Creating a wireless LAN connection to a measurement system

Application Note 1409-3

⠿ Agilent Technologies

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Introduction

Using a LAN to communicate with your test instruments gives you the ability to share instruments easily, collaborate with geographically dispersed colleagues, and control and program your instruments from remote locations. A wireless LAN provides all these advantages and more.

The primary benefit of using a wireless LAN connection is obvious: with no wires to worry about, test equipment can be placed in hard-to-access locations where conventional LAN infrastructure does not exist. A wireless connection allows technicians and engineers to easily access a remote test system to monitor or configure the equipment or retrieve system data.

This application note discusses applications for wireless LAN connections and outlines situations where their use is not appropriate. It provides instructions for integrating test and measurement equipment into a wireless LAN, including an overview of hardware requirements and software or configuration considerations.

When to use wireless LAN

You can easily implement wireless LAN for most measurement applications using either 802.11a or 802.11b technology. There are some situations where wireless LAN solves a knotty problem or is significantly more convenient, and a few where it is unsuitable.

Optimal applications

Wireless LAN is particularly useful in situations where:

• Infrastructure for conventional LAN cabling does not exist (old buildings without LAN wiring, for example)

• Test equipment needs to be located in a difficult-to-reach location (on a rooftop or in a tunnel, for example)

• Test equipment is moving (in a racecar or on a boat, for example)

• Test equipment needs to be electrically isolated from the surrounding environment (high-voltage systems, for example)

• Test equipment is frequently shared by multiple people

Unsuitable applications

Wireless LAN is not a good choice when the test system itself is measuring, generating or using frequencies in the wireless LAN low-gigahertz range (2-6 GHz). For example, if you were using a network analyzer to measure the antenna pattern of a 2 GHz antenna, you would not want to transmit your data on a wireless LAN that is also operating at 2 GHz. You also need to avoid situations where your instrument is sensitive to the transmission frequency. For example, if you were measuring a 12 GHz communication with a satellite that has a broadband antenna (1-50 GHz) and transmitted your data via wireless LAN signals at 2 GHz, that transmission could be picked up by your antenna.

Security issues

A common misperception about wireless LAN security—or lack of it—makes some engineers and technicians reluctant to adopt the technology. They are concerned that data is left "floating in air" and is readily retrievable by a passerby. However, it is not difficult to protect your data.

A wireless LAN can be encrypted with a coding system similar to the one you use when you buy books from Amazon.com or make purchases from other Internet vendors. See Figure 1. You can further increase security by limiting access to computers from a single subdomain, or even to one particular computer.

Figure 1. Wireless LAN can be limited to a set of particular computers.
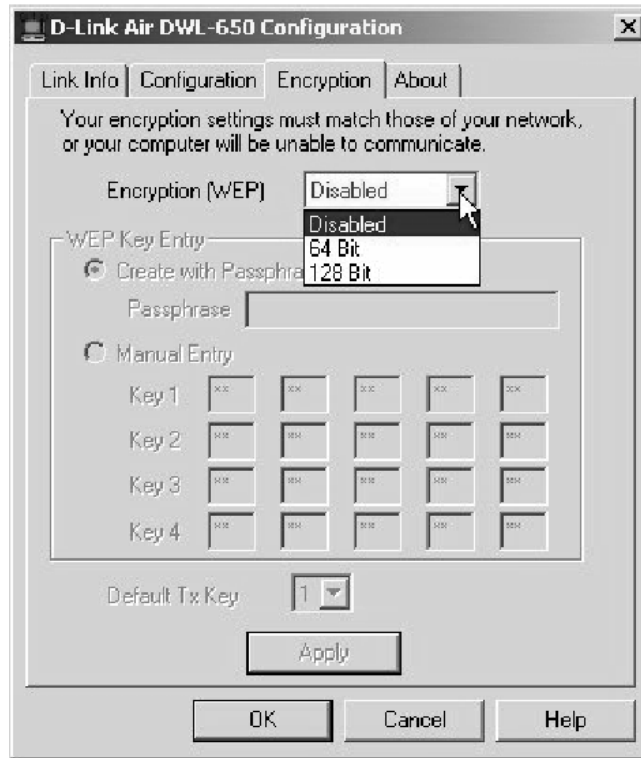
How to integrate test and measurement equipment into a wireless LAN

Implementing a wireless LAN for your measurement applications is not particularly difficult, at least in part because several of the necessary components are commonly available and widely used for other applications.

