Agilent Technologies

GPIB/USB/LAN Interfaces

E2094S

IO Libraries Suite 15.5 Connectivity Guide with Getting Started

Agilent Technologies

Notices

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This guide is valid for Revisions 15.xx of the Agilent IO Libraries Suite software, where xx refers to minor revisions of the software that do not affect the technical accuracy of this guide.

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Getting Started

This chapter includes:

- Using This Guide
- What is Agilent IO Libraries Suite?
- Agilent Web Resources
- Contacting Agilent

NOTE

Unless specifically noted, this version of the Agilent Connectivity Guide is valid for Revisions 15.5 of the Agilent IO Libraries Suite softwareand later including minor revisions of the software that do not affect the technical accuracy of this guide

NOTE

This guide does not describe LAN networks that include a gateway, such as the Agilent E5810A LAN/GPIB Gateway for Windows. See the applicable gateway documentation for information on gateway systems.

Also, this guide does not provide a detailed description of LAN, USB, or GPIB interfaces or TCP/IP networks. Consult standard reference texts for this information.

If you need to contact Agilent, see “Contacting Agilent” on page 22 for addresses.

Using This Guide

A typical complex test system includes a collection of instruments under the control of a PC that has been programmed to perform testing and reporting routines. Often, the communication between the test instruments and the PC involve various forms of I/O; refer to Figure 1.

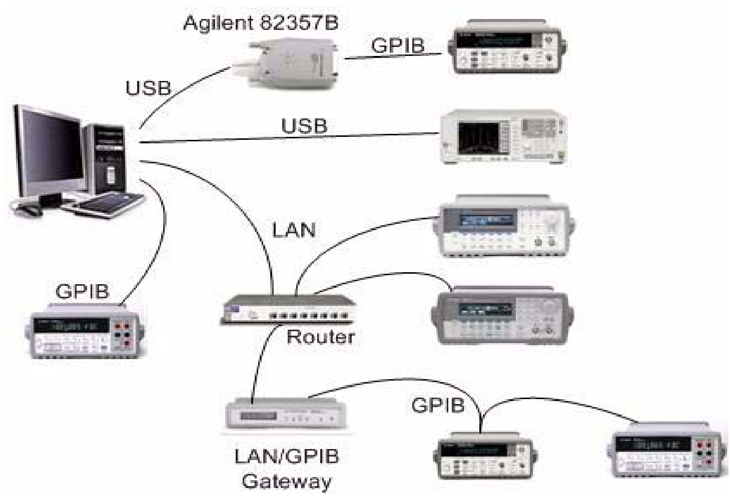
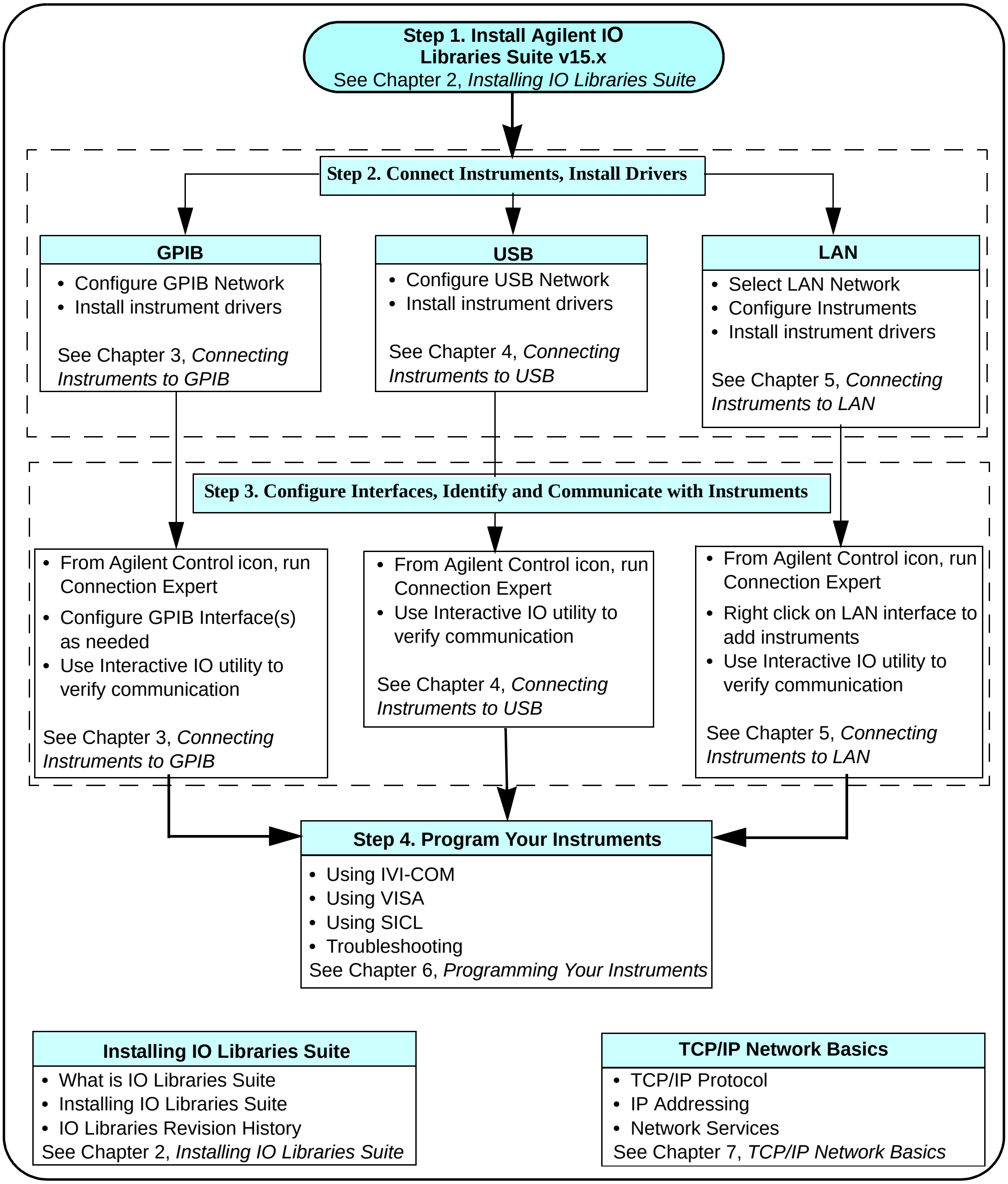


Figure 1 Example test system: PC, instruments, Three Types of I/O

Configuring interfaces to connect your PC to the test instruments can be daunting. Agilent's IO Libraries Suite v15 significantly simplifies this task.

This *Agilent Connectivity Guide* with *IO Libraries Suite Getting Started* describes in detail how to connect instruments to GPIB, USB, and LAN interfaces and how to configure and troubleshoot these interfaces on PCs with Windows Vista or XP operating systems.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What is Agilent IO Libraries Suite?

Agilent IO Libraries Suite is a collection of libraries that give you the ability to use your instruments from a test and measurement program, and utilities that help you quickly and easily connect your instruments to your PC.

Agilent IO Libraries Suite speeds your success with software utilities that let you quickly connect your instruments to your PC, configure and verify your connection, and get on with your job — whether that entails programming instruments or using pre-existing application software. For test and measurement programmers, the IO Libraries Suite brings the power of the industry-standard VISA and VISA COM libraries, as well as SICL and Agilent 488, to your programming experience.

NOTE

To access the *Agilent IO Libraries Suite Online Help* from the Connection Expert window, click **Help** > **Help Topics** on the menu bar or press the **F1** key. To access the online Help without running Connection Expert, click the IO Control icon(IO) in the Windows Notification area, click **Documentation** and then **IO Libraries Suite Help**.

NOTE

To find out where the Agilent Connectivity Guide components listed below have been installed on your system, click the IO Control icon (IO) in the Windows notification area, then click **Installation Information.**

Agilent IO Libraries

There are four IO Libraries included in Agilent IO Libraries Suite; each of them allows you to programmatically control instruments, send commands to them, and receive responses and data. The *Agilent IO Libraries Suite Online Help* provides guidelines to help you choose among these libraries; in general, VISA and VISA COM are recommended for new development.

Agilent VISA

Agilent VISA (Virtual Instrument Software Architecture) is used to develop I/O applications and instrument drivers that are interoperable with VISA applications from other vendors, and that comply with IVI Foundation standards (formerly VXI*plug&play* standards).

- visa.h is included for use with C/C++.
- visa32.bas is included for programming in Visual Basic 6.
- visa32.vb is included for programming in Visual Basic .Net.
- visa32.cs is included for programming in C#.
- Agilent VISA is the API used by DirectIO in Agilent VEE 8.0 and greater.
- Agilent VISA is compatible with MATLAB if you have installed the MATLAB Instrument Control Toolbox.
- Agilent VISA is compatible with the current generation of National Instrument's LabVIEW and LabWindows/CVI products (NI-VISA does not need to be installed).

Agilent VISA COM

Agilent VISA COM is a COM (Microsoft Common Object Model) implementation based on the Agilent VISA architecture. Like VISA, VISA COM conforms to IVI Foundation standards. The VISA COM API works in environments that provide standard COM support such as Visual Basic 6, Visual Basic.Net, and C#.

Agilent SICL

Agilent SICL (Standard Instrument Control Library) is an I/O library developed by Agilent that is portable across many instrument I/O interfaces. Agilent does not recommend using SICL for new development; instead use either VISA or VISA COM.

- sicl.h is included for use with C/C++.
- sicl32.bas is included for programming in Visual Basic 6.

Agilent 488

Agilent 488 is a GPIB I/O library provided for compatibility with existing test and measurement programs developed using National Instruments' NI-488.2 or other similar libraries. Agilent 488 can be used with any application development program that can access it including LabVIEW, LabWindows/CVI, C/C++ and Visual Basic. Agilent does not recommend using Agilent 488 (NI-488.2) for new development; instead use either VISA or VISA COM.

Agilent IO Libraries Suite Utilities

Agilent's IO Libraries Suite includes a number of utilities to help you connect, configure, and troubleshoot your test system.

- Agilent Connection Expert
- Event Viewer (Microsoft Utility)
- Interactive IO
- ViFind32 (Debug Utility)
- VISA Assistant
- IO Monitor
- Agilent VISA Options
- Interactive LXI

Click the Agilent IO Control icon (IO) in the Windows Notification Area and select the appropriate utility.

NOTE

If the IO Control icon is not visible, you can display the icon by clicking **Start > Programs > Agilent Connectivity Guide > Utilities > IO Control** or, in Connection Expert, **View > IO Control**.

Agilent Connection Expert

Connection Expert is a software utility that helps you quickly get your instruments connected to your PC and troubleshoot connectivity problems. You can use Connection Expert to:

- Configure instrument I/O interfaces
- Automatically discover instruments that are connected to your PC or to the local subnet of your local area network
- Specify connections to instruments that are on your local area network beyond the local subnet
- Browse the structure and connections of your test system (including your PC, instruments, and interfaces)
- Detect and troubleshoot connectivity problems in your test system
- Create programming aliases that you can use in place of addresses to improve portability and readability of your test program

Connection Expert includes a task guide (the left pane of the utility's window) that provides shortcuts to common tasks and information. Refer to Figure 2, "Agilent Connection Expert Screen," on the next page.

New to IO Libraries Suite v15 is the Agilent VISA Open Report. Available from the I/O Configuration drop-down menu, this report shows the combined view of your system from a VISA program perspective. Conflicts or inconsistencies are listed and possible fixes are also listed. This report does not cover VISA-COM behavior.

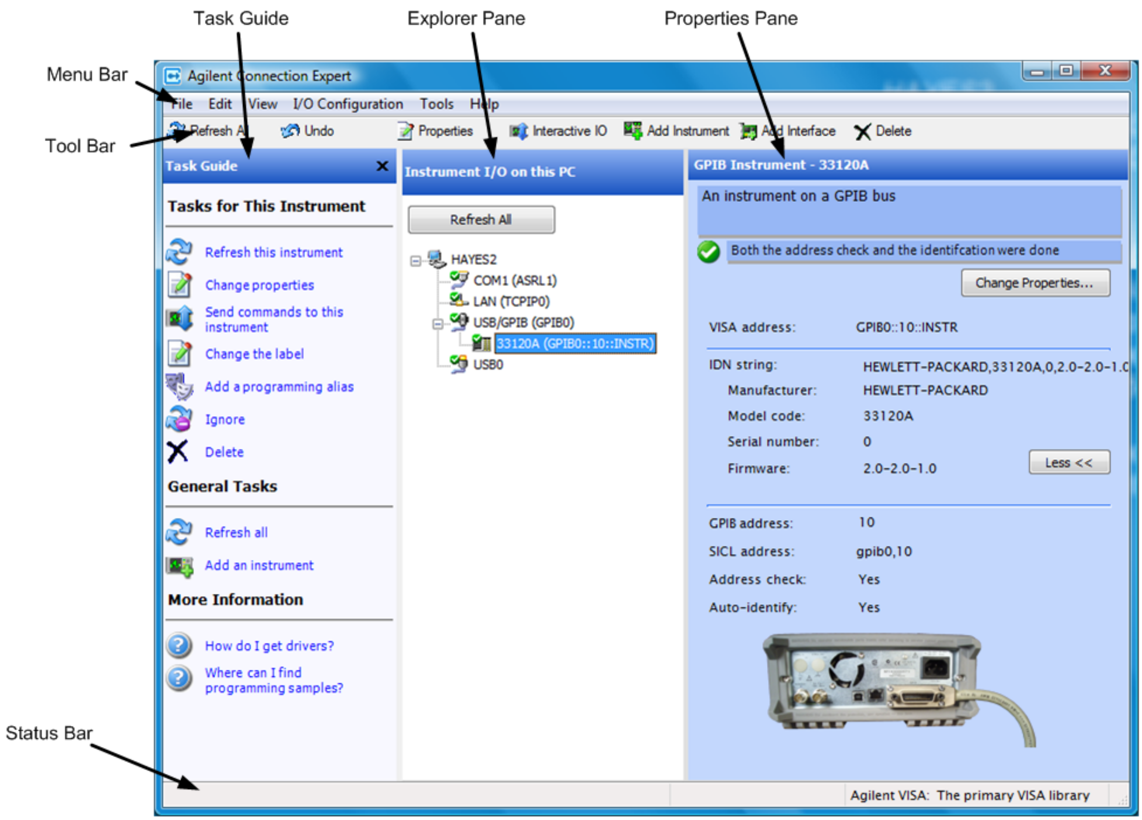

Figure 2 Agilent Connection Expert Screen

Agilent 488

Sets Agilent Connection Expert Options. Specifically Agilent VISA options, Configuration Settings, 82357B options, and Agilent 488 options which enables Agilent GPIB cards to work in NI-488-2 compatible systems. Also available under **Tools>Options**.

Remote IO Server

The Remote IO Server software provides a way to connect via local area network (Ethernet) to instruments that are physically connected to another PC on the network. When the Remote IO Server is running on one PC (the server), you can use instruments connected to that server from other PCs (the clients) by using the Connection Expert to create remote interfaces on the client PCs. See the *Agilent IO Libraries Suite Online Help* for details.

VXI Resource Manager

The VXI Resource Manager is a software utility that initializes and prepares a VXI system for use. If your system includes an E8491 IEEE-1394 PC Link to VXI interface, you can use the VXI Resource Manager to determine whether your VXI system is properly configured.

The VXI Resource Manager runs when any of the following conditions occurs:

- You start it from the Connection Expert's Tools menu (select **Tools > VXI Resource Manager > Edit Resources**, then click **Run** in the resulting Resource Manager dialog box)
- You apply or cycle VXI mainframe power
- You press the E8491 Reset button
- You reboot your PC

In VXI systems with multiple E8491 interfaces, you can turn off individual VXI mainframes without affecting other mainframes in the system. When a mainframe is turned on, the VXI Resource Manager reconfigures that mainframe.

Interactive IO

Agilent Interactive IO is a software utility that allows you to interact with an instrument by sending commands to the instrument and seeing the instrument’s responses. You can use Interactive IO to:

- quickly verify connectivity to your instrument
- troubleshoot communication problems
- learn the instrument's command set
- rapidly prototype commands and check the instrument's responses before writing code

With Interactive IO, you can choose from a menu of common commands (listed in Table 1) or type in commands that are specific to your instrument.

To start Interactive IO from within Connection Expert, click **Tools > Interactive IO** from the Connection Expert menu bar or click **Send commands to this instrument** on the task guide. You can also start Interactive IO from the IO Control by clicking the **IO** icon in the Windows notification area and then selecting **Interactive IO**.

Note that some commands (such as *TST?, instrument self-test) may take longer than Interactive IO’s default time-out; you can modify the time-out in the Interactive IO window by selecting **Interact > Options...**

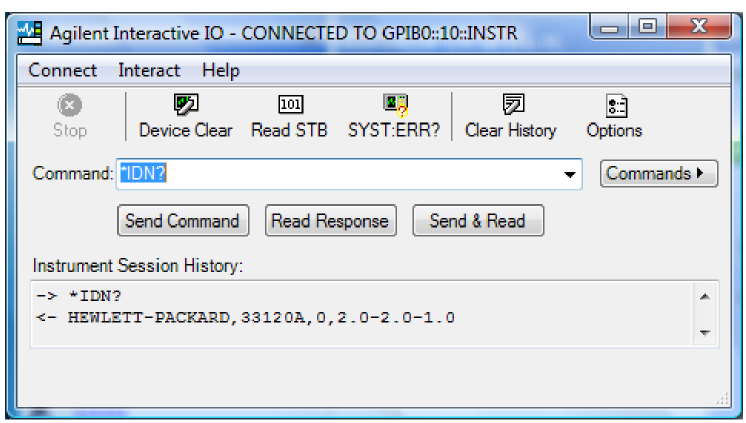

Figure 3 Interactive IO Screen

Command	Description
***IDN?**	The Identification query returns manufacturer, model, serial number, and firmware level or equivalent.
***CLS**	The Clear Status command clears status data structures, and forces the device to the Operation Complete query idle state.
***OPC?**	The Operation Complete query places an ASCII character “1” into the device’s Output Queue when all pending selected device operations have been finished.
***RCL**	The Recall command restores the current settings of a device from a copy stored in local memory.
***RST**	The Reset command performs a device reset, which sets the device-specific functions to a known state that is independent of the past-use history of the device.
***SAV**	The Save command stores the current settings of the device in local memory.
***STB?**	The Read Status Byte query returns the status byte and master Summary Status bit.
***TRG**	The Trigger command signals the transition of the Device Trigger (DT) function to the Device Trigger Active State (DTAS).
***TST?**	The Self-test query returns zero to indicate the test completed with no errors. A return value not equal to zero indicates the test is not completed or completed with errors.

Table 1 Interactive IO Common Commands

Event Viewer

Invokes the Microsoft Event Viewer, which can be useful in debugging I/O programs

Agilent VISA Options

Provides commands to set the Logging and LockWait options for the Agilent VISA library.

ViFind32 (Debug Utility)

ViFind32 is a console application that uses the **viFindRsrc** and **viFindNext** VISA functions to enumerate all resources visible to VISA. This application is useful for verifying that all expected interfaces have been configured by Connection Expert, and that the expected devices have been attached.

To run ViFind32, you can do any one of the following:

- Click **Start** > **Programs** > **Agilent Connectivity Guide** > **Utilities** > **ViFind32**
- Click the IO Control, and then click **ViFind32**
- In Connection Expert, click **Tools** > **ViFind32**

VISA Assistant

The VISA Assistant utility is provided for your convenience, though most of its capabilities have been replaced by Interactive IO and Connection Expert.

IO Monitor

IO Monitor is a utility that traces the I/O calls of targeted library layers. Although IO Monitor is specifically targeted for the .NET Framework, it also works for legacy applications that use the targeted I/O library layers.

NOTE Agilent IO Monitor installed as part of Agilent T&M ToolKit will cease to function after IO Libraries Suite 15 is installed. IO Libraries installs a newer, revised version of IO Monitor.

Interactive LXI

Agilent's Interactive LXI provides two user interface tools to learn about LXI Events and IEEE 1588 timing and also provide debugging tools for your LXI and IEEE 1588 systems. The Agilent LXI Event Explorer provides tools for creating/monitoring LXI events. The LXI Timing Explorer provides tools for monitoring the IEEE 1588 PTP clocks (setting time, selecting the system Master Clock, etc.).

Visa Open Reports

VISA Open Reports provide a quick “snapshot” of information about all of the hardware interfaces (GPIB, USB, VXI, etc.) configured on your PC.

Open the Report: From Agilent Connection Expert,

1. Select **I/O Configuration** from the menu bar.
2. Select **VISA Open Report**.

NOTE

Test and Measurement Interfaces (T&M), such as GPIB or VXI, respond differently than standard computer interfaces (USB, LAN, etc.). In general, for T&M interfaces all instruments on an interface either pass or fail indicating the hardware interface is properly or improperly configured. However, with computer interfaces, one instrument may fail and all the others pass indicating the problem is with the actual instrument.

For information on using the reports and the meaning of the various messages, refer to the Agilent IO Libraries Suite 15 help file; search for Visa Open Reports.

Agilent Web Resources

System Developer Center

Focus on what matters most: the performance, reliability and delivery of your product. Agilent Open is a versatile combination of hardware, I/O, and software tools that make it easy to create, enhance and maintain systems. The System Developer Center provides application notes, programming examples, instrument drivers, and much more:

`http://www.home.agilent.com/find/systemcomponents`

Test & Measurement Software and Connectivity Products

You can find product information on interface cards and converters at:

`http://www.agilent.com/find/connectivity`

You can find product information on I/O software at:

`http://www.agilent.com/find/iosuite`

Contacting Agilent

In the USA, you can reach Agilent Technologies at this telephone number:

USA: 1-800-829-4444

Outside the USA, contact your country's Agilent support organization. A list of contact information for other countries is available on the Agilent Web site:

`http://www.agilent.com/find/assist`

2
Installing Agilent I/O Libraries Suite

This chapter includes:

NOTE

This chapter assumes that you are installing Agilent IO Libraries Suite from the *Automation-Ready CD*. If you are installing from the Web, double-click the downloaded executable to extract files and launch the setup program; then proceed with the software installation as documented in this chapter.

System Requirements for Agilent IO Libraries Suite 15.5

The following table lists the system configurations that we tested IO Libraries 15.5 on and are therefore guaranteed to work. In general, any x86 or x64 (except Itanium) should work but there may be a decrease in performance.

Operating System	Windows XP Service Pack 2 or later	Windows Vista SP1 and SP2 (32-bit and 64-bit), Business, Ultimate, Enterprise, Home Basic, and Home Premium	Windows 7 (32- and 64-bit) Starter, Home Basic, Home Premium, Professional, Ultimate, Enterprise
Processor Speed	600 MHz or higher required, 800 MHz recommended	1Ghz 32-bit (x86), 1GHz 64-bit (x64), no support for Itanium64	1Ghz 32-bit (x86), 1GHz 64-bit (x64), no support for Itanium64
Available memory	256 MB minimum (1 GB or greater recommended)	1 GB minimum	1 GB minimum
Available hard disk space[1]	1.5 GB available hard disk space, includes: • 1GB available for Microsoft .NET Framework 2.0 SP2 • 65MB for Agilent IO Libraries Suite	1.5 GB available hard disk space, includes: • 1GB available for Microsoft .NET Framework 2.0 SP1 • 65MB for Agilent IO Libraries Suite	1.5 GB available hard disk space, includes: • 1GB available for Microsoft .NET Framework 2.0 SP1 • 65MB for Agilent IO Libraries Suite
Video	Super VGA (800x600) 256 colors or more	Support for DirectX 9 graphics with 128MB graphics memory recommended (Super VGA graphics is supported)	Support for DirectX 9 graphics with 128MB graphics memory recommended (Super VGA graphics is supported)
Browser	Microsoft Internet Explorer 6.0 or greater	Microsoft Internet Explorer 7 or greater	Microsoft Internet Explorer 7 or greater

1 Because of the installation procedure, less memory may be required for operation than is required for installation.

If possible, you should always use the current version of the Agilent IO Libraries Suite. This version supports the newest interfaces and operating systems, and has the most advanced features.

However, you may need an earlier version of the IO Libraries Suite to support an older interface or operating system. For example, Agilent IO Libraries Suite 15.1 is required for Windows 2000. If you need an earlier version of Agilent IO Libraries, go to http://www.agilent.com/find/iosuite to locate the version you need.

Installing the IO Libraries Suite Software

NOTE You must have Administrator privileges to install Agilent IO Libraries Suite Connection Expert.

This section describes how to install Agilent IO Libraries Suite on your PC. The process is as follows:

1. Verify that your PC meets the minimum system requirements. (See "System Requirements for Agilent IO Libraries Suite 15.5" on page 24.)
2. If you are upgrading to IO Libraries Suite from a previous version of IO Libraries, you must remove the instruments and interfaces listed below before you upgrade your software. This step is necessary in order for these devices to obtain the correct drivers to work with Agilent IO Libraries Suite.
   - **a** Disconnect any USB instruments from your PC.
   - **b** Disconnect any Agilent 82357 USB/GPIB interface converters from your PC.
   - **c** Disconnect any Agilent E8491 IEEE 1394 PC Link to VXI interfaces from your PC.
3. Close all other applications on your PC.

NOTE If you install a PCI card in your computer at the same time you install Agilent IO Libraries Suite 15, a possible conflict can occur. The "New Hardware Found" dialog for the PCI card must be closed before installing IO Libraries. Otherwise the IO Libraries installation will stop until PCI card installation is complete.

NOTE If you have NI software installed (such as NI MAX, etc.), then all NI services must be stopped prior to installing IO Libraries.

4 Insert the *Automation-Ready CD with Agilent IO Libraries Suite* into the CD-ROM drive of your PC.
   - Wait a few seconds for the auto-run window to appear.
   - If the auto-run window does not appear automatically,
      - Click **Start** > **Run...**
      - Type:
        `<drive>:Autorun\IOLibraries.hta`
        where `<drive>` is your CD drive letter.

5 When the installation start-up window appears, click the "**Click here to install now**" button once, and wait for the InstallShield Wizard to appear.

   Note: you also have the opportunity to watch a two-minute video how easy it is to install, set-up and configure your interfaces and instruments using Agilent IO Libraries Suite 15.5.

NOTE

If the **IVI Shared Components** and **VISA Shared Components** are not already installed on your PC, Agilent IO Libraries Suite installs them in the standard, default locations. If the **IVI Shared Components** and **VISA Shared Components** are already installed, the Agilent IO Libraries Suite installer will upgrade them to the latest version (if necessary), using the same installation location used by the older version. If this is a first-time installation, you will be able to select installation locations for these components by choosing a Custom Installation.

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6 When the InstallShield Wizard appears, click **Next >** to begin the IO Libraries Suite software installation.

7 Read the License Agreement(s). If you accept the terms, click the radio button labeled **I accept the terms of the license agreement** and then click **Next >** to continue.

8 When the InstallShield Wizard **Setup Type** dialog box appears, as shown, select **Typical** or **Custom**, then click **OK**. The **Typical** setup installs the recommended features for your configuration in standard locations on your PC. In a **Typical** setup, if another vendor's VISA software is already installed on this PC, Agilent VISA is installed as secondary. If no other vendor's VISA software is found on this PC,

Agilent VISA is installed as primary. (See "Using Agilent VISA in Side-by-Side Mode" on page 40.)

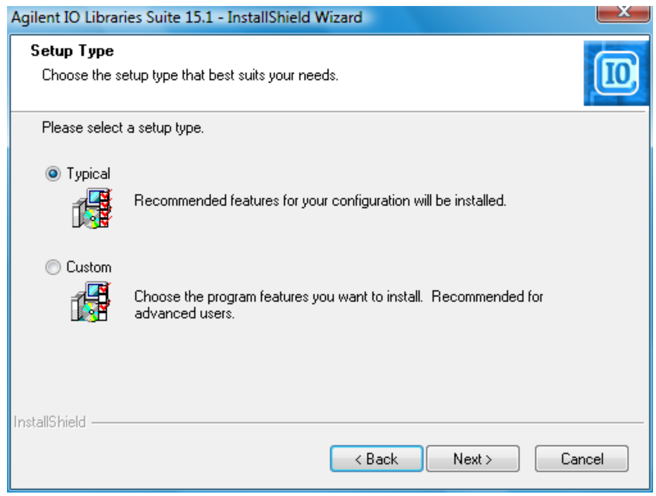


Figure 4 Choosing Setup Type

NOTE:

- **If you accept the Typical Installation, click "Next" and proceed to Step 12, Start Copying Files, on page 30.**
- **If you chose the Custom Installation radio button, click "Next" and proceed with Step 10 below.**

9 If you chose the **Custom** setup *and* you do not have another vendor's VISA implementation installed on your PC, then you will see the dialog box below, which asks whether you want to install Agilent VISA as the primary VISA.

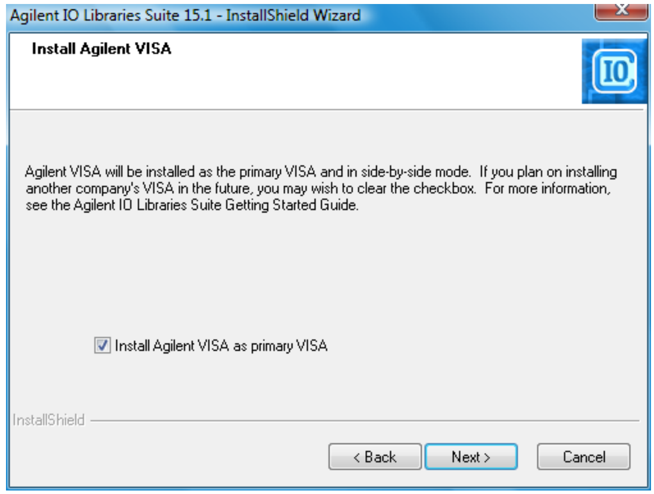


Figure 5 Agilent VISA as Primary VISA

If you do have another vendor's VISA installed, you will see a similar dialog box, but the check box will be not selected, indicating that the default is to install Agilent VISA as secondary.

For details on this topic, see Using Agilent VISA in Side-by-Side Mode on page 40.

10 If you chose a **Custom** setup on 32-bit Windows, the next dialog shows the location of:

- The Agilent IO Libraries Suite Destination Folder
- The VISA Destination Folder
- The IVI Shared Components Destination Folder

If VISA and IVI software is already installed, the VISA and IVI destinations are greyed out. On a first-time installation on 32-bit Windows, you can change all three destination folders.

On 64-bit Windows systems, you cannot change the destination folders. The **Choose Destination Location** dialog box is not displayed on those systems..

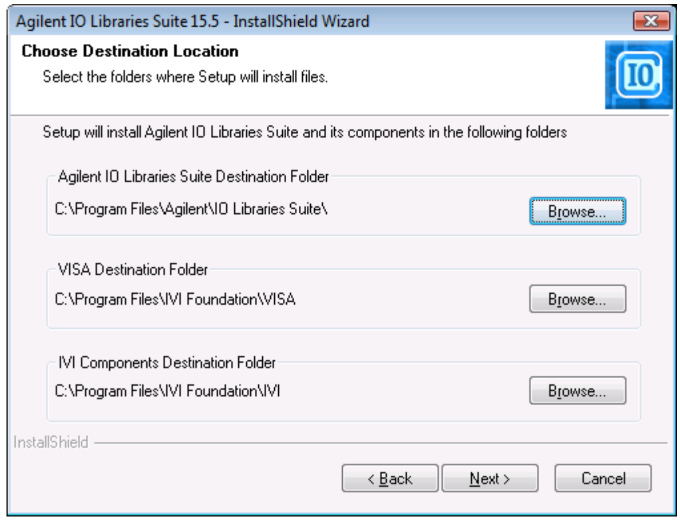


Figure 6 Choose Destination Location

11 If you chose a **Custom** setup, you will now see the **Select Features** dialog box.

- Click on any feature in the list to see the feature description and the space requirements for the selected set of features. It is recommended that you install the manuals and sample programs if you plan to program with the Agilent IO Libraries; however, you may omit them to save space.
- Select the check box for each feature to be installed. Clear the check box for each feature to omit.
- When you are done selecting features, click **Next >.**

12 The **Start Copying Files** dialog appears; click **Install** to begin copying files.

- If the Microsoft .NET Framework has not previously been installed on your PC, or if IO Libraries requires a newer version, IO Libraries will install it; this may take up to ten minutes. The Microsoft .NET Framework provides necessary infrastructure for Agilent IO Libraries Suite utilities, as well as for .NET programming tools and many other applications.

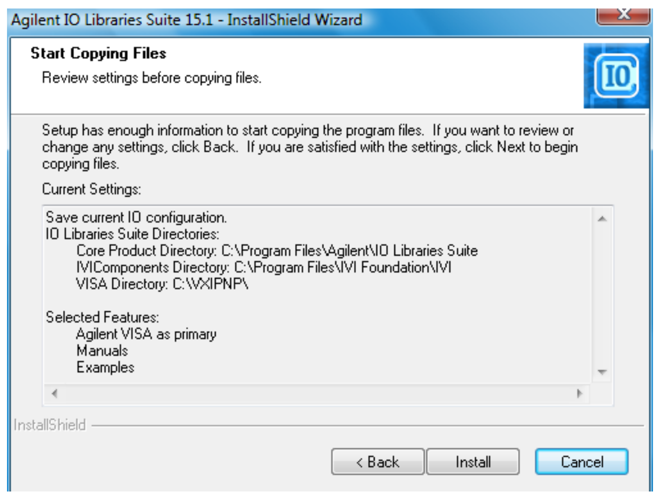


Figure 7 Copying Files

13 After the files have been copied, you may see a dialog asking you to restart your PC. This occurs only if you have certain I/O hardware configurations. If you choose not to reboot at this time, you should reboot before running Connection Expert.

14 When the **InstallShield Wizard Complete** dialog appears indicating that Agilent IO Libraries was successfully installed**:**

   a Click **Finish** to close the window

   b Or click on one of the product/solution links for information on other Agilent solutions.

15 Click the IO control icon ( ) in lower right Windows Notification area to run Agilent IO Libraries.

16 If you are installing Agilent IO Libraries Suite along with another instrument, interface, or software package such as Agilent VEE,

there may be another CD with additional software (drivers, sample programs, etc.). If you want to install this additional software,

- Insert the CD into the CD drive on your PC.
- Follow the instructions that came with the CD or the hardware or software product.

17 Re-connect any USB instruments or E8491 IEEE-1394 FireWire to VXI interfaces that you may have disconnected in step 2. Install any new hardware.

18 If Connection Expert is already running, click the **Refresh All** button to identify any hardware you have just installed or re-connected.

If Connection Expert is not already running, run it now to verify your I/O configuration: In the Windows Notification area, click the **IO** icon ( ), then click **Agilent Connection Expert**.

a Locate your interfaces and instruments in the Explorer Pane. Click on them to see their properties (displayed in the right-hand pane). Observe their state, also displayed in the right-hand pane: if communication to the interface or instrument has been successfully established, it will be in the Verified state, denoted by a green check mark.

b Change the default I/O configuration (if necessary) by clicking **Change Properties...** in the property pane of the interface or instrument you wish to configure.

NOTE

If you plan to program your GPIB instruments using the Agilent 488 API, or to run NI-488.2–compatible programs with Agilent interface hardware (such as GPIB cards), you may need to enable the Agilent 488 library. To do this, click **Tools > Agilent 488...**, then select the check box labeled **Enable Agilent GPIB cards for 488 programs**.

c If you would like to test your connections manually, select your instrument, right-click and choose **Send Commands To This Instrument**.

Installation Troubleshooting

If you encounter problems while installing the IO Libraries Suite, the following steps may help.

1. Close or Cancel all InstallShield Wizards and other Agilent IO Libraries Suite windows. Exit any other applications on your system.
2. Browse to the `autorun` folder of your Automation-Ready CD and double-click to run `IOLibraries.hta`. This restarts the installation process.
3. If you see the standard InstallShield Wizard, step through the installation process as described in this chapter.
4. If you see **Modify**, **Repair**, and **Remove** options, select **Repair**. This will reinstall all installed features of IO Libraries Suite. If this does not solve the problem, restart the installation again, select **Remove**, and then reinstall the product.

Selecting Application Software

This table gives guidelines for using additional I/O software.

When You Want to:	Use This Software:
Instrument Web Browser *(Product Design or Product Characterization)*	
Remotely communicate with instruments from your PC, but do not need to program the instruments. (The IO Libraries are not required.)	Provides a “soft front panel” displayed on your Web browser that you can use to control the instrument (Web-enabled instruments only).
Agilent IntuiLink *(Product Design or Product Characterization)*	
Remotely communicate with instruments from your PC, but do not need to program the instruments (The IO Libraries are required.)	Provides a “soft front panel” specific to an instrument that you can use to control instruments.
IVI-COM Drivers *(Product Characterization or Product Test)*	
IVI-COM drivers that implement standard instrument-class interfaces provide syntactical interchangeability; this means that you may be able to replace an instrument in your test system with another, similar instrument with fewer changes or even no changes to your test program, depending on your use of instrument-specific interfaces.	IVI-COM drivers are implemented as COM (Microsoft Common Object Model) objects, and are therefore optimized and recommended for use in Microsoft Visual Studio and Visual Studio .NET.
VXI*plug&play* Drivers *(Product Characterization or Product Test)*	
VXI*plug&play* drivers allow you to develop application programs that are portable across many computer platforms and I/O interfaces.	VXI*plug&play* drivers (also known as Plug&Play or Universal Instrument Drivers) conform to a set of system-level standards produced by the VXI*plug&play* Systems Alliance. These standards apply to instrument drivers, soft front panels, installation packages, documentation, technical support and application development environments. VXI*plug&play* drivers are widely used and based on the VISA API.

Modifying, Repairing, or Removing IO Libraries Suite

On Windows XP, click **Start** > **Settings** > **Control Panel** > **Add/Remove Programs**.

On Windows Vista or Windows 7, click **Start** > **Control Panel** > **Programs and Features**.

