# Networking possibilities in the analytical laboratory with Agilent instrumentation and data systems

## Application Note

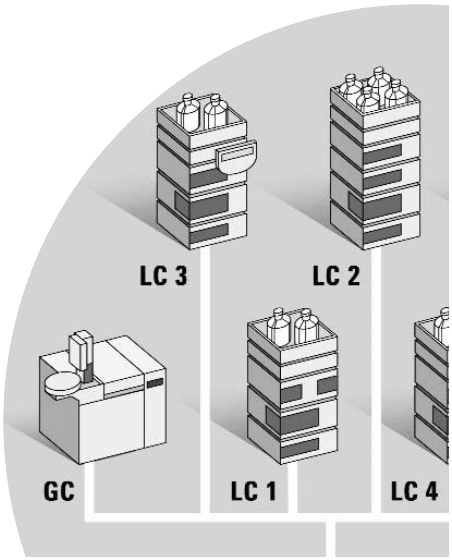
### Introduction

As the need for better information increases, connecting computers in a network is becoming more and more prevalent as a means to share resources and enable better decisions by bringing information together from diverse platforms. Networking is straightforward and easy to understand with standard platforms and protocols governed by the computer and telecommunications industry.

The infrastructure needed such as network interface cards (NICs), hubs and cabling is inexpensive. What can be costly is the labor and materials required to install the network cables throughout laboratories, between buildings, and across geographically dispersed sites.

The industry has addressed these costs by utilizing new technology that allows to connect computers in wireless networks. A standard called IEEE 802.11b was developed using the previously unused 2.45 GHz band of the radio spectrum. This technology enables wireless communication between computers at speeds of 11 Mb/s (megabits per second.) This frequency band is restricted for communication use by the United States Federal Communications Commission (FCC) to reduce interference by other equipment.

Using standard, low-cost interfaces such as those available form Cisco, Linksys, D-Link, Lucent, 3Com, and other vendors, a laboratory can set up an infrastructure for networking computers without the cost of installing cables throughout the building to all possible nodes.

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In addition to lower installation costs, users are free to roam about while retaining full connectivity. The first commercial installations are being realized at college campuses in the United States, enabling students to be fully connected to the network while doing research or studies anywhere on the campus. For laboratory staff, this setup would enable them to bring a portable PC such as a laptop into the lab where the samples are prepared and the instrument is loaded, then take the laptop to their office while maintaining full control over the instrument.

Strict adherence to open standards has allowed Agilent to take advantage of this new technology. All modern Agilent instrumentation can utilize standard local area networks (LAN) for communication between the computer and the instrument. For older instruments the familiar and rugged JetDirect interface is used, which was designed for the Hewlett-Packard LaserJet family of printers. For new instrumentation, the Ethernet LAN connection is built in. This enables the instrument to use the speed and reliability of this protocol as opposed to the outdated and problematic general-purpose interface bus, GPIB (IEEE-488). GPIB was developed in the early 1970's by Hewlett-Packard for computer communication and has been used successfully for nearly 30 years.

The speed and advancement of computers today has meant that this protocol has outlived its usefulness. Some of the shortcomings of the GPIB interface are listed below.

- Instrument can only be a short distance from the computer
- Cables are expensive
- Support for outdated interfaces is poor
- Daisy-chain design means disruption on one node affects all nodes on the bus
- 8-bit data stream
- Only connected device allow to access instrumentation

Local area networks and the underlying TCP/IP protocol was developed to share information among many users across the globe. This is the protocol that the internet is built on and thereby has many advantages over older technologies.

- Built-in error checking — if a data packet does not reach its destination, it is resent automatically
- Low-cost cabling and connectivity
- High-speed transfer rates (surpassing gigabits per seccond)
- Standards are open, well supported, and well understood by industry
- Distributed nature allows resources to be shared by all connected users
- No distance limitations between connections

## Moving to wireless

Adding to all of the benefits of the standard LAN, a wireless LAN takes networking one step further by simply removing the need to install cables within or between buildings. The system uses wireless access points and wireless receiver interface cards in the PC's requiring access to the system. Because it's an industry standard, solutions are provided by many vendors and all can work together. Wireless network cards are available in PCMCIA format for laptop PCs or PCI formats for desktop PCs.