Hardware requirements

To get your test instruments and your computer to communicate over a wireless LAN, both pieces of equipment ultimately need to have a wireless LAN interface. There are several different ways to accomplish that.

• **Computer**—You can use a desktop or laptop computer equipped with either a wireless LAN interface or a wired LAN interface. Some newer computers come with wireless LAN already built-in, and for most other computers, you can use wireless LAN adapters. (See Figure 2 for a typical setup with a laptop.) If you have a wired LAN interface on your computer, you can use a commercial wireless access point (such as D-Link Air or Apple Airport Base Station) for converting wired LAN to wireless LAN.

• **Test instruments**—For some newer test instruments, LAN is a standard interface. If your instrument is equipped with a LAN interface, all you need to do is connect the instrument to a wireless access point, such as an Apple Airport Base Station or D-Link Air wireless hub. For other GPIB and RS-232 instruments without built-in LAN interfaces, an I/O converter such as the Agilent E5810 LAN/GPIB Gateway provides GPIB and RS-232 communication over the LAN. See Figure 3. With an I/O converter in place, you can use a wireless access point (such as the ones listed above) to

Figure 2.
The simplest configuration: a laptop with a wireless LAN interface communicates via a hub to a test instrument with a built-in LAN interface
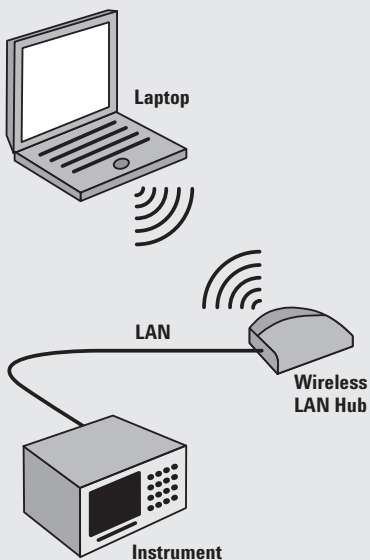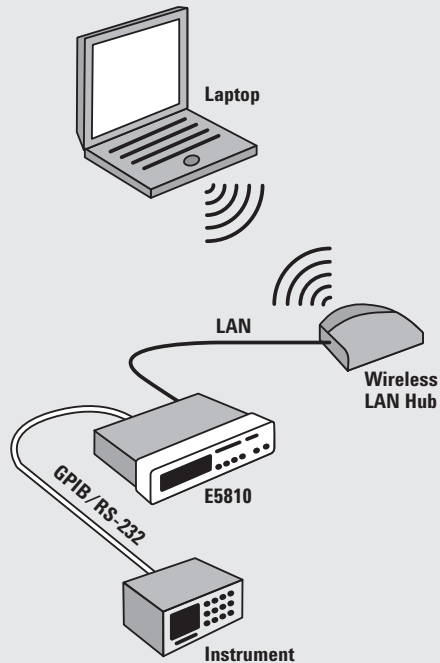

Figure 3.
Wireless connection with GPIB instruments connected via a LAN/GPIB gateway

convert the LAN connection to a wireless LAN. Figures 3 and 4 show setups that include the I/O converter. Figure 4 represents a typical system operating via a wireless LAN.

Software configuration

You can configure a wireless hub (such as Apple's Airport Base Station) to automatically serve IP addresses—through a protocol called DHCP (dynamic host configuration protocol)—to the attached devices, either directly to the LAN instrument or indirectly, through I/O converters such as the E5810A LAN/GPIB Gateway.