On 32-bit Windows systems, there are two entries for Agilent IO Libraries Suite:

- Agilent IO Libraries Suite 15.5
- Agilent LXI Mdns Responder

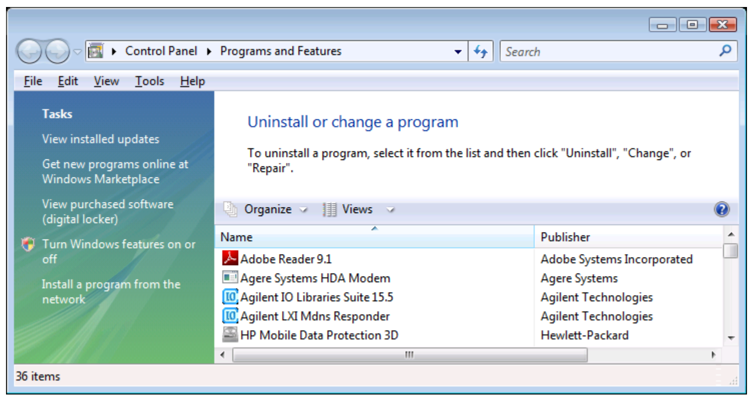


Figure 8 Agilent IO Libraries Suite 32-Bit Programs and Features

On 64-bit Windows systems, there are three entries:

- Agilent IO Libraries Suite 15.5
- Agilent IO Libraries Suite 64-bit
- Agilent LXI Mdns Responder 64bit

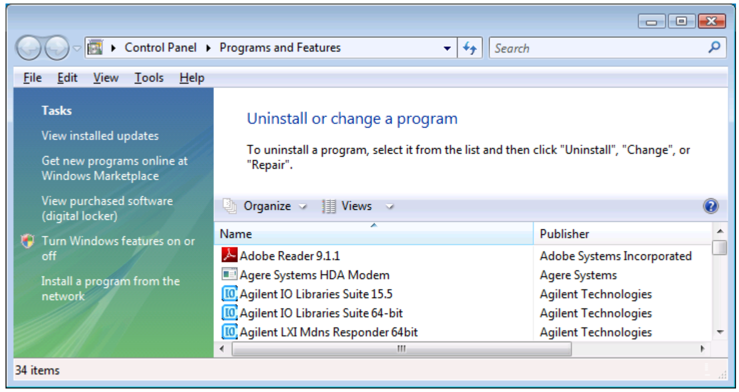
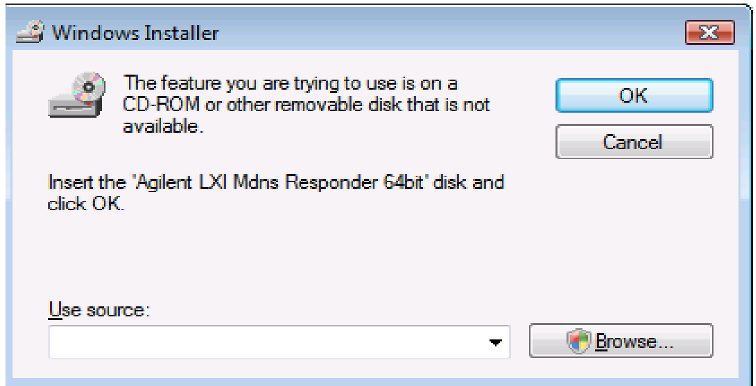


Figure 9 Agilent IO Libraries Suite 32-Bit Programs and Features

To Uninstall (remove) or Modify Agilent IO Libraries Suite, you must select **Agilent IO Libraries Suite 15.5**. You cannot Modify or Uninstall the other entries. If you Uninstall **Agilent IO Libraries Suite 15.5**, the other related entries will automatically be uninstalled. You can modify all of the optional features by Modifying **Agilent IO Libraries Suite 15.5**.

To Repair Agilent IO Libraries Suite, you must Repair each of the entries in Programs and Features (or Add/Remove Programs) separately. Always Repair **Agilent IO Libraries Suite 15.5** last, because doing that Repair restarts some of the programs that are part of the other entries.

When you Repair or Modify Agilent IO Libraries Suite, you may see a dialog similar to the following.



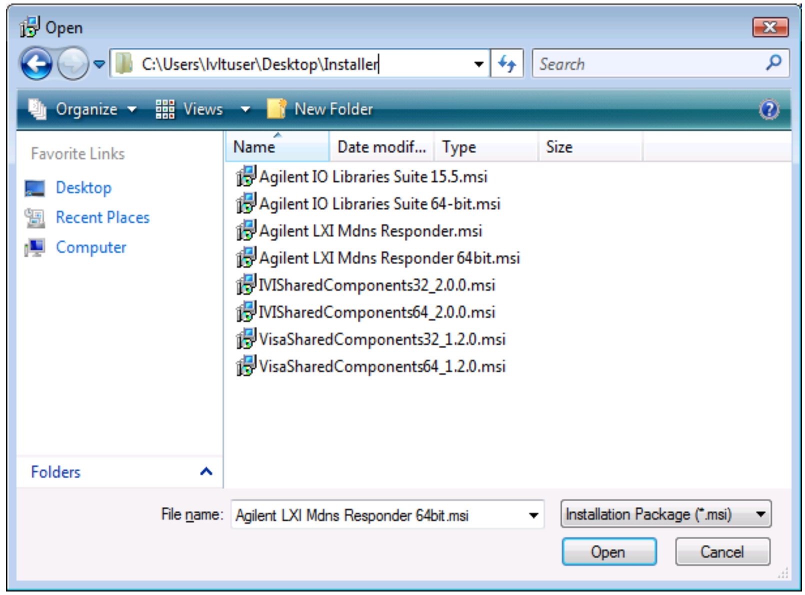
If you see this dialog box, insert the *Automation-Ready CD with Agilent IO Libraries Suite* into the CD-ROM drive of your PC. Windows will use the files on the CD to make repairs.

If you are using Windows Vista or Windows 7 with User Access Control (UAC) enabled, you may see this dialog box even if the CD is in the CD-ROM drive. You will be able to browse to the files on the CD, but you will get the dialog box above again and again when you click **OK**.

In order to complete the repair in this case, you must do one of the following two procedures:

- Perform the repair with User Access Control disabled:
  1. Close the Windows Installer dialog box (shown above).
  2. Disable User Access Control.
  3. Restart the PC.
  4. Perform the Repair or Modify operation.
  5. Enable User Access Control and follow any further instructions from Windows. (You may be asked to restart your PC.)
- Run the installer from your desktop:
  1. Do not close the Windows Installer dialog box shown above.
  2. Copy the *Installer* folder from the *Automation-Ready CD with Agilent IO Libraries Suite* to your PC's desktop.

3 Use the **Browse** button in the Windows Installer dialog box to browse to the location of the Installer folder on your desktop (as shown below).



4 Select the installer that was indicated in the Windows Installer dialog box (in the example shown, *Agilent LXI Mdns Responder 64bit.msi*). Click **Open**.

Keeping Your Software Up To Date

Web resource for the latest IO Libraries Suite software:

`http://www.agilent.com/find/iosuite`

When you update IO Libraries Suite software, your test system configuration is preserved and passed on to the new installation. This includes the instruments, aliases, interfaces, and all related properties.

Web resource for the latest instrument drivers:

`http://www.agilent.com/find/drivers`

This Web site includes many types of instrument drivers, including IVI-COM and VXI*plug&play* drivers.

NOTE

Agilent IO Libraries version 15.5 installs version 2.0.0 of the IVI Shared Components (see http://www.ivifoundation.org/) and .NET version 2.0 (with a Service Pack level that depends on your operating system). If you are developing .NET programs, the development environment you use must support .NET 2.0. For example, if you use Visual Studio to develop C# or VB.NET applications, you must use Visual Studio 2005 or higher. (MS Visual Studio 2003 does not recognize .NET Framework 2.0, and as a result, Visual Studio 2003 may not be used to develop .NET solutions with IO Libraries Suite 15.5.)

Using Agilent 488 in Multi-Vendor Systems

Agilent IO Libraries Suite includes the Agilent 488 library, allowing you to use your National Instruments' NI-488.2 and other vendors' 488 libraries compatible programs with Agilent GPIB interfaces and other vendors' interfaces (even simultaneously).

If your test system includes only Agilent GPIB interface hardware and software, you do not need to take any special action to use Agilent 488.

If your system includes NI-488.2 software from National Instruments, or any other vendor's compatible implementation, you may need to explicitly enable Agilent 488. To do this, click **Tools > Agilent 488...**, then select the check box labeled **Enable Agilent GPIB cards for 488 programs**.

NOTE

If you install Agilent IO Libraries Suite on a PC that has third-party 488 library software (such as NI-488.2) already installed, *or* if you subsequently install such third-party software, Agilent 488 will automatically be disabled. If you want to use Agilent 488, you must re-enable it after installing any third-party 488 library.

Although Agilent 488 does not conflict with NI-488.2 and both libraries can be used simultaneously, some National Instruments software may display error messages when Agilent 488 is enabled; for example, you may see the message **Missing or Damaged GPIB-32.DLL** when you attempt to use National Instruments Measurement & Automation Explorer to change the properties of an NI GPIB interface. If this occurs:

1 Disable Agilent 488: in Connection Expert, click **Tools > Agilent 488...** and clear (deselect) the check box labeled **Enable Agilent GPIB cards for 488 programs.**
2 Perform the operation that caused the error (such as changing the properties of the NI interface).
3 Re-enable Agilent 488: in Connection Expert, click **Tools > Agilent 488...** and select the check box labeled **Enable Agilent GPIB cards for 488 programs.**

(In a few cases, you may be prompted to restart your PC before you can successfully enable or disable Agilent 488.)

Using Agilent VISA in Side-by-Side Mode

NOTE The following discussion applies specifically to 32-bit Windows systems. For information on VISA architecture and interoperability on 64-bit Windows systems, see the *Agilent IO Libraries Suite Online Help.*

Agilent IO Libraries Suite includes an implementation of VISA (Virtual Instrument Software Architecture), one of three available application programming instruments for instrument control. The VISA standard requires that visa32.dll, the dynamic-link library that implements the VISA interface, be installed in prescribed locations; therefore, only one installed implementation (the **primary** implementation) can fully comply with the standard at any one time. Because of this, you must take special care if you want to use Agilent IO Libraries Suite alongside any other implementation of VISA, such as National Instruments' NI-VISA.

When you have both Agilent VISA and another vendor's VISA installed on the same system, you will need to decide whether to let your programs use the primary VISA or whether to explicitly direct them to use the Agilent VISA implementation.

NOTE

You do not need to install NI-VISA to use National Instruments GPIB cards and devices. You can install National Instruments' NI-488.2 as a driver for these devices, and avoid the complications of side-by-side operations.

Agilent IO Libraries Suite supports the option to install Agilent VISA in side-by-side mode, which allows Agilent VISA to be used simultaneously with another vendor's VISA implementation. In side-by-side mode, Agilent VISA is installed only in a secondary location and therefore does not overwrite another vendor's VISA if it is present on the computer.

In general, non-Agilent VISA implementations do not support operation as the secondary VISA (in side-by-side mode). This means that you must operate Agilent VISA in side-by-side mode as the secondary VISA, and the other vendor's VISA as primary.

About primary and secondary VISA:

- VISA programs normally use visa32.dll, which is installed in the Windows system directory. This is the primary VISA, as defined by the VISA standard.
- Agilent VISA is implemented in agvisa32.dll, which is also installed in the Windows system directory.
- If Agilent VISA is installed as primary, the Agilent version of visa32.dll is installed in the Windows system directory. It simply forwards all VISA calls to agvisa32.dll.
- If you install Agilent VISA as primary, all files needed to support side-by-side mode are also installed. This means that if you subsequently install another vendor's VISA as primary, you can still use Agilent VISA as secondary.

If Agilent VISA is installed in side-by-side mode (as the secondary VISA):

- agvisa32.dll is installed, but Agilent's visa32.dll is not. Thus, it will not overwrite another vendor's visa32.dll residing in the standard location.
- Agilent support files are not installed in the bin, include and lib directories of the VISA path (e.g. c:\program files\visa\winnt), since they would overwrite the other vendor's support files. Copies of the Agilent versions of the VISA support files reside in the agbin, include and lib subdirectories under <VISA path>\agvisa. (These files are installed even when Agilent VISA is primary.)
- The IO Control menu and the status bar at the bottom of the Connection Expert window will contain a message indicating whether Agilent VISA is installed as primary, installed as secondary, or installed as primary but overwritten by another vendor's VISA. In the latter case, Agilent VISA will operate identically to a secondary installation.

VISA programs that are linked to the standard VISA DLL (e.g. `C:\WINDOWS\system32\visa32.dll`) will use the primary VISA. However, if a VISA program is linked with `agvisa32.lib` or dynamically loads `agvisa32.dll`, it will always use Agilent VISA (regardless of whether Agilent VISA is primary or secondary). Addressing is identical regardless of whether you are using the primary or secondary VISA in your program.

See the *Agilent IO Libraries Suite Online Help* for more information about side-by-side VISA operation.

Specifying IVI and VISA Paths in Microsoft Visual Studio

In Visual Studio (VS), you must add the directories that contain IVI and VISA executables, include files, and libraries to the corresponding search paths. If these paths do not include IVI and VISA directories, various Visual Studio programs (including the C++ preprocessor, the MIDL compiler, and the linker) may not be able to find needed IVI and VISA files, and will generate errors. Typical errors are:

fatal error C1083: Cannot open type library file: 'IviDriverTypeLib.dll': No such file or directory

fatal error C1083: Cannot open include file: 'IviDriver.h': No such file or directory

This section explains how to identify the IVI and VISA directories that must be added to Visual Studio. For information on how to add directories to the Visual Studio search paths, consult the help for your version of Visual Studio.

VISA and VISA COM

To find the base directory where VISA and VISA-COM files are stored on your system, look in the registry for the key:

HKLM\SOFTWARE\VXIPNP_Alliance\VXIPNP\CurrentVersion\VXIPNPPATH

Using the value of this key as the visa_base_path add the following to your VS search directories:

For Executable files:

<visa_base_path>\WinNT\bin
<visa_base_path>\agvisa\agbin
<visa_base_path>\VisaCom

For Include files:

<visa_base_path>\WinNT\include
<visa_base_path>\WinNT\agvisa\include

For Library files:

<visa_base_path>\WinNT\lib\msc
<visa_base_path>\WinNT\agvisa\lib\msc

IVI Shared Components and IVI Drivers

To find the base directory where IVI files are stored on your system, look in the registry for the key: HKLM\SOFTWARE\IVI\IviStandardRootDir

Using the value of this key as the ivi_base_path add the following to your VS search directories:

For Executable files:

<ivi_base_path>\bin

For Include files:

<ivi_base_path>\include

For Library files:

<ivi_base_path>\lib\msc

NOTE

Agilent IO Libraries version 15.5 installs version 2.0.0 of the IVI Shared Components (see http://www.ivifoundation.org/) and .NET version 2.0 (with a Service Pack level that depends on your operating system). If you are developing .NET programs, the development environment that you are using must support .NET 2.0. For example, if you are using Visual Studio to develop C# or VB.NET applications, you must use Visual Studio 2005 or higher. (MS Visual Studio 2003 does not recognize .NET Framework 2.0, and as a result, Visual Studio 2003 may not be used to develop .NET solutions with IO Libraries Suite 15.5.)

CAUTION

Once you have installed version 2.x of the IVI Shared Components (for example, by installing Agilent IO Libraries Suite 15.5), you will not be able to build IVI drivers and applications developed with earlier versions. You will need to upgrade those drivers/applications to the new IVI Shared Components (and to build on Visual Studio 2005 or higher, or you will need to build those drivers/applications on a different machine that does not have version 2.x of the IVI Shared Components.

3
Connecting Instruments to GPIB

This chapter includes:

GPIB Quick Start

This section shows suggested steps to help you quickly get started connecting GPIB instruments to the General Purpose Interface Bus (GPIB).

Typical GPIB Interface System In this guide, a **GPIB interface system** is defined as a system in which GPIB instruments are connected to a GPIB interface card in a Windows PC via GPIB cables. (Refer to **Installing I/O Software** for a Windows support matrix.) Figure 10 shows a typical GPIB interface system with a PC and two GPIB instruments connected via GPIB cables.

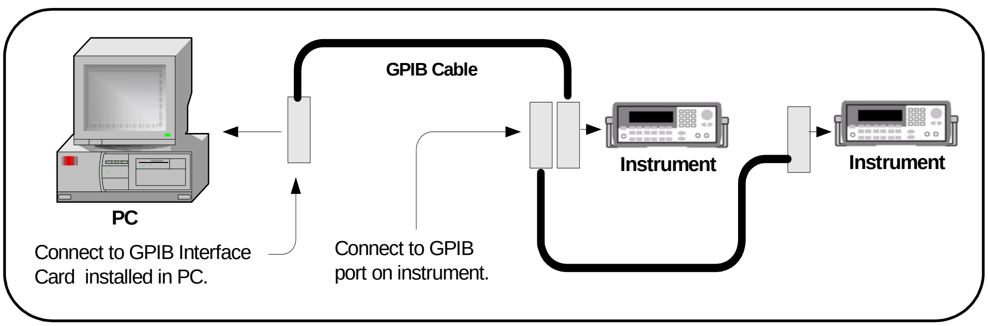


Figure 10 Typical GPIB Interface System

NOTE You can also connect GPIB instruments using the Agilent 82357B USB/GPIB Interface Converter -- then you won't need a GPIB card. For more information, go to www.agilent.com/find/gpib.

Step 1: Install Agilent IO Libraries Suite on Your PC

Before you connect your instruments to GPIB, install Agilent IO Libraries Suite software on your PC. See Installing Agilent IO Libraries Suite in Chapter 2 for details.

Step 2: Connect Instruments to GPIB Card

This step gives guidelines to connect GPIB instruments to a GPIB Interface Card (such as an Agilent 82351 PCIe™-GPIB Interface Card) installed in your PC by using GPIB cables. When you have made the connections for your system, go to Step 3: Run Agilent Connection Expert.

Install GPIB Cards in Your PC

Install GPIB interface cards (such as an Agilent 82351) in your PC, following the manufacturers instructions.

NOTE If you have not yet installed I/O software on your PC, go to Step 1: Install Agilent IO Libraries Suite on Your PC and install the software BEFORE you install GPIB Interface Cards in your PC.

NOTE If your GPIB card is not an Agilent Technologies card, you may need to install a driver from the card's manufacturer.

Connect GPIB Instruments

1 **Review Connection Guidelines.** The recommended method for connecting a GPIB system is linear with the system controller (PC) at one end of the system. However, a GPIB system can also be connected together in a star or combination configuration. The total number of devices on the system must be ≤14 and these guidelines are followed:

- To minimize stress on connector mountings, stack no more than three cable connector blocks on top of one another. The GPIB connector screws should be finger-tightened only.
- Minimize cable length as much as possible. All system devices must be powered on. Turning devices on or off while a system is running may cause faulty operation.
- For data transfer rates <500 Kbytes/sec., the total allowed length of all GPIB cables is ≤2 meters times the number of devices connected together, up to a maximum of 20 meters.
- For data transfer rates > 500 Kbytes/sec., the total allowed length of all GPIB cables is ≤1 meter times the number of devices connected together, up to a maximum of 15 meters.
- The cable length between adjacent devices is not critical as long as the system meets the overall restriction. GPIB bus extenders are available that allow operation over much greater distances.

- **Connect GPIB Cables to the GPIB Interface Card.** Connect a separate GPIB cable to each installed GPIB Interface Card. Tighten the GPIB connector screws finger-tight only. (The screwdriver slots are for removal purposes only.) Two example connections follow to connect a single GPIB instrument or to connect multiple GPIB instruments.

Example: Connecting a Single GPIB Instrument

The following figure shows connections from a single GPIB instrument to the GPIB connector of an Agilent GPIB Interface Card installed in your PC.

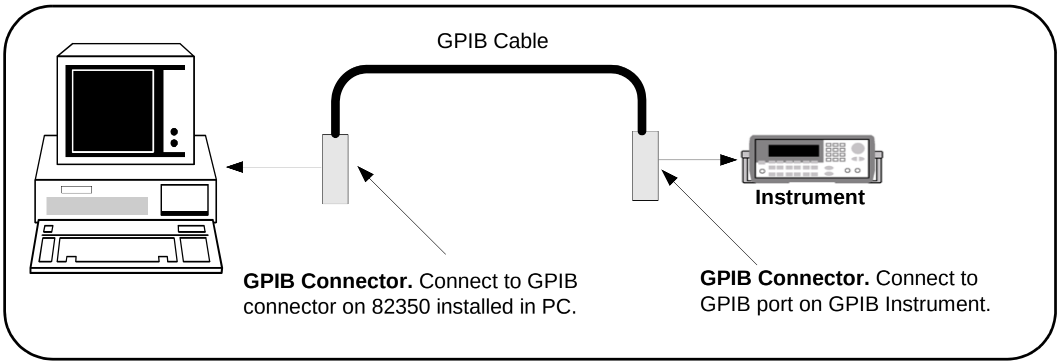


Figure 11 Connecting a Single GPIB Instrument

You may want to record the primary GPIB address of the attached instrument for future programming use. Or you can use Connection Expert to create programming aliases that are meaningful to you. After making the connections, reconnect the PC power cord and apply power to the PC and to attached peripherals/instruments.

CAUTION To avoid damage to the connectors, only finger-tighten the connectors.

Example: Connecting Multiple GPIB Instruments

Figure 12 shows one way to connect three GPIB instruments to an Agilent GPIB interface card. You may want to record the primary GPIB address of each attached instrument for future programming use; or you can use Connection Expert to create programming aliases that are meaningful to you. After making the connections, reconnect the PC power cord and apply power to the PC and attached peripherals/instruments.

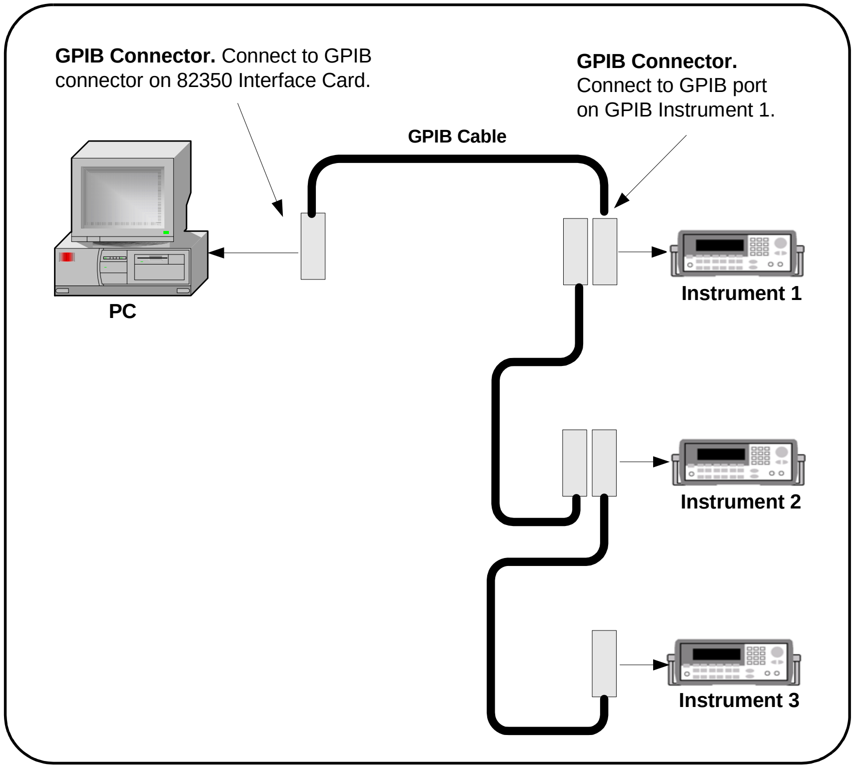


Figure 12 Connecting Three GPIB Instruments

Step 3: Run Agilent Connection Expert

This step shows how to use Agilent Connection Expert to configure a Windows operating system for a PC that has an Agilent GPIB Interface Card (or equivalent) installed. The default configuration is done automatically. Click **Refresh All** to update it at any time. This section shows how to verify or change configuration parameters.

Configure GPIB Interface Cards

1 **Apply Power.** Apply power to the PC and to the installed GPIB instruments. As Windows starts again, a **Found New Hardware Wizard** may start.

2 **Install Configuration Files.** Click **Next>** to accept the defaults. (Make sure that you have installed Agilent IO Libraries Suite first. You will not need a CD.) Click **Finish** to complete the installation.

3 **Open Connection Expert.** Click the **Agilent IO Control** icon in the Windows Notification area, and then click **Agilent Connection Expert**. When the main screen appears, you will see a map of the system connections in the **Instrument I/O on this PC** pane (also called “Explorer Pane”). *If you see your interface and instruments in the Explorer Pane, you are ready to go!*

NOTE For help with Connection Expert, refer to “Agilent Connection Expert” on page 15 and the Agilent *IO Libraries Suite help* file. This help file is available from the IO Control > **Documentation** menu.

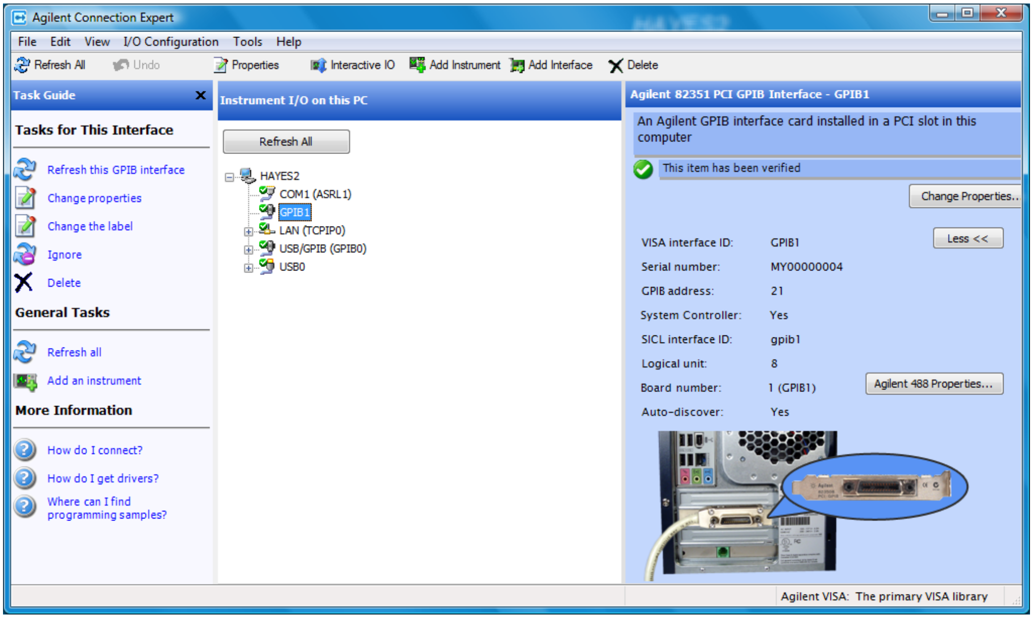


Figure 13 Agilent Connection Expert

When you select a particular instrument in the Explorer Pane, you see the parameters of the instrument in the Properties Pane on the right – such as the product number, serial number, VISA address, GPIB address, and firmware revisions. The green check mark icon at the top signifies that a listener check and IDN query were performed automatically.

4 **Configure GPIB Card Parameters.** With the GPIB interface selected in the Explorer Pane, click **Change Properties...**.

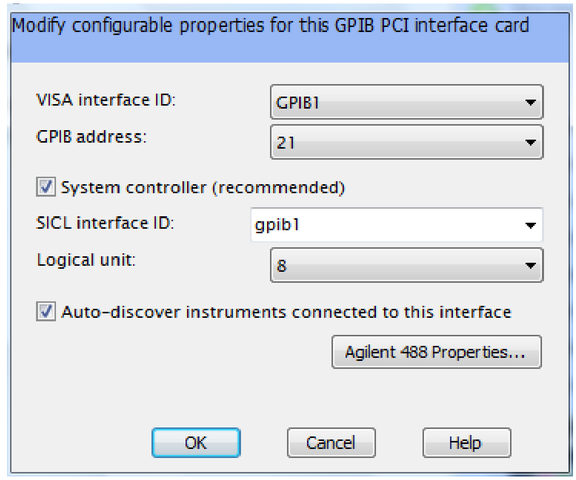


Figure 14 The 82351 Configuration Dialog Box

Set the GPIB interface properties as required. Also, verify that this is the System Controller for the GPIB to which it is attached (this is the typical operating mode). (See the System Controller discussion below.) If you plan to program your instruments using the Agilent 488 API, or to run NI-488.2–compatible programs with Agilent interface hardware (such as GPIB cards), click the button labeled **Agilent 488 Properties...** to enable the Agilent 488 library (if it is not already enabled) or to change other properties as needed. Details of each interface parameter are available in this dialog box’s online Help.

NOTE Beginning with Agilent IO Libraries Suite 15.1, the Agilent 488 Board Number always corresponds to the VISA Interface Number and it cannot be modified. In IO Libraries 15.0 and earlier versions, the Agilent 488 Board Number was a separate entity from the VISA Interface Number and could be modified.

5 **Change/Accept the Configuration Values.** When the configuration values displayed are acceptable to you, click the **OK** button.

Repeat Steps for Other Interfaces. If you have installed more than one GPIB interface in your test system, repeat these steps for the remaining interfaces.

System Controller

The System Controller setting determines whether this GPIB interface controls which bus devices talk and which bus devices listen. If several devices exist on a bus, be sure each has a unique GPIB bus address and only one device is the system controller (it is usually the device installed in the computer). Each GPIB interface has its own independent bus. Thus, each interface may be a System Controller as long as it is not chained together with other GPIB interfaces. However, two or more System Controllers on the same bus will cause the bus to be inoperative.

Note that the Agilent 82357B USB/GPIB Interface Converter will always be System Controller for its bus.

Step 4: Communicate with Instruments

If your instruments show up in the Explorer Pane as verified, communication has been established. This section shows how to further verify instruments and connections using Interactive IO.

Communicating Using Interactive IO

Interactive IO is a utility within Agilent IO Libraries Suite that communicates with instruments. It can be used to send and receive strings to instruments, which support formatted I/O.

NOTE

Time-out Errors: If you are getting time-out errors when sending commands and waiting for results, you can lengthen the time-out in the **Interact > Options** menu, which is set at 5000 ms by default.

NOTE

When to Use VISA Assistant: VISA Assistant is still installed as part of the Agilent IO Libraries Suite, but, for most users, it has been replaced by the Interactive IO utility. Interactive IO provides a simpler, more intuitive way to send commands to instruments and read the results.

Some capabilities of VISA Assistant are not yet available in the Interactive IO utility. These include:

- Memory I/O for VXI and GPIB-VXI interfaces
- Reading and writing of VISA attributes
- Configuration of VXI*plug&play* drivers

If you need these capabilities, you can start the VISA Assistant utility by clicking the **Agilent IO Control > VISA Assistant**, or by clicking **Tools > VISA Assistant** on the Connection Expert menu bar.

Example using Interactive IO to control an Agilent 34401A

1 Select an instrument in the Connection Expert Explorer Pane.
2 Click the Interactive IO icon below the menu bar.
3 Open the **Commands** menu and select a command. The example below shows a ***IDN?** command has been chosen. (See the table below for commands and meanings. You can also type an instrument-specific command.)
4 Click **Send & Read** to send the selected command and have the instrument return a result. Your selections are displayed in the **Instrument Session History** area, as shown in this example below. (You can also click the **Send Command** and **Read Response** buttons separately for additional control over these actions.)

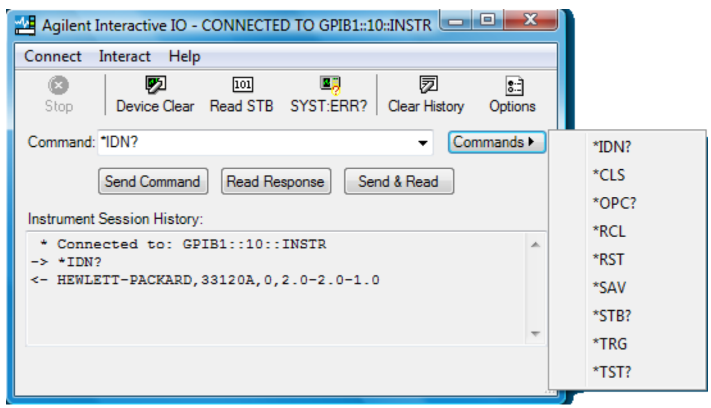


Figure 15 Interactive IO Utility with Instrument Session History

488.2 Commands	Meaning
***IDN?**	The Identification query returns manufacturer, model, serial number, and firmware level or equivalent.
***CLS**	The Clear Status command clears status data structures, and forces the device to the Operation Complete query idle state.
***OPC?**	The Operation Complete query places an ASCII character “1” into the device’s Output Queue when all pending selected device operations have been finished.
***RCL**	The Recall command restores the current settings of a device from a copy stored in local memory.
***RST**	The Reset command performs a device reset, which sets the device-specific functions to a known state that is independent of the past-use history of the device.
***SAV**	The Save command stores the current settings of the device in local memory.
***STB?**	The Read Status Byte query allows the programmer to read the status byte and master Summary Status bit.
***TRG**	The Trigger command signals the transition of the Device Trigger (DT) function to the Device Trigger Active State (DTAS).
***TST?**	The Self-test query returns zero to indicate the test completed with no errors. A return value not equal to zero indicates the test is not completed or completed with errors.
SCPI Commands	
SYST:ERR?	The error queue query message is a request for the next entry from the instrument’s error/event queue. Items in this queue contain an integer in the range [-32768 to 32767] denoting an error/event number and associated descriptive text. Negative numbers are reserved by the SCPI standard; positive numbers are instrument-dependent. A value of zero indicates that no error or event has occurred.

Troubleshooting GPIB Interfaces

This section shows suggested troubleshooting steps for an Agilent GPIB interface, including:

- GPIB Troubleshooting Overview
- GPIB Hardware Checks
- GPIB Software Checks
- Agilent IO Libraries Suite Checks

NOTE The troubleshooting procedures in this section are primarily oriented toward an Agilent GPIB card and the Agilent IO Libraries Suite. Consult your instrument's User's Guide for troubleshooting details for the instrument.

GPIB Troubleshooting Overview

Figure 16 shows a typical GPIB system with a PC and two GPIB instruments. A suggested troubleshooting flowchart for GPIB cards, installed instruments, and the Agilent IO Libraries Suite follows.

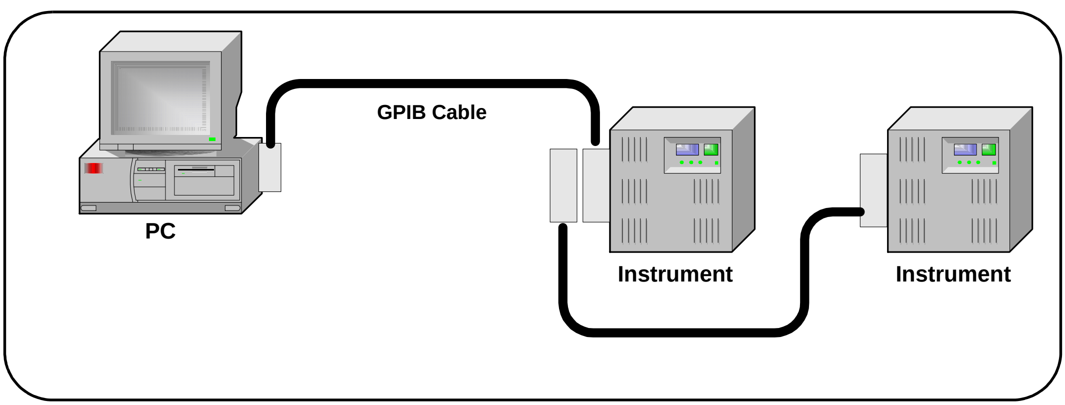


Figure 16 Typical GPIB System

1 GPIB Hardware Checks

Typical Causes

Bad GPIB cables/connections or power not ON for PC or instruments

Check cables/ connections/power

Check Device Manager

Other hardware checks

After doing these checks:

- If the cause is not identified, see **GPIB Software Checks**

- If the cause is identified as an 82350 hardware problem, contact Agilent to return the 82350.

2 GPIB Software Checks

Typical Causes

GPIB card drivers not installed or GPIB card not properly configured.

Check for GPIB driver files

Disable Agilent Connection Expert Auto-Detection

Check BIOS/interrupt settings

Set 82350 Read/Write performance mode

After doing these checks:

- If the cause is not identified, see **Agilent IO Libraries Suite Checks**

- If the cause is identified, but the problem cannot be fixed, contact Agilent for support.

3 Agilent IO Libraries Suite Checks

Typical Causes

Agilent IO Libraries Suite not installed or improper IO Libraries Suite configuration

Check IO Libraries Suite Installation

Check IO Control Operation

Install IO Libraries Suite (if GPIB already installed)

After doing these checks:

- If the cause is not identified or the problem cannot be fixed, contact Agilent for support.

GPIB Hardware Checks

This section gives guidelines to make hardware troubleshooting checks for the GPIB card (such as an Agilent 82351 PCIe™-GPIB), including:

- Check Cables/Connections/Power.
- Check Device Manager
- If Sound Card Does Not Work
- If Data Transfers to Devices Fail
- If Connection Expert Finds an Agilent 82350 Card with Serial Number ffffffff

Check Cables/Connections/Power. Start your troubleshooting sequence by performing the following hardware checks. If the hardware checks do not solve the problem, see GPIB Software Checks.

NOTE There are no user-serviceable parts for the GPIB Interface cards. If you suspect a hardware failure for interface card, contact Agilent for instructions to replace or repair the unit. See Contacting Agilent for telephone numbers/web site address.

1 **Check GPIB Cable Connections.** Check all GPIB cables for good connection to the GPIB connector on the interface card installed in your PC and the GPIB cable connections between all connected GPIB instruments. An improperly attached GPIB connector can cause the bus to malfunction.

