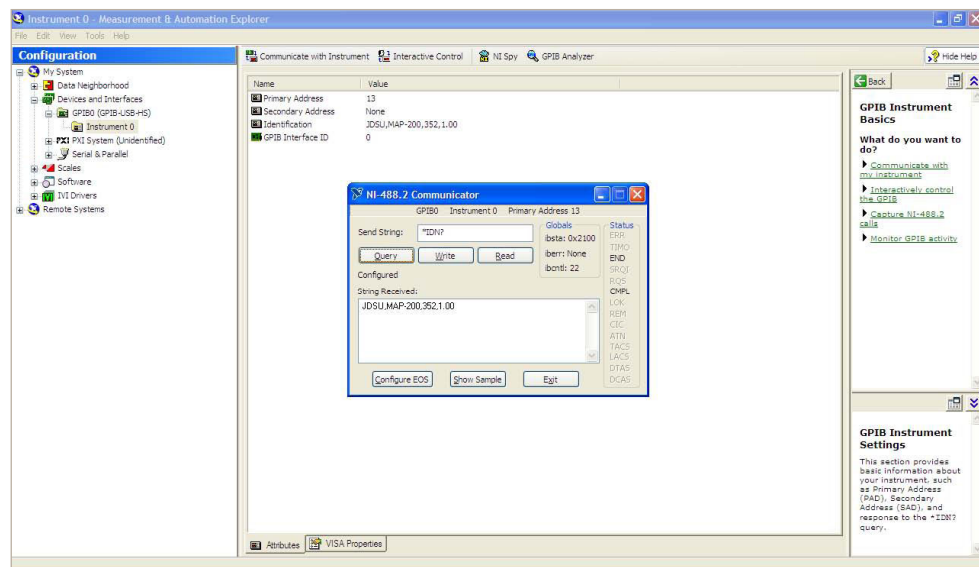


Figure 2: GPIB Resource in NI MAX

### **LXI to MAP-200 Chassis**

The MAP-200 can be operated in DHCP, Auto IP, or Static IP mode. Discover the MAP-200 through NI MAX using these steps:

1. Right click **Devices and Interfaces** and select **Create New...**
2. From the pop-up window, scroll down and select **VISA TCP/IP Resource**.
3. If the IP is unknown, choose **Auto-detect of LAN Instrument**; or if not on the same subnet but the IP is known, choose **Manual Entry of LAN Instrument**.
4. A populated list of all LXI instruments on the subnet will appear and at this stage select **Modules of Interest to Add**, and click on **Finish**.

The MAP-200 chassis and modules are then added as resources, as Figure 3 shows. Note that this example refers to a three-slot MAP-230 chassis populated with three modules.

Instrument 0 refers to the chassis and the resource:

```
TCPIP0::10.13.32.61::inst0::INSTR
```

This can be used to route commands to modules through the chassis controller.

### **LXI to MAP-200 Cassette**

Refer to details in the LXI to MAP-200 Chassis section to establish resources as shown in Figure 3. After adding resources, each of the modules appear to have their own resource string. For the example above, the three resource strings are:

1. TCPIP0::10.13.32.61::inst1::INSTR
2. TCPIP0::10.13.32.61::inst2::INSTR
3. TCPIP0::10.13.32.61::inst3::INSTR

To communicate directly to the module in Slot 1, use the first resource string. The modules are named according to the slot they in which they reside.

### **Socket**

The port number is required to establish a socket for communicating with a particular MAP-200 module. Several methods enable acquiring a port number as listed below:

1. Use the SCPI command: **:SYSTem:LAYout:PORT?**
2. Access the GUI and extract port information from the Detailed Instrument View screen.
3. Use the JDSU LXI Discovery Browser (supplied with the MAP-200) to display detailed information.

After acquiring the port number, set up a socket resource following these steps:

1. Right click **Devices and Interfaces** and select **Create New...**
2. From the pop-up window, scroll down and select **VISA TCP/IP Resource**.
3. Choose **Manual Entry of Raw Socket**.
4. Enter the MAP-200 IP address in **Hostname or IP Address** text box.
5. Enter the applicable port number for your module in **Port Number** text box.
6. Select the **Validate** button.