Once the wireless hub gives an IP address to the attached devices, you can communicate with the wireless hub from a laptop equipped with a wireless LAN interface, or from another wireless hub. The actual procedure for doing this is system-dependent and typically involves using supplied system software to scan for the wireless LAN and to establish a connection. See Figure 5. For example, using an Apple laptop and Airport Base Station, you can configure the Airport Base Station with a known name (e.g., "wireless_hub1") and then just push a button to connect to that hub.
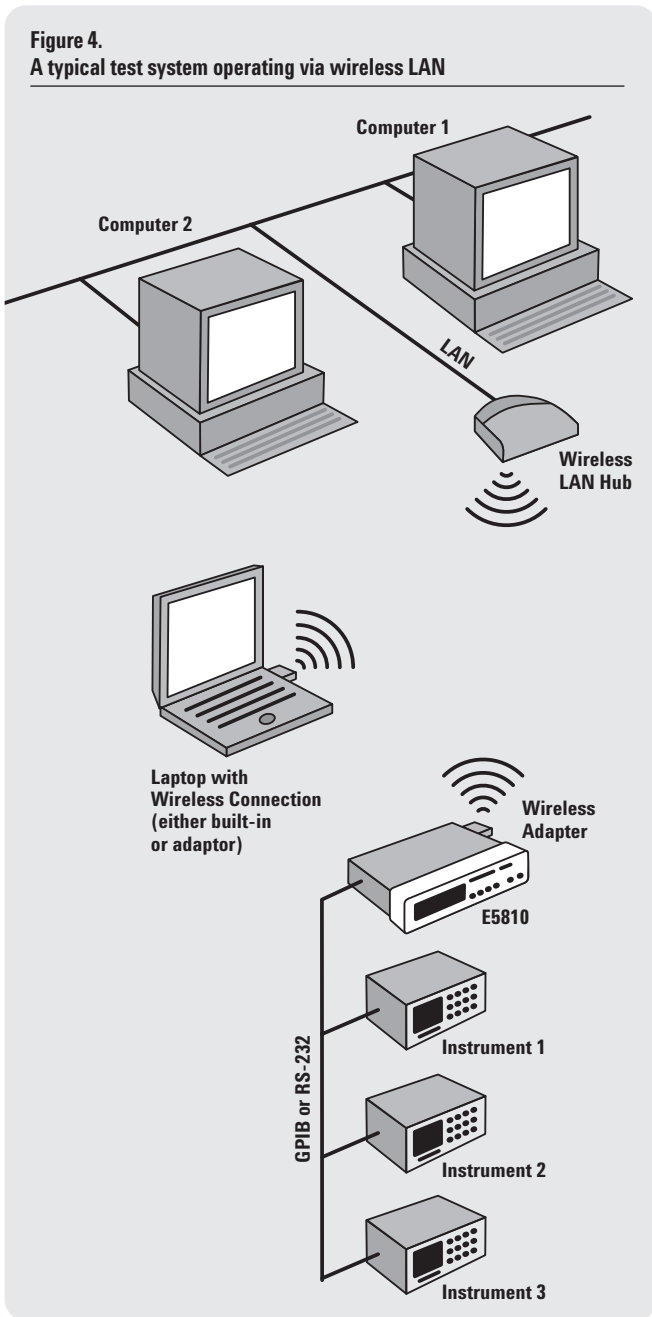
Figure 4.
A typical test system operating via wireless LAN

Figure 5. Wireless hub configuration typically is a straightforward process.

## Communicating with test system instruments

Through a web browser

You can use a Web browser to communicate with test instruments that have a built-in Web server (such as Agilent ESG-series signal generators, PSA- and VSA-series signal analyzers, PNA-series network analyzers, and Infiniium oscilloscopes). Just type the IP address of the instrument as the URL. Since a Web browser is operating-system independent, you can configure or view current instrument settings from most every type of computer or operating system.

For GPIB or RS-232 instruments that lack a native LAN interface, an E5810A LAN/GPIB Gateway simulates a Web server interface to the test instruments. See Figure 6. This interface allows you to easily configure and retrieve data and status information via a Web browser.