2 **Check GPIB Cables for Damage.** Check all GPIB cables for cuts/damage and check for bent/misaligned/crushed connector pins. Replace cables as required.

3 **Disconnect/Reconnect GPIB Cables.** If Steps 1 and 2 do not solve the problem, try disconnecting and reconnecting (or replacing) GPIB cables.

4 **Check PC/Instrument Power-on.** Verify that the PC and all connected GPIB instruments are functional and are powered ON. Verify that host computer is not in a Suspended power management state.

5 **Reboot Your PC.** If doing Steps 1, 2, 3 or 4 does not solve the problem, reboot the PC. If this does not solve the problem, go to Check Device Manager.

Check Device Manager You can use the Windows Device Manager to reinstall the interface card as required. For example, open the **Control Panel**.

Then, select **System > Hardware > Device Manager**. From Device Manager, select the interface card and then **Properties**. Tab to **Driver** and click **Update Driver** or **Reinstall Driver.** This allows the Windows Plug and Play Manager to begin searching for a driver for the interface card. Since Device Manager may have disabled the card device, click **Enable** to restart the card. If this does not resolve the problem, go to GPIB Software Checks.

If your sound card stops working after configuring interfaces, disable the auto-detection process in Connection Expert. Click **Tools > Options...** . Then de-select **Automatic discovery or refresh of I/O resources** under the **Configuration Settings** tab.

If Data Transfers to Devices Fail If devices attached to your ISA (82341) GPIB card are detected, but data transfers to those devices fail, this is usually caused either by an IRQ conflict with another card or by your system having no IRQs available for this card. If no IRQs are available, the IRQ value shown in Connection Expert will be -1.

Try changing the IRQ setting to other values. You must reboot after changing the value to test it. If none work, you will have to free up other IRQs by disabling devices such as serial ports or sound cards.

If Connection Expert Finds an Agilent 82350 Card with Serial Number ffffffff If Connection Expert reports finding an 82350 card with serial number ffffffff, this is typically caused by a Windows system configuration that results in failure to properly configure PCI cards. In this case, upgrade your system BIOS to the latest version. Note that even new computers tend to have new BIOS available.

GPIB Software Checks

This section provides guidelines for GPIB Interface Card software checks, including:

- Check for Driver Files
- Check Agilent 488 Settings
- Disable Connection Expert Auto-Detection
- Check BIOS/Interrupts Settings
- Set 82350 Read/Write Performance Mode

Check for Driver Files After installing the Agilent IO Libraries Suite, check for installed driver files. Files are listed in their default directories.

Windows 2000	
Program Files	*C:/Program Files/Agilent/IO Libraries Suite/drivers/ag350i32.dll*
Driver Files	*C:/Winnt/system32/drivers/agt82350.sys*
.inf Files	*C:/Winnt/inf/agtgpib.inf*
Windows XP	
Program Files	*C:/Program Files/Agilent/IO Libraries Suite/drivers/ag350i31.dll*
Driver Files	*C:/Windows/system32/drivers/agt82350.sys*
.inf Files	*C:/Windows/inf/agtgpib.inf*

Uninstall/Reinstall the Agilent IO Libraries Suite. If the driver files are not found, uninstall the Agilent IO Libraries Suite by inserting the *Automation-Ready CD with Agilent IO Libraries Suite* and following the instructions to remove the libraries. Then, follow the instructions to re-install the libraries.

Check Agilent 488 Settings If you are running a program that was written to use NI-488.2, Agilent 488, or another vendor's 488-compatible library, and that program is not operating correctly, check Agilent 488 parameters:

1 For Agilent 488 or NI-488.2 code to work with Agilent GPIB interfaces, the Agilent 488 library must be enabled. Click **Tools** >

Agilent 488..., then select the check box labeled **Enable Agilent GPIB cards for 488 programs**. This setting allows correct operation of 488 programs with both Agilent and third-party GPIB interfaces (even simultaneously).

If you receive errors from third-party tools (such as National Instruments Measurement & Automation Explorer) when Agilent 488 is enabled, disable Agilent 488, use the third-party tool, then re-enable Agilent 488.

2 Most NI-488.2 programs are written to expect the GPIB card at board number 0 (zero). The default board numbers for Agilent GPIB interfaces begin with zero, but *for Agilent GPIB interfaces, the board number is set independently from the VISA interface ID*, so please note that you may need to set the board number explicitly to work with your program. To set the board number, select the GPIB interface (the icon *above* your GPIB instruments) in Connection Expert's explorer view, then click the **Agilent 488 Properties...** button in the detail (right) pane of the Connection Expert window and set the board number in the resulting dialog box.

Disable Connection Expert Auto-Detection If your PC sound card stops working after configuring interfaces, disable the auto-detection process in Connection Expert, as the auto-detection process in Connection Expert can cause sound and other cards to stop responding. To disable the auto-detection process, click **Tools > Options...** . Then de-select **Automatic discovery or refresh of I/O resources** under the **Configuration Settings** tab.

Check BIOS/Interrupts Settings If Connection Expert reports finding an 82350 card with Serial Number fffffff, this is typically caused by PCI cards not being configured properly. Try the following steps. If these steps do not work, remove and re-install the 82350 and then reconfigure the card.

1 **Check BIOS Setting.**

2 **Upgrade your system BIOS to the latest version.** New computers oftentimes have newer BIOS' available.

3 **If your computer locks up or freezes after installing.** This is typically caused by interrupt conflicts with other drivers in the system. PCI allows sharing of IRQs, but this also means the drivers for cards which share an IRQ must be handling interrupt chaining properly.

When the IRQ is asserted, the OS calls each ISR in turn until one of them returns TRUE (meaning that it handled the interrupt). The ISR's responsibility is to correctly return TRUE if its device was interrupting or FALSE if not. Drivers that return TRUE, even though they did not service the interrupt, will cause problems. Try the following steps:

- Upgrade the drivers for devices sharing an IRQ with Agilent, including, but not limited to, your video drivers, your LAN drivers, Agilent IDE and/or SCSI drivers, and your sound drivers.

4 **Reconfigure Your PC.** Configure your PC so as to not share IRQ lines. Many PCI cards have bugs when sharing IRQ lines. You may or may not be able to do this on all PCs. Many PCs can be configured using the setup option when the PC is first booting.

5 **Upgrade your system BIOS.** New computers may have a newer BIOS available. When installing a new system BIOS:

6 Make sure the BIOS **Installed O/S** setting is set correctly. This determines what software will configure all the VXI*plug&play* cards in your system. Either the BIOS or the O/S can perform the task of querying all the cards to determine their resource needs, picking a valid configuration for all these cards, and telling the cards what their actual resource settings are.

- If the BIOS **Installed O/S** is set to **Windows 95**, **Windows 98**, **Windows 2000** or **Running a PnP O/S**, the BIOS will not perform this task and will leave it to the O/S to do this. If the **Installed O/S** is set to **NOT PnP O/S**, or **Other**, the BIOS will perform this task and the system may not work properly.

Set 82350 Read/Write Performance Mode The 82350 card read and write calls use one of two modes:

- **Polling.** Bytes are transferred to/from the card, one at a time. Polling mode is advantageous for transferring a small number of bytes because the setup overhead is very low, but it does require CPU involvement for each byte transferred.
- **Interrupt.** An entire buffer is transferred to/from the card without CPU involvement. Interrupt mode is advantageous for transferring large buffers because the higher per byte transfer rate more than compensates for the relatively long interrupt setup overhead.

The default behavior of the 82350 driver is to use **Polling** mode for transfers of 256 bytes or less and to use **Interrupt** mode for larger transfers. You can modify this default behavior by doing the following:

VISA: The VISA function
`viSetAttribute(vi, VI_ATTR_DMA_ALLOW_EN, attrValue)`
can be called to modify the read/write behavior for a VISA session. The `VI_ATTR_DMA_ALLOW_EN` values allowed are:

- **`VI_TRUE`** (default value) Use Interrupt mode for transfer requests larger than 256 bytes, otherwise, use Polling mode.
- **`VI_FALSE`** Use the Polling mode.

SICL: The SICL function
`ihint(id, hint)`
can be called to modify the read/write behavior for on a SICL session. The `hint` values allowed are:

- **`I_HINT_DONTCARE`** (default value) Use Interrupt mode for transfer requests larger than 256 bytes, otherwise, use Polling mode.
- **`I_HINT_USEPOLL`** Use the Polling mode.
- **`I_HINT_IO`** Use the Interrupt mode.

Some additional factors to consider are:

- The settings discussed above are per session. This means you can open multiple sessions to a device and set different transfer modes for different sessions. The actual mode used will then depend on which session you are using for the read/write calls.
- In both SICL (with **`hint = I_HINT_DONTCARE`**) and VISA (with **`VI_ATTR_DMA_ALLOW_EN = VI_TRUE`**), the size of the read request (as specified by **`bufsize`** in a SICL **`iread()`** or **`count`** in a VISA **`viRead()`** function call) will determine the mode used even if the number of bytes actually read is less.
- The default formatted I/O read buffer size is 4096 so when using this default size, formatted reads in SICL (with **`hint = I_HINT_DONTCARE`**) and VISA (with **`VI_ATTR_DMA_ALLOW_EN = VI_TRUE`**) will use Interrupt mode even when a small number of bytes are expected.

- The default formatted IO write buffer size is 128 so when using this default size, formatted writes in SICL (with **`hint = I_HINT_DONTCARE`**) and VISA (with **`VI_ATTR_DMA_ALLOW_EN = VI_TRUE`**) will used Polling mode even when a large number of bytes are being sent.
- In SICL, Polling mode will always be used for the **`iread()`**, **`ifread()`** and **`iscanf()`** regardless of the above settings, when a **`termchr`** is set (**`itermchr()`** is not set to **`-1`**).
- In VISA, Polling mode will always be used for **`viRead()`**, **`viBufRead()`** and **`viScanf()`** regardless of the above settings, when **`VI_ATTR_TERM_CHAR_EN = VI_TRUE`**.

The **crossover point** at which the Interrupt mode becomes faster then the Polling mode depends on the CPU speed, with a faster CPU having a higher crossover point.

Agilent IO Libraries Suite Checks

This section gives troubleshooting guidelines for the Agilent IO Libraries Suite, including:

- Check IO Libraries Suite Installation
- Check Agilent IO Control Operation
- Install IO Libraries Suite (if 82350 was Installed First)

Check IO Libraries Suite Installation Start your Agilent IO Libraries Suite troubleshooting sequence by verifying IO Libraries Suite installation. If the IO Libraries Suite is installed, go to Check Agilent IO Control Operation.

1 **Check Agilent IO Libraries Suite Version.** If Agilent IO Libraries Suite version 15.0 or later is installed, a blue IO icon ( ) is normally displayed in the Windows notification area (on the lower right side of the screen).

- If the **IO** icon is displayed, click the icon and click **About Agilent IO Control** to display the version. Version 15 or greater must be installed. (The next version of the IO Libraries after "M" discontinued this naming convention, and uses *IO Libraries Suite 14.0* instead to designate the version immediately following M.01.01.)
- If the **IO** icon is not displayed, a version may still be installed. To check this, click **Start | Programs** and look for the *Agilent IO Libraries Suite* program group.
- If this group is displayed, click **Agilent IO Libraries Suite > Utilities > IO Control** to display the **IO** icon. Then, click the icon and click **About Agilent IO Control** to display the installed version (must be M.01.00 or greater).
- If neither the **IO** icon nor the Agilent IO Libraries Suite program group is displayed, no Agilent IO Libraries Suite are installed.

2 **Install Agilent IO Libraries Suite (as Required).** If Agilent IO Libraries Suite v15 or greater is not installed on your PC, install the IO Libraries Suite. Otherwise, go to Check Agilent IO Control Operation.

Check Agilent IO Control Operation When the Agilent IO Libraries Suite was installed, the Agilent IO Control was started. When the IO Control is active, it is displayed as a blue circled **IO** icon on the Windows tasteable. If the Agilent IO Control is deactivated, I/O applications that are running with the GPIB interface card may be unable to open sessions or to communicate with the card and devices.

By default, the Agilent IO Control is always active after the Agilent IO Libraries Suite is installed and the blue **IO** icon is displayed. However, the IO Control may be active even though the blue **IO** icon is not displayed. There are two ways that the blue **IO** icon can be hidden:

- **Clicking Hide Agilent IO Control**. Clicking the blue **IO** icon and then clicking **Hide Agilent IO Control** hides the **IO** icon, but does *not* deactivate the Agilent IO Control.
- **Clicking Exit.** Clicking the blue **IO** icon and then clicking **Exit** causes a dialog box to appear that asks you if you want to terminate the Agilent IO Control. Clicking **Yes** hides the blue **IO** icon *and* deactivates the Agilent IO Control.

If the blue **IO** icon is not displayed, either the blue **IO** icon display has been turned off and/or the Agilent IO Control (and associated **iprocsvr.exe**) is not active. In this case, click **Start > Programs > Agilent IO Libraries** and then click **Agilent IO Control** to re-start the Agilent IO Control and to display the blue **IO** icon.

Install IO Libraries Suite (if 82350 was Installed First)

NOTE When you install the Agilent IO Libraries Suite, drivers for your 82350 GPIB card will be installed automatically. You should not need to take additional steps to install drivers. The information in this section is provided to assist you in case you have problems with your GPIB card and drivers.

- If you installed the 82350 GPIB card before installing the Agilent IO Libraries Suite software, use the applicable step for your operating system to install the Agilent IO Libraries Suite. After the drivers for all new cards are installed, you can run **Setup** from the *Automation-Ready CD with Agilent IO Libraries Suite* to install and configure the Agilent IO Libraries Suite.

NOTE On older operating systems, you may be asked to insert the 'HP I/O Libraries' CD. You should use the CD that contains the Agilent IO Libraries Suite in this case. The card will be identified as a Hewlett-Packard card. This is necessary for backward compatibility.

NOTE On Windows 2000, the Found New Hardware Wizard will identify this card as a PCI Simple Communications Controller. The driver is typically located in the \Windows 2000 directory on the instrument CD.

4
Connecting Instruments to USB

This chapter includes:

USB Quick Start

This section shows suggested steps to help you quickly get started connecting Universal Serial Bus (USB) enabled instruments to the USB.

NOTE

Optionally, a USB hub may be connected between the PC and USB instrument(s). However, this configuration is not described in this guide. See your USB hub documentation if you use a USB hub.

Typical USB Interface System In this guide, a **USB interface system** is defined as a system in which USB-enabled instruments are connected via a USB cable to a USB 1.1 port in a Windows PC or to a USB 2.0 port in a Windows XP PC (with Service Packs 1 or 2). Figure 17, below, shows a typical USB interface system with a PC and a USB instrument connected via a USB cable.

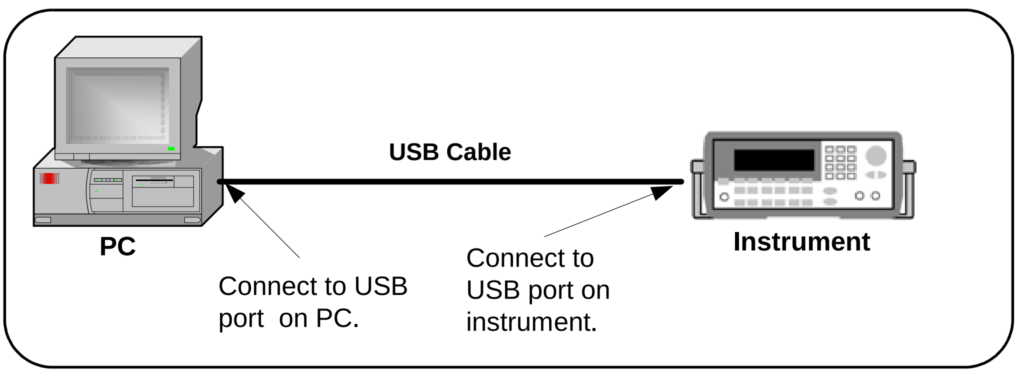


Figure 17 Typical USB Interface System

Step 1: Install Agilent IO Libraries Suite on Your PC

Install Agilent IO Libraries Suite and other I/O software on your PC before you connect instruments to USB. See Installing Agilent I/O Libraries Suite in Chapter 2 for details.

Step 2: Connect Instruments to USB

This step provides a USB interface overview, shows how to connect USB Instruments using the USB ports on your PC, or by using the Agilent 82357B USB/GPIB Interface Converter.

USB Interface Overview

When a USB device that implements the USBTMC (Universal Serial Bus, Test and Measurement Class) or USBTMC-USB488 protocol is plugged into the computer, the Agilent IO Libraries Suite automatically detects the device. It is important to note that only USBTMC and USBTMC-USB488 devices are recognized by the IO Libraries Suite. Other USB devices such as printers, scanners, and storage devices are not recognized and cannot be programmed with the Agilent IO Libraries Suite. “USB instruments” in the remainder of this chapter refers to devices that implement the USBTMC or USBTMC-USB488 protocol.

Connecting an Instrument via USB or Converter. The Universal Serial Bus (USB) is a quick and easy way to connect instruments to PCs on a benchtop. Some newer instruments have USB interfaces built in; for those that do not, you can use the **Agilent 82357B USB/GPIB Interface Converter** to connect GPIB instruments to a USB port on your PC. You can use USB to connect a single instrument to a PC; or, with the 82357B, you can connect up to 14 GPIB instruments.

NOTE Do not confuse the **Agilent 82357 USB/GPIB Interface Converter** with a USBTMC device. Agilent Connection Expert automatically configures the 82357 as a GPIB interface, not as a USBTMC device, when it is plugged into the computer.

Connect USB Instruments

Use the steps in this figure to directly connect USB instruments to a Windows PC. If you have not yet installed I/O software on your PC, go to Installing Agilent I/O Libraries Suite and install the software BEFORE you connect USB instruments to your PC. When you have made the connections for your system, go to Step 3: Run Agilent Connection Expert.

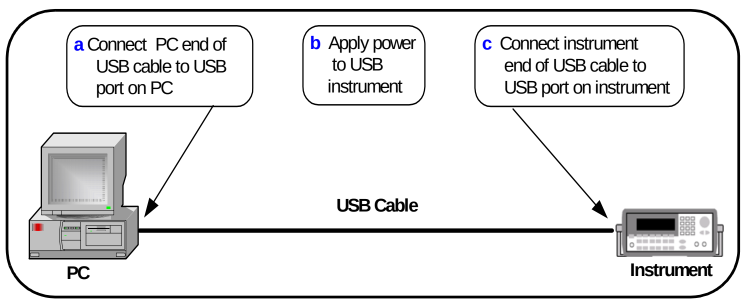


Figure 18 Connecting a USB Instrument to a PC

NOTE If you have not yet installed I/O software on your PC, go to Step 1: Install Agilent IO Libraries Suite on Your PC and install the software BEFORE you connect USB instruments to your PC. Be sure to use a USB 2.0-compliant USB cable, even if you are using USB 1.1 operation.

Step 3: Run Agilent Connection Expert

This step provides an overview of how Connection Expert automatically identifies USB instruments, and how you can assign VISA aliases, or programming aliases, to address those instruments in a more convenient way.

Click the **Agilent IO Control** icon in the Windows Notification area, and then click **Agilent Connection Expert**. When the main screen appears, you will see a map of the system connections in the **Instrument I/O on this PC** pane (also called “Explorer Pane”). *If you see your interface and instruments in the Explorer Pane, you are ready to go!*

NOTE For help with Agilent Connection Expert, refer to “Agilent Connection Expert” on page 15 of this manual and the Agilent *IO Libraries Suite help* file. This help file is available from the IO Control **Documentation** menu.

Automatic Identification of USB Devices. When a USB instrument is plugged into the PC, the IO Libraries Suite adds a USB interface, a USB instrument, and a VISA alias (**UsbDevice1**, in this case) to the **Instrument I/O on this PC** explorer tree. Note that the USB/GPIB converter, **USB/GPIB (GPIB0)**, looks different than the USB interface.

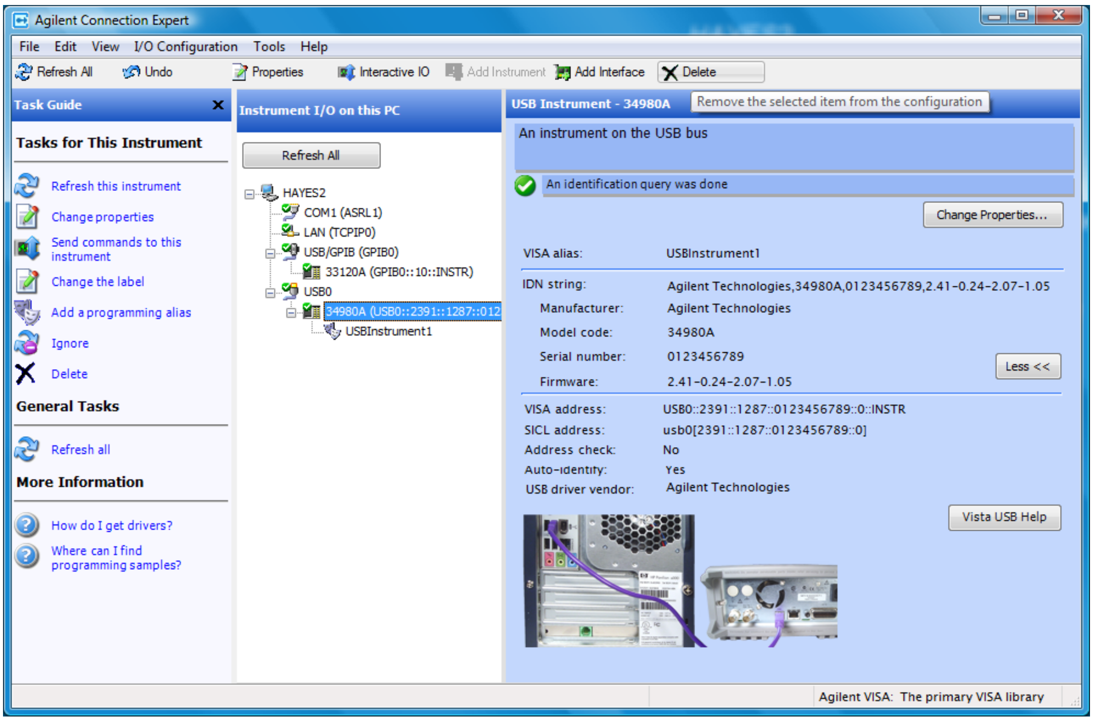


Figure 19 Appearance of the USB Converter vs. USB Interface

Both a listener check and an identification query are done automatically, as you can see on the right side in the **USB Instrument** pane next to the green-white check mark symbol.

NOTE

When you apply power, a **Found New Hardware** wizard may appear from the Windows operating system. Just step through the wizard clicking **Next**. (You don't need to insert a CD, since you have already installed the I/O software.) You may see two wizards when you connect a USB/GPIB interface converter. Don't worry; step through both. Then return to this section.

The instrument's identification parameters can also be seen, such as the IDN string, the manufacturer, the model code, the serial number, the firmware revision as well as pictures of the instrument and PC rear connection panels.

Assigning a VISA Alias. Connection Expert automatically assigns a default alias name. You can modify a VISA alias by right-clicking on the USB instrument in the Instrument IO pane and selecting **Add VISA alias** from the drop-down menu. A **VISA Alias Properties** dialog box appears.

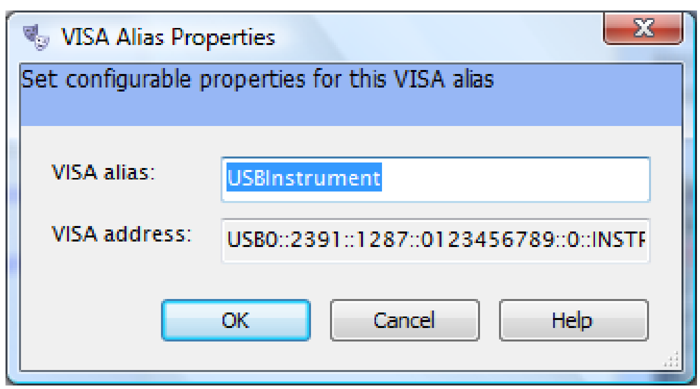


Figure 20 VISA Alias Dialog Box

You can change this VISA alias name to one of your own choosing before clicking **OK**.

NOTE

A VISA alias is a name of your choosing, which you assign to a device and use in your programs. Once assigned, the alias is a synonym for the device's VISA address, so you can use it to open a VISA session (using the **viOpen** function) and to get resource information (using **viParseRsrc** or **viParseRsrcEx**).

Using VISA aliases in your programs, rather than VISA addresses, provides two significant advantages:

- **Portability.** If you program using aliases, you can run your program on a new test system, whose instruments are at different addresses, simply by using Connection Expert to create the same aliases on the new system as you created on your development system. Similarly, you can move or replace instruments without changing or recompiling test code, simply by changing the alias definitions in Connection Expert.
- **Readability.** Your programs will be much easier to read and understand if, for example, your multimeter is called “myDMM” instead of “GPIB2::14::8::INSTR”. This is particularly important in the case of USB instruments, whose VISA addresses are typically long and cumbersome, containing the instrument's serial number among other information.

Step 4: Communicate with Instruments

This step shows how to use Interactive IO to send 488.2 commands to your USB instruments and read responses.

NOTE

Communication with installed instruments was established in Step 2: Connect Instruments to USB. Therefore, this is an optional step you can use to verify communication with instruments.

Check Identification Parameters

1 Highlight the USB instrument in the **Instrument I/O on this PC** pane. Then click the **Interactive IO** icon on the tool bar. (If you are using a USB/GPIB converter, then you would be highlighting a GPIB instrument.)

The **Interactive IO** dialog box appears. The **Commands** menu is selected, as shown below.

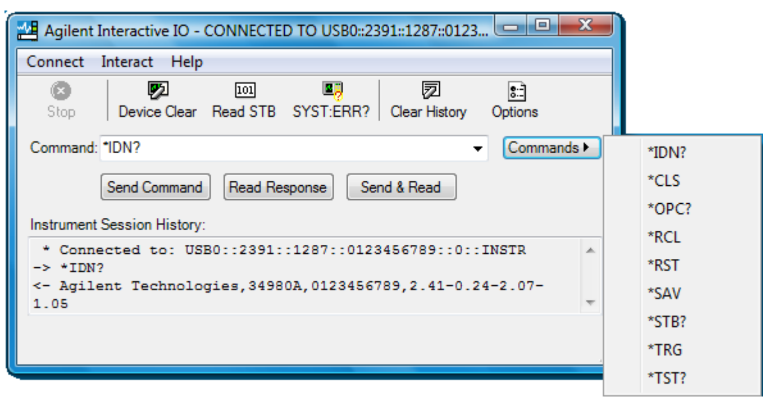


Figure 21 Interactive IO with 488.2 Commands Displayed

2 Select a command, or enter one in the **Command** area.

3 Click **Send & Read** to send the command to the instrument and read a response. Alternatively, click **Send Command** and **Read Response**. The Instrument Session History area displays the results.

NOTE

If a time-out occurs when sending/receiving commands, change the default **Time-out** setting of 5000ms in the **Interact>Options** dialog.

488.2 Commands	Meaning
*IDN?	Identification query returns manufacturer, model, serial number, and firmware level or equivalent.
*CLS	Clear Status clears status data structures, and forces the device to the Operation Complete query idle state.
*OPC?	Operation Complete query places an ASCII character "1" into the device's Output Queue when all pending selected device operations have been finished.
*RCL	Recall restores the settings of a device from a copy stored in local memory.
*RST	Reset performs a device reset, which sets the device-specific functions to a known state that is independent of the past-use history of the device.
*SAV	Save stores the current settings of the device in local memory.
*STB?	Read Status Byte query allows the programmer to read the status byte and master Summary Status bit.
*TRG	Trigger signals the transition of the Device Trigger (DT) function to the Device Trigger Active State (DTAS).
*TST?	Self-test returns zero indicating the test completed with no errors. A return value not equal to zero indicates the test is not completed or completed with errors.
SCPI Commands	
SYST:ERR?	This message requests the next entry from the instrument's error/event queue. Items in this queue contain an integer in the range [-32768, 32767] denoting an error/event number and associated descriptive text. Negative numbers are reserved by the SCPI standard; positive numbers are instrument-dependent. A value of zero indicates that no error or event has occurred.

NOTE

Some instruments do not recognize any/all 488.2 commands.

Troubleshooting USB Interfaces

This section shows suggested troubleshooting steps for Universal Serial Bus (USB) interfaces, including:

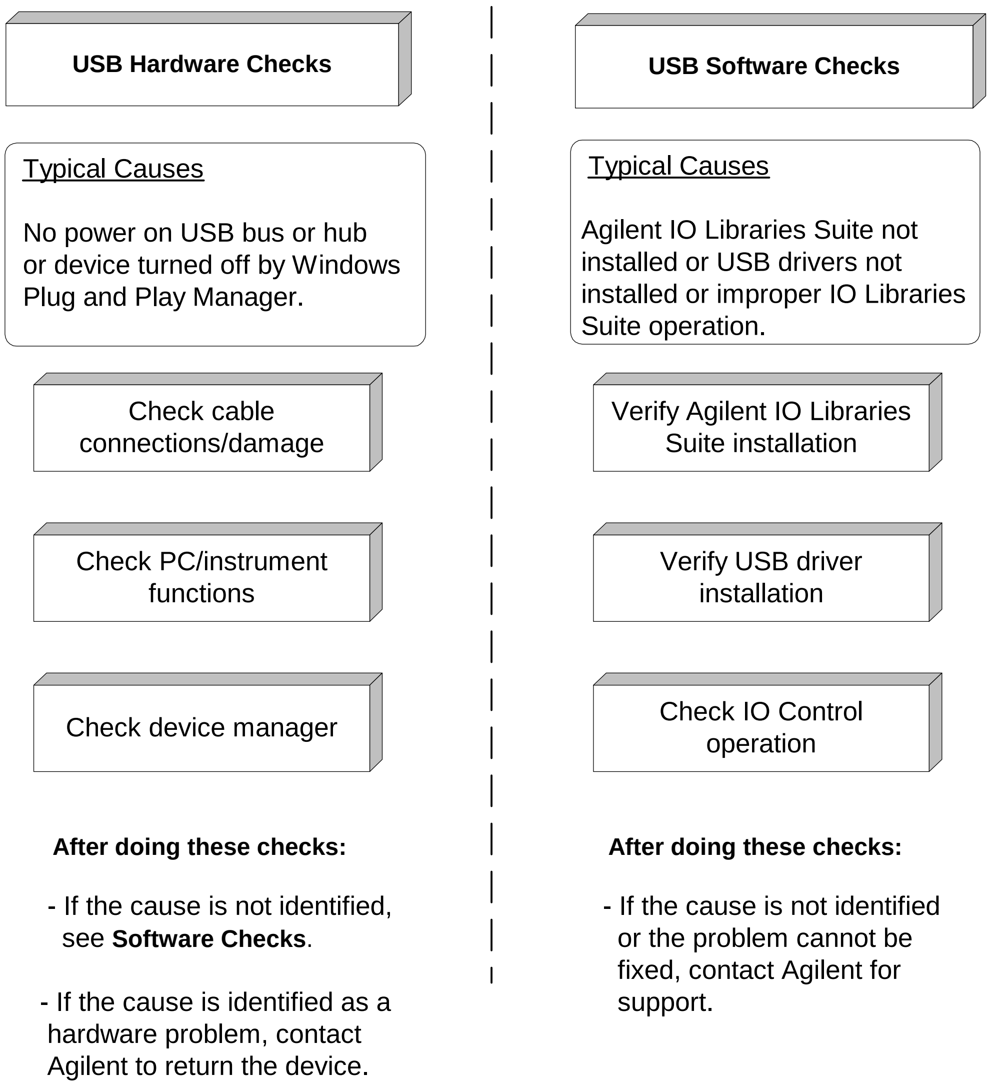
- USB Troubleshooting Overview
- USB Hardware Checks
- USB Software Checks

NOTE

The troubleshooting procedures in this section are primarily oriented toward USB instruments and the Agilent IO Libraries Suite. Consult your instrument's User's Guide for troubleshooting details for the instrument.

USB Troubleshooting Overview

This figure shows a typical USB interface with a PC and a USB instrument. A suggested troubleshooting flowchart for USB instruments and the Agilent IO Libraries Suite follows. We suggest you start at USB Hardware Checks and then go to USB Software Checks, as required.


USB Hardware Checks
Typical Causes
No power on USB bus or hub or device turned off by Windows Plug and Play Manager.
Check cable connections/damage
Check PC/instrument functions
Check device manager
After doing these checks:
- If the cause is not identified, see Software Checks.
- If the cause is identified as a hardware problem, contact Agilent to return the device.
USB Software Checks
Typical Causes
Agilent IO Libraries Suite not installed or USB drivers not installed or improper IO Libraries Suite operation.
Verify Agilent IO Libraries Suite installation
Verify USB driver installation
Check IO Control operation
After doing these checks:
- If the cause is not identified or the problem cannot be fixed, contact Agilent for support.

USB Hardware Checks

This section gives guidelines to make hardware troubleshooting checks for connected USB instruments. Start your troubleshooting sequence by performing the following hardware checks. If performing the hardware checks do not correct the problem, go to USB Software Checks.

Check Cable Connections/Damage Check all USB cables for good connection to the USB connector on your PC, to all USB hubs (if installed) and the USB cable connections to connected USB instruments. An improperly attached USB connector can cause the interface to malfunction.

Check all USB cables for cuts/damage and check for bent/misaligned/crushed connector pins. Replace cables as required. If these actions do not solve the problem, try disconnecting and reconnecting (or replacing) USB cables. If the cable checks do not solve the problem, go to Check PC/Instrument Functions.

Check PC/Instrument Functions Verify that all USB hubs, and all connected USB instruments are functional and are powered ON. Verify that host computer is not in a Suspended power management state. If these actions do not solve the problem, reboot the PC. If this does not solve the problem, go to Check Device Manager.

Check Device Manager You can use the Windows Device Manager to reinstall the USB instrument driver, as required. For example, with Windows XP, go to **Control Panel**. Then, select **System** > **Hardware** > **Device Manager**. From **Device Manager**, select the **USB Test and Measurement Device** and then right click for **Properties**.

Tab to **Driver** and click **Reinstall Driver**. This will allow the Windows Plug and Play Manager to begin searching for a driver for the instrument. Since Device Manager may have disabled the instrument, click **Enable** to restart the instrument.

NOTE

Windows may place a misbehaving USB device in an “Unknown device” category. To see if this has happened, change the View in **Device Manager** by selecting **View** > **Show Hidden Devices**. Next, right-click the **Universal Serial Bus Controllers Unknown device** and select **Uninstall**. Then, select **Device Manager** > **Action** > **Scan** for hardware changes.

USB Software Checks

This section provides guidelines to make software troubleshooting checks for connected USB instruments. If you have not already done so, we suggest you start your troubleshooting sequence by performing the hardware checks in USB Hardware Checks. If performing the hardware and then the software checks does not correct the problem, contact Agilent for instructions. See Contacting Agilent for addresses.

Verify USB Driver Installation

1 **Check for USB Driver Files.** Files are listed in their default Windows directories. Verify that the driver files are installed. If they are installed, go to Check Agilent IO Control Operation. If not, go to step 2.

Windows 2000	
Program Files	*C:/Program Files/Agilent/IO Libraries Suite/drivers/agusb48832.dll*
Driver Files	*C:/Winnt/system32/drivers/ausbtmc.sys*
.inf Files	*C:/Winnt/inf/ausbtmc.inf*
Windows XP / Vista	
Program Files	*C:/Program Files/Agilent/IO Libraries Suite/drivers/agusb48831.dll*
Driver Files	*C:/Windows/system32/drivers/ausbtmc.sys*
.inf Files	*C:/Windows/inf/ausbtmc.inf*

2 **Uninstall/Reinstall the Agilent IO Libraries Suite.** If the driver files are not found, uninstall the Agilent IO Libraries Suite by inserting the *Automation-Ready CD with Agilent IO Libraries Suite* and following the instructions to install the libraries. The installation program will detect the existence of the IO Libraries Suite and offer you the option to remove it. Then reinstall the IO Libraries Suite.

Agilent IO Libraries Suite Checks

This section give troubleshooting guidelines for the Agilent IO Libraries Suite, including:

- Check IO Libraries Suite Installation
- Check Agilent IO Control Operation

Check IO Libraries Suite Installation Start your Agilent IO Libraries Suite troubleshooting sequence by verifying IO Libraries Suite installation. If the IO Libraries Suite is installed, go to Check Agilent IO Control Operation.

1 **Check Agilent IO Libraries Version.** If a version of the Agilent IO Libraries or IO Libraries Suite has been installed, a blue icon () is normally displayed on the Windows notification area (on the lower right side of the screen).

- If the **IO** icon is displayed, click the icon and click **About Agilent IO Control** to display the version. Version 15 or greater must be installed. (The next version of the IO Libraries after "M" discontinued this alphabetic naming convention, and uses *IO Libraries Suite 14.0* to designate the version immediately following M.01.01.)
- If the **IO** icon is not displayed, a version may still be installed. To check this, click **Start** > **Programs** and look for the **Agilent IO Libraries** or the **Agilent IO Libraries Suite** program group.
- If this group is displayed, click **Agilent IO Libraries > Utilities > IO Control** or **Agilent IO Libraries Suite > Utilities > IO Control** to display the **IO** icon. Then, click the icon and click **About Agilent IO Control** to display the installed version (must be M.01.00 or greater).
- If neither the **IO** icon nor the Agilent IO Libraries Suite program group is displayed, no Agilent IO Libraries are installed. In this case, or if the installed version is not M.01.00 or greater, you must install the newer version (see step 2 following).

2 **Install Agilent IO Libraries Suite (as Required).** If Agilent IO Libraries v15 or later is not installed on your PC, use this step. Otherwise, go to "Verify USB Driver Installation" on page 84.