If all the information is correct, a pop-up will appear indicating: **Successfully opened a VISA session to “TCPIP::<IP Address>::<Socket Number>::SOCKET”**. Finally, this is added as a resource with the word SOCKET as part of the resource name, as Figure 4 shows.

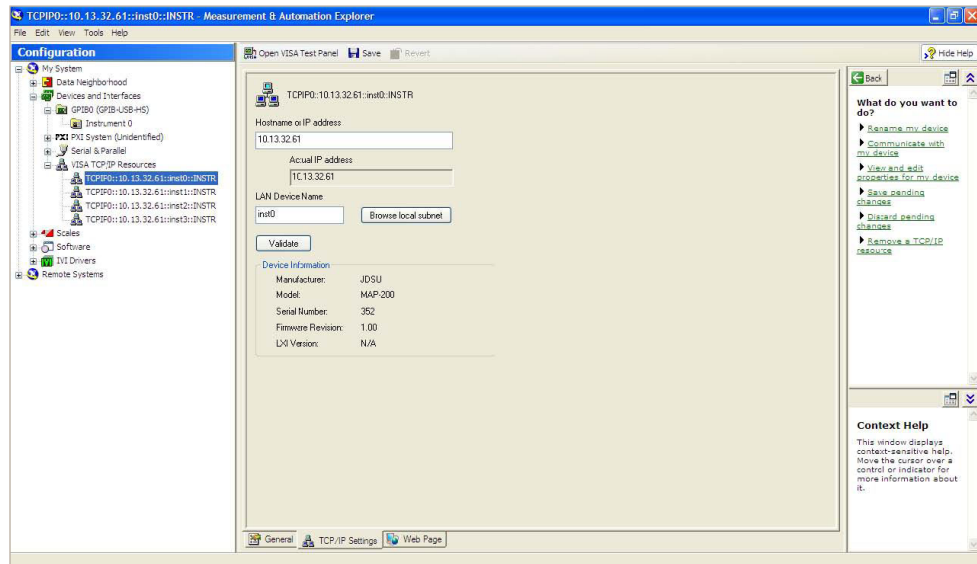


Figure 3: MAP-200 VISA TCP/IP Resources

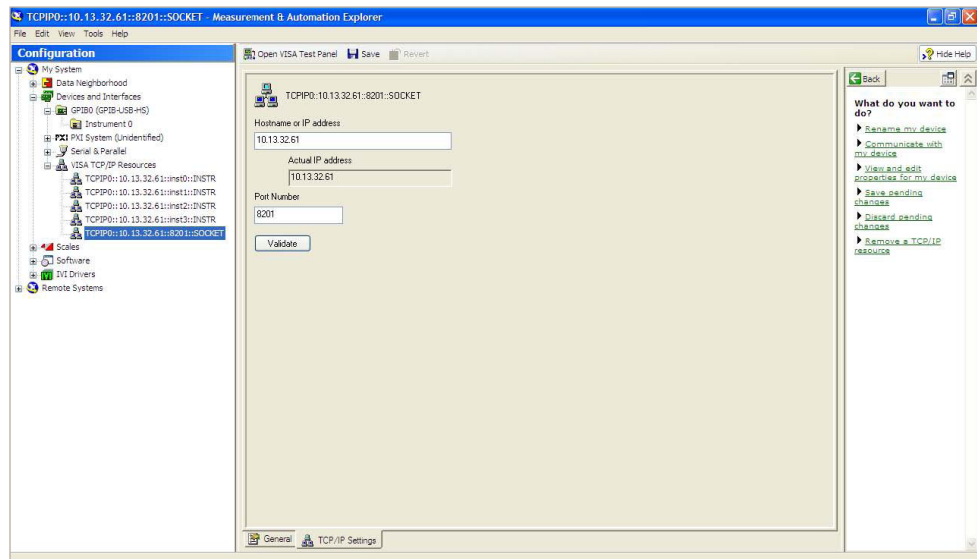


Figure 4: MAP-200 TCP/IP Socket Resource

**Creating Instrument Resources Directly**

It is also possible to bypass NI MAX and create Instrument Resource Strings if you know the device address information, such as the TCP/IP address, slot information, and port information. This is particularly useful for replicating test sets that do not all have the same version of NI MAX or VISA. Creating such VISA resources dynamically also allows the user more control on the settings applicable to VISA properties that govern instrument IO. LabVIEW examples of creating such resource strings and VISA properties are available upon request.

The following example strings show communication type resource strings that can be created by filling in the blanks, according to set-up:

- For socket → TCPIP::::<port number>::SOCKET
- For cassette → TCPIP0::::inst<slot number>::INSTR
- For chassis → TCPIP0::::inst0::INSTR

**Software Options**

Two options are available for software (SW) development. Users can use IVI drivers or direct SCPI. Brief descriptions of each of these options follow, allowing users to select the option that most suits their programming style.

**Interchangeable Virtual Instruments (IVI) Driver**

The LXI Standard mandates that every LXI instrument must have IVI drivers, which facilitates the use of LXI instruments in test setups that employ the use of non-LXI instruments that communicate over GPIB, PXI, or VXI. Table 1 summarizes the advantages of using IVI drivers.

The MAP-200 IVI drivers have been tested with Visual Basic, Visual C++, LabVIEW, and LabWindows. In addition, LabVIEW wrappers are available that are based on these IVI drivers for use with LabVIEW. Both IVI drivers and LabVIEW wrappers are compatible with LabVIEW; however LabVIEW wrappers are recommended.