Figure 6. I/O converters with a built-in web server let you configure or view instrument settings via a web browser.
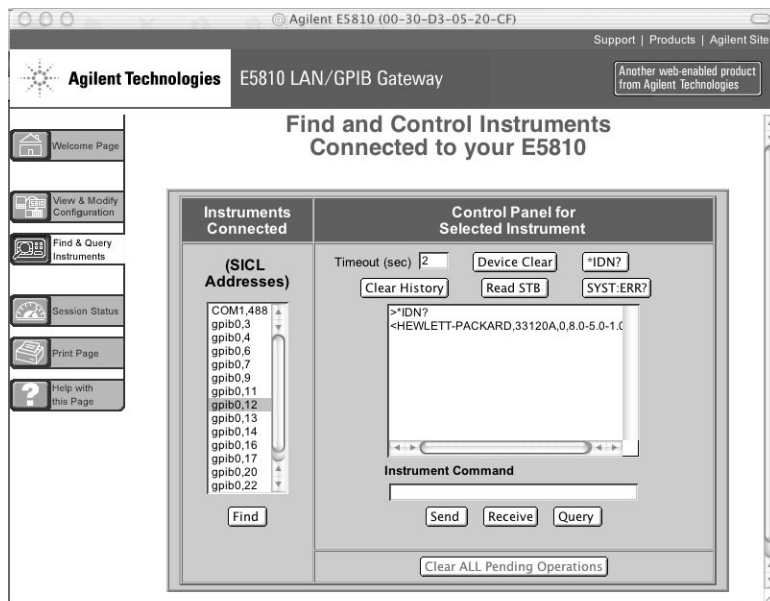
Through programmatic control

For more programmatic control, some vendors have standard I/O libraries such as VISA, which allow for programming instruments with standard languages. The Agilent I/O Libraries allow you to configure the LAN interface to emulate GPIB or RS-232. Since the wireless LAN uses standard LAN protocol, you can use the same methods you use for programming over the LAN to program over the wireless LAN. The I/O libraries provide a level of transparency to higher-level programming, so standard programs that use such libraries are able to access and control the instruments using standard GPIB commands. To these programs, the "wireless" nature of the interface is completely transparent. For example, if you send the SCPI command

"MEAS:VOLT:DC"

to a DMM at address 2 on interface GPIB0, the 'c' code

viOpenDefaultRM(&defRM);

viOpen(defRM, "GPIB0::2::INSTR", VI_NULL, VI_NULL,&vi);

viPrintf(vi, "Meas:Volt:DC\n");

viClose(vi);

remains the same regardless of whether you are communicating over a wireless LAN, wired LAN, GPIB, or RS-232 interface.

Summary

Now, test equipment that resides in hard-to-access locations can be easily accessed via a wireless LAN connection. For the majority of test systems, wireless LAN is easy to set up. It is transparent to most programming models and has many advantages over traditional wired LAN models. You can easily connect instruments with built-in LAN via a wireless hub. And you can integrate GPIB or RS-232 instruments to wireless LAN using a LAN/GPIB gateway (such as Agilent's E5810) and a wireless hub.

Glossary

802.11a—5GHz wireless LAN protocol transmitting at 54Mbps

802.11b—2.4GHz wireless LAN protocol transmitting at 11Mbps

802.11g—2.4GHz wireless LAN protocol transmitting at 22Mbps

LAN—local area network. Commonly refers to a means of allowing multiple computers to transfer data.

Byte—eight bits

Mbps—mega-bits per second

MBps—Mega-bytes per second

Kbps—kilobits per second

Airport—Apple computer's name for 802.11b, a 2.4-GHz wireless LAN protocol transmitting at 11 Mbps

GPIB—General purpose interface bus. A common backplane protocol originally known as HPIB, which was developed by Hewlett-Packard (now Agilent Technologies), for communication between test instruments. Maximum transfer speed is around 1MBps (8Mbps)

RS-232—A common serial interface found on many test instruments and computers. A common transfer speed is around 100 kbps.

Related Agilent literature

Data sheet—E5810A LAN/GPIB Gateway, pub no. 5988-5810EN

Application Note—AN 1409-1, Simplified PC Connections for GPIB Instruments, pub no. 5988-5897EN

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