- Remove the USB cable from the USB port on the PC.
- Uninstall the IO Libraries by using **Add/Remove Programs** in the **Control Panel**.
- Install IO Libraries Suite from the *Automation-Ready CD with Agilent IO Libraries Suite.* (Go to Installing Agilent I/O Libraries Suite for more information.)
- Connect the USB cable to the PC.
- If this does not correct the problem, go to Verify USB Driver Installation.

Check Agilent IO Control Operation When the Agilent IO Libraries Suite was installed, the Agilent IO Control was started. When the IO Control is active, it is displayed as a blue **IO** icon on the Windows task bar. If the IO Control is deactivated, I/O applications may be unable to open sessions or to communicate with instruments.

By default, the Agilent IO Control is always active after the Agilent IO Libraries Suite is installed and the blue **IO** icon is displayed. However, the IO Control may be active even though the blue **IO** icon is not displayed. There are two ways that the blue **IO** icon can be hidden:

- **Clicking Hide Agilent IO Control**. Clicking the blue **IO** icon and then clicking **Hide Agilent IO Control** hides the blue **IO** icon, but does *not* deactivate the Agilent IO Control. (You can also do this from the Connection Expert **View** menu.)
- **Clicking Exit.** Clicking the blue **IO** icon and then clicking **Exit** causes a dialog box to appear that asks you if you want to terminate the Agilent IO Control. Clicking **Yes** hides the blue **IO** icon *and* deactivates the Agilent IO Control.

If the blue **IO** icon is not displayed, either the blue **IO** icon display has been turned off and/or the Agilent IO Control is not active. In this case, click **Start > Programs > Agilent IO Libraries Suite > Utilities > IO Control** to re-start the Agilent IO Control and to display the blue **IO** icon.

5
Connecting Instruments to LAN

This chapter includes:

LAN Quick Start

This section shows suggested steps to help you quickly get started connecting and configuring your LAN-enabled instruments for site LAN or private LAN operation.

Typical LAN Interface Systems The advantages of LAN technology are making it an attractive alternative to GPIB for system I/O. As a result, LAN interfaces are becoming more common in test equipment -- though LAN ports will likely coexist with GPIB for years to come.

On the surface, the presence of LAN ports in most current-generation PCs and many new-generation test instruments may make connections seem as simple as finding a network cable and plugging it into both devices. Making the connection work depends on the LAN services of Microsoft® Windows® and the additional capabilities provided by the Agilent IO Libraries Suite v15. A quick, one-time configuration process will make LAN-based instrument connections as easy as using GPIB.

Once the IO Libraries Suite is installed and configured, it accelerates the connection process with software libraries and utilities that let you quickly discover instruments on your network, configure and verify the connections, and get on with your job — whether it entails the creation of instrument control software or the use of pre-existing application software.

Getting Started Use the following sequence of steps as a guide to help you set up your instruments for site LAN or private LAN operation. For additional information:

- TCP/IP Network Basics for an introduction to TCP/IP networks
- Troubleshooting LAN Interfaces for LAN troubleshooting tips
- Glossary for a definition of some LAN terms
- Contacting Agilent if you need to contact Agilent

Step 1: Install Agilent IO Libraries Suite on Your PC

Install Agilent IO Libraries Suite and other I/O software on your PC before you connect instruments to your LAN port(s). See Installing Agilent I/O Libraries Suite for details. Then, go to Step 2: Connect LAN Instruments.

Step 2: Connect LAN Instruments

This section gives guidelines to connect your PCV, LAN test instruments and LAN interface devices (routers, hubs, switches, etc.) together. When you have connected your instruments, go to Step 3: Run Agilent Connection Expert.

Network Topologies

There are countless ways to connect one or more instruments to a PC using network/LAN connections. While this section cannot describe every possible network topology, it does provide basic concepts to help you configure your instrument network and troubleshoot problems.

Table 2 provides a brief summary of the network topologies described in this section. These topologies are not mutually exclusive. For example, some of your test system instruments are connected in a private subnet and other instruments available through the corporate intranet.

Table 2 Summary of Network Topologies

Network Topology	Description	Comments
Direct Connection	Direct connection between PC and single instrument (requires cross-over cable).	Only connects one instrument, suitable for instrument testing.
Private Instrument Subnet	PC has NIC connected to a private instrument subnet	Recommended topology for deployed manufacturing test systems.
Private Subnet on Corporate Intranet	Instruments and PC on same subnet, connected to corporate LAN through a router	Recommended topology for deployed manufacturing test systems.
Open Subnet on Corporate Intranet	Instruments and PC both on corporate internet, but on same subnet	Simple connection for many users.
Instruments on Corporate Intranet	Instruments and PC both on corporate LAN, with arbitrary topology of routers/bridges/switches/hubs between them.	Generally not recommended.
WAN	Instrument and PC both on the network, separated by firewall	Agilent Connection Expert does not support this topology since it requires access through one or more firewalls.

In general:

- **IP Address:** The local router or the corporate DHCP server assigns IP addresses.You can set instrument IP address manually but you must ensure that each instrument on the subnet uses the same network address.
- **Hostname:** The Hostname is the host portion of the domain name, which is translated into an IP address. If DHCP is enabled, the DHCP server can change the specified Host Name.
- **DHCP:** In general, allow the local router or corporate DHCP server to assign IP addresses to the instruments. This ensures that each instrument is correctly configured for its local subnet. Check instrument documentation to ensure this capability.
- **DNS:** If DNS is available and your instrument uses DHCP, the Hostname is registered with the Dynamic DNS service at power-on.
- **Subnet Mask:** If DHCP is enabled, the Subnet Mask is automatically configured.

Directly Connect Instrument to Computer

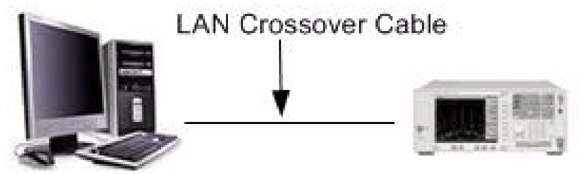


Figure 22 Direct Connect

This is the simplest possible network topology. One instrument connects directly to the computer with no other devices on the network. Typically, this requires a cross-over network cable; however, either the instrument or computer could support Auto-MDIX which automatically establishes the correct sense of the cable.

- This topology:
  - Does not require LAN configuration.Only one LAN instrument can connect to the PC’s NIC.
  - Allows you to configure the instrument prior to installing it on a different LAN.
  - Does not allow LXI Compliant instruments access to their manufacturer's web site for updates.
  - Typically, the PC does not run DCHP.
  - Other non-LAN instruments (GP-IB, USB, etc.) can connect to the PC.

Private Instrument Subnet

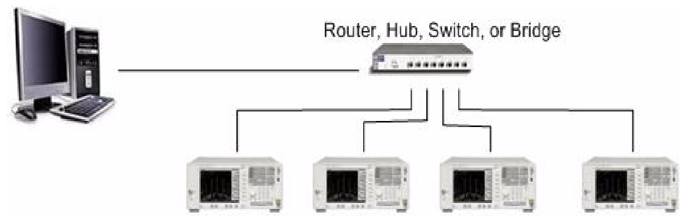


Figure 23 Private Instrument Subnet

This configuration creates a private LAN subnet for the instrument system. If the PC and instruments are on the same side of the router, then router runs a DHCP server and assigns address IP addresses to each device, including the computer. Agilent Connection Expert easily finds all of the instruments in this system. This topology is recommended for deployed manufacturing systems. Devices separated by a hub or switch are not on a private subnet. Other non-LAN instruments (GP-IB, USB, etc.) can connect to the PC.

Optionally, there may be a second NIC in the computer or there may be an intranet connection through the router (see the next example).

Private Instrument Subnet on Corporate Intranet

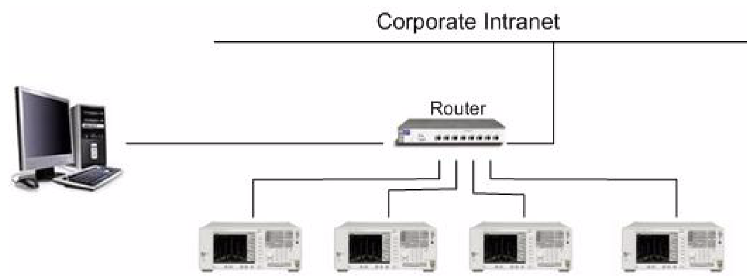


Figure 24 Private Subnet on Corporate Intranet

In this topology, the computer is on the same subnet (same side of the router) as the LAN instruments. Both are “shielded” from the corporate LAN by the router. Other PCs on the network cannot easily reach the instruments. The router runs a DHCP server for the local devices, including the computer. This scenario presumes that the router does Network Address Translation (NAT) when the PC or instruments attempt to access the corporate intranet. Note that if the router were replaced by a hub, switch, or bridge, then this would be equivalent to an open instrument subnet topology (see next example).

Open Instrument Subnet of Corporate Intranet

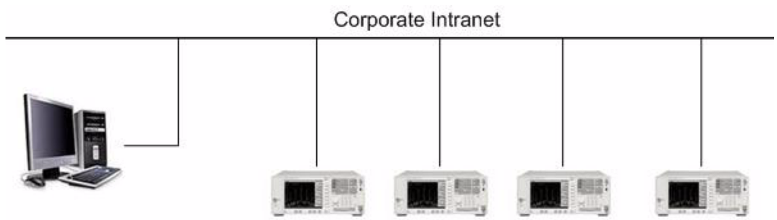


Figure 25 Open Subnet of Corporate Intranet

The computer and instruments connect directly to the corporate LAN. To add another instrument, just plug it into any available LAN port (or stack onto a hub). The corporate DHCP server assigns IP addresses. The DNS server or corporate IT department either assigns hostnames or acquires them from the instruments through dynamic DNS.

A hub or switch can provide the physical connections for the system so that the physical topology resembles the Private Instrument Subnet, however, all instruments are visible to the Corporate intranet.

Latency and throughput are compromised because instruments must share the network with all other traffic.

Corporate Intranet

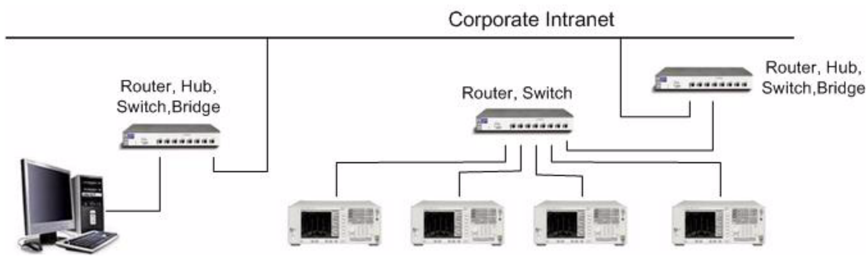


Figure 26 Private subnet different from PC

In order for the PC to access the instruments, the network infrastructure must make them visible. This suggests that the instruments are placed on the corporate intranet with a hub or switch and not a router. While this is a good model for a large, distributed organization, any computers on the corporate intranet can access the test system. Use locking to prevent test disruption. Latency and throughput are compromised because the system must share the network with all other traffic

Agilent Connection Expert may not be able to auto-discover all of the instruments. You may need to manually enter the IP address or hostname of each instrument you want to configure.

Across the WAN -- Using the Internet

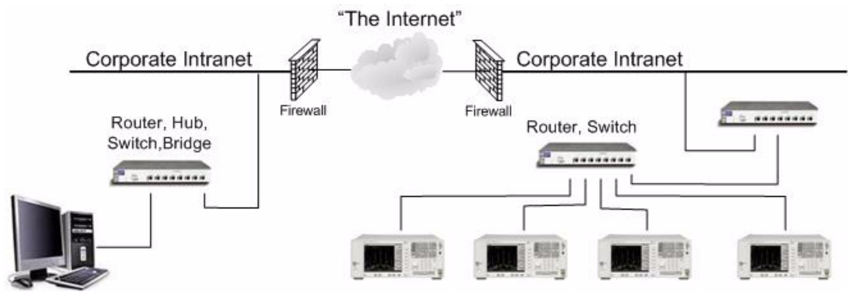


Figure 27 Internet access through firewall

This topology is full internet access through firewalls; the test system instruments are behind a different firewall on a different intranet. The instruments must be assigned fixed and publicly known hostnames or IP addresses. The addresses must be available through the firewalls. This requires approval and management from the IT department. Agilent Connection Expert may not find all of the instruments in this system because it does not have access through the firewalls.

It can be very difficult to write test programs because locking must be used to prevent disruption of tests.

General Issues with LAN Configuration

Basic design considerations for a LAN-based test system include:

Dynamic nature of IP addresses If instruments are assigned IP addresses by DHCP or AutoIP, the IP address will occasionally change. With DHCP, this could happen when the DHCP lease expires (unlikely since most configurations grant the same IP address) or when the instrument is turned off and on (this is more likely). With AutoIP, it is more likely that instruments will show up at different addresses. Therefore, do not rely on dynamically assigned IP addresses as the primary way to address an instrument controlled from your programs.

Using hostnames Accessing instruments via hostname requires that the instrument's hostname is registered with DNS. Most LAN instruments provide a default hostname composed of the manufacturer, instrument ID, and serial number. The instrument then requests that hostname via DHCP when it requests an IP address. If DHCP supports Dynamic DNS, then registers the hostname. After discovering an instrument, Agilent Connection Expert does a reverse DNS lookup to determine if the instrument has a hostname and it has been successfully registered with DNS. The same reverse DNS lookup solution works if the hostname and IP addresses are both statically assigned by IT.

Security Private networks generally involve direct connections between the PC and the test instruments and may include switches or routers. Access to the instruments is limited to users connected to the private network as opposed to users on a site (corporate) network that could locate and access the instruments from any location -- possibly disrupting tests in progress. Code generation is often simplified as protection against unauthorized users may not be required.

Performance Test systems where large amounts of data are transferred usually have faster throughput on private networks. On a site network, heavy and unpredictable LAN traffic affects each instrument on the network. Test system repeatability is difficult to achieve as latencies are difficult to account for.

Reliability Private networks are fundamentally more reliable than site networks as they host fewer users and are less complex. Private networks are isolated from conditions that might crash a site network.

Multiple NIC Cards If Agilent Connection Expert (see "Step 3: Run Agilent Connection Expert" on page 102) does not discover instruments because there are multiple NIC cards/interfaces in your PC (for example, a notebook computer with a built-in wireless LAN as well as a directly connected LAN). Windows Vista and Windows XP may be broadcasting on the wrong NIC and/or AutoIP may be turned on for one or more instruments.

Connection Expert sends a separate UDP broadcast to the broadcast address of each NIC. This broadcast address is the network part of each NIC's IP address with the subnet part set to all 1's. The PC network stack uses the network part of the address to determine which NIC to route the broadcast packet to. Additionally, a UDP broadcast of 255.255.255.255 is also sent. It is this address that will pick up AutoIP instruments whose network addresses aren't consistent with the subnet they are connected to. The problem is that Windows will only send the 255.255.255.255 packet to one NIC. That is the only NIC where AutoIP'd instruments will be found.

If Connection Expert doesn't discover an AutoIP instrument that you expect to find, temporarily disable network connections and force AutoIP discovery on a particular LAN interface. Use the following procedure:

1 Open the '**Network Connections**' dialog from the Windows Control Panel. You can also open this dialog from the *Start* > *Run* box by opening '**ncpa.cpl**'. See Figure 28 below.

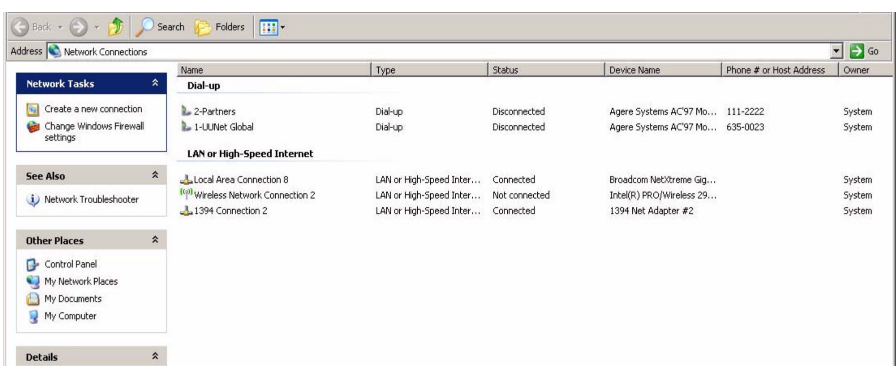


Figure 28 Network Connections Dialog Box (Windows XP, details view)

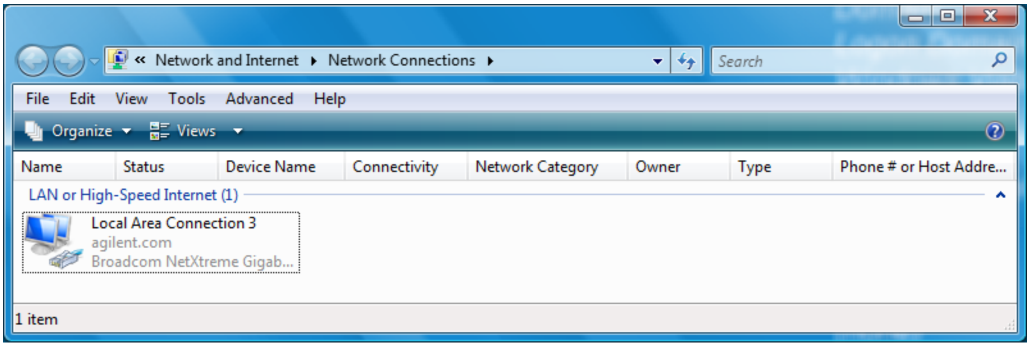


Figure 29 Network Connections Dialog Box (Windows Vista)

2 Look in the **'Status'** column in for *'connected'* interfaces.

3 Right-click on the interface(s) you don't want to be searched and select *'Disable'*.

4 Run Agilent’s Connection Expert again and look for the LAN devices. Add and configure the instruments you want in your test system.

5 Return to the **'Network Connections'** dialog from the Windows Control Panel.

6 Right-click on the interface(s) you disabled in Step 3 above and click *'Enable'*.

Note that while this process allows you to locate AutoIP-addressed instruments, you still may not be able to communicate with them. This is because WIndows will still try to send communications through the default NIC card. In order to communicate with these instruments, you should turn off AutoIP on all instruments and let the DHCP server (or router) assign IP addresses. Also, ensure that the network address for each NIC card is different; refer to “Verify PC and Instrument IP Address Configuration” on page 123.

Step 3: Run Agilent Connection Expert

This step shows how to

- Run Agilent Connection Expert
- Add and configure a LAN instrument on a local or remote subnet
- Add and configure a GPIB or USB instrument that is on a LAN portal (optional)
- Communicate with your instruments (optional)
- Add and configure a LAN interface (optional)

Click the Agilent IO Control icon in Windows' Notification area, and select **Agilent Connection Expert**. When the main screen appears (Figure 30), you will see a map of the system connections in the Explorer Pane, **Instrument I/O on this PC**. If the interface and instrument(s) you want to configure display in the Explorer Pane, proceed to "Step 4: Communicate with Instruments" on page 114!

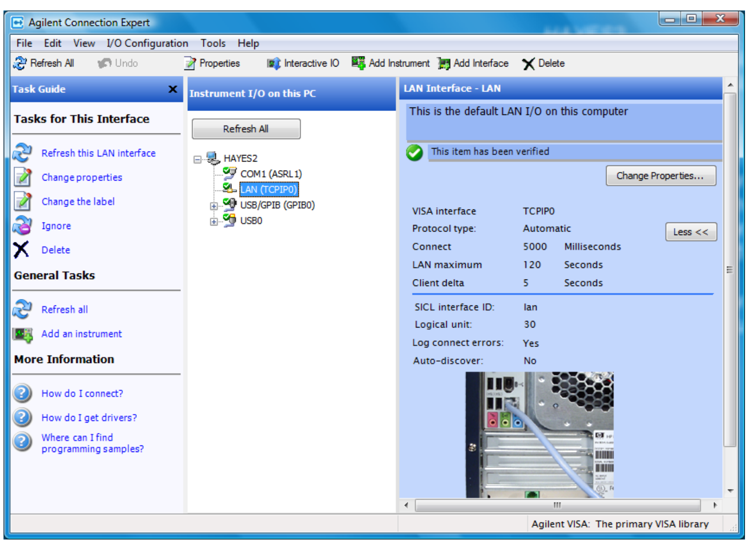


Figure 30 Agilent Connection Expert, LAN Connections

Add and Configure LAN Instruments

When instruments reside on your local area network (LAN), Agilent’s Connection Expert automatically locates each instrument and allows you to configure it.

1 From the Connection Expert main screen, select the LAN interface node in the Explorer Pane (center pane). **LAN (TCPIP0)** is selected in Figure 30. Right-click to get a menu and select **Add Instrument**. (Alternatively, you could click the **Add Instrument** button on the tool bar, the Task Guide, or the I/O Configuration menu.)

2 This opens the Add LAN Instruments dialog box (see Figure 31). The **Auto Find** tab is preselected.

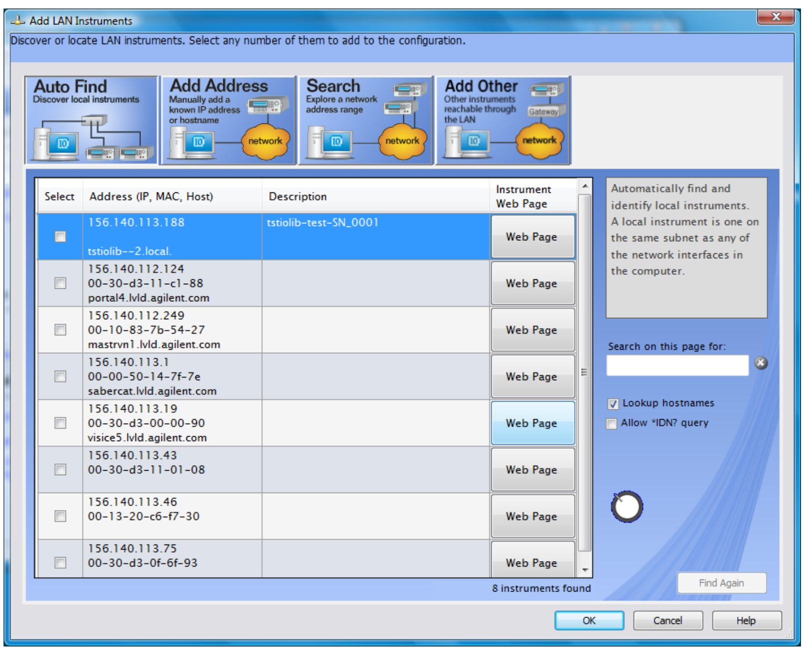


Figure 31 Add LAN Instruments Auto Find Dialog Screen

Agilent Connection Expert automatically locates, identifies, and verifies all LAN instruments that use either the VXI-11 or the SICL-LAN protocol on your local subnet and lists them in the display. This may take a few minutes; please be patient.

.

NOTE A separate UDP broadcast is sent to the broadcast address of each NIC. This broadcast address is the network part of each NIC's IP address with the subnet part set to all 1's. The PC network stack uses the network part of the address to determine which NIC to route the broadcast packet to. In addition a UDP broadcast of 255.255.255.255 is also sent. It is this address that will pick up AutoIP instruments whose network addresses aren't consistent with the subnet they are connected to. MS Windows will only send the 255.255.255.255 packet to one NIC. That is the only NIC where AutoIP'd instruments will be found. Use the Add Address or Search tab to locate other instruments.

3 Click the **Select** check box for each instrument you want to include as part of your test system. Click the **OK** button to verify each selected instrument and add it to the Connection Expert Explorer Pane. Refer to "Newly Added LAN Instrument in Connection Expert" on page 112. Proceed to "Step 4: Communicate with Instruments" on page 114.

What if it didn't find my instrument? If the Connection Expert Auto Find (default tab) did not find one or more instruments:

- Verify that AutoIP is **not** used in any instrument AND if your PC has multiple NICs, that each NIC has a different network address.
- If instrument(s) are not on the same local subnet as the PC and you know the instrument IP address or hostname, use the Add Address tab. Refer to "Connecting a LAN instrument outside your local subnet" on page 105.
- If instrument(s) are not on the same local subnet as the PC and you don't know the instrument IP address or the Hostname, use the Search tab.Refer to "Searching for LAN instruments" on page 106.
- To find GPIB or USB instruments on a LAN portal, refer to "Connecting a GPIB, USB, etc. instrument on a LAN Gateway" on page 108.

Connecting a LAN instrument *outside* your local subnet

When an instrument resides outside your LAN local subnet, select the **Add Address** tab to specify the instrument by either the IP address or the instrument hostname.

1 From the Add LAN Instruments screen, select the Add Address tab. (Figure 32).

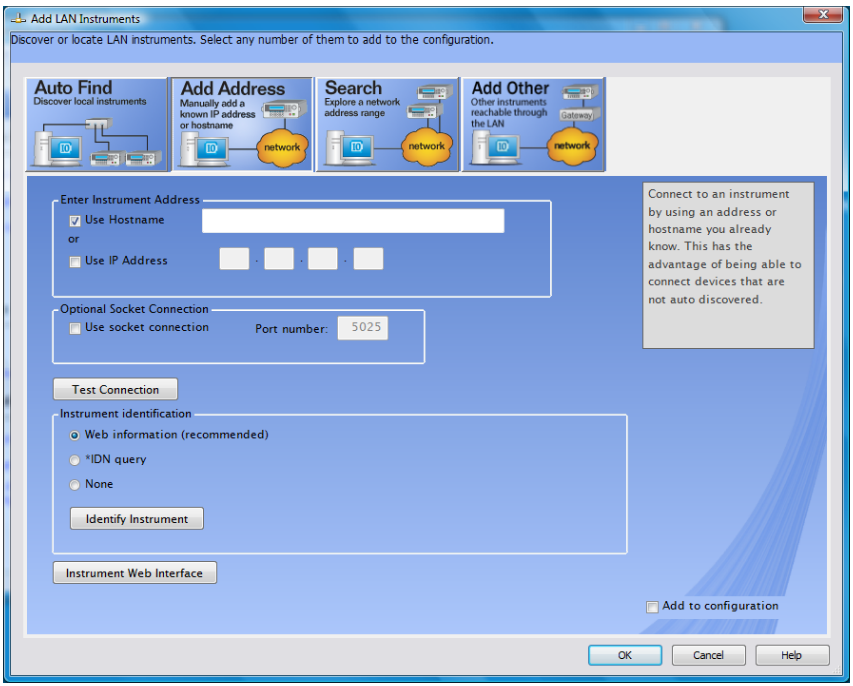


Figure 32 Add LAN Instruments Add Address Dialog screen

2 Enter either the hostname or the IP address for the instrument you want to add and click the **Test Connection** or **Identify Instrument** button. Click **OK** to return to verify the instrument and add it to the Connection Expert Explorer Pane.

All added instruments are listed in Connection Expert as shown in "Newly Added LAN Instrument in Connection Expert" on page 112. Proceed to "Step 4: Communicate with Instruments" on page 114.

Searching for LAN instruments

If you don’t know the IP address or hostname for an instrument, select the **Search** tab on the Add LAN Instruments screen (Figure 33). This allows Connection Expert to search a range IP addresses and identify all instruments in the range. This locates instruments on remote subnets.

NOTE

When specifying a range of IP addresses, Connection Expert pings each address in the range. For each device that responds, Connection Expert sends a VXI-11 port map request (using TCP protocol so that it is passed through routers, etc.). Initially, Connection Expert displays all devices that respond with a valid port number but then sends an **inst0** request to each device. This narrows the list to only LAN instruments that use the VXI-11.3 protocol. *This search may take a few minutes.*

The initial ping in the Search may be perceived by your IT department as a security intrusion.

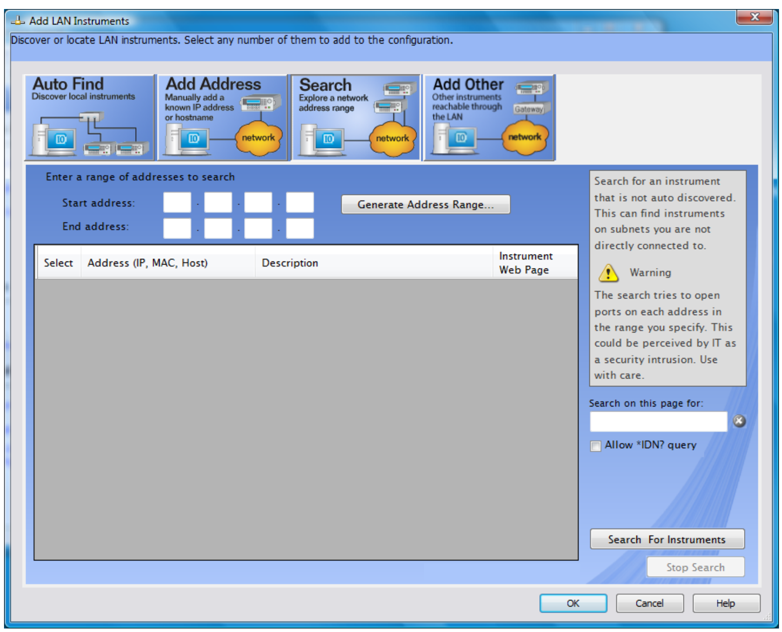


Figure 33 Add LAN instruments Search Dialog Screen

1 Enter a range of legitimate IP addresses for Connection Expert to search. In general, keep the search range as narrow as possible.

a. Alternately, select the **Generate Address Range** button. This opens the following dialog (Figure 34).

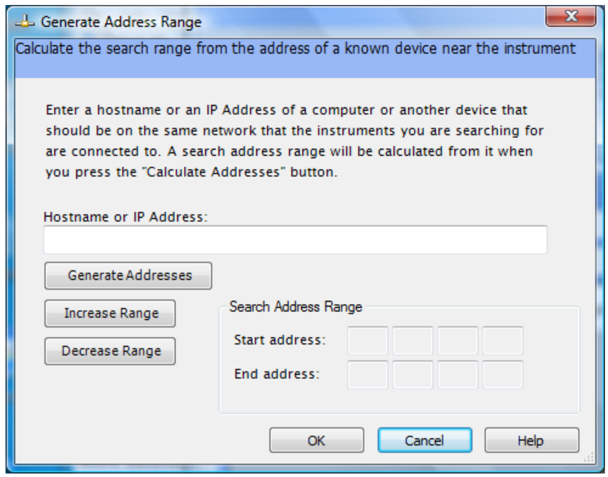


Figure 34 Generate Address Range Dialog

Enter a hostname or IP address of a computer or other device on the same network as the instrument you want to locate. For example, if you know that the instrument is part of a system connected to SysTest1 computer (where SysTest1 is a device hostname), enter SysTest1 in the Hostname field. Click the **Calculate Addresses** button to calculate a range of addresses. Click **OK** to populate the range in the Search screen.

2 Once you have a range of address in the Search screen, click the **Search for Instruments** button. Any instruments in that IP address range populate the Instruments window in the Search screen.

3 Click the **Select** check box for each instrument you want to include as part of your test system. Click the **OK** button to verify each selected instrument and add it to the Connection Expert Explorer Pane. All added instruments are listed in Connection Expert as shown in “Newly Added LAN Instrument in Connection Expert” on page 112. Proceed to “Step 4: Communicate with Instruments” on page 114

Connecting a GPIB, USB, etc. instrument on a LAN Gateway

1 From the Connection Expert main screen, select the LAN interface node in the Explorer Pane, **LAN (TCPIP0)** for this example. Right-click to get a menu. Then click **Add Instrument**. (Alternatively, you could click the **Add Instrument** button on the tool bar, the Task Guide, or the I/O Configuration menu.)

This opens the Add LAN Instruments dialog box. Select the **Add Other** tab (shown below).

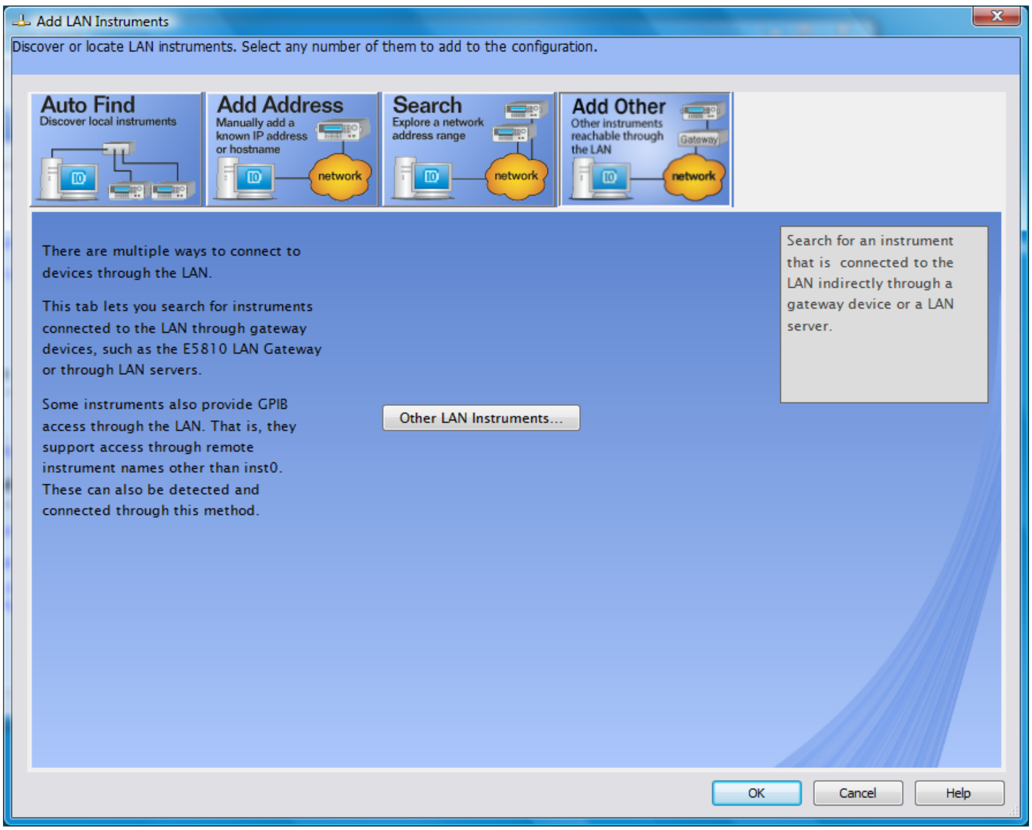


Figure 35 Add LAN Instruments Add Other Tab

Since your device is remote (connected through a gateway device such as the Agilent E5810A), click the **Other LAN Instruments** button. Continue with Step 2 below.

2 This opens the LAN instrument configuration dialog box, as shown.

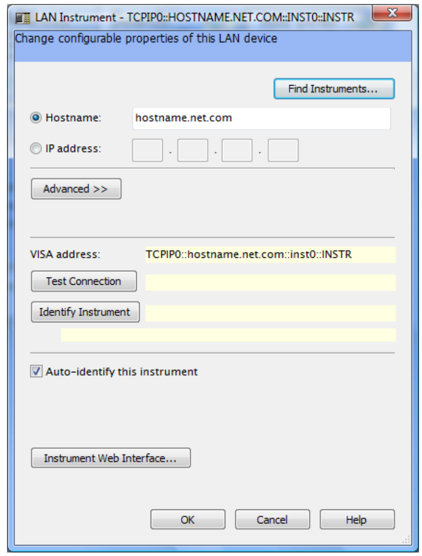


Figure 36 LAN Instrument Configuration Dialog Box

Click **Find Instruments...**

NOTE

Find Instruments only searches in your local subnet. In practical terms, your **local subnet** is defined as instruments on your side of the nearest router. To communicate with LAN instruments that are remote (on the other side of the router), you must be able to specify a **Hostname** or **IP address** in the LAN Instrument dialog box above.

3 When the **Search for Remote Instruments** dialog box appears (as shown below), select GPIB, USB, etc., and click **Find Now**.

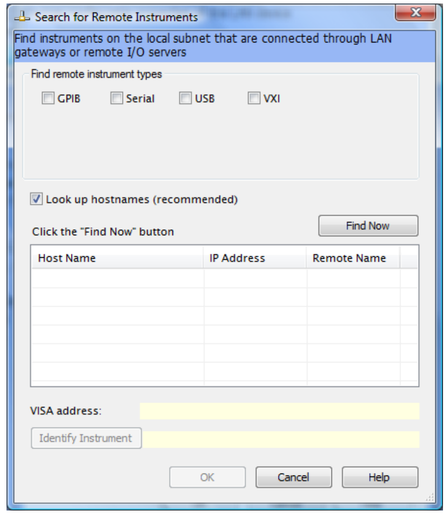


Figure 37 Search for Instruments on the LAN Dialog Box

4 When the instruments on the subnet are discovered as shown below, select one of interest, click **Identify Instrument**.

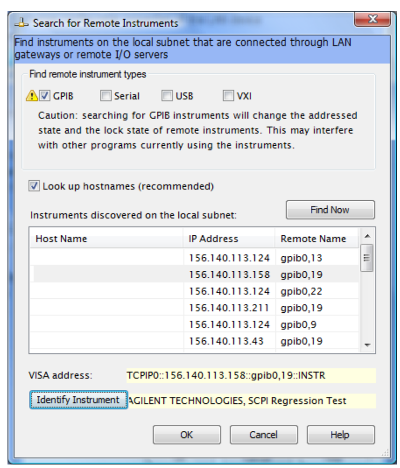


Figure 38 Discovery of LAN Instruments on the Subnet

5 Click **OK** when you are satisfied that the correct instrument has been located and selected. You now see the instrument configuration dialog box displayed including information from your selected instrument, as shown below.