Download MAP-200 IVI Drivers and LabVIEW wrappers with complete installation instructions at: [www.jdsu.com/products/communications-test-measurement/products/downloads/map-200-ivi-driver.html](http://www.jdsu.com/products/communications-test-measurement/products/downloads/map-200-ivi-driver.html)

Factor	Advantage
Consistent	<ul style="list-style-type: none"> <li>• Common model to control instrument</li> <li>• Easier replacement or addition of instruments</li> <li>• Encourages greater software reuse</li> </ul>
Ease of Use	<ul style="list-style-type: none"> <li>• Enhanced features in popular Application Development Environments (ADE)</li> <li>• Simple integration in many different environments</li> <li>• Fast, intuitive access to functions</li> </ul>
Quality	<ul style="list-style-type: none"> <li>• Rigorously tested to ensure driver of high quality</li> <li>• Focus on common commands and desirable options</li> </ul>
Simulation	<ul style="list-style-type: none"> <li>• Run and debug code without physical instrument presence</li> </ul>
Range Check	<ul style="list-style-type: none"> <li>• Ensures supplied parameters within acceptable range</li> </ul>
State Cache	<ul style="list-style-type: none"> <li>• Instrument communication only upon state change improving system performance</li> </ul>

Table 1: Advantages of IVI Drivers

### Installing LabVIEW (IVI) Wrappers

After extracting and installing IVI drivers, the following directory should appear in the location where the driver was extracted:

C:\.\ 21132699-001\_CM100\CM100\LabVIEW\IVI-CLV70 Wrappers

A directory should exist named `jdxxx` where `xxx` represents the name of the module, such as `jdCMR`, for the chassis drivers. Copy this directory to the Instrument Library Folder of NI LabVIEW:

C:\Program Files\National Instruments\LabVIEW 7.0\instr.lib

Placing the driver folder in the `instr.lib` folder for LabVIEW enables access to the drivers through Instrument IO, Instrument Drivers, and `jdCMR` to expose available functions, as Figure 5 shows.