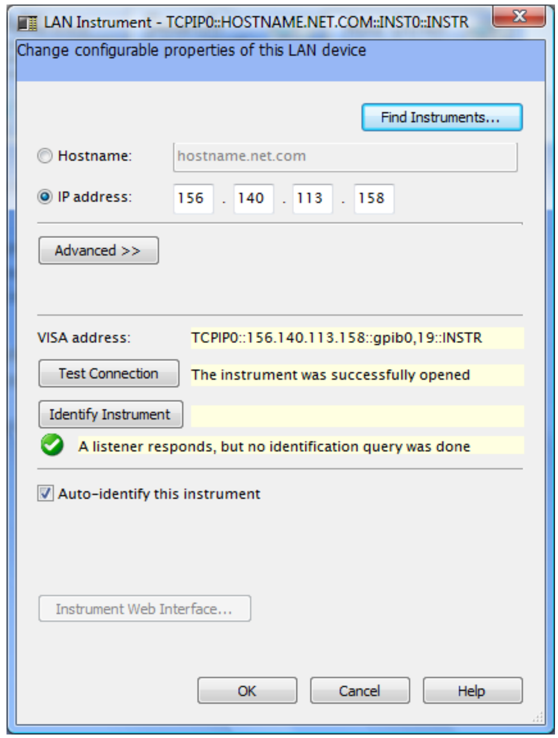


Figure 39 Configuration Properties for Selected Instrument

Automatically, you have the IP address, the Hostname, a default Remote name, the VISA address, a verified test connection. The instrument's identity has been verified. Click **OK** to add the instrument and return to the main Connection Expert window. All added instruments are listed in Connection Expert as shown in "Newly Added LAN Instrument in Connection Expert" on page 112. Proceed to "Step 4: Communicate with Instruments" on page 114

Newly Added LAN Instrument in Connection Expert

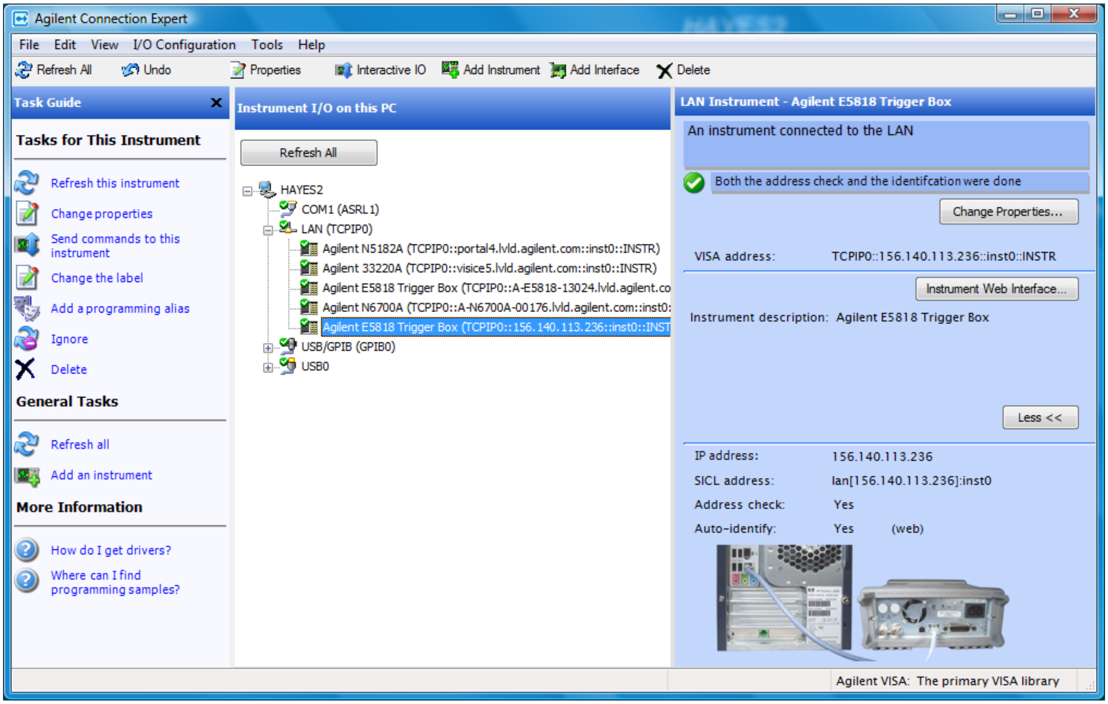


Figure 40 Newly Added LAN Instruments in Connection Expert

Figure 40 shows that instruments have been added to the interface and acknowledged by Connection Expert. Select an instrument and click the **Instrument Web Interface** button (if available) to open the LXI instrument's web interface in a browser window.

To get more instrument information or change the configuration, click the **Change Properties** button. This opens the Change Properties Dialog box shown in Figure 41.

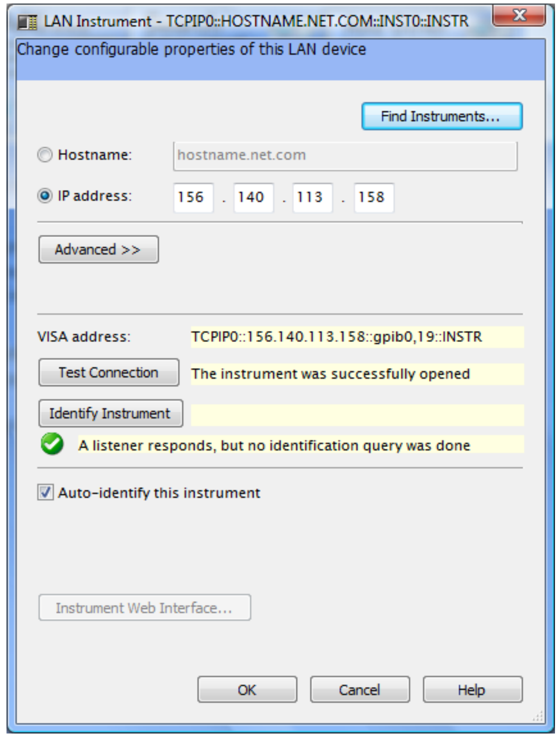


Figure 41 Change Instrument Properties Dialog Box

Step 4: Communicate with Instruments

You can use the Interactive IO utility within Connection Expert, VISA Assistant, or the Telnet utility to verify communication with instruments via the LAN.

This section gives guidelines to communicate with your instruments using Interactive IO.

NOTE

Communication with installed LAN instruments was established in Run Agilent Connection Expert if the instruments were visible and verified in the Connection Expert explorer view. Therefore, this is an optional step you can use to verify communication with instruments.

Interactive IO is a software utility that lets you interactively send commands to instruments and see their responses without writing any program code.

You can use Interactive IO to quickly verify connectivity to your instrument, to troubleshoot communication problems, to learn the instrument's command set, and to rapidly prototype commands and check the instrument's responses before writing code.

Start Interactive IO from within Connection Expert, either by clicking the *Send commands to this instrument* task in the task guide, or, on the Connection Expert menu bar, by clicking **Tools > Interactive IO**.

Example using Interactive IO

1 Select the desired instrument in the explorer view. Click **Tools > Interactive IO**. Interactive IO gives you a number of common IEEE

488.2 and SCPI commands for communicating with instruments, as shown below.

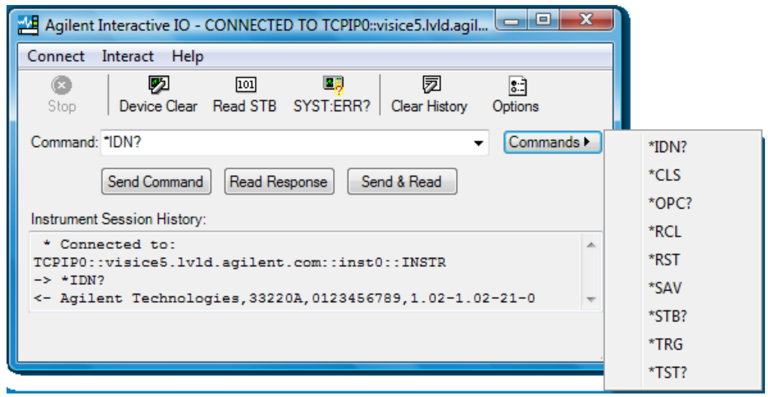


Figure 42 Common 488.2 and SCPI Commands in Interactive IO

You can also type in instrument-specific commands (from your instrument's programming guide). The common 488.2 commands and their meanings are listed in the table below.

488.2 Commands	Meaning
*IDN?	The Identification query returns manufacturer, model, serial number, and firmware level or equivalent.
*CLS	The Clear Status command clears status data structures, and forces the device to the Operation Complete query idle state.
*OPC?	The Operation Complete query places an ASCII character "1" into the device's Output Queue when all pending selected device operations have been finished.
*RCL	The Recall command restores the current settings of a device from a copy stored in local memory.
*RST	The Reset command performs a device reset, which sets the device-specific functions to a known state that is independent of the past-use history of the device.

***SAV**	The Save command stores the current settings of the device in local memory.
***STB?**	The Read Status Byte query allows the programmer to read the status byte and master Summary Status bit.
***TRG**	The Trigger command signals the transition of the Device Trigger (DT) function to the Device Trigger Active State (DTAS).
***TST?**	The Self-test query returns zero to indicate the test completed with no errors. A return value not equal to zero indicates the test is not completed or completed with errors.
SCPI Commands	
SYST:ERR?	The queue query message is a request for the next entry from the instrument's error/event queue. Items in this queue contain an integer in the range [-32768, 32767] denoting an error/event number and associated descriptive text. Negative numbers are reserved by the SCPI standard; positive numbers are instrument-dependent. A value of zero indicates that no error or event has occurred.

2 Open the **Commands** menu and select a command. The example below shows a *IDN? command selected.

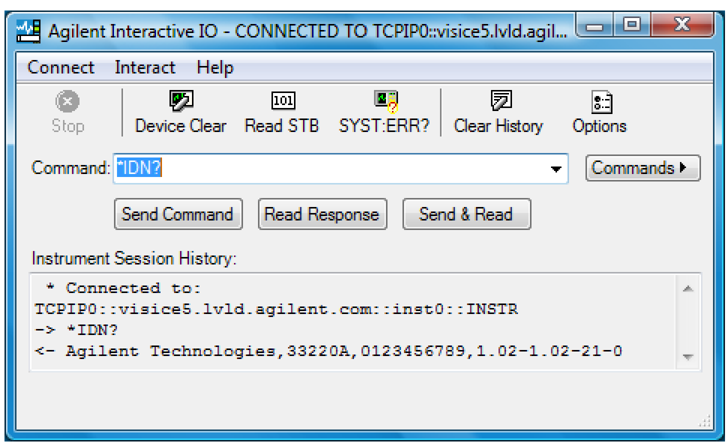


Figure 43 *IDN? Command Example in Interactive IO

3 Click **Send & Read** to send the command and receive a response. The results are displayed in the **Instrument Session History**. Alternatively, you can click the **Send Command** and **Read Response** buttons, when you desire, to control the time gap between these commands.

Interactive IO has a default timeout value set (5000 ms.), which may not be long enough for your particular application. To change that default, go to **Interact** > **Options**, edit the **Timeout** value, and click **OK**.

Communicate with Instruments Using Telnet

You can use the Interactive IO utility within Connection Expert, VISA Assistant, or the Telnet utility to verify communication with instruments via the LAN. This section gives guidelines to communicate with your instruments using the Telnet utility.

NOTE Communication with installed LAN instruments was established in Run Agilent Connection Expert if the instruments were visible and verified in the Connection Expert explorer view. Therefore, this is an optional step you can use to verify communication with instruments.

1 Display the instrument’s Welcome Page.

2 Find the SCPI Telnet Port for this instrument. For many Agilent instruments, you can find this port number by clicking **Advanced information** on the **Welcome** page. For most Agilent products, the SCPI Telnet Port is 5024.

3 Open a DOS window. (On Windows XP, click **Start** > **All Programs** > **Accessories** > **Command Prompt**.)

4 Optionally, test your connection by typing:

`ping` XXX.XXX.XXX.XXX

where XXX.XXX.XXX.XXX is the IP address of the product. If the connection is established, you will see several status lines indicating replies from the instrument to the **ping** command. Otherwise, you will see the message **Request timed out**.

5 Run the Microsoft Telnet Client. (On Windows XP, click **Start > Run** and type

```
telnet
```

6 At the Telnet command line, type:

```
open XXX.XXX.XXX.XXX PPPP
```

where `XXX.XXX.XXX.XXX` is the instrument's IP address and **PPPP** is the port (5024 for most Agilent products). You should see a response from the instrument, such as:

Welcome to Agilent's 33220A Waveform Generator

7 Enter commands for the product. CTRL-C is typically a device clear; check your instrument documentation for other commands.

8 Close the Telnet window to close the connection to the instrument and exit Telnet.

Add a LAN interface

One LAN interface labeled LAN (TCPIP0) appears in the Explorer Pane by default. If there is not a LAN interface available, or you wish to connect instruments via LAN with different connection parameters (such as different connect time-outs), then take the following steps:

1 Click **Add Interface** on the Connection Expert toolbar to create an additional LAN interface.

2 When the **Manually Add an Interface** box appears with LAN interface highlighted, click **Add**.

3 When the **LAN Interface** configuration box appears, modify the properties as desired, then click **OK.**

NOTE

The required Auto-discover setting for LAN interfaces is **off**. To prevent disrupting network traffic, Connection Expert does not automatically query each bus on the LAN to detect new devices.

NOTE

Another reason to add a LAN interface is that additional LAN interfaces are 'exported' so they are visible to NI-VISA with Passport enabled. This would allow a program to use Agilent's LAN stack on TCPIP1 for example instead of or in addition to NI's LAN stack on TCPIP0. A couple of reasons to do this:

1.Agilent's LAN stack understands SICL-LAN protocol - NI's does not.

2.LAN instruments configured on TCPIP1, would show up in a viFindRsrc/viFindNext scan when configured in ACE without having to also be configured in MAX.

Configure a LAN Interface

When you select a LAN interface in the Explorer Pane, the Properties Pane displays the current properties for that interface. The properties that you are most likely to need are displayed at the top of the Properties Pane. If you see a button labeled More, you may click it to see additional properties, as shown in the graphic below.

1 Click **More** to view the full property list.

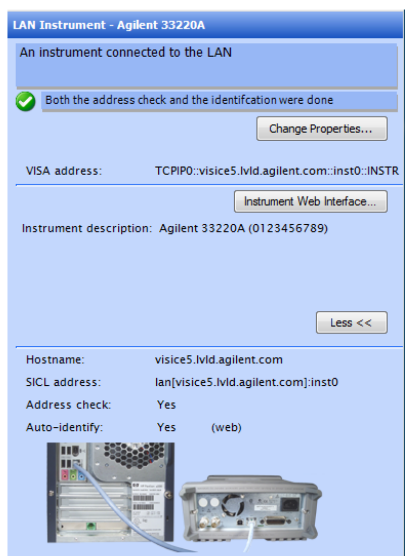


Figure 44 LAN Interface Properties Pane

2 Select a **LAN** interface in the Explorer Pane. Click the **Change Properties...** button in the Properties Pane. The LAN Interface dialog box appears, as shown below.

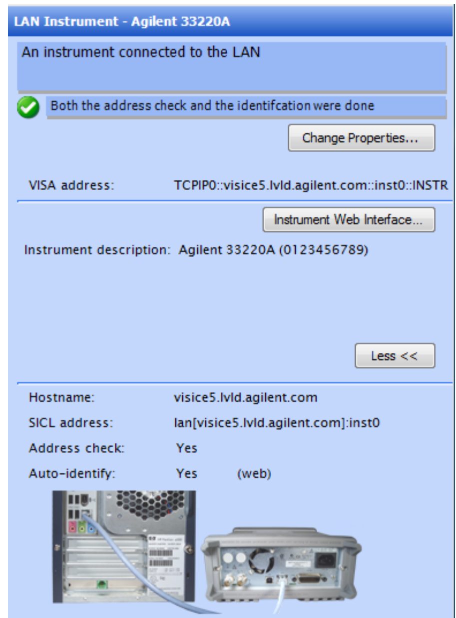


Figure 45 LAN Interface Configuration Dialog Box

3 Change the properties and click **OK**. Your changes will appear in the Properties Pane.

VISA Interface ID. A symbolic name that is used to uniquely identify this interface. The VISA interface ID combines the interface type and a numeric identifier. For example, TCPIP0 is the default VISA interface ID for a TCPIP interface.

Protocol type. The protocol type to be used with the LAN client software on this PC. The Agilent IO Libraries Suite supports three protocol choices: Automatic (automatically detect protocol), VXI-11 (TCP/IP Instrument protocol), and SICL-LAN protocol.

Default selection: Automatic

Connect timeout. The time, in milliseconds, that the PC will wait when attempting to connect to a LAN instrument. Default value: 5000 milliseconds

LAN maximum timeout: The actual timeout value used when a test program specifies a timeout value of infinity. Default value: 120 seconds

Client delta timeout. The incremental time that is added to the timeout value specified in a test program to allow for the additional time required to transfer information over a LAN connection. Default value: 25 seconds

SICL interface ID. The unique name that SICL programs use to identify this interface.

Logical unit. A number used to uniquely identify an interface in Agilent VEE and SICL applications. The logical unit number is an integer in the range of 0-99.

NOTE

The logical unit may be used in place of the SICL interface ID in Agilent VEE and SICL applications. The logical unit is not used by VISA.

Log LAN connect errors. You can set Connection Expert to log LAN connection error information in your Windows Event Viewer or Event Log. Default setting: Yes

Auto-discover. Auto-discover is not shown in the Change Properties dialog box, because it is required to be Off (No) for a LAN interface.

Troubleshooting LAN Interfaces

This section shows suggested troubleshooting steps for LAN interfaces, including the following items. For information on TCP/IP networks, see TCP/IP Network Basics.

- LAN Troubleshooting
  - Using the ping Command
  - Web Browser Checks
  - Communication Settings Checks
- Network Diagnostics

LAN Troubleshooting

This section provides basic network troubleshooting guidelines. Because of the complex nature of networks, you may need to contact your IT department for assistance.

NOTE There are additional troubleshooting tips in the *IO Libraries Suite Online Help*.

The following list is a series of fundamental troubleshooting tips for a simple network.

1 Make certain that each device (computer, instrument, printers, etc.) is plugged-in and power is applied.

2 Make sure that each device is properly connected to the network. Have you been able to connect to this device before? If so, what has changed? If not, (i.e., this is the first time you've plugged the device into the network), are you using the correct cable. Do you know what routers/hubs/switches/etc. are between your computer and the instrument?

   a Check the Network Interface Card (NIC) on your computer. Check for a small (often green) light near where the network cable plugs into the computer; it should be glowing steadily. If it is not lit or flashes intermittently, you may have a cable problem, a problem with the network card, hub, switch, etc.

b Try disconnecting and reconnecting or replacing each network cable. Make certain you are using a known-good cable.

c Do any error messages appear on the computer screen or device display? If so, attempt to resolve those errors.

d Restart your computer and the instrument.

e Can anyone else access the instrument from their computer? If so, you may have a problem with your computer, account management, or the routing of the network connections.

f Finally, try connecting the instrument directly to your computer (see Figure 22, "Direct Connect," on page 93). This eliminates all routers, switches, hubs, etc. in the network. If Connection Expert still does not recognize the instrument, the instrument may be defective.

Verify PC and Instrument IP Address Configuration If the instrument IP address is manually configured, make sure the subnet mask is set correctly for the subnet to which the instrument is attached. A symptom of an incorrect subnet mask is that the instrument does not show up in the Connection Expert LAN discovery window but it can be manually configured successfully.

If you have multiple NIC cards in your PC (for example, if you have a hard-wired network connected to one router AND a wireless network connected to a different router), use the DOS Command Prompt to execute an **ipconfig /all** command. The network address (the first two or three octets of the IP Address) for each NIC card MUST be different. Each instrument on the NIC card subnet must also use the same network address.

Using the ping Command

If there are no hardware problems, but normal communication has not been established, the next step is to make communication checks using the **ping** command. In addition, for private LANs only, you may need to use the **route add** command to establish communication. If you can establish communication using these checks, but the web browser display is not correct, go to Web Browser Checks.

An example to verify communication using the **ping** command follows.

NOTE

If you cannot verify communication to connected instruments using the ping command, try using **ping** to a device at a known address. If this is successful, the problem is likely with the instrument (for site LANs) or with the hub/switch or instruments (for private LANs).

Example: Verifying Communication Using the ping Command

For example, to send a ***ping*** command from your PC to an instrument click open a **Command Prompt** window. When the **Command Prompt** window opens, type ***ping <IP_address>***, where ***<IP_address>*** is the IP address of the instrument, and then press the **Enter** key. A typical display follows, where **ping** was successful.

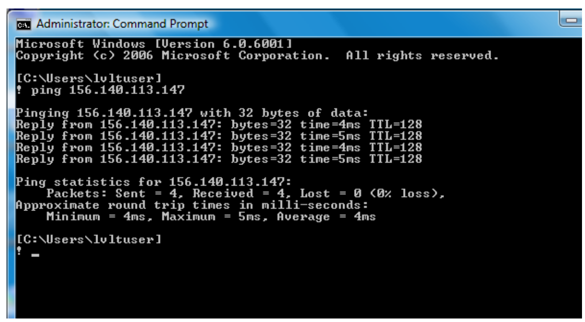


Figure 46 PING Command

A typical display follows, where **ping** was not successful:

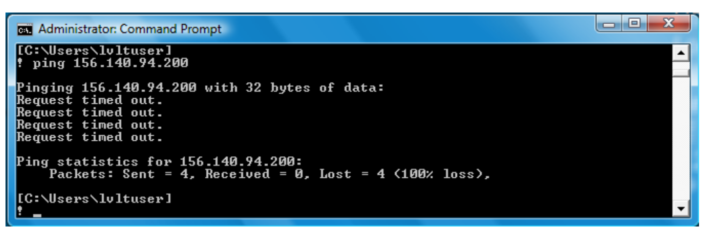


Figure 47 Failed PING Command

.Using the route add Command If you are having difficulty with a private LAN (using a hub, switch, or even a simple crossover cable), a possible cause for no communication between the PC and connected instruments is that the PC has not recognized that it is connected to two different subnets. (See Local and Remote Networks for details.)

One way to put the PC and the instrument on the same subnet is to use **route add <*Instrument IP Address*> <*PC IP Address*>** from the **Command Prompt**. If this action does not correct the problem, go to Web Browser Checks.)

NOTE If your devices are connected to site LAN, do not use the **route add** command.

Example: Using the route add Command

For example, to send a **route add** command, open a **Command Prompt** window. When the **Command Prompt** window opens, type **route add <*Instrument IP Address*> <*PC IP Address*>**, where **<*Instrument IP_address*>** is the IP address of the instrument and **<*PC IP Address*>** is the IP address of the instrument. Then press the **Enter** key.

For example, if the IP address of your PC is 155.139.103.152 and the instrument address is 169.254.58.10, the two devices are probably on different subnets. To add the instrument to the subnet for the PC, use one of the following:

! route is lost when the PC is rebooted
route add 169.254.58.10 155.139.103.152

or

! route persists when the PC is rebooted
route -p add 169.254.58.10 155.139.103.152

Web Browser Checks

To see if your PC has network access to an instrument, open the Web browser on the PC and type in the instrument’s IP address (or hostname, if known) on the web browser’s address line.

If the instrument’s **Welcome Page** appears, this PC has network connection to the instrument. Repeat this step for each instrument on the network. An example for the Agilent 33220A follows.

Example: Using a Web Browser

Since the 33220A is Web-enabled, to display the 33220A **Welcome Page**, first determine the 33220A IP address from the instrument’s front panel display. Next, open your web browser and type **‘http://<*33220A IP Address*>’**, where **<*33220A IP Address*>** is the IP address displayed on the front panel.

Then, press **Enter** to display the 33220A **Welcome** page.

For example, if the current IP address is 169.254.3.2, typing **http://169.254.3.2** and pressing **Enter** displays the 33220A **Welcome** page. This figure shows a portion of an example **Welcome** page display for the Agilent 33220A.

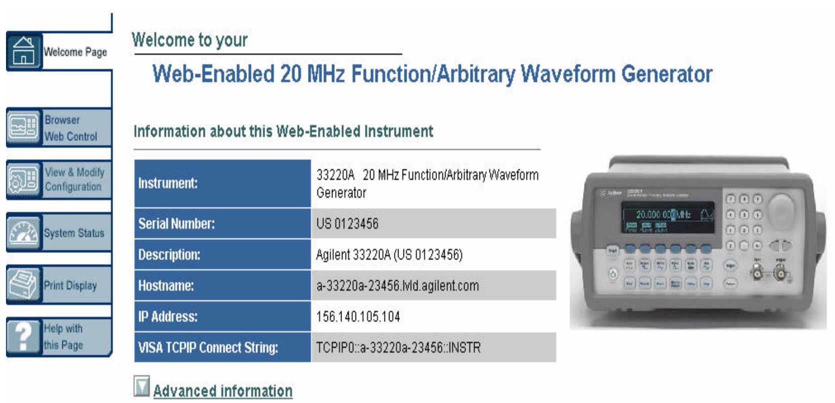


Figure 48 Agilent 3320A Web Browser Welcome Page

Communication Settings Checks

If all hardware connections are OK and you have been able to establish communication between your PC and instruments, but the web browser display is incorrect or the web browser display does not appear at all, the problem could be that the web browser settings are incorrect.

Suggested steps follow to check your web browser settings, including the following items. If doing these steps does not correct the problem, contact Agilent for support. See Contacting Agilent for addresses.

- Checking Proxy Settings
- Setting Cache and Page Refresh
- Enabling Javascript

Checking Proxy Settings A **proxy** is a service running on a computer that takes an information request from another computer and passes the request on as if the request were its own. Typically, many companies use proxies to control access from their internal network to the external Internet.

In some situations, you may not be able to communicate with the instrument if you are using a proxy server. Typically, the web page will time out because the requested address is not accessible by the network, although the correct IP address or hostname is entered into the web browser address field.

To fix this communication problem between the web browser and the instrument web server, the browser must be informed that any requests to the instrument should **not** utilize a proxy.

Example: Setting Proxy Notification (Internet Explorer 5.0 and above)

The following example steps show how to check proxy settings for Internet Explorer versions 5.0 and above follow.

1. Open the **Control Panel**
2. From **Control Panel**, double-click **Internet Options** to display the **Internet Properties** dialog box
3. From the **Internet Properties** dialog box, select the **Connections** tab
4. Click the **LAN Settings…** button under **Local Area Network (LAN) settings**

5 Under **Proxy server**, if “**Use a proxy server**” is checked, click the **Advanced…** button

6 Under **Exceptions**, add the IP address of the instrument or a fully-qualified domain name (such as **myinstr.example.com**) to the list box called “**Do not use proxy server for addresses beginning with:”** Use a semicolon (;) to separate multiple entries.

7 Click the **OK** button on the bottom of the **Internet Options** dialog box to make changes active.

Setting Cache and Page Refresh For faster performance, most web browsers cache web pages. If a page is cached, an image of the web page is stored locally. When you navigate to a page that has already been viewed, the browser will load the page from its cache rather than loading it from the network.

Usually, this process works well for static web pages. However, this process may cause problems for 'dynamically' changing web pages. This problem may occur when you are navigating using the browser’s forward/back/refresh options.

Doing this usually causes the browser to first look in its cache to see if the page exists. If the page is cached, the browser displays the page from the cache instead of going to the network to update changes. Since instrument web pages are dynamic in nature, the cache may contain content that is outdated. If you see a problem where dynamic pages are not being updated automatically, the browser should be instructed to check for newer versions of a web page on every page visit.

Example: Cache and Page Refresh (Internet Explorer 5.0 and above)

Example steps for cache and page refresh for Internet Explorer versions 5.0 and above follow.

1 Open the **Control Panel**.

2 From **Control Panel**, double-click **Internet Options** to display the **Internet Properties** dialog box.

3 From the **Internet Properties** dialog box, select the **General** tab.

4 Under **Temporary Internet files**, click the **Settings...** button to display the **Settings** dialog box.

5 Under **Check for newer versions of stored pages:**, click the **“Every visit to the page”** radio button (“**Automatically**” should be okay for Internet Explorer 5.5 and greater).

6 Click the **OK** button on the **Settings** page to accept the change.

7 Click the **OK** button on the bottom of the **Internet Options** dialog box to make changes active.

NOTE

If the previous steps to not resolve the problem, you may want to clear the cache. To do this, repeat steps 1 - 4. Then, in the **Temporary Internet files**, click the **Delete Files...** button to display the **Delete Files** dialog box. Click **OK** to delete the files and clear the cache.

Enabling Javascript Instruments that are Web-enabled may generate web pages that depend on Javascript and Frames. For proper operation, you may need to enable Javascript.

Example: Enabling Javascript (Internet Explorer 5.0 and above)

Example steps for enabling Javascript for Internet Explorer versions 5.0 and above follow.

1 Open the **Control Panel**.

2 From **Control Panel**, double-click **Internet Options** to display the **Internet Properties** dialog box.

3 From the **Internet Properties** dialog box, select the **Securities** tab.

4 Click the **Custom Level…** button.

5 Under **Settings**, scroll down to the category called **Scripting**.

6 Click the **Enable** radio button under **Active Scripting**.

7 Click the **Enable** radio button under **Scripting of Java** applets.

8 Click the **OK** button on bottom of page to accept security settings.

9 When the **Warning!** dialog box appears, click **YES** when asked “**Are you sure you want to change the security settings for this zone?”**

Click the **OK** button on the bottom of the **Internet Options** dialog box to make the changes active.

Network Diagnostics

Microsoft provides valuable network diagnostic tools on their TechNet website. For example, if you are using the XP Professional Operating System, check:

TechNet Home > Products & Technologies > Desktop Operating Systems > Windows XP Professional > Maintain

to see their Network Diagnostics Tools Features Overview.

Agilent IO Libraries Suite Checks

This section give troubleshooting guidelines for the Agilent IO Libraries Suite, including:

- Check IO Libraries Suite Installation
- Check Agilent IO Control Operation

Check IO Libraries Suite Installation Start your Agilent IO Libraries Suite troubleshooting sequence by verifying IO Libraries Suite installation. If the IO Libraries Suite is installed, go to Check Agilent IO Control Operation.

1 **Check Agilent IO Libraries Version.** If a version of the Agilent IO Libraries or IO Libraries Suite has been installed, a blue **IO** icon () is normally displayed on the Windows task bar (on the lower right side of the screen).

- If the **IO** icon is displayed, click the icon and click **About Agilent IO Control** to display the version. Version 15 or greater must be installed. (The next version of the IO Libraries after "M" discontinued this alphabetic naming convention, and uses *IO Libraries Suite 14.0* to designate the version immediately following M.01.01.)
- If the **IO** icon is not displayed, a version may still be installed. To check this, click **Start** > **Programs** and look for the **Agilent IO Libraries** or the **Agilent IO Libraries Suite** program group.
- If this group is displayed, click **Agilent IO Libraries** > **Utilities** > **IO Control** or **Agilent IO Libraries Suite** > **Utilities** > **IO Control** to display the **IO** icon. Then, click the icon and click **About Agilent IO Control** to display the installed version (must be M.01.00 or greater).
- If neither the **IO** icon nor the Agilent IO Libraries Suite program group is displayed, no Agilent IO Libraries are installed. In this case, or if the installed version is not M.01.00 or greater, you must install the newer version (see step 2 following).

2 **Install Agilent IO Libraries Suite (as Required).** If Agilent IO Libraries v15 or later is not installed on your PC, use this step.

- Uninstall the IO Libraries by using **Add/Remove Programs** in the **Control Panel**.
- Install IO Libraries Suite from the *Automation-Ready CD with Agilent IO Libraries Suite.* (Go to Installing Agilent I/O Libraries Suite in Chapter 2 for more information.)

Check Agilent IO Control Operation When the Agilent IO Libraries Suite was installed, the Agilent IO Control was started. When the IO Control is active, it is displayed as a blue **IO** icon on the Windows task bar. If the IO Control is deactivated, I/O applications may be unable to open sessions or to communicate with instruments.

By default, the Agilent IO Control is always active after the Agilent IO Libraries Suite is installed and the blue **IO** icon is displayed. However, the IO Control may be active even though the blue **IO** icon is not displayed. There are two ways that the blue **IO** icon can be hidden:

- **Clicking Hide Agilent IO Control**. Clicking the blue **IO** icon and then clicking **Hide Agilent IO Control** hides the blue **IO** icon, but does *not* deactivate the Agilent IO Control. (You can also do this from the Connection Expert **View** menu.)
- **Clicking Exit.** Clicking the blue **IO** icon and then clicking **Exit** causes a dialog box to appear that asks you if you want to terminate the Agilent IO Control. Clicking **Yes** hides the blue **IO** icon *and* deactivates the Agilent IO Control.

If the blue **IO** icon is not displayed, either the blue **IO** icon display has been turned off and/or the Agilent IO Control is not active. In this case, click **Start > Programs > Agilent IO Libraries Suite > Utilities > IO Control** to re-start the Agilent IO Control and to display the blue **IO** icon.

6
Programming Your Instruments

This chapter includes:

Programming Overview

This section provides an overview of programming instruments via LAN, USB, and GPIB interfaces. Sample programs are included to demonstrate generating a simple sine wave on an Agilent 33220A 20 MHz Function/Arbitrary Waveform Generator using Standard Commands for Programmable Instruments (SCPI).

The sample programs are written in Microsoft Visual Basic 6.0, Visual C++, and C# using Agilent VISA COM and VISA I/O.

NOTE

The programs in this guide are protected by copyright.

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You have a royalty-free right to use, modify, reproduce and distribute the programs listed in this guide (and/or any modified version) in any way you find useful, provided that you agree that Agilent has no warranty, obligations, or liability for any program content.

Agilent Technologies provides programming examples for illustration only. All example programs assume you are familiar with the programming language being demonstrated and the tools used to create and debug procedures. Agilent support engineers can help explain the functionality of Agilent software components and associated commands, but they will not modify these samples to provide added functionality or construct procedures to meet your specific needs.

NOTE

If you plan to program your instruments using the Agilent 488 API, or to run NI-488.2–compatible programs with Agilent interface hardware (such as GPIB cards), you may need to explicitly enable the Agilent 488 library. To do this in Agilent Connection Expert click **Tools > Agilent 488...** and select the check box labeled **Enable Agilent GPIB cards for 488 programs**.

Obtaining Instrument Drivers

Selected combinations of program environments and I/O are included in the sample programs in this guide. You will need to acquire the programming environment independently of your I/O and instrument software.

In many cases, you receive two CDs with your purchase of an Agilent hardware or software product: one is the *Automation-Ready CD with Agilent IO Libraries Suite* and the other is the product-specific CD.

VISA, VISA COM, SICL, and Agilent 488 I/O libraries are available as part of the Agilent IO Libraries Suite, on the *Automation-Ready CD*. The product CD typically contains drivers and/or sample programs that increase the ease of use of programming or support your instrument's measurement applications.

IVI-COM, VXI*plug&play*, and other types of instrument drivers for the Agilent 33220A and other instruments may be obtained at **http://www.agilent.com/find/drivers**. To download a driver, you will be asked to register on the Agilent Developer Network (ADN) free of charge.

The types of drivers on ADN include:

- IVI-COM drivers and components
- VXI*plug&play* drivers
- IntuiLink connectivity software (Agilent IntuiLink Toolbars, which provide access to instruments in Microsoft Excel and Microsoft Word)
- VEE panel drivers
- D-SCPI drivers
- SCPI drivers

Using Agilent IO Libraries Suite Sample Code

The *Automation-Ready CD with Agilent IO Libraries Suite* provides easy instructions for connecting, configuring, and verifying your instruments with IO Libraries Suite. Go to Chapter 2, “Installing Agilent I/O Libraries Suite”**,** for a more detailed discussion.

NOTE

To obtain the Agilent IO Libraries Suite, go to **www.agilent.com/find/iosuite**. If you own any Agilent instrumentation or software products, you can download the IO Libraries Suite free of charge.

When you’re ready to start programming, IO Libraries Suite provides a number of sample programs for a variety of instruments. To access these programs from the Windows Start menu, click **Start > Programs > Agilent IO Libraries Suite > Programming Samples.** Sample programs are provided in various languages, including Microsoft C, C#, Excel, Visual Basic 6.0, and Visual Basic .NET.

To use a sample program:

1 Select a program for your instrument or a similar instrument. Open the program in your programming environment.
2 Replace the instrument addressing in the program with your instrument's VISA address or VISA alias.
3 If necessary, replace the command strings in the program with commands for your instrument.
4 Run the program and debug, if necessary.

Using VISA COM in Other Visual Basic Projects

Some of the sample programs in this chapter use Agilent VISA COM. To use VISA COM in another Visual Basic project, perform these steps:

1 **Set the Reference.** Set the reference to include the libraries in the **Project > References** menu:
   - “VISA COM 3.0 Type Library” corresponds to GlobMgr.dll

- “VISA COM 488.2 Formatted I/O 1.0" corresponds to BasicFormattedIO.dll

2 **Create Formatted I/O Reference.** Create the formatted I/O reference with a statement such as:
```
Dim Fgen As VisaComLib.FormattedIO488
```

3 **Create the New Object.** Use
```
Set Fgen = New VisaComLib.FormattedIO488
```
to create the formatted I/O object.

For additional information on VISA COM usage, see the *VISA COM Help* (click the IO Control, then click **Documentation > VISA COM Help**).

Addressing Instruments

This section gives guidelines to address instruments, including:

- Addressing Instruments via GPIB
- Addressing Instruments via USB
- Addressing Instruments via LAN

NOTE

This chapter discusses addressing for VISA and VISA COM. This form of addressing is also used with IVI-COM and VXI*plug&play* instrument drivers. This chapter also includes some discussion of SICL addressing.

For a full discussion of SICL addressing, see the *Agilent SICL User's Guide*. For a discussion of addressing for the Agilent 488 API, see the *Agilent 488 Online Help*. Both of these documents are available from the IO Control's **Documentation** menu.

To simplify the addressing in your programs, you can use VISA aliases. A VISA alias is a name of your choosing, which you assign to a device and use in your programs. Once assigned, the alias is a synonym for the device's VISA address, so you can use it to open a VISA session (using the **`viOpen`** function) and to get resource information (using **`viParseRsrc`** or **`viParseRsrcEx`**).

Agilent Connection Expert allows you to define VISA aliases for the devices in your test system.

Why use VISA aliases? Using VISA aliases in your programs, rather than actual VISA addresses, provides two significant advantages:

- **Portability.** If you program using aliases, you can run your program on a new test system, whose instruments are at different addresses, simply by using Connection Expert to create the same aliases on the new system as you created on your development system. Similarly, you can move or replace instruments without changing or recompiling test code, simply by changing the alias definitions in Connection Expert.

- **Readability.** Your programs will be much easier to read and understand if, for example, your multimeter is called "myDMM" instead of "GPIB2::14::8::INSTR". This is particularly important in the case of USB instruments, whose VISA addresses are typically long and cumbersome, containing the instrument's serial number among other information.

Using aliases with SICL and with Agilent 488. When you create a VISA alias, Connection Expert automatically creates SICL and Agilent 488 aliases of the same name. You can use a SICL alias in place of a SICL address in the `iopen` function call, or an Agilent 488 alias in the `ibfind` function call, with the same advantages described above.

Default aliases for USB devices. Connection Expert gives an alias to each instrument you connect via USB, because VISA addresses for USB devices are long and cumbersome. Connection Expert assigns aliases **UsbDevice1**, **UsbDevice2**, etc.; you can change these names by selecting the alias in the explorer view and clicking the **Change...** button.

Addressing Instruments via GPIB

To address instruments via a GPIB interface (such as an 82351 GPIB interface or 82357 USB/GPIB interface converter), first check the default configuration of the interface using Connection Expert.

Steps to Configure a GPIB Interface

These steps are written for the 82351 PCI GPIB interface card. Modify the steps as required if you use another type of supported GPIB interface. The *Agilent IO Libraries Suite Online Help* includes a description of configurable parameters for each supported interface type.

NOTE If you plan to program your instruments using the Agilent 488 API, or to run NI-488.2–compatible programs with Agilent interface hardware (such as GPIB cards), you may need to enable the Agilent 488 library. To do this, click **Tools** > **Agilent 488...**, then select the check box labeled **Enable Agilent GPIB cards for 488 programs**.

Configure GPIB Card Parameters. With the GPIB interface selected in the instrument Explorer Pane, click **Change Properties...** in the **Agilent 82351 PCI GPIB Interface** Properties Pane on the right. The PCI GPIB configuration dialog box appears, as shown below.

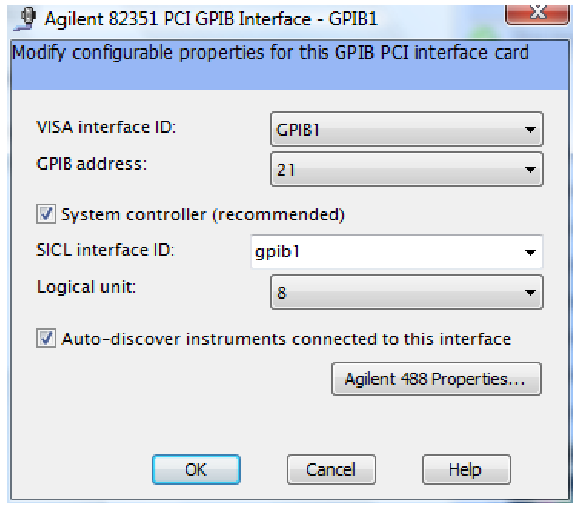


Figure 49 The 82351 Configuration Dialog Box

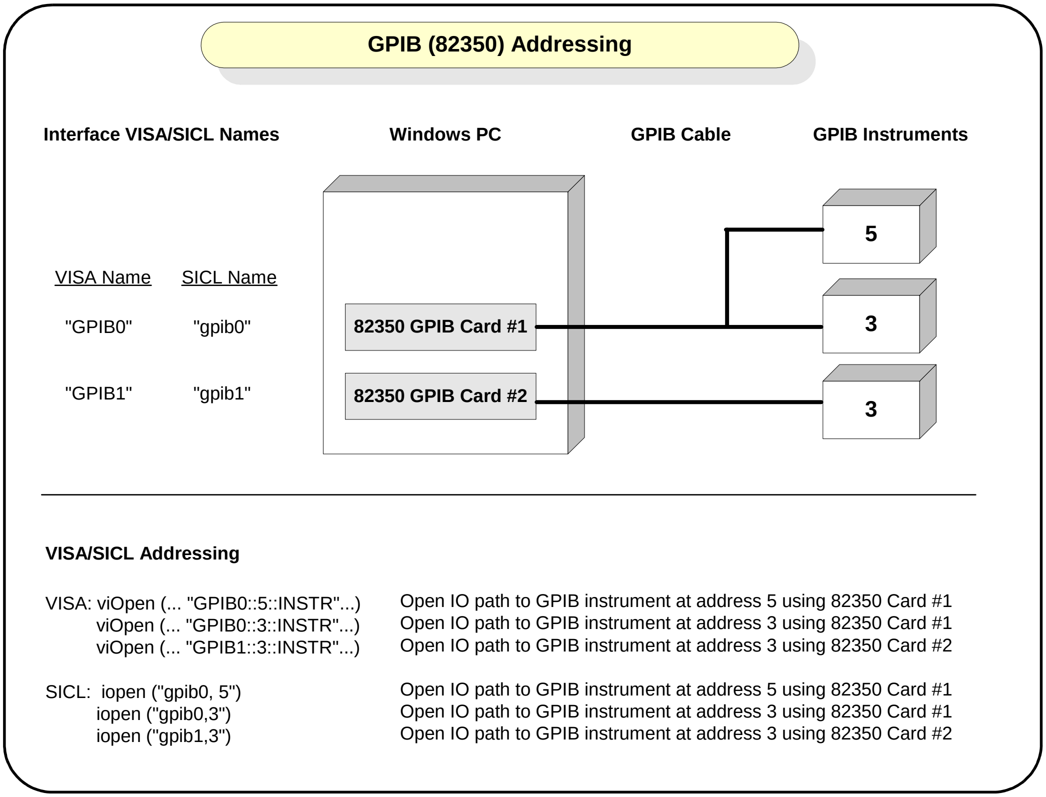
1 Set the GPIB properties as required, referring to the online Help for specific information on each property as needed. Also, verify that this is the System Controller for the GPIB to which it is attached (this is the typical operating mode). (See “System Controller” on page 56.) Then, click the **OK** button.

2 **Change/Accept the Configuration Values.** When the configuration values displayed are acceptable to you, click the **OK** button.

Repeat Steps for Other Interfaces. If you have installed more than one GPIB interface in your test system, repeat the above steps for the remaining interfaces.

Example: Addressing GPIB Instruments Using VISA/SICL

This figure shows example VISA and SICL addressing for GPIB instruments connected to a PC via a GPIB interface.



The GPIB interface system consists of a Windows PC with two 82350 GPIB cards connected to three GPIB instruments via GPIB cables. For this system, Connection Expert has been used to assign GPIB card #1 a VISA interface ID of “GPIB0” and a SICL interface ID of “gpib0”.

Connection Expert has also been used to assign GPIB card #2 a VISA interface ID of “GPIB1” and a SICL interface ID of “gpib1”. With these names assigned to the interfaces, the VISA/SICL addressing is as shown in the figure.

Since unique names have been assigned by Connection Expert, you can use the VISA **viOpen** command to open the I/O paths to the GPIB instruments as shown in this figure. Or, you can use the SICL **iopen** command to open the I/O paths shown.

Addressing Instruments via USB

As desired, you can use a VISA alias to address instruments via USB. The VISA alias associates a symbolic name with a specific instrument. You can use it as a VISA *rsrcName* or SICL *address* instead of using the full address (or resource descriptor), which may include the instrument's vendor ID, product ID, serial number, and interface ID, etc. See the following steps to set, add, delete or change a VISA alias.

1 **Start Connection Expert.** Click the blue **IO** icon (on the Windows task bar) and select **Agilent Connection Expert** to display Connection Expert's main window.

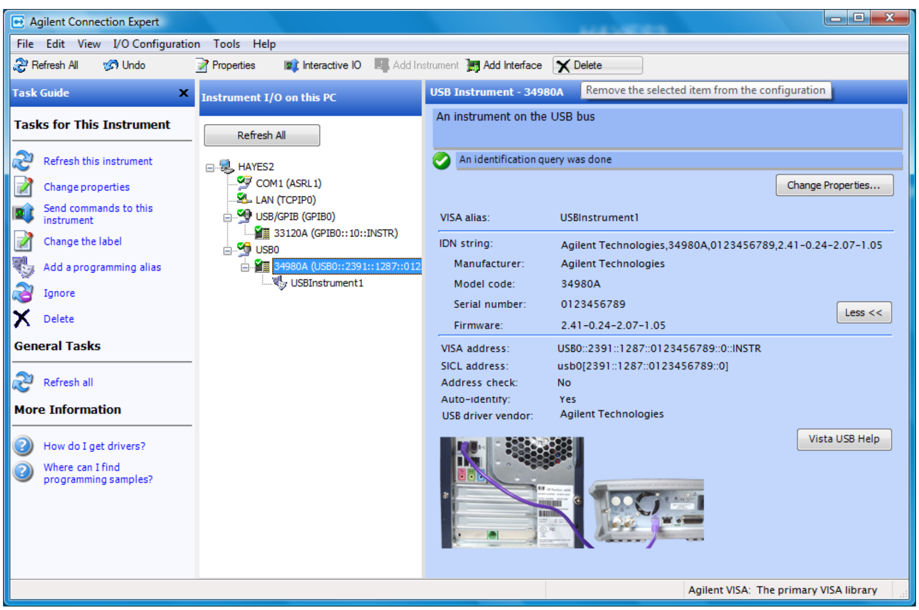


Figure 50 Agilent Connection Expert - USB Interface Selected

1 Connection Expert automatically configures a USB interface, discovers any USB devices, and assigns default VISA alias names, as shown in the figure above.

2 **Display the Changing VISA Alias Properties dialog box.** Highlight the USB alias name in the explorer (center) pane. Then click **Change Properties...** in the **VISA Alias Properties** pane on the right to display the **VISA Alias** dialog box. Change the default VISA alias name to something meaningful.

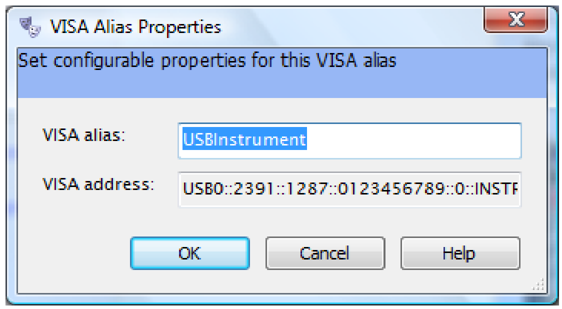


Figure 51 Changing VISA Alias Properties Dialog Box

The VISA address of a USB instrument is based on the instrument's vendor ID, product ID, serial number, and VISA interface ID.

3 Click **OK**.

Addressing Instruments via LAN

To address instruments via the LAN, you must first check the default configuration of the LAN interface using Agilent Connection Expert. A summary of the applicable LAN networking protocols follows. See "LAN Interface Overview" on page 160 for a description of LAN hardware, software, and network protocols.

LAN Networking Protocols

There are two LAN networking protocols provided with the Agilent IO Libraries Suite software. You can use one or both of these protocols when configuring your systems to use VISA and SICL over LAN.

- **SICL-LAN Protocol** is a networking protocol developed by Agilent that is compatible with all VISA LAN products. This LAN networking protocol is the default choice in the Agilent IO Libraries Suite configuration when configuring the LAN interface. The SICL-LAN protocol on Windows supports VISA operations over LAN to GPIB interfaces.
- **VXI-11 (TCP/IP Instrument Protocol)** is a networking protocol developed by the VXIbus Consortium based on the SICL-LAN Protocol that permits interoperability of LAN software from different vendors who meet the VXIbus Consortium standards.

When using either of these networking protocols, the LAN software uses the TCP/IP protocol suite to pass messages between the LAN device and the server. The server accepts device I/O requests over the network from the device and then proceeds to execute them.

By default, the LAN supports both protocols by automatically detecting the protocol the server is using. When a VISA **`viOpen`** or SICL **`iopen`** call is performed, the LAN interface driver first tries to connect using the SICL-LAN protocol. If that fails, the driver will try to connect using the VXI-11 protocol.

If you want to control the protocol used, you can configure more than one LAN interface using Connection Expert and set each interface to a different protocol. The protocol used will then depend on the interface you are connecting through.

In VISA, the protocol used is determined by the configuration settings and cannot be changed programmatically. In SICL, you can override the configuration settings programmatically by specifying the protocol in the **`iopen`** string.

Example: Using Network Protocols in SICL

Some examples using VXI-11 and SICL-LAN protocol follow. Note that SICL names are case-sensitive.

- **iopen("lan[machineName]:gpib0,1")** will use the protocol type configured in Connection Expert. If **Automatic** is configured, SICL-LAN protocol will be attempted. If SICL-LAN is not supported, VXI-11 protocol will be used.
- **iopen("lan;auto[machineName]:gpib0,1")** will automatically select the protocol (SICL-LAN if available and VXI-11 otherwise.)
- **iopen("lan;sicl-lan[machineName]:gpib0,1")** will use SICL-LAN protocol.
- **iopen("lan;vxi-11[machineName]:gpib0,1")** will use VXI-11 protocol.
- The Agilent IO Libraries Suite also supports TCP/IP socket reads and writes. To open a socket session, use **iopen("lan,socketNbr[machineName]")**. For example, **iopen("lan,7777[machineName]")** will open a socket connection for socket number 7777 on '**machineName**'.

Configuring LAN Interfaces

When you have configured LAN interfaces, you can then use the interface name specified during configuration in a VISA **viOpen** call in your program. A summary of the steps to configure a LAN interface follows.

NOTE

A single LAN interface can be used by any number of devices. The main reason for having more than one LAN interface configured is that you want to use different protocols (such as SICL-LAN and VXI-11) with different devices. You can also specify different time-out durations for different LAN interfaces.

1 To check the configuration of your LAN interfaces using Connection Expert, click the Agilent IO Control icon (blue **IO** icon in the Windows notification area) and click **Agilent Connection Expert**. When the main screen appears, highlight the LAN interface in the explorer (center) pane – **LAN (TCPIP0)** in this example – and check

the configuration in the **LAN Interface** Properties Pane on the right. To alter any default properties, click **Change Properties...**.

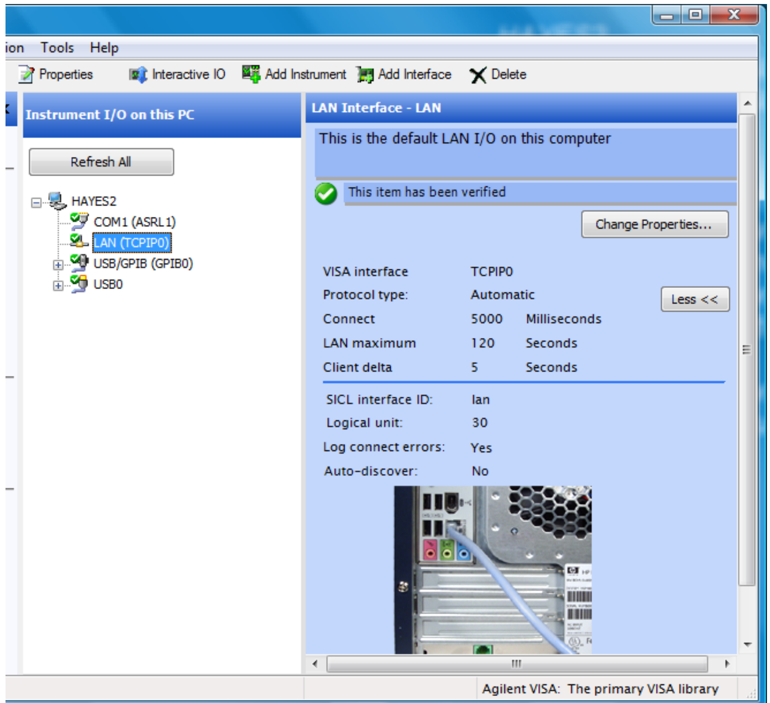


Figure 52 LAN Interface Properties Pane (on right)

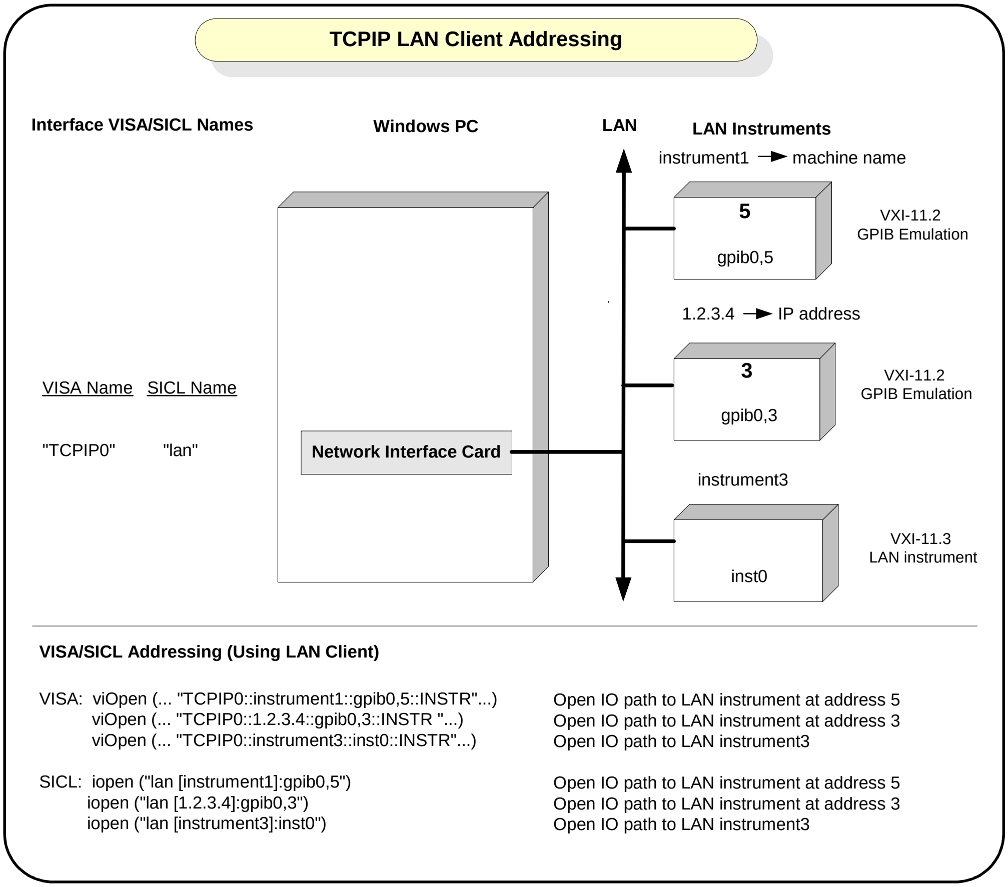
2 When the **LAN Interface** dialog box appears, you can change the interface's properties, such as the VISA interface ID, logical unit number, time-out durations, as required. Here you can select the protocol type (Auto, VXI-11, or SICL-LAN) and choose whether to log LAN connection errors. When you finish setting properties, click **OK**.

Example: Addressing LAN Instruments Using VISA/SICL

The LAN interface system in this figure consists of a Windows PC with a LAN (NIC) card and three LAN instruments. **instrument1** and **instrument2** are VXI-11.2 (GPIB Emulation) instruments, and **instrument3** is a VXI-11.3 LAN instrument.

For this system, Connection Expert has been used to assign the LAN card a VISA interface ID of “TCPIP0” and a SICL interface ID of “lan”. For the addressing examples, **instrument1** has been addressed by its machine name, **instrument2** by its IP address, and **instrument3** by its remote instrument name (`inst0`).

Since unique names have been assigned by Connection Expert, you can now use the VISA **`viOpen`** command or the SICL **`iopen`** command to open the I/O paths to the GPIB instruments as shown in the figure.



Sample Programs

Sample programs follow to demonstrate sine waveform generation for an Agilent 33220A 20 Mhz Function/Arbitrary Waveform Generator. The sample programs are essentially repeated to show the same functionality with different programming environments and I/O. Agilent IO Libraries Suite provides a number of additional sample programs for a variety of instruments. To access other sample programs from the Windows Start menu, click **Start** > **Programs** > **Agilent IO Libraries Suite** > **Programming Samples**.

The example programs in this section are:

- Example: Simple Sine Waveform (Visual Basic and VISA COM)
- Example: Simple Sine Waveform (C# and VISA COM)
- Example: Simple Sine Waveform (Visual C++ and VISA)

Example: Simple Sine Waveform (Visual Basic and VISA COM)

This program selects the function as “sine,” and then sets the frequency, amplitude and offset of the waveform for an Agilent 33220A. The program is written in Visual Basic 6.0 and uses VISA COM.

```
Private Sub cmdSimpleSine_Click()

Dim io_mgr As VisaComLib.ResourceManager
Dim Fgen As VisaComLib.FormattedIO488

Set io_mgr = New AgilentRMLib.SRMCls
Set Fgen = New VisaComLib.FormattedIO488
Set Fgen.IO = io_mgr.Open(txtIO.Text)

On Error GoTo MyError

' This program sets up a waveform by selecting the waveshape
```

```
' and adjusting the frequency, amplitude, and offset.

With Fgen
  .WriteString "*RST"               ' Reset the function generator
  .IO.Clear                         ' Clear errors and status registers

  .WriteString "FUNCtion SINusoid"  ' Select waveshape
    ' Other options are SQUare, RAMP, PULSe, NOISe, DC, and USER
  .WriteString "OUTPut:LOAD 50"     ' Set the load impedance in Ohms
                                    ' (50 Ohms default)

    ' May also be INFinity, as when using oscilloscope or DMM

  .WriteString "FREQuency 2500"     ' Set the frequency.
  .WriteString "VOLTage 1.2"        ' Set the amplitude in Vpp.
                                    ' Also see VOLTage:UNIT
  .WriteString "VOLTage:OFFSet 0.4" ' Set the offset in Volts

    ' Voltage may also be set as VOLTage:HIGH and VOLTage:LOW for
    ' low level and high level

  .WriteString "OUTPut ON"          ' Turn on the instrument output

End With

Exit Sub

MyError:
  txtError = Err.Description & vbCrLf
  Resume Next
End Sub
```

Example: Simple Sine Waveform (C# and VISA COM)

This program selects the function as “sine,” and then sets the frequency, amplitude and offset of the waveform for an Agilent 33220A. The program is written in C# and VISA COM.

NOTE

“VISA COM 3.0 Type Library” corresponds to GlobMgr.dll.

Once you have selected C# in Visual Studio, click **Project > Add Reference...** . Select the **COM** tab. Scroll down the list of components presented, and select **VISA COM 3.0 Type Library**.

```
using System;
using System.Drawing;
using System.Collections;
using System.ComponentModel;
using System.Windows.Forms;
using System.Data;

namespace WindowsApplication1
{
  /// <summary>
  /// Summary description for Form1.
  /// </summary>
  public class Form1 : System.Windows.Forms.Form
  {
    private System.Windows.Forms.Button button1;
    private System.Windows.Forms.TextBox USBInstrument;
    /// <summary>
    /// Required designer variable. “USBInstrument” is a VISA alias
    /// for the 33220A Function/Arbitrary Waveform Generator.
    /// </summary>
    private System.ComponentModel.Container components = null;
    public Form1()
    {
      //
      // Required for Windows Form Designer support
      //
      InitializeComponent();
```

```
        //
        // TODO: Add any constructor code
        // after InitializeComponent call
        //
    }

    /// <summary>
    /// Clean up any resources being used.
    /// </summary>
    protected override void Dispose( bool disposing )
    {
        if( disposing )
        {
            if (components != null)
            {
                components.Dispose();
            }
        }
        base.Dispose( disposing );
    }

    #region Windows Form Designer generated code
    /// <summary>
    /// Required method for Designer support -
    /// do not modify
    /// the contents of this method with the
    /// code editor.
    /// </summary>
    private void InitializeComponent()
    {
        this.button1 = new System.Win-
            dows.Forms.Button();
        this.USBInstrument = new System.Win-
            dows.Forms.TextBox();
        this.SuspendLayout();
        //
        // button1
        //
        this.button1.Location = new System.Drawing.Point(56, 96);
        this.button1.Name = "button1";
        this.button1.TabIndex = 0;
```

```
        this.button1.Text = "button1";
        this.button1.Click += new
System.EventHandler(this.button1_Click);
        //
        // textBox1
        //
        this.USBInstrument.Location = new System.Drawing.Point(88, 136);
        this.USBInstrument.Name = "USBInstrument";
        this.USBInstrument.TabIndex = 1;
        this.USBInstrument.Text = "USBinstrument";
        this.USBInstrument.TextChanged += new
System.EventHandler(this.USBInstrument_TextChanged);
        //
        // Form1
        //
        this.AutoScaleBaseSize = new System.Drawing.Size(5, 13);
        this.ClientSize = new System.Drawing.Size(292, 273);
        this.Controls.Add(this.USBInstrument);
        this.Controls.Add(this.button1);
        this.Name = "Form1";
        this.Text = "Form1";
        this.Load += new System.EventHandler(this.Form1_Load);
        this.ResumeLayout(false);

      }
      #endregion

      /// <summary>
      /// The main entry point for the application.
      /// </summary>
      [STAThread]
      static void Main()
      {
        Application.Run(new Form1());
      }

      private void Form1_Load(object sender, System.EventArgs e)
      {

      }
```

```
    private void USBInstrument_TextChanged(object sender,
      System.EventArgs e)
    {
    }

    private void button1_Click(object sender, System.EventArgs e)
    {
      Ivi.Visa.Interop.ResourceManager io_mgr=new
        Ivi.Visa.Interop.ResourceManagerClass();
      Ivi.Visa.Interop.FormattedIO488 fgen=new
        Ivi.Visa.Interop.FormattedIO488Class();

fgen.IO=(Ivi.Visa.Interop.IMessage)io_mgr.Open(USBInstrument.Text,Ivi.
Visa.Interop.AccessMode.NO_LOCK,2000,"");
      fgen.WriteString("*rst",true);
      fgen.IO.Clear();
      fgen.WriteString("FUNCtion SINusoid",true);  //Select waveshape
      //
      //Other options are SQUare, RAMP, PULSe, NOISe, DC, and USER
      //
      fgen.WriteString("OUTput:LOAD 50",true);
      //Set the load impedance in Ohms
      //(50 ohms default)
      //
      //May also be INFinity, as when using oscilloscope or DMM
      //
      fgen.WriteString("FREQuency 2500",true); //Set the frequency
      fgen.WriteString("VOLTage 1.2",true); //Set the amplitude in
                                             //Vpp.
                                             //Also see VOLTage:UNIT
      fgen.WriteString("VOLTage:OFFSet 0.4",true);
      //Set the offset in Volts
      //Voltage may also be set as VOLTage:HIGH and VOLTage:LOW for
      //low level and high level.
      //
      fgen.WriteString("OUTPut ON",true);
      //Turn on the instrument output
    }
  }
}
```

Example: Simple Sine Waveform (Visual C++ and VISA)

This example program is intended for use with Microsoft Visual C++ 6.0 and Agilent VISA. This program uses the arbitrary waveform function to download and output a square wave pulse with a calculated rise time and fall time. The waveform consists of 4000 points downloaded to the function generator as ASCII data.

```
#include <string.h>
#include <stdlib.h>
#include <stdio.h>
#include <visa.h>

#define CHECK(func)\
do {\
    ViStatus _s = (func);\
    if (_s < 0)\
    {\
  fprintf(stderr, "Error: %s returned %d\n", #func, _s);\
  exit(0);\
    }\
} while (0)

/* Specify the default address */
#define DEFAULT_LOGICAL_ADDRESS "GPIB0::10::INSTR"

void main()
{
  ViSession   viDefaultRM, Instrument;
  ViRsrc      TxtAddress = DEFAULT_LOGICAL_ADDRESS;
  ViUInt32 actual;
  char SCPIcmd[10000];
  unsigned short i;

  CHECK(viOpenDefaultRM(&viDefaultRM));
  CHECK(viOpen(viDefaultRM, TxtAddress, VI_NULL, VI_NULL,
&Instrument));

  /* Specify long seconds timeout for waveform download */
  CHECK(viSetAttribute(Instrument, VI_ATTR_TMO_VALUE, 40000));
  strcpy(SCPIcmd,"*RST\n");  /* Reset the function generator */
```

```
  CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));
  strcpy(SCPIcmd,"*CLS\n");  /* Clear errors and status registers */
  CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));

  /* Compute waveform */

  fprintf(stderr, "Computing Waveform...\n");

  strcpy(SCPIcmd, "DATA VOLATILE");
  for(i = 1; i <= 5; i++)        /* Set rise time (5 points) */
    sprintf(SCPIcmd, "%s,%3.1f", SCPIcmd, (double)(i - 1)/5);

  for(i = 6; i <= 205; i++)
    strcat(SCPIcmd, ",1");     /* Set pulse width (200 points) */

  for(i = 206; i <= 210; i++)    /* Set fall time (5 points) */
    sprintf(SCPIcmd, "%s,%3.1f", SCPIcmd, (double)(210 - i)/5);

  for(i = 211; i <= 4000; i++)
    strcat(SCPIcmd, ",0");     /* Set remaining points to zero */

  strcat(SCPIcmd,"\n");


  /* Download data points to volatile memory */

  fprintf(stderr,"Downloading Arb...\n");

  CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));

  fprintf(stderr,"Download Complete\n");

  /* Set up arbitrary waveform and output */

  strcpy(SCPIcmd,"DATA:COPY PULSE, VOLATILE\n");  /* Copy arb to
non-volatile memory */
  CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));
```

```
  strcpy(SCPIcmd, "FUNCtion:USER PULSE\n"); /*  Select the active
arb waveform */
  CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));
  strcpy(SCPIcmd, "FUNCtion:SHAPe USER\n"); /* Output the selected
arb waveform */
  CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));

  strcpy(SCPIcmd, "OUTPut:LOAD 50\n"); /* Output termination is 50 Ohms
*/
  CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));
  strcpy(SCPIcmd, "FREQuency 5000;VOLTage 5\n"); /* Output frequency is
5 kHz @ 5 Vpp */
  CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));
  strcpy(SCPIcmd, "OUTPut ON\n"); /* Enable output */
  CHECK(viWrite(Instrument, SCPIcmd, (ViUInt32)strlen(SCPIcmd),
&actual));

  CHECK(viClose(Instrument));
  CHECK(viClose(viDefaultRM));
}
```

7
TCP/IP Network Basics

This chapter includes:

NOTE The information in this section is a summary of TCP/IP networks and LANs and is not intended to be a complete discussion of the subject. Consult standard reference texts for further details on TCP/IP and LANs.

LAN Interface Overview

This section provides an overview of Local Area Networks (LANs) that use Transmission Control Protocol/Internet Protocol (TCP/IP), including:

- Typical Network Topologies
- LAN Hardware Architecture

Typical Network Topologies

LANs using TCP/IP can be divided into two categories: Site LANs and Private LANs.

Site LAN Topology

A Site LAN can be a workgroup LAN, Intranet, or enterprise (corporate) LAN. Typically, a site LAN includes several PCs, routers, and servers. The LAN network is usually administered and controlled by a **system administrator** (or **network administrator**) who installs, monitors, and troubleshoots the network.

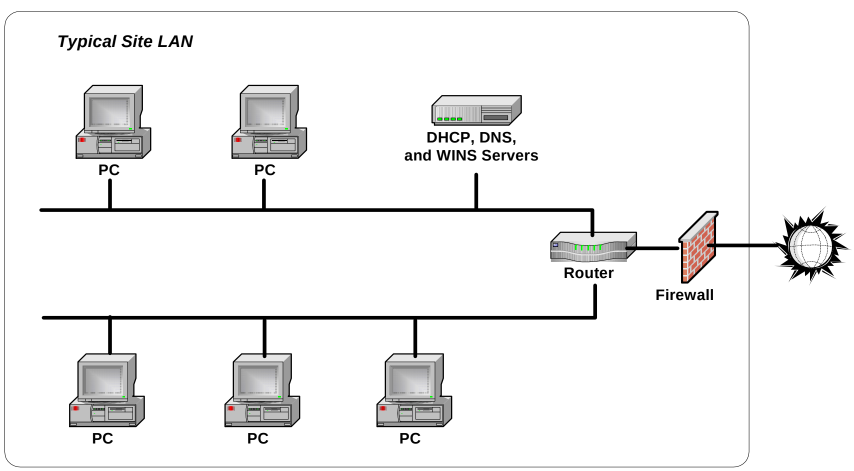


Figure 53 Portion of a Typical Site LAN

Within the site LAN, every device (PC, router, server, etc.) is called a **host**. A host is any device on a network that has a TCP/IP address. TCP/IP addresses are called **IP addresses**, and each device on the network must have a unique IP address. A typical IP address for a device is 156.140.105.50. In general, communication within the site LAN and to private LANs is behind a **firewall**.

Communication among devices on the site LAN is controlled by **routers**. A router is a host that interfaces with other networks and can move data (called packets) from one network to another or can move data within the network, depending on the IP addresses of the hosts that are communicating with each other.

The **servers** on the site LAN can supply addressing and naming services, such as Dynamic Host Configuration Protocol (DHCP) to automatically assign IP addresses to hosts on the network or Domain Name Service (DNS) or Windows Internet Naming Service (WINS) that allow hostnames to be associated with their IP addresses.

Private LAN Topology

A private LAN (also called a local or isolated network) can operate as a local network (not connected to any other network) or can be connected to a site LAN or to another local network. This figure shows an example private LAN with three hosts (PC and two instruments). Communication between the PC and the instruments is via a **switch** or **hub**. You can also connect a single instrument to a PC by using a **crossover cable**.

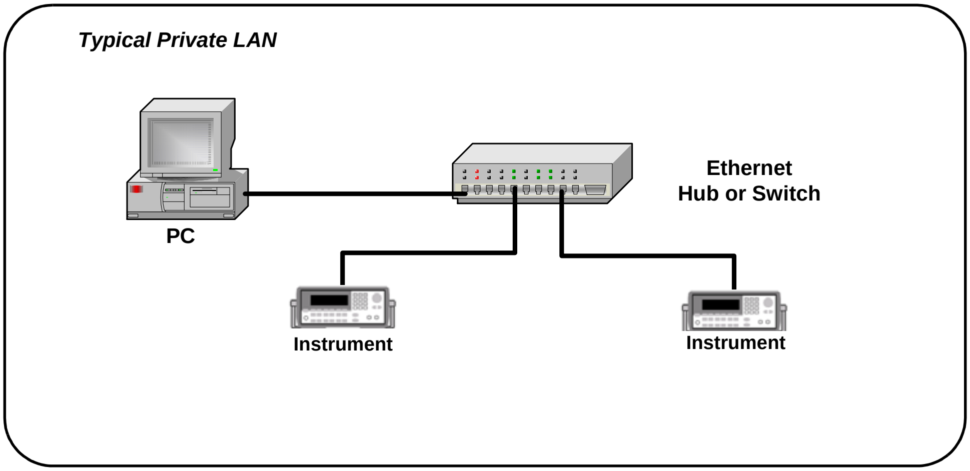


Figure 54 Typical Private LAN

LAN Hardware Architecture

A LAN is a way to extend the control of instrumentation beyond the limits of typical instrument interfaces. You can communicate with instruments using a web browser, the Telnet utility, or sockets. However, to program (send SCPI commands) over the LAN, you must first configure the LAN interface using Agilent Connection Expert, provided with the Agilent IO Libraries Suite.

Client-Server Model

The LAN software uses the **client-server model** of computing. Client-server computing refers to a model where an application (the **client**) does not perform all necessary tasks of the application itself. Instead, the client makes requests of another device (the **server**) for certain services.

A LAN interface, such as a PC, makes requests over the network to a server, such as a PC or a LAN-enabled instrument. For example, in this figure the Server PC and the instruments can act as LAN servers. Once the LAN server has completed the requested operation on the instrument or device, the LAN server sends a reply to the LAN interface. This reply contains requested data and status information that indicates whether or not the operation was successful.

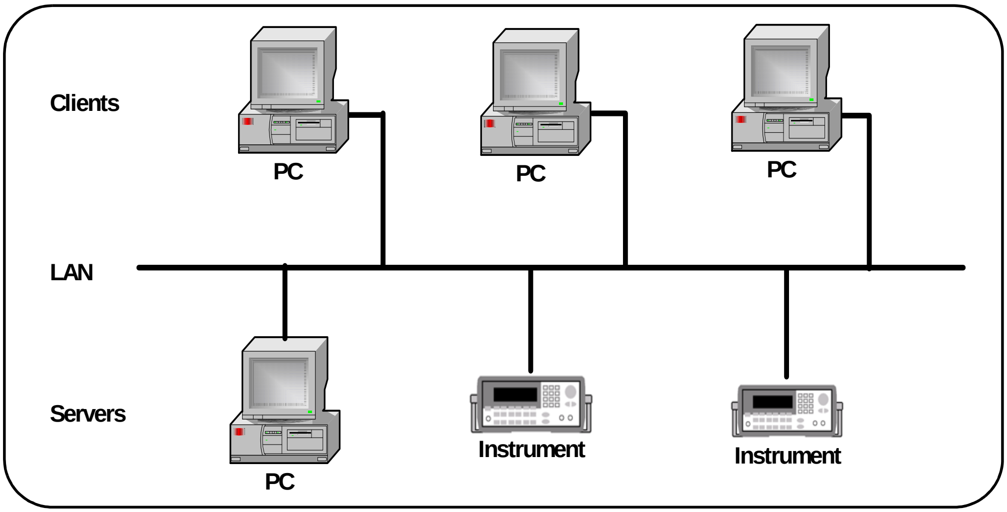


Figure 55 Client-Server Model

Packet Switching

A TCP/IP network is a **packet-switched** network. In this type of network, the computer that is sending the data (source host) breaks the data into smaller segments, called **packets**.