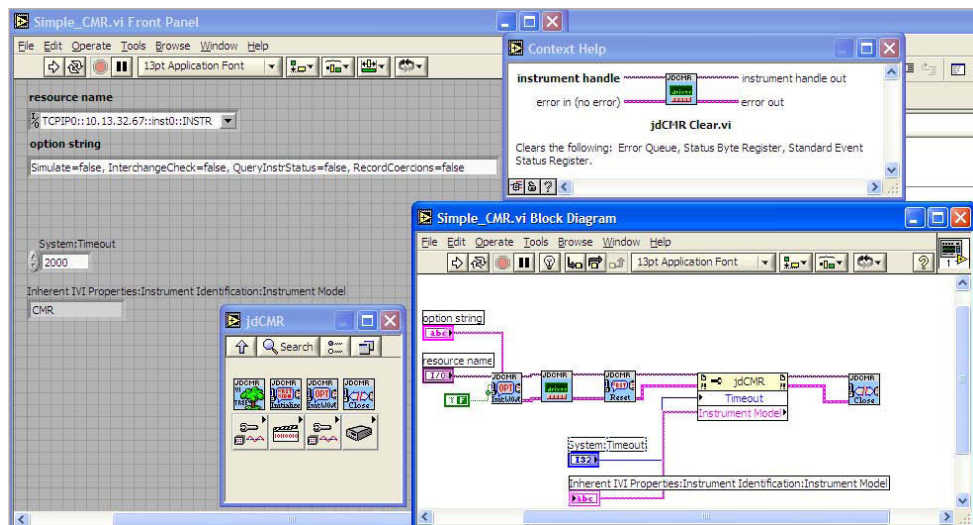


Figure 5: MAP-200 LV Instrument Driver

### Viewing MAP-200 LabVIEW Driver Examples

Examples are available that provide guidance on how to access instrument functionality through these drivers. Find these examples in the extracted driver directory in the following location:

C:\.\ 21132699-001\_CM100\CM100\Samples\LabVIEW\LV70Samples

### Standard Commands for Programmable Instruments (SCPI)

Users who are not interested in using instrument drivers have another option of using SCPI commands to interact with the MAP-200. The commands are ASCII-based text strings that enable controlling all MAP-200 chassis and modules using SCPI commands. SCPI does not specify the communication bus, enabling its use through GPIB or LXI (Ethernet).

### SCPI Syntax and Legacy Mode

With several ways to establish instrument communication, the SCPI command syntax can vary slightly, depending on the type of connection and usage mode. In addition, to support Legacy MAP customers, the MAP-200 supports “Legacy Mode” which should only be enabled if a test set has MAP-200 and Legacy MAP instruments. A new development should typically be done with Legacy Mode disabled.

Table 2 shows the appropriate syntax for the various connection modes and Legacy Mode settings. <C> represents Chassis number, <S> represents Slot number and <D> represents Device number.

	Legacy Mode	Non-Legacy Mode	Example of address
GPIB	:OUTPut:ATTenuation <C>,<S>,<D>,<Attenuation>	:OUTPut:ATTenuation <S>,<D>,<Attenuation>	GPIB::13::INSTR 1
LXI (Ethernet) to Contoller	:OUTPut:ATTenuation <C>,<S>,<D>,<Attenuation>	:OUTPut:ATTenuation <S>,<D>,<Attenuation>	169.254.100.1
LXI (Ethernet) to Cassette	N/A	:OUTPut:ATTenuation <D>,<Attenuation>	169.254.100.1:8003

Table 2: SCPI Syntax According to Connection Mode and Legacy Mode

### Using SCPI Commands in LabVIEW

If using IVI drivers is not preferred, use SCPI commands instead. Once communication has been established, users can access the VISA palette to quickly read and write to and from the instrument. Access the VISA palette by selecting: Instrument I/O, VISA. Figure 6 shows a simple block diagram created to write and read from the MAP-200 using VISA open, write, read and close VIs.

**Note:** It is good programming practice to acquire a resource handle and reuse that handle until finished. Opening and closing of VISA resources can be made to be a simple sub-VI that is passed onto top-level VIs. Figure 6 does not indicate this as it is intended to depict a simple example.