Each packet is individually addressed and is sent to the destination (destination host.) The destination host then reassembles the packets into the original message. Each packet can be sent from source to destination in any of several routes. The **routers** in the network control the paths of the packets.

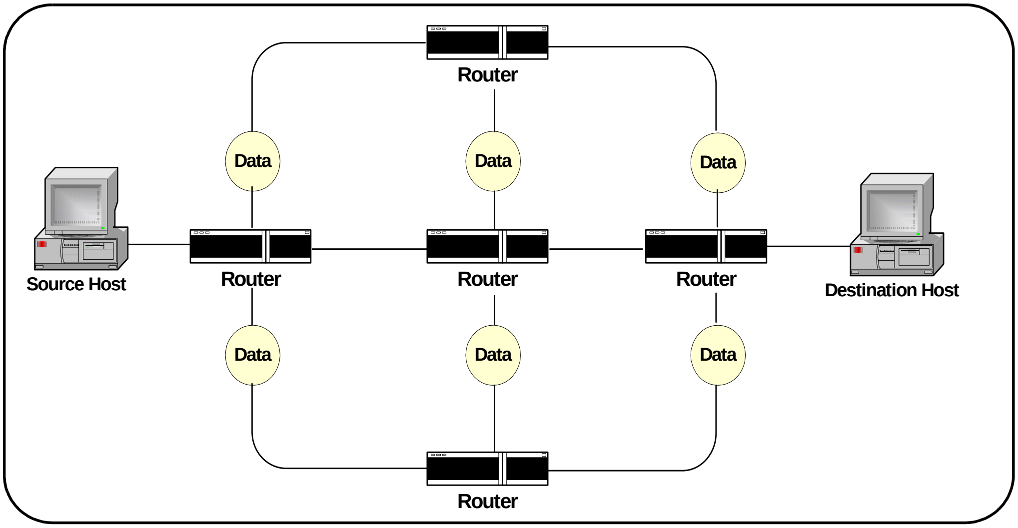


Figure 56 Example of Packet-Switched Network

TCP/IP Protocols

This section summarizes protocols for LAN networks that use TCP/IP for communication between hosts (devices such as computers, printers, and instruments), including:

- The TCP/IP Network Model
- The Network Interface Layer
- The Internet Layer
- The Transport Layer
- The Application Layer

The TCP/IP Network Model

The TCP/IP network model is based on **protocols** and an associated set of layers that control the actions of the network. A **protocol** is a rule or set of rules and standards for communication and data transfer between **hosts** on a network. A **host** is any device on the network (such as a computer, server, printer, etc.) that has a TCP/IP address. To exchange data on the network, the source and destination hosts must agree on the protocol and each host must have a unique (TCP/IP) address. When protocols are grouped together, they form a **protocol suite** and work together as a **protocol stack**.

TCP/IP Layers The TCP/IP network model is based on the Department of Defense (DoD) model.

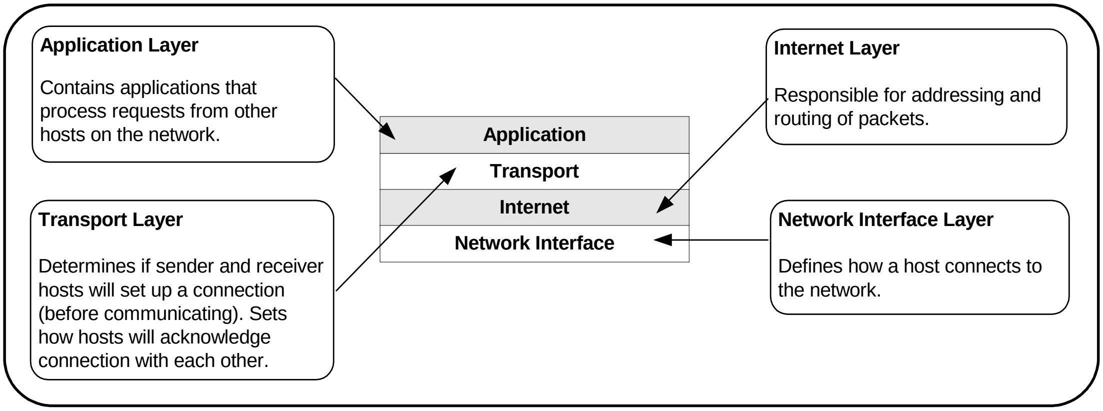


Figure 57 Functions of the TCP/IP Layers

TCP/IP Protocol Overview This table summarizes the components of each layer and shows the applicable Request for Comments (RFC) for each component.

Layer	Component Name	Description	Specification
Internet	IP - Internet Protocol	The lowest level protocol by which data are sent from one computer to another on the Internet.	RFC 791* RFC 2460**
	ICMP - Internet Control Message Protocol	A message control and error-reporting protocol between IP devices on a network.	RFC 792
	ARP - Address Resolution Protocol	A protocol for translating IP addresses into Ethernet addresses.	RFC 826
Transport	TCP - Transmission Control Protocol	A connection-oriented protocol running over IP that reliably delivers data.	RFC 793
	UDP - User Datagram Protocol	A datagram-oriented protocol running over IP	RFC 768

Layer	Component Name	Description	Specification
Application	DNS - Domain Name System	A protocol for translating a Hostname into an IP address.	RFC 1034 and RFC 1035
	DHCP - Dynamic Host Configuration Protocol	A protocol for obtaining TCP/IP parameters from a central server.	RFC 2131 and RFC 2132
	FTP - File Transfer Protocol	A protocol that defines how files are transferred from one host to another on a network.	RFC 959
	HTTP - Hypertext Transfer Protocol	A protocol that defines how files are exchanged on the Internet	RFC 1945 and RFC 2068

* = IPv4 (current standard), ** = IPv6 (proposed new standard)

The Network Interface Layer

The lowest layer in the TCP/IP stack is the Network Interface Layer. The primary responsibility of this layer is to define how a host device (computer, instrument, etc.) connects to the network. The Network Interface Layer acts as a host's connection (interface) to the network. There are no TCP/IP protocols associated with the Network Interface layer.

The Network Interface Layer is used to send and receive packets. At the Network Interface Layer, a header that contains addressing information is applied to each packet. A part of this header is the host **hardware address**. The hardware address must be unique to the device and does not change during the life of the device.

The hardware address, also called the Media Access Control (MAC) Address, Ethernet Address, Physical Address, or Network Interface Card (NIC) Address, is a 12-digit hexadecimal address. A typical hardware address is 00:30:D3:00:00:23, where the first six digits represent the manufacturer of the device and the last six digits represent the serial number assigned to the device.

NOTE

For a TCP/IP packet to be delivered to a device, the packet **must** contain the destination device's hardware address.

As packets are sent through the network, each host on the network looks at the packet to see if the packet is addressed to the host's hardware address. If not, the host ignores the packet.

The Internet Layer

The Internet Layer of the TCP/IP model contains the protocols responsible for addressing and routing of packets. The Internet Layer includes several protocols, including:

- Internet Protocol (IP)
- Address Resolution Protocol (ARP)
- Internet Control Message Protocol (ICMP)

For TCP/IP communications to be successful, the packet examined by the Network Interface Layer must include a hardware address. As the packet moves up to the Internet Layer, it also must include an **IP address**. The Internet Layer provides the protocols to determine the hardware address for routing the packet to its destination.

Internet Protocol (IP) Internet Protocol (IP) is responsible for determining the source and destination IP addresses of every packet sent on the network. Typically,
IP addresses are assigned by a **System Administrator**. An IP address is assigned to each host on a network and each host must have a unique IP address.

In contrast to a hardware address that refers to a physical network interface card, an IP address is a **logical address** that is assigned to the host. The IP address can be changed, since it refers only to the host. A typical IP address is 167.155.21.45. See IP Addressing for a description of IP addresses.

Address Resolution Protocol (ARP) Address Resolution Protocol (ARP) is a protocol used to **resolve** (translate)
a **logical address** to a physical (hardware) address. ARP is used when a source host wants to communicate with a destination host, but has only the IP address. After the hardware address is resolved, ARP maintains that information for a short period of time.

Internet Control Message Protocol (ICMP) Internet Control Message Protocol (ICMP) is primarily used to send error messages, perform diagnostics, and control data flow. You can also use ICMP with the Packet InterNet Groper (**Ping)** utility. To ping another host from a Command Prompt, type **ping <*ip_address*>**.

Example: Using ping for Echo Request

For example, you could use the Ping utility to send ICMP echo request packets to the destination host and request the destination host return these packets. If the packets are returned, you can assume the connection is good. If the packets are not returned, a connectivity problem exists. This figure shows an example return from pinging a computer at IP address 156.140.72.1.

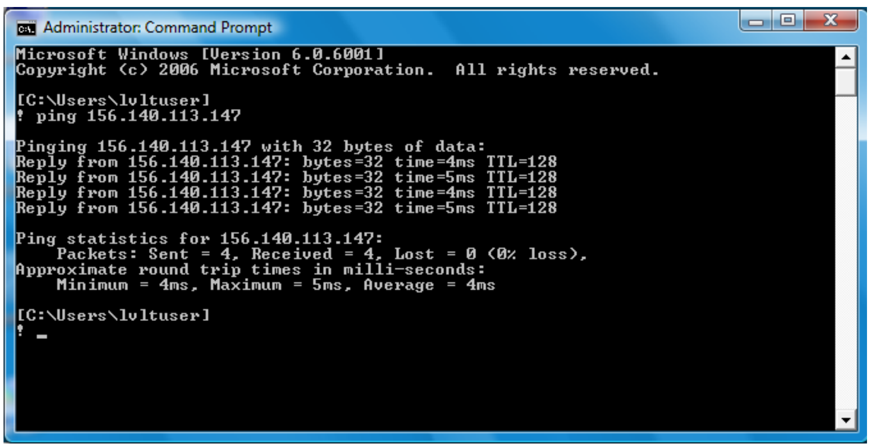


Figure 58 Example Using Ping Utility

The Transport Layer

The Transport Layer of the TCP/IP model contains the protocols responsible for addressing and routing of packets. The Transport Layer determines if the sender and receiver will establish a connection before communicating and how often acknowledgements of the connection are sent. The protocols at the Transport Layer deliver data to and receive data from the Transport Layer protocols of other hosts. Hosts can be on the same local network or on a remote network. The Transport Layer has two protocols:

- Transmission Control Protocol (TCP)
- User Datagram Protocol (UDP)

Transmission Control Protocol (TCP) Transmission Control Protocol (TCP) is the protocol that connects the sending host and the receiving host to each other. TCP provides the connection as packets are moved between hosts having the conversation. Every packet has a TCP header that includes **sequence numbers**, acknowledgement numbers, address information, and other information. If packets get out of order enroute from the source to the destination, the sequence number allows the packets to be reassembled in the correct order.

As each packet is sent from the source host, an acknowledgement of receipt is sent by the destination host within a specified time. If the acknowledgement is not sent within this time, the sender re-sends the packet.

If the receiver gets the packet in a damaged condition, the packet is discarded and the receiver sends no acknowledgement. In this case, since an acknowledgement was not received in the specified time, the sender re-sends the packet. This figure shows a network in which the source and destination are using TCP and summarizes the steps to use TCP for communication between hosts.

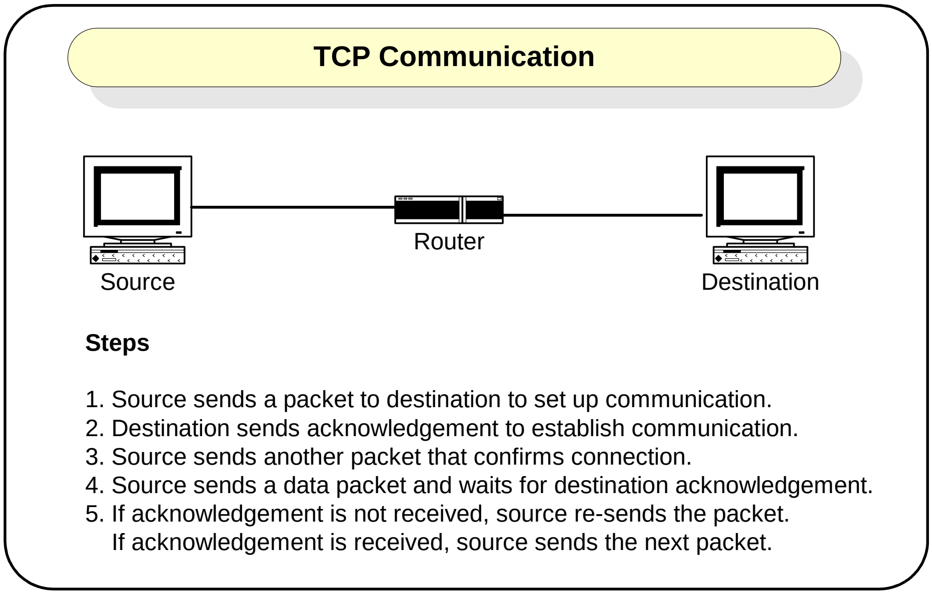


Figure 59 TCP Comunication

User Datagram Protocol (UDP) User Datagram Protocol (UDP) is used for connectionless, non-guaranteed communication. Unlike TDP, UDP does not set up a connection and does not use acknowledgements. Instead, UDP sends out packets without waiting for acknowledgement from the destination.

The Application Layer

The Application Layer is the layer where requests for data or services are processed. Applications at this layer are waiting for requests to process and all applications are “listening” at their respective **port**. The Application Layer has two protocols:

- File Transfer Protocol (FTP)

- Hypertext Transfer Protocol (HTTP)

NOTE

The Application Layer is not where an Internet browser, spreadsheet, etc. interact. Applications running at the Application Layer interact with the browser, spreadsheet, etc. applications.

Ports This figure shows the TCP/IP protocol stack. In the stack, TCP and UDP each have access to 65,536 ports at the Application Layer. As a packet moves up the stack, IP directs the packet to either a TCP port or to a UDP port. Since all applications are listening at their respective ports, when the packet arrives at the appropriate port, it can be processed correctly.

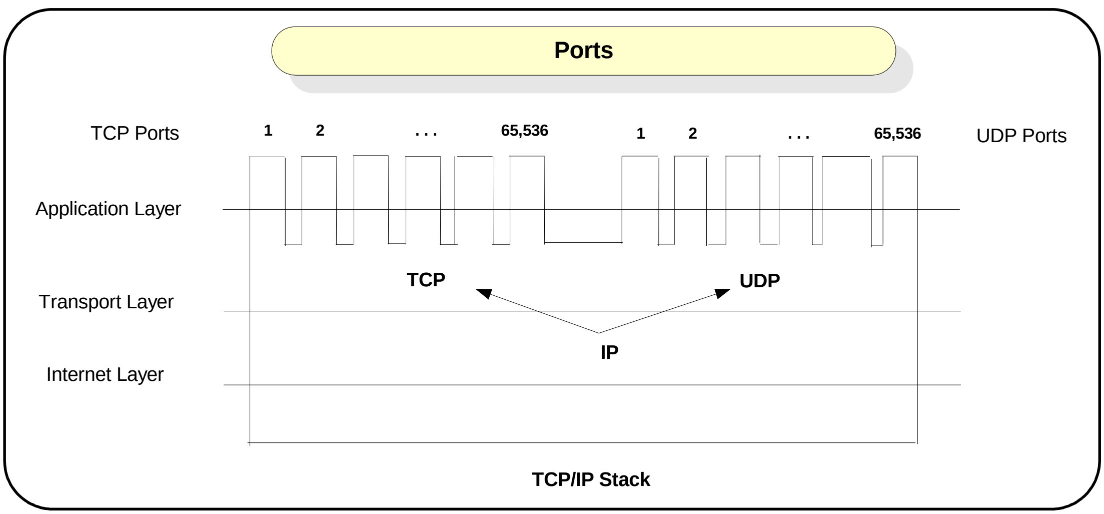


Figure 60 TCP/IP Protocol Stack

Sockets For TCP/IP protocol, when a packet is delivered to a specific IP address, it is passed up to TCP or UDP and then to the appropriate host. This process forms a funnel through the TCP/IP stack, called a **socket**. A socket is uniquely defined by the IP address, the end-to-end protocol (TCP or UDP), and the port number.

This figure shows typical socket architecture. When a socket is first created, it has an associated protocol but not an IP address or port number. A socket must be **bound** to a port number before it can receive messages from a remote application.

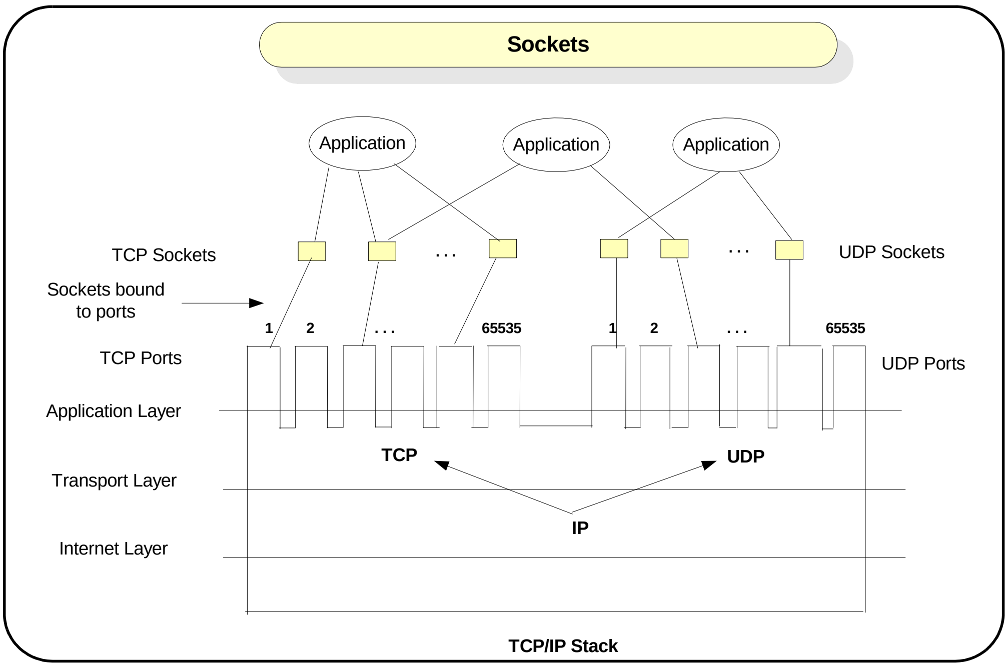


Figure 61 Typical Socket Architecture

File Transfer Protocol (FTP) File Transfer Protocol (FTP) is an application used to transfer files from a host to another host and store the files on the requesting host. In an FTP session, one host (the client) requests a file and the other host (the server) transfers a copy of the file to the client. The two hosts thus establish a **client/server** relationship. File transfer can be in text or binary format.

An FTP client can use a word processor, FTP command line utility or FTP command server to request a file from the server. The command-line FTP client application requires you to know FTP commands, while an FTP command interpreter allows you to connect to an FTP server without using FTP commands. You can login to FTP using anonymous so that no password is required.

Hypertext Transfer Protocol (HTTP) Hypertext Transfer Protocol (HTTP) is an application used to transfer files from one host (the server) to another host (the client) and to display the files at the requesting host. The HTTP application runs on a Web server, listens for requests at a TCP port (usually port 80 for requests), and sends files back to the requestor.

The requesting host displays the files on a web browser, such as Internet Explorer. A client makes an HTTP request by typing a **Uniform Resource Locator (URL)** in the address line of the web browser or by clicking a **hyperlink** on a page that is displayed on the web browser.

IP Addressing

This section describes IP addressing for TCP/IP networks, including:

- IP Address Classes
- Subnets and Subnet Masks
- Local and Remote Networks
- IP Address Configuration Methods

IP Address Classes

Each host on a TCP/IP network must have a unique address. This address is called the **IP address** and consists of a **network portion** and a **host portion**. The network portion and host portion of an IP address are determined by the **subnet mask**.

Each IP address consists of four decimal numbers separated by periods. However, TCP/IP uses the 32-bit binary equivalent of the IP address. For example, the decimal value and binary equivalent of IP address 14.230.26.116 is:

14.230.26.116 = 0000 0110.1110 0110.0001 1010.0111 0100

IP addresses are divided into five classes: Class A, Class B, Class C, Class D, and Class E. This table summarizes standard Class A, Class B, and Class C IP addresses. In the table, the **Range** is the range of values for the first 8 bits of the IP address, regardless of class. In the **Binary Equivalent** column, **N** = a network bit and H = a host bit.

Class	Range	Network Bits	Binary Equivalent
A	1 - 127	8	**NNNN NNNN**.HHHH HHHH.HHHH HHHH.HHHH HHHH
B	128 - 191	16	**NNNN NNNN.NNNN NNNN**.HHHH HHHH.HHHH HHHH
C	192 - 223	24	**NNNN NNNN.NNNN NNNN.NNNN NNNN**.HHHH HHHH

NOTE

Dot-notation addresses ("nnn.nnn.nnn.nnn" where “nnn” is a byte value) such as IP addresses must be expressed with care, as most web software on the PC will interpret byte values with leading zeros as octal numbers. Thus, “255.255.020.011” is actually equivalent to decimal “255.255.16.9” rather than “255.255.20.11” because “.020” is interpreted as “16” expressed in octal and “.011” as “9”. To avoid confusion, use only decimal expressions of byte values (0 to 255), with **no leading zeros**.

For example, the Agilent 33220A assumes that all IP addresses and other dot-notation addresses are expressed as decimal byte values and strips all leading zeros from these byte values. Thus, trying to enter “255.255.020.011” in the IP address field, it becomes “255.255.20.11” (a purely decimal expression). You should enter exactly the same expression, “255.255.20.11” in your PC web software to address the instrument. Do not use “255.255.020.011” as the PC will interpret that address differently due to the leading zeros.

Example: Class A, B, and C IP Addresses

This table shows three example IP addresses, where the bold part of the binary equivalent is the network portion of the address and the non-bold portion is the host portion of the address. For a Class A address, the first 8 bits are the network portion and the remaining 24 bits are the host portion of the address.

For a Class B IP address, the first 16 bits are the network portion and the remaining 16 bits are the host portion of the address. For a Class C IP address, the first 24 bits are the network portion and the remaining 8 bits are the host portion of the address.

Class	IP Address	Binary Equivalent
A	54.16.23.1	**0011 0110**. 0001 0000. 0001 0111. 0000 0001
B	154.16.23.1	**1001 0110. 0001 0000**. 0001 0111. 0000 0001
C	204.16.23.1	**1100 1100. 0001 0000. 0001 0111**. 0000 0001

Subnets and Subnet Masks

As noted, an IP address consists of a network portion and a host portion. A **subnet mask** is a number that looks like an IP address that shows IP how many bits are used for the network portion of the IP address by "masking" the network portion of the IP address. Every IP address must have a subnet mask. You can use standard or custom subnet masks.To see how subnet masks are used, we will first define a **subnet**.

What is a Subnet? Large networks can be divided by a System administrator by creating a number of smaller networks, called **subnets**. The larger network is divided into subnets by using **routers** (also called **default gateways**). All devices on one side of the router form a separate subnet. Each subnet must have a unique set of IP addresses that are defined by the **subnet mask** for that network. Each side of the router must have a separate network address.

Standard Subnet Masks A subnet mask (like an IP address) is 32 bits long, with several contiguous bits (all 1s) that represent the network portion of the IP address and the rest of the bits (all 0s) that represent the host portion of the IP address.

For example, the standard subnet mask for a Class A address is **255**.0.0.0 (binary **1111 1111**.0000 0000.0000 0000.0000 0000), so the first eight bits (all 1s) are used for the network portion of the IP address and the remaining 24 bits (all 0s) are used for the host portion of the IP address. This table shows the standard subnet masks for Class A, Class B, and Class C IP addresses.

Class	Standard Subnet Mask	Standard Subnet Mask (Binary Equivalent)
A	**255**.0.0.0	**1111 1111**. 0000 0000. 0000 0000. 0000 0000
B	**255.255**.0.0	**1111 1111. 1111 1111**. 0000 0000. 0000 0000
C	**255.255.255**.0	**1111 1111. 1111 1111. 1111 1111**. 0000 0000

Custom Subnet Masks You can create custom subnet masks for Class A, Class B, and Class C IP addresses. For example, for a Class A IP address, by using custom subnet mask **255.255.224**.0 you can create 2,046 unique networks with 4,094 unique host on each network.

A custom subnet mask adds more bits for the network portion of the IP address and uses fewer bits for the host portion of the IP address. These additional bits are called **subnet bits.**

NOTE Consult a standard network or TCP/IP book or use a subnet calculator (available on the Web) for creating custom subnets.

Local and Remote Networks

For every packet sent from a source host, IP must determine if the destination host is on the same **local network** or is on a **remote network**. If the destination host is on the same local network as the source host, IP directly gets the hardware address of the destination host. If the destination host is on a remote network, IP sends packets to the **router**.

Example: Creating Local and Remote Networks

For example, consider the two networks (subnets) in this figure that are created using a router. Computer A, instrument B, instrument C, and one side of the router form one local network, while computer D, instrument E, instrument F, and the other side of the router form another local network.

If computer A wants to send a packet to instrument B or to instrument C, the destination is **local** (all hosts are on the same side of the router). In this case, IP can get the hardware address of the destination host (instrument B or instrument C) and can establish communication directly with the destination host.

However, if computer A wants to send a packet to instrument E or to instrument F, the destination is **remote** (hosts are separated by the router). In this case, IP gets the hardware address of the router. The packet is then sent to the router for transmission to the destination host (instrument E or instrument F).

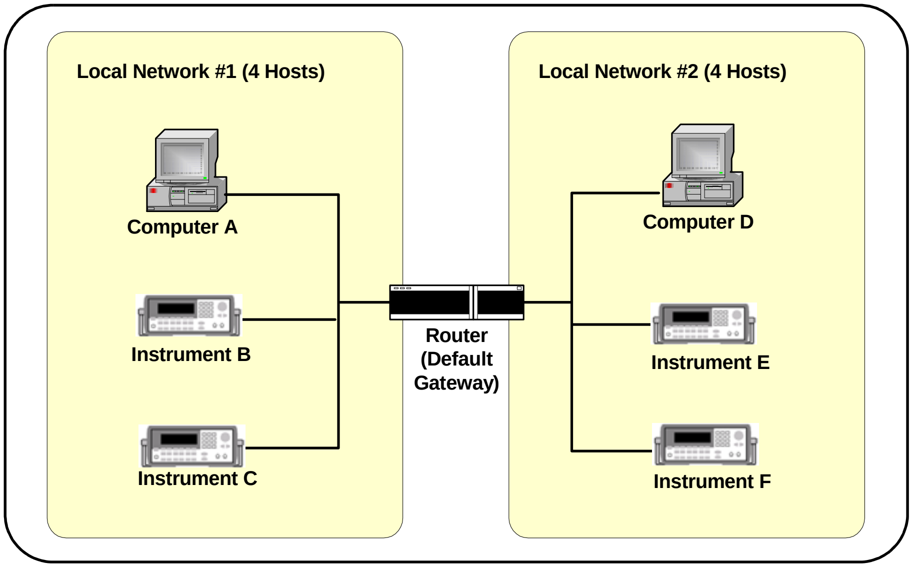


Figure 62 Two Networks (Subnets) Using a Router

IP Address Configuration Methods

This section introduces some IP address configuration methods, including:

- Configuration Methods Overview
- Dynamic Host Configuration Protocol (DHCP)
- AutoIP/ZEROCONF
- Duplicate IP Address Detection

Configuration Methods Overview

IP address configuration methods can be divided into two categories: automatic IP configuration and manual IP configuration.

- **Dynamic Host Configuration Protocol (DHCP)** provides **automatic** TCP/IP setup for devices on networks that support DHCP.
- **AutoIP/ZEROCONF** provides **automatic** TCP/IP setup for devices on networks that do not support DHCP.
- **Manual IP Configuration** provides **manual** TCP/IP setup for devices on manually configured networks.

This table shows the applicablility of these methods to various network topologies.

Network Topology	Automatic IP			Manual IP
	DHCP	AutoIP	ZEROCONF	
Site LAN [with DHCP]	Yes	No	No	Yes
Site LAN [without DHCP]	No	Yes	Yes	Yes
Private LAN [with DHCP]	Yes	No	No	Yes
Private LAN [without DHCP]	No	Yes	Yes	Yes

Dynamic Host Configuration Protocol (DHCP)

Dynamic Host Configuration Protocol (DHCP) allows each host on the network to be automatically assigned a unique IP address when the device is connected to a network that supports DHCP and is turned ON.

To enable DHCP on a Site LAN, the System Administrator assigns a pool of IP addresses to a **DHCP Server** to be leased to hosts on the network. Each host on the network is called a **DHCP Client**.

AutoIP/ZEROCONF

AutoIP/ZEROCONF can be used to automatically assign IP addresses on networks that do not have DHCP Servers. AutoIP is a defacto standard for IP address allocation implemented by Microsoft and Apple. ZEROCONF is an Internet standard (RFC) that is currently under development and is expected to be widely implemented in Linux, Windows, etc. AutoIP and ZEROCONF are similar techniques for IP address allocation and can interoperate together.

Both AutoIP and ZEROCONF allocate IP addresses from the link-local IP address range (169.254.xxx.xxx). The addresses are allocated using an ARP-based protocol to determine is the desired address is already in use. AutoIP and ZEROCONF can both be used such that DHCP is tried first and then AutoIP/ZEROCONF are used after DHCP times out (typically after about 45 - 60 seconds).

Check your instrument's *User's Guide* to determine if the instrument supports AutoIP/ZEROCONF and, if supported, if AutoIP/ZEROCONF can be disabled.

Duplicate IP Address Detection

Duplicate IP address detection ensures that an instrument does not attempt to start operation using an IP address that is already in use on that network. Duplicate IP Address detection provides basic diagnostic information to identify a problem on the network.

Duplicate IP Address detection is described by several Internet standards (RFC 2642/RFC 2131/ZEROCONF). It is implemented using ARP (Address Resolution Protocol) and uses broadcast Ethernet communication. The scope of duplicate IP address detection is the current Ethernet subnet. Most operating systems (Windows, Apple, etc.) implement duplicate IP address detection.

Duplicate IP Addresses on non-DHCP Networks Generally, duplicate IP addresses only occur on a manually configured IP address network that does not use DHCP and AutoIP/ZEROCONF. For example, a user may try to determine an IP address for a host by PINGing IP addresses on the network until an IP address is selected that does not respond.

Based on this non-response, the user may assume the IP address is unused and assign it to their device. However, at a later date, a host that legitimately has that IP address will attempt to use it. As a result, both hosts will experience network problems that can be very difficult to track down.

A duplicate IP address can also happen when a user makes an error during manual entry of an IP address and accidentally configures an IP address already in use elsewhere.

Duplicate IP Addresses on DHCP Networks Duplicate IP addresses on DHCP systems are unlikely but they are possible. The DHCP specification (RFC 2131) specifies how a duplicate IP address check should be done within the DHCP Discover/Offer/Request/Acknowledgement protocol sequence. Ideally, the network interface should be disabled when a duplicate IP address is detected. Windows informs the user of the duplicate IP address, but does NOT disable the network interface.

If two or more devices on the network have the same IP address, the first device that starts using the duplicate IP address will not detect a problem because it is the only device using that IP address. However, when a second device starts and attempts to use the duplicate IP address, a duplicate IP address error is reported.

To recover from a duplicate IP address condition, eliminate the duplicate IP address condition and then restart the affected devices. For example, an instrument can be restarted (to clear up the error) by disconnecting the Ethernet port long enough to be detected by the Ethernet connection monitoring or by cycling power to the instrument.

Device Hostname Services

This section introduces some device hostname services, including:

- Device Hostname Services Overview
- Dynamic DNS Naming
- RFC NetBIOS Naming
- Static DNS Naming

Device Hostname Services Overview

For ease of operation and communication on a TCP/IP network, you can assign a name to a host, called a **hostname**. However, since TCP/IP must use IP addresses to connect a host to another host, hostnames must be resolved (translated) to an IP address before TCP/IP can use the names.

Device hostname services can be divided into two categories: automatic hostname services and manual hostname services. This table shows the applicablility of these services to various network topologies.

	Automatic Hostname Services		Manual Hostname
Network Topology	**Dynamic DNS**	**RFC NetBIOS**	**Static DNS**
Site LAN (Direct Connection)	Works with networks that have Dynamic DNS	Works in all network topologies	Works in all network topologies
Site LAN (Router Connection)	Works with networks that have Dynamic DNS	Works in all network topologies	Works in all network topologies
Private LAN (Router Connection)	Works with networks that have Dynamic DNS	Works in all network topologies	Works in all network topologies
Private LAN (Direct Connection)	Typically not used in this topology	Works in all network topologies	Works in all network topologies

Dynamic DNS Naming

Dynamic Domain Name System (Dynamic DNS) is a distributed database of **hostnames** and associated IP addresses on the Internet. All hostnames on the Internet are divided into categories, called **domains**, such as .com, .edu, .org, etc. Dynamic DNS automatically provides hostnames and domain names for devices on networks that support Dynamic DNS. This figure shows a typical process for a DHCP Client to register a hostname and a PTR (pointer) name via a DHCP Server.

If the registration process fails, the DHCP Client hostname may not be assigned to the instrument. If you want to change the hostname after the registration process initiated by the DHCP server, you will probably need to cycle power on the instrument to re-initiate a DHCP request and hostname registration attempt.

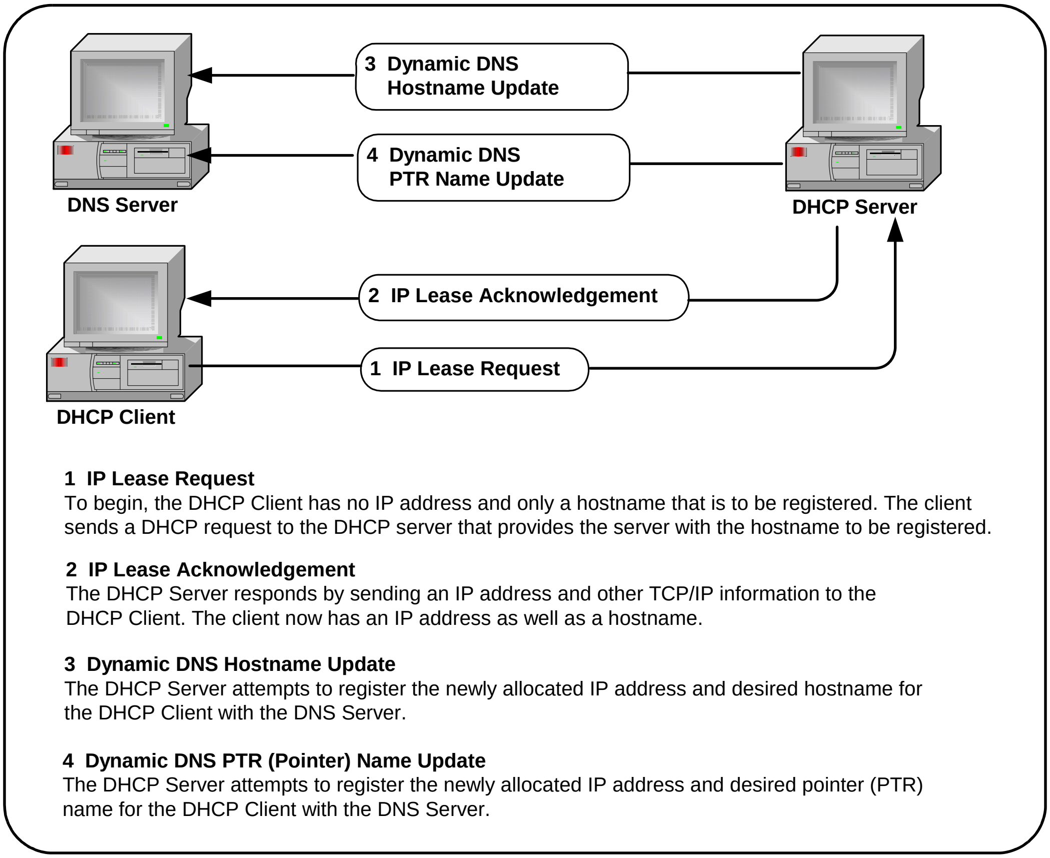


Figure 63 DHCP Client Registering a Hostname and PTR Name

RFC NetBIOS Naming

RFC NetBIOS Naming is a peer-to-peer naming protocol used by Microsoft File/Print Sharing that automatically provides hostnames for devices on networks that support RFC NetBIOS Naming. RFC NetBIOS naming uses a six-step process to resolve an IP address for a specified host name, as shown in the following figure. TCP/IP completes each step in the sequence shown before returning an error message. RFC NetBIOS naming does require a reboot to force a naming change to take effect.