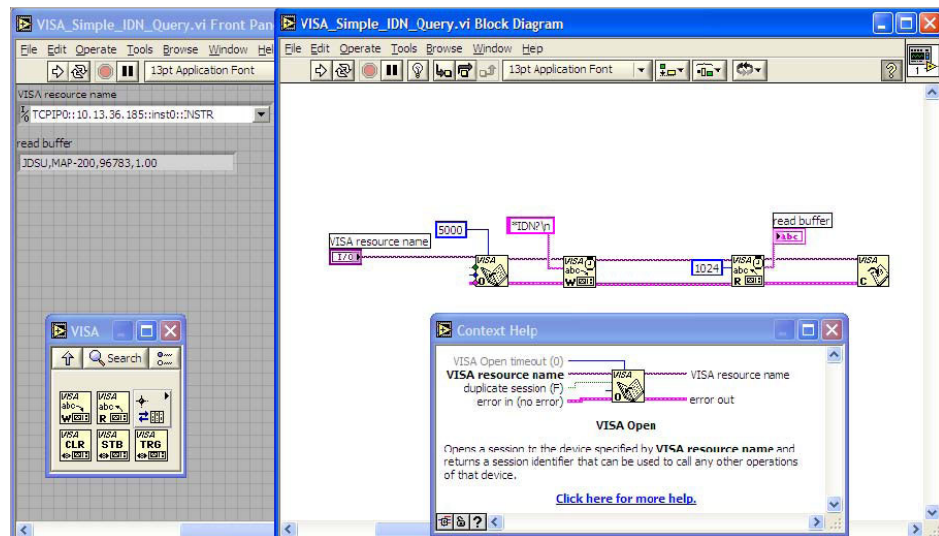


Figure 6: Simple MAP-200 SCPI & LVVI Using VISA VIs

**NI-VISA Property: Term Char and Suppress End Enabled**

NI-VISA users are able to specify the Term Char property to denote the termination character. For the MAP-200 and associated modules, this is 0x0A. Enabling this property allows a READ operation to terminate when this termination character is received.

Enabling the Suppress End Enabled property affects only READ operations. For all session types on which this attribute is supported with this attribute enabled, read will not terminate due to an END condition. However, a read may still terminate successfully if Term Char is also enabled. Otherwise, read will not terminate until all requested data is received (or an error occurs). More importantly, there are different cases depending on the type of resource being used.

**TCP/IP Socket Sessions**

If this attribute is set to false, if NI-VISA reads some data and then detects a pause in the arrival of data packets, it will terminate the read operation. On TCP/IP SOCKET sessions, this attribute defaults to true in NI-VISA.

**LXI/VXI INSTR Sessions**

If this attribute is set to false, the END bit terminates read operations.

The applicable settings for these properties according to the resource type are listed in Table 3.

Resource Type	Example	Term Char Enable	Suppress End Enabled	Comment
GPIB		TRUE	FALSE	Using C,S,D or S,D syntax and routing commands through chassis
(LXI/VXI) To Chassis	TCPIP0::10.13.36.148::inst0::INSTR	TRUE	FALSE	Using C,S,D or S,D syntax and routing commands through chassis
(LXI/VXI) To Cassette	TCPIP0::10.13.36.148::inst1::INSTR	TRUE	FALSE	Using D syntax and routing commands directly to cassette (for example, VOA slot 1)
Raw Socket To Cassette	TCPIP0::10.13.36.148::8003::SOCKET	TRUE	TRUE	Create Socket resource using Cassette Port Number

Table 3: NI VISA Term Char and Suppress End Enabled Property Settings for Resource Types

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## Support

For access to MAP-200 LabVIEW drivers, examples or further information or support, please contact the FO-PLT support group.