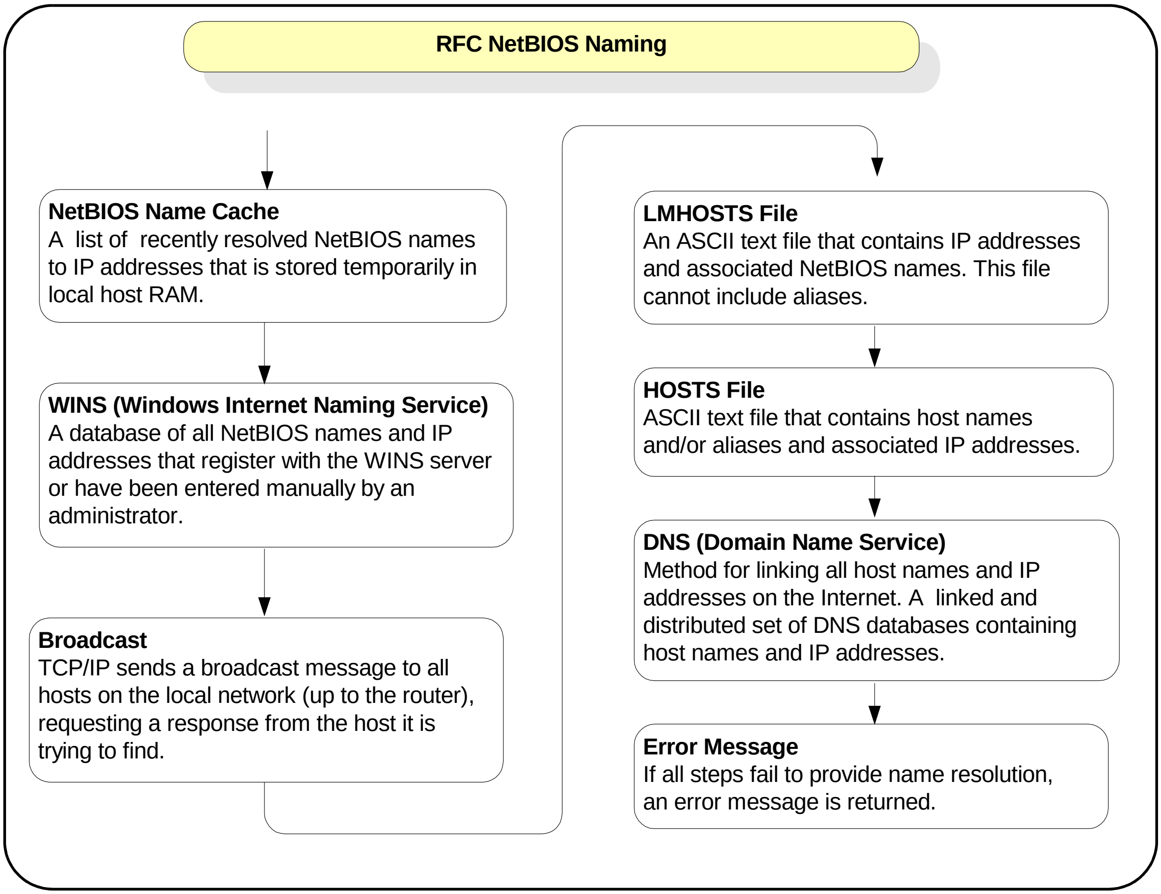


Figure 64 RFC NetBIOS Naming

Static DNS Naming

In contrast to automatic DNS name resolution, **Static DNS naming** does not require any host functionality to support dynamic methods of hostname resolution. Static DNS Naming uses a seven-step process to resolve an IP address to a specified hostname. TCP/IP completes each step in the sequence shown before returning an error message. See your instrument's *User's Guide* to determine if your instrument supports Static DNS Naming.

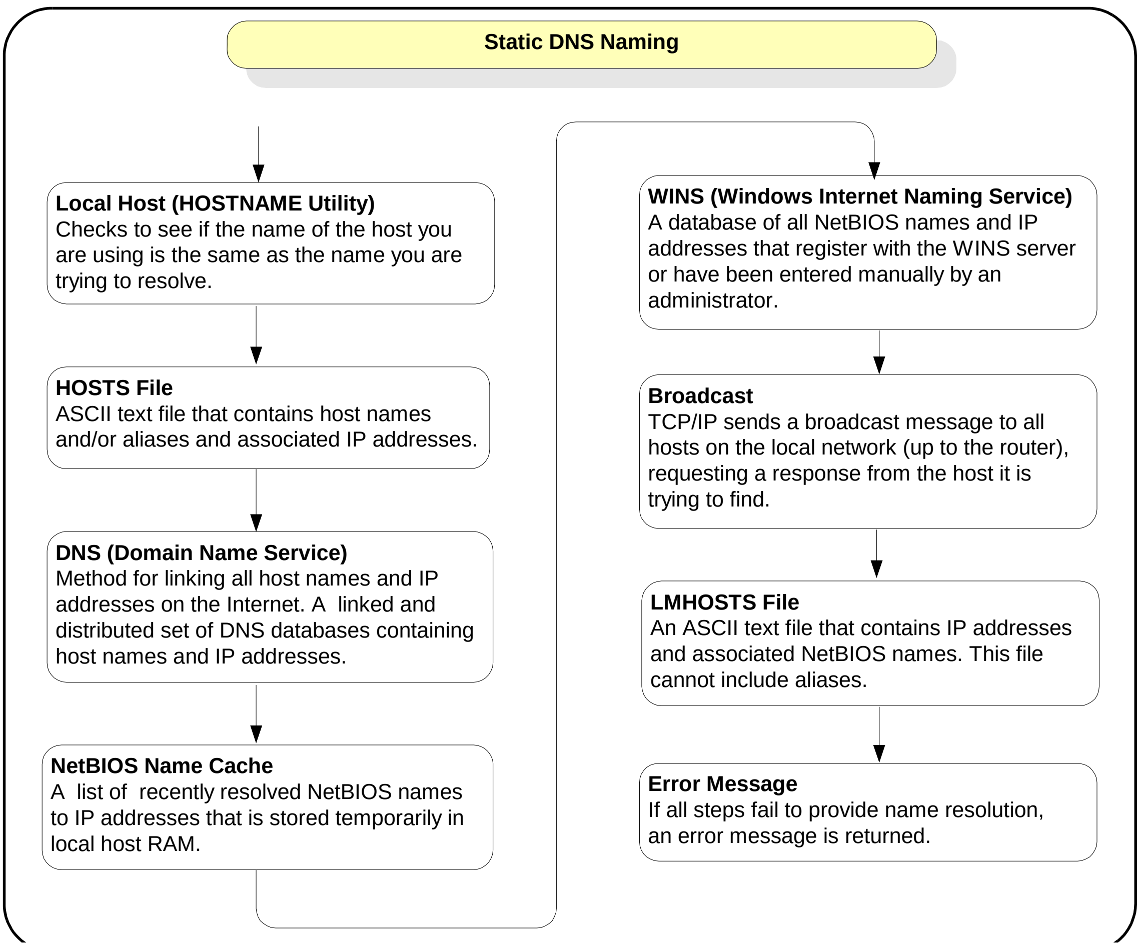


Figure 65 Static DNS Naming

Configuring Your PC for LAN Operation

This section shows steps to configure your PC, as required, for operation on a private LAN or for operation on site LANs that do not support DHCP, including:

- Checking PC Settings
- Installing Network Interface Cards
- Installing TCP/IP on Your PC
- Setting PC IP Address
- Setting PC Hostname

NOTE If your PC is part of an existing private LAN or site LAN, you probably do not need to do the steps in this section. If local policies require it, contact your System Administrator before changing PC settings.

Checking PC Settings

To check the current settings for your PC, type **ipconfig /all** from the Command Prompt. The figure below shows a typical display for a Windows Vista PC. The display for other operating systems may be different. If the settings are correct for your LAN operation, do not do any of the steps in this section. If the settings need to be changed, go to Installing Network Interface Cards.

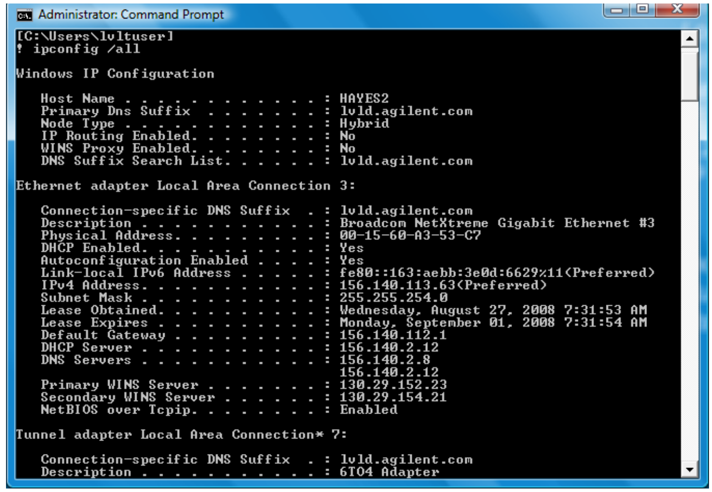


Figure 66 ipconfig /all Screen Capture

Installing Network Interface Cards

Network Interface Cards (NIC) provide the hardware interface between your PC and network devices such as routers, hubs, or switches. As required, install NIC(s) in your PC according to the NIC manufacturer's instructions.

Installing TCP/IP on Your PC

To configure a network interface card, the TCP/IP protocol must be installed and configured. See the following examples for a Windows XP PC or a Windows Vista PC. Modify the steps as required for your operating system.

Example: Installing TCP/IP (Windows XP)

1 Click **Start** > **Network** > **Internet Connnections.** From the “or pick a control panel icon”, select **Network Connections**.

2 Right-click **Local Area Connection** and then click **Properties** to display the **Local Area Connection Properties** dialog box.

3 The General tab should display **Internet Protocol (TCP/IP)**. If not, click **Install**, then select **Protocol** and click **Add**. Then, select **TCP/IP Protocol** and click **Install**.

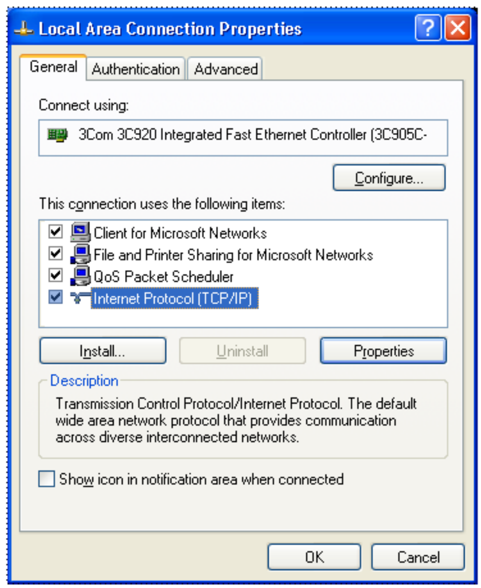


Figure 67 Local Area Comunication Properties

Example: Installing TCP/IP (Windows Vista)

1 Click **Start** > **Control Panel** > **Network Connections**.

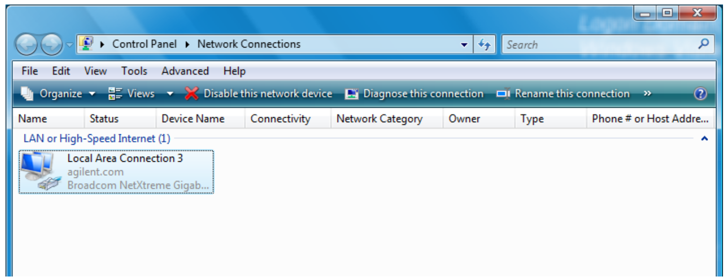


Figure 68 Windows Vista Network Connections

2 Right click the connection you want to change and click **Properties**.

3 Click the Networking tab.

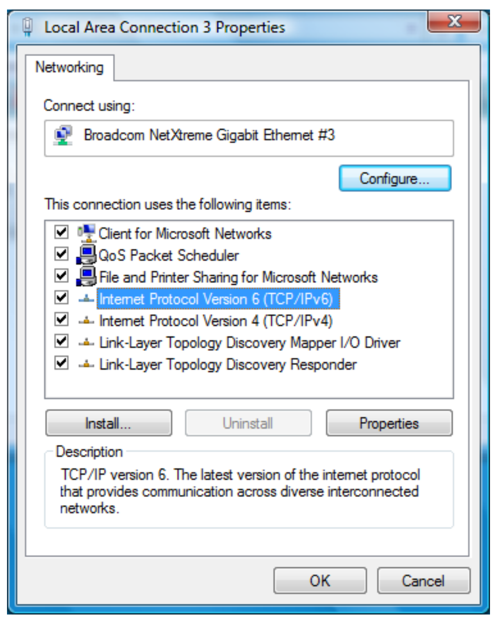


Figure 69 Windows Vista Local Area Connections Properties

4 In the frame, **This Connection uses the following items:**, select either **Internet Protocol Version 4 (TCP/IPv4)** or **Internet Protocol Version 6 (TCP/IPv6)** or select both

5 Ensure that the two radio buttons, **Obtain an IP address automatically** and **Obtain DNS Server address automatically** are both selected. Note, if you need to manually specify an IP or DNS address, you may do it from this screen.

6 Click the **OK** button on the two screens to exit.

Setting PC IP Address

Depending on the LAN capabilities, you can select automatic or manual methods to set the IP address and the DNS Server address on your PC. These examples show how to set an IP address for a Windows XP PC. Modify the steps as required for your operating system.

NOTE You should *not* change the IP configuration of your PC unless you are sure this is necessary. In almost all cases, the PC should be automatically configured.

Example: Setting PC IP Address (Windows XP)

1 Click **Start** > **Network** > **Internet Connnections**.

2 From the “or pick a control panel icon”, select **Network Connections**.

3 Right-click **Local Area Connection** and then click **Properties** to display the **Local Area Connection Properties** dialog box.

4 From the **General** tab, select **TCP/IP Protocol** and then click **Properties**.

5 Select **Use the Following IP Address** and then enter the IP address and subnet mask for the network. As required, enter the default gateway and DNS settings. Follow the on-screen instructions and reboot your PC as required.

6 Figure 70 shows an **Internet Protocol (TCP/IP) Properties** dialog box to automatically obtain IP addresses and to manually assign DNS Server addresses on a Windows XP PC.

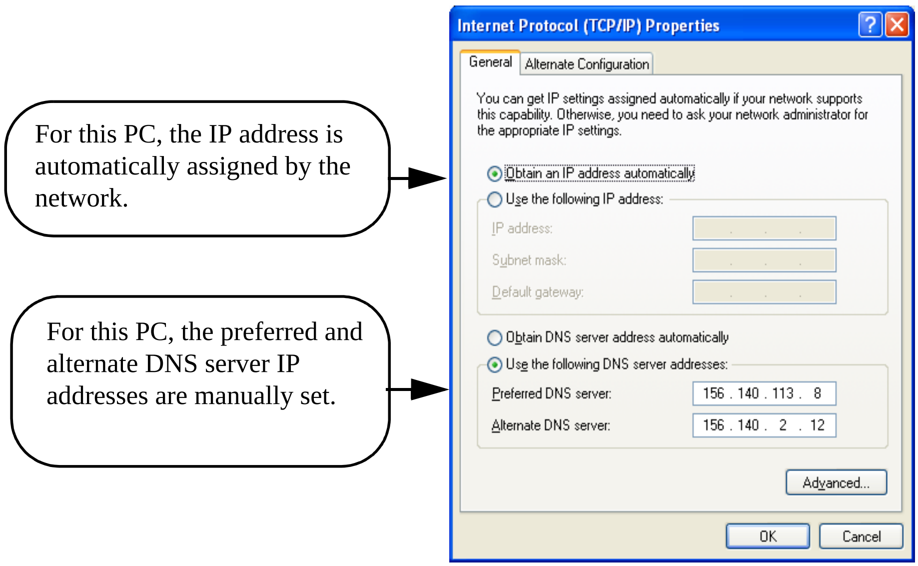


Figure 70 TCP/IP Properties Dialog Box (Windows XP)

Example: Setting PC IP Address (Windows Vista)

1 Refer back to the section titled "Installing TCP/IP on Your PC" on page 190. follow those instructions through step 4.

2 Select the radio buttons that allow you to specify the IP or DNS address.

3 Click the **OK** button on the two screens to exit.

Setting PC Hostname

As desired, you can set an approved Hostname and a Domain Name (such as *dept.company.com*) for your PC. Examples for Windows XP follow. Modify the steps as required for your operating system.

Example: Setting PC Hostname (Windows XP)

1. Right-click the **My Computer** icon and then click **Properties** to display the **System Properties** dialog box.
2. Select the **Network Identification** tab and then click **Properties** to display the **Identification Changes** dialog box.
3. As required, set/change the Hostname and/or Domain Name. When you have finished, click the **OK** box to enable the assignments.
4. This figure shows an example **Identification Changes** dialog box on a Windows XP PC. As desired, you can change the hostname and/or domain name.

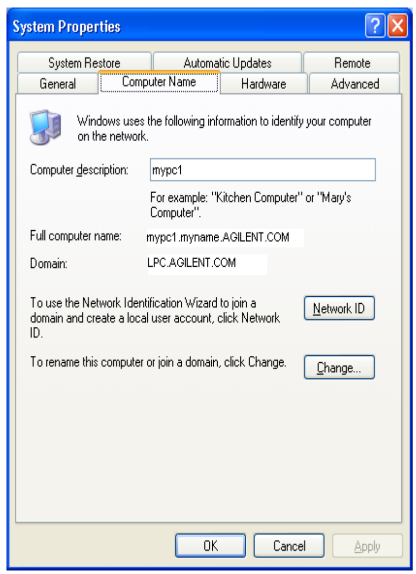


Figure 71 System Properties (Windows XP)

Example: Setting PC Hostname (Windows Vista)

1 Right-click the Computer icon, then click Properties. This opens the Properties Dialog window.

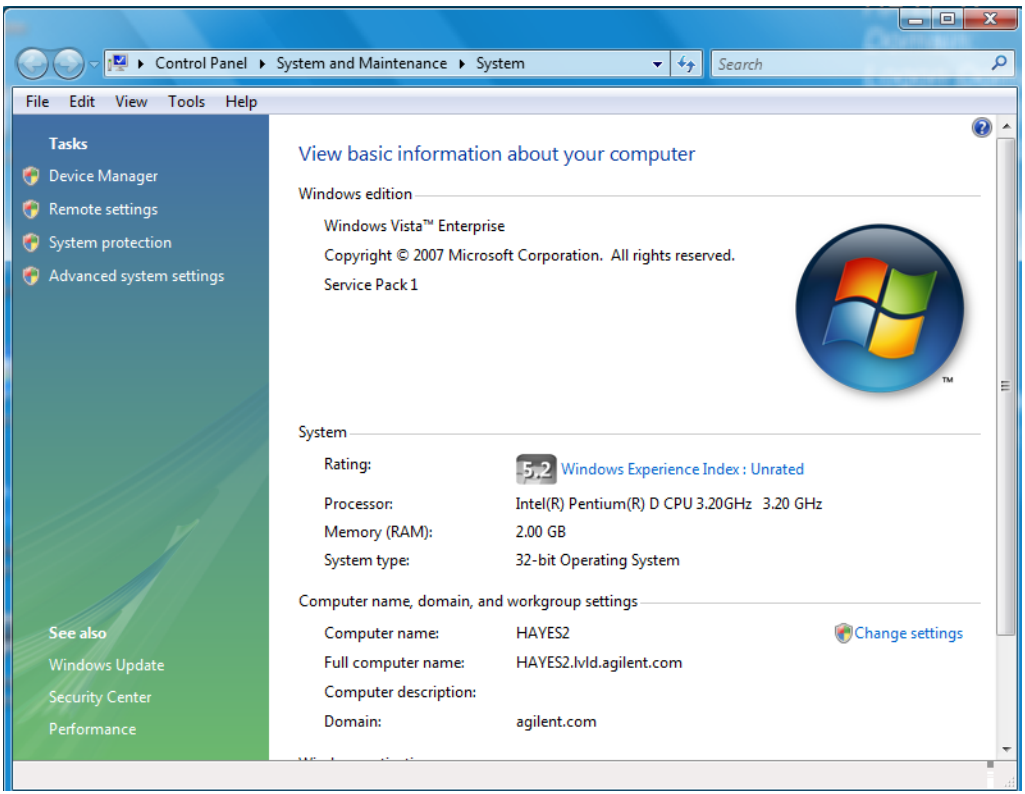


Figure 72 System Maintenance Screen

2 Click the Change Setting button to open the setting window.

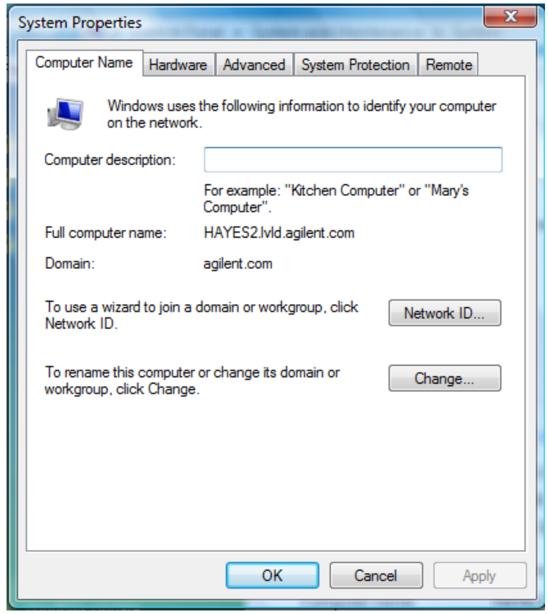


Figure 73 System Properties Screen

Glossary

address

A string (or other language construct) that uniquely locates and identifies a resource. VISA defines an ASCII-based grammar that associates address strings with particular physical devices or interfaces and VISA resources.

Agilent 488

An I/O library provided in Agilent IO Libraries Suite for compatibility with existing test & measurement programs that were developed using National Instruments' NI-488.2 or other similar libraries. Agilent 488 supports communication with GPIB devices and interfaces, but does not support USB, LAN, RS-232, or VXI communications.

alias

See **VISA alias**.

API

Application Programming Interface. The interface that a programmer sees when creating an application. For example, the VISA API consists of the sum of all of the operations, attributes, and events of each of the VISA ResourceClasses.

bridge

In telecommunication networks, a bridge is a product that connects a local area network (LAN) to another local area network that uses the same protocol (for example, Ethernet or token ring). You can envision a bridge as being a device that decides whether a message from you to someone else is going to the local area network in your building or to someone on the local area network in the building across the street. A bridge examines each message on a LAN, “passing” those known to be within the same LAN, and forwarding those known to be on the other interconnected LAN (or LANs).

client

Part of the client/server model used in distributed computing. A client is a computer system that requests services from a server computer system, such as I/O application requests, networking requests, etc.

Connection Expert (or Agilent Connection Expert)

An Agilent software utility that helps you quickly establish connections between your instruments and your PC. It also helps you troubleshoot connectivity problems. Connection Expert is part of the Agilent IO Libraries Suite product.

controller

A computer used to communicate with a remote device such as an instrument. In the communications between the controller and the device, the controller is in charge of and controls the flow of communication that is, it does the addressing and/or other bus management).

device

A unit that receives commands from a controller. Typically a device is an instrument but could also be a computer acting in a non-controller role, or another peripheral such as a printer or plotter.

device driver

Software code that communicates with a device: for example, a printer driver that communicates with a printer from a PC. A device driver may either communicate directly with a device by reading to and writing from registers, or it may communicate through an interface driver.

DHCP

Short for Dynamic Host Configuration Protocol, a protocol for assigning dynamic IP addresses to devices on a network. With dynamic addressing, a device can have a different IP address every time it connects to the network.

In some systems, the device's IP address can even change while it is still connected. DHCP also supports a mix of static and dynamic IP addresses.

Dynamic addressing simplifies network administration because the software keeps track of IP addresses rather than requiring an administrator to manage the task. This means that a new computer can be added to a network without manually assigning it a unique IP address.

DNS

Short for Domain Name System (or Service), an Internet service that translates domain names into IP addresses. Because domain names are alphabetic, they are easier to remember. The Internet, however, is really based on IP addresses. Every time you use a domain name, therefore, a DNS service must translate the name into the corresponding IP address.

For example, the domain name **www.example.com** might translate to 198.105.232.4. The DNS system is a distributed system. If one DNS server does not know how to translate a particular domain name, it asks another one, and so on, until the correct IP address is returned.

driver

See **instrument driver** and **device driver**.

Ethernet (MAC) address

The Media Access Control Address, also known as the link-level address, the Ethernet (station) address, the LANIC ID, and the hardware address. This is a unique 48-bit address assigned by the manufacturer for each Ethernet device. It is usually displayed as 12 hexadecimal characters, sometimes with colon or dash separators between every two characters, such as “00:03:d3:00:00:17” or “00-03-d3-00-00-17”.

explorer view

The tree view within the Connection Expert window that shows all devices connected to a test system.

gateway

Hardware that permits a network connection between the LAN that your computer understands and the instrument specific interface that your device understands.

gateway IP address

This parameter is the IP address of the default subnet gateway that allows an instrument to communicate with systems that are not on the local subnet. Thus, this is the default subnet gateway where packets are sent that are destined for a device not on the local subnet, as determined by the subnet mask setting. Only one default subnet gateway can be configured. A value of 0.0.0.0 indicates that no subnetting is to be done.

hub

A common connection point for devices in a network. Hubs are commonly used to connect segments of a LAN. A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.

- **Passive hubs** serve simply as a conduit for the data, enabling it to go from one device (or segment) to another.
- **Intelligent hubs** include additional features that enables an administrator to monitor the traffic passing through the hub and to configure each port in the hub. Intelligent hubs are also called manageable hubs.
- **Switching hubs** actually read the destination address of each packet and then forward the packet to the correct port.

instrument

A device that accepts commands and performs a test or measurement function.

instrument driver

Software that runs on a computer to allow an application to control a particular instrument.

Interactive IO

An Agilent application that allows you to interactively send commands to instruments and read the results. Interactive IO is part of the Agilent IO Libraries Suite product.

interface

A connection and communication media between devices and controllers. Interfaces include mechanical, electrical, and protocol connections.

interface driver

Software that communicates with an interface. The interface driver also handles commands used to perform communications on an interface.

interrupt

An asynchronous event that requires attention and actions that are out of the normal flow of control of a program.

IO Control

The icon in the Windows notification area (usually the lower right corner of your screen). The IO Control gives you access to Agilent I/O utilities such as Connection Expert, Agilent I/O documentation, and VISA options.

IO Libraries

Application programming interfaces (APIs) for direct I/O communication between applications and devices. There are four Agilent IO Libraries in the Agilent IO Libraries Suite: VISA, VISA COM, SICL, and Agilent 488.

IP address

An Internet Protocol (IP) address is an identifier for a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination. The format of an IP address is a 32-bit numeric address written as four numbers separated by periods. Each number can be zero to 255. For example, 1.160.10.240 could be an IP address.

Within an isolated network, you can assign IP addresses at random as long as each one is unique. However, connecting a private network to the Internet requires using registered IP addresses (called Internet addresses) to avoid duplicates. The four numbers in an IP address are used in different ways to identify a particular network and a host on that network. The InterNIC Registration Service assigns Internet addresses from the following three classes.

- Class A - supports 16 million hosts on each of 127 networks
- Class B - supports 65,000 hosts on each of 16,000 networks
- Class C - supports 254 hosts on each of 2 million networks

LAN

Local Area Network. A computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANs over any distance via telephone lines and radio waves. A system of LANs connected in this way is called a wide-area network (WAN).

Most LANs connect workstations and personal computers. Each node (individual computer) in a LAN has its own CPU with which it executes programs, but it also is able to access data and devices anywhere on the LAN. This means that many users can share expensive devices, such as laser printers, as well as data. Users can also use the LAN to communicate with each other, by sending e-mail or engaging in chat sessions.

There are many different types of LANs, Ethernets being the most common for PCs. Most Apple Macintosh networks are based on Apple's AppleTalk network system, which is built into Macintosh computers. The following characteristics differentiate one LAN from another:

topology: The geometric arrangement of devices on the network. For example, devices can be arranged in a ring or in a straight line.

protocols: The rules and encoding specifications for sending data. The protocols also determine whether the network uses a peer-to-peer or client/server architecture.

media: Devices can be connected by twisted-pair wire, coaxial cables, or fiber optic cables. Some networks do without connecting media altogether, communicating instead via radio waves.

LANs are capable of transmitting data at very fast rates, much faster than data can be transmitted over a telephone line. However, the distances are limited and there is also a limit on the number of computers that can be attached to a single LAN.

Listener

A device that can receive data from the bus when instructed (addressed to listen) by the System Controller.

lock

A state that prohibits other users from accessing a resource, such as a device or interface.

logical unit

A number associated with an interface. A logical unit, in SICL and Agilent VEE, uniquely identifies an interface. Each interface on the controller must have a unique logical unit.

network

A group of two or more computer systems linked together. There are many types of computer networks, including:

local-area networks (LANs): The computers are geographically close together (that is, in the same building).

wide-area networks (WANs): The computers are farther apart and are connected by telephone lines or radio waves.

campus-area networks (CANs): The computers are within a limited geographic area, such as a campus or military base.

metropolitan-area networks MANs): A data network designed for a town or city.

home-area networks (HANs): A network contained within a user's home that connects a person's digital devices.
In addition to these types, the following characteristics are also used to categorize different types of networks:

topology: The geometric arrangement of a computer system. Common topologies include a bus, star, and ring. See the Network topology diagrams in the Quick Reference section of Webopedia.

protocol: The protocol defines a common set of rules and signals that computers on the network use to communicate. One of the most popular protocols for LANs is called Ethernet. Another popular LAN protocol for PCs is the IBM token-ring network.

architecture: Networks can be broadly classified as using either a peer-to-peer or client/server architecture.

Computers on a network are sometimes called nodes. Computers and devices that allocate resources for a network are called servers

network protocols

The protocol defines a common set of rules and signals that computers on the network use to communicate. One of the most popular protocols for LANs is called *Ethernet*. A description of the ARP, DHCP, DNS, FTP, HTTP, ICMP, and RPC protocols follows.

ARP: Short for Address Resolution Protocol, a TCP/IP protocol used to convert an IP address into a physical address (called a DLC address), such as an Ethernet address.

DHCP: See DHCP

DNS: See DNS

FTP: Abbreviation of File Transfer Protocol, the protocol used on the Internet for sending files.

HTTP: Short for HyperText Transfer Protocol, the underlying protocol used by the World Wide Web. HTTP defines how messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands.

ICMP: Short for Internet Control Message Protocol, an extension to the Internet Protocol (IP) defined by RFC 792. ICMP supports packets containing error, control, and informational messages. The ping command, for example, uses ICMP to test an Internet connection.

RPC: Abbreviation of remote procedure call, a type of protocol that allows a program on one computer to execute a program on a server computer. Using RPC, a system developer need not develop specific procedures for the server. The client program sends a message to the server with appropriate arguments and the server returns a message containing the results of the program executed.

non-Controller role

A computer is in a non-Controller role when it acts as a device communicating with a computer that is in a Controller role.

notification area

The area on the Windows taskbar where notifications are posted, typically in the lower right corner of the screen. Also called **taskbar notification area** or **Windows notification area**.

primary VISA

The VISA installation that controls the visa32.dll file. The primary VISA will be used by default in VISA applications. See also **secondary VISA**.

programming alias

See **VISA alias**.

proxy server

A server that sits between a client application, such as a web browser, and a real server. It intercepts all requests to the real server to see if it can fulfill the requests itself. If not, it forwards the request to the real server. Proxy servers have two main purposes:

Improve performance: Proxy servers can dramatically improve performance for groups of users, since a proxy server saves the results of all requests for a certain amount of time. Consider the case where both user X and user Y access the Web through a proxy server. First user X requests a certain Web page, which we will call Page 1. Sometime later, user Y requests the same page.

Instead of forwarding the request to the Web server where Page 1 resides, which can be a time-consuming operation, the proxy server returns the Page 1 it already fetched for user X. Since the proxy server is often on the same network as the user, this is a much faster operation. Real proxy servers support hundreds or thousands of users.

Filter requests: Proxy servers can also be used to filter requests. For example, a company might use a proxy server to prevent its employees from accessing a specific set of Web sites.

refresh

In Connection Expert, the action that invokes the discovery mechanism for detecting interfaces and instruments connected to your computer. The explorer view is then refreshed to show the current, discovered state of your test system.

register

An address location that contains a value that represents the state of hardware, or that can be written into to cause hardware to perform a specified action or to enter a specified state.

router

A device that connects any number of LANs. Routers use headers and a forwarding table to determine where packets go. They use Internet Control Message Protocol (ICMP) to communicate with each other and configure the best route between any two hosts. Very little filtering of data is done through routers. Routers do not care about the type of data they handle. Routers often have DHCP Server capability.

SCPI

Standard Commands for Programmable Instrumentation: a standard set of commands, defined by the SCPI Consortium, to control programmable test and measurement devices in instrumentation systems.

secondary VISA

A VISA installation that does not install visa32.dll in the standard VISA location. The secondary VISA installation names its VISA DLL with a different name (agvisa32.dll) so that it can be accessed programmatically. The primary VISA will be used by default in VISA applications. See also **primary VISA**.

server

Part of the client/server model used in distributed computing. The server is a computer system designated to act as a main servicer of requests from other client computer systems, such as I/O application requests, networking requests, and so forth.

session

VISA term for a communication channel. An instance of a communications path between a software element and a resource. Every communication channel in VISA is unique.

SICL

Standard Instrument Control Library. SICL is an Agilent-defined API for instrument I/O. Agilent SICL is one of the IO Libraries installed with Agilent IO Libraries Suite.

side-by-side

A side-by-side installation allows two vendors' implementations of VISA to be used on the same computer. See also **primary VISA** and **secondary VISA**.

SRQ

An IEEE-488 Service Request. This is an asynchronous request (an interrupt) from a remote device that requires service. In GPIB, an SRQ is implemented by asserting the SRQ line on the GPIB. In VXI, an SRQ is implemented by sending the Request for Service True event (REQT).

status byte

A byte of information returned from a remote device that shows the current state and status of the device. If the device follows IEEE-488 (GPIB) conventions, bit 6 of the status byte indicates whether the device is currently requesting service.

subnet

A portion of a network that shares a common address component. On TCP/IP networks, subnets are defined as all devices whose IP addresses have the same prefix. For example, all devices with IP addresses that start with 100.100.100. would be part of the same subnet. Dividing a network into subnets is useful for both security and performance reasons. IP networks are divided using a subnet mask.

subnet mask

A mask used to determine to what subnet an IP address belongs. An IP address has two components: the network address and the host address. For example, consider the IP address 150.215.017.009. Assuming this is part of a Class B network, the first two numbers (150.215) represent the Class B network address and the second two numbers (017.009) identify a particular host on this network.

Subnetting enables a system administrator to further divide the host part of the address into two or more subnets. In this case, a part of the host address is reserved to identify the particular subnet.

For example, the full address for 150.215.017.009 is 10010110.11010111.00010001.00001001. The Class B network part is 10010110.11010111 and the host address is 00010001.00001001. If this network is divided into 14 subnets, the first four bits of the host address (0001) are reserved for identifying the subnet.

The subnet mask is the network address plus the bits reserved for identifying the subnetwork. (By convention, the bits for the network address are all set to 1, though it would also work if the bits were set exactly as in the network address.) In this case, the subnet mask is 11111111.11111111.11110000.00000000.

It is called a mask because it can be used to identify the subnet to which an IP address belongs by performing a bitwise AND operation on the mask and the IP address. The result is the subnetwork address:

Subnet Mask 255.255.240.000
11111111.11111111.11110000.00000000
IP Address 150.215.017.009
10010110.11010111.00010001.00001001
Subnet Address 150.215.016.000
10010110.11010111.00010000.00000000

switch

A device that filters and forwards packets between LAN segments. Switches operate at the data link layer (layer 2) and sometimes the network layer (layer 3) of the OSI Reference Model and therefore support any packet protocol. LANs that use switches to join segments are called switched LANs or, in the case of Ethernet networks, switched Ethernet LANs. A hub connects all the devices on its “ports” together.

A switch is a bit smarter, as it understands when two devices (out of four, five, eight, sixteen, or even more) want to talk to each other and gives them a switched connection.

symbolic name

A name corresponding to a single interface. This name uniquely identifies the interface on a controller or gateway. If there is more than one interface on the controller or gateway, each interface must have a unique symbolic name.

System Controller

One Controller on a GPIB is the System Controller. This is a master Controller; it has the ability to demand control and to assert the IFC (Interface Clear) and REN (remote enable) lines.

system tray

See **notification area**.

task guide

The information and logic represented in the left pane of the Connection Expert window. The task guide provides links to actions and information that help guide you through the most common I/O configuration tasks.

taskbar notification area

See **notification area**.

test system

An entire test setup including a controller (often a PC), instruments, interfaces, software, and any remote controllers, instruments, and interfaces that are configured to be used as part of the system.

Universal Plug and Play

Universal Plug and Play (UPnP) is an open industry standard that uses Internet and Web protocols to enable devices such as PCs, peripherals, intelligent appliances, and wireless devices to be plugged into a network and automatically know about each other.

UPnP is an architecture for pervasive peer-to-peer network connectivity of PCs and intelligent devices or appliances. UPnP builds on Internet standards and technologies, such as TCP/IP, HTTP, and XML, to enable LAN devices to automatically connect with one another and work together.

With UPnP, when a user plugs a device into the network, the device will configure itself, acquire a TCP/IP address, and use a discovery protocol based on the Internet's Hypertext Transfer Protocol (HTTP) to announce its presence on the network to other devices. UPnP devices use Extensible Markup Language (XML) to establish a common language, or “protocol negotiation”, to talk to each other and determine capabilities.

VEE

The Agilent Visual Engineering Environment, which is software used for I/O application programming.

virtual instrument

A name given to the grouping of software modules (such as VISA resources with any associated or required hardware) to give them the functionality of a traditional stand-alone instrument. Within VISA, a virtual instrument is the logical grouping of any of the VISA resources. The VISA Instrument Control Resources Organizer serves as a means to group any number of any type of VISA Instrument Control Resources within a VISA system.

VISA

The Agilent Virtual Instrument Software Architecture library, which is software used for I/O application programming. Agilent VISA is part of the IO Libraries Suite product.

VISA address

A resource descriptor that can be used to open a VISA session.

VISA alias

A string that can be used instead of a resource descriptor in VISA programs. Using VISA aliases rather than hard-coded resource descriptors makes your programs more portable. You can define VISA aliases for your instruments in Connection Expert.

VISA COM

The VXI*plug&play* specification for a COM-compliant VISA I/O library and its implementation. Agilent VISA COM is part of the Agilent IO Libraries Suite.

Windows notification area

See **notification area**.

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