<b>Web</b>	Technical Support Request Form	
<b>Phone</b>	North America	800 406-9559 (toll-free)
	Outside North America	+800 4069-5599 (toll-free)
	China	+10 800 140-5599 (toll-free)
	Toll-Free Access Codes by Country or Area	
<b>E-mail</b>	support@jdsu.com	
<b>Fax</b>	North America	800 898-8537 (toll-free)
		613 843-3333
	Outside North America	+800 7777-5378 (toll-free)
	Toll-Free Access Codes by Country or Area	

## Appendix A: LXI versus GPIB

### Introduction to LXI: LAN eXtension for Instrumentation

LXI is the LAN-based successor to the 30-year-old stable GPIB platform for instrument communication and control. LXI exploits the benefits of proven Ethernet standards and provides instrument communication and control that is robust, easy to use, cost-effective, fast, and limitless in terms of distance and number of connections.

Ethernet is the most widely used communication platform and comes standard on most PCs. It supports high-speed communication, automatic discovery of addresses and assignment, unlimited range and nodes, low-cost cables, scalable speed, and choice of media support that enables simple linkage to enterprise software. All of these advantages are inherent in LXI.

### Advantages of LXI over GPIB

LXI has many advantages over GPIB that are summarized in Table 1 below. In general, the Test and Measurement industry is gearing towards the use of LXI instruments, utilizing TCP/IP-based communication due to the numerous advantages such as lower cost components, flexible configuration, and efficient data transfer rates and remote instrument access.

Factor	GPIB	LXI
Hardware cost	Controller card: \$550 Cables: \$100 each	Racks and/or Ethernet interface: \$0–\$3000 Cables: \$10 each Hubs: \$25–\$100
Computer connectivity	PCI card	Standard on most PCs Off-the-shelf adaptors
Remote access	Only through controlling PC	Yes
Max. devices	32	Unlimited
Cable length	20 m	100 m for 10/100BaseT Unlimited with router and Internet
Max. data transfer rate	8 Mbps	V10: 10 Mbps V100: 100 Mbps V1000: 1000 Mbps
Scalability	Limited by number of devices Limited by cable length Requires additional PCI cards	Unlimited scalability Requires additional racks and/or hubs
Interface isolation/type	Parallel Non-isolated	Full duplex peer-to-peer Isolated

Table 4: Platform differences between GPIB and LXI

**Recommended Interface: LXI (Ethernet)**

Given the advantages of LXI over GPIB, and its growth in the direction of dominant hardware platform for programmable instrument communication, it is recommended that new users consider using LXI (Ethernet) as the communication interface. Table 5 below summarizes the realizable advantages of this interface.

Technical Feature	Details
Communication Platform	10/100/1000BaseT Ethernet
Data Rate	10/100/1000 MBps
Auto MDIX	Allows straight-through or cross-over cable use
Number of Connections	Unlimited
Maximum Distance	Unlimited
Communication Protocol	TCP/IP: DHCP, Static IP, Auto IP
Auto Discovery	LXI discovery tool for automatic instrument IP detection
Modular Instruments	Chassis and cassette (module) configuration
Web Interface	For remote monitoring, configuration and control
IVI Drivers	Simplified programming for easier debug and development
Hybrid Platforms	Multiple communication platform support, for example, GPIB and LXI

Table 5: LXI Technical Overview

**When to Use GPIB**

The following reasons support the use of GPIB:

**Familiarity:** Some users prefer to use GPIB because it is familiar and proven and, therefore, it is worthwhile to investigate creating hybrid test systems that use both GPIB and LXI instruments.

**Legacy MAP Users:** Applicable only to those users who have purchased Legacy MAP equipment in the past and have used GPIB as the communication platform.

It is possible that Legacy MAP users do not have the time to modify existing test software, in which case, they continue with GPIB. However, it is recommended that if ample time is available, users should make modifications to the test software only to alter the instrument communication section of the script to use Ethernet.

**Standardized on GPIB:** Some policies recommend using GPIB as the hardware communication interface, leaving users with GPIB as their only option.

**Lack of Network Support:** IP addresses for test instruments are not always easy to obtain and in networks with heavy traffic, users can experience increased communication delays between the test PC and the instrument, thus making it better to use GPIB.

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