The devices tested were the Aeronet family of wireless products provided by Cisco Systems, San Jose, CA. The Cisco products were chosen for the test because of their superior encryption and easy-to-use software that visually monitors the connection quality. In the test setup of the wireless laboratory, the Cisco Aeronet 340 series access point and the 340 series PCMCIA wireless network interface cards were used.

## Experimental

In the test lab, Agilent 1100 Series LC systems and Agilent Series 6890 and 6850 GC systems were set up, including option #500 JetDirect card to make a connection to a standard LAN hub. This hub was then linked to the Cisco Aeronet wireless access point. From this access point, any computer with a wireless network card can be given full access to the laboratory network, see figure 1.

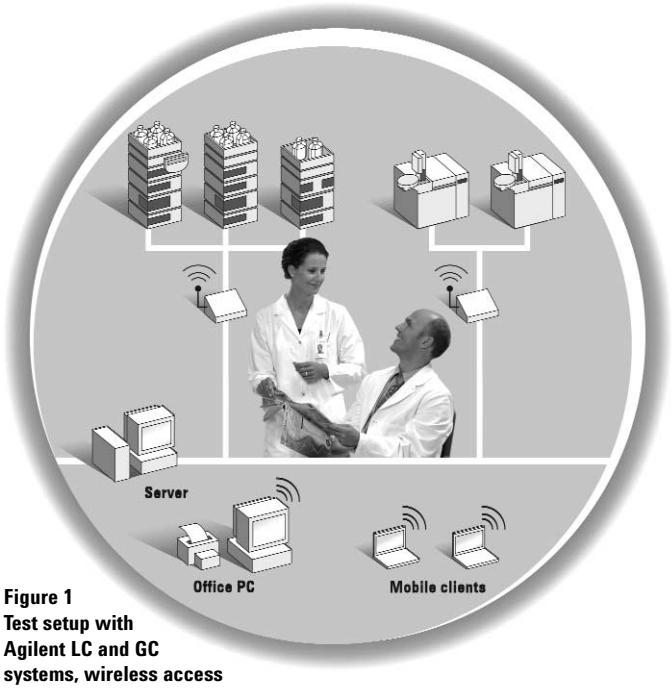


**Figure 1**
**Test setup with Agilent LC and GC systems, wireless access points and remote PCs**

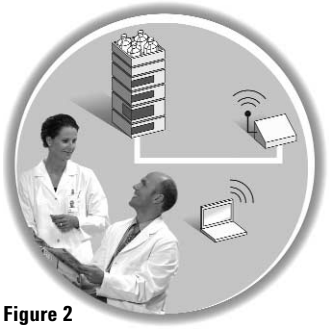

**Figure 2**
**Test setup with single instrument and PC**

This allows users to have full control over the laboratory instruments, including monitoring, data analysis and run control, as well as access to previous data stored on the centralized database server.

A simple system with a single connection to the instrument, allowing the instrument to be wireless, was also tested. In this setup, no LAN backbone is necessary. A simple crossover cable allows the instrument to be connected to the wireless access point, and then controlled with the wireless laptop PC, see figure 2. With this configuration, no wires are needed at all and the instrument itself becomes portable as far as the communication is concerned.

This setup used the cheapest access point (US$ 250) and interface (US$ 100) and allowed to use a range of up to 1500 feet (about 500 meters) in an open environment or up to 300 feet (about 100 meters) in an office building. To extend the range, more expensive equipment could be purchased, some equipment have ranges of up to 25 miles (about 40 km), or more wireless cells could be added by installing further access points at strategic locations throughout the building similar to cell-phone towers. If a connection is lost by moving outside of the covered range, the instrument will hold data in its buffer for a short period depending on data collection rates, giving the user time to reconnect by moving back into range.

In the Agilent ChemStation there is a one-to-one relationship between the controlling computer and the instrument, allowing only one controlling connection to the instrument. This access control ensures that once one person has control of an instrument, another person cannot try to take over control of that instrument. When the instrument has been freed after a run, any person with system access through secure passwords and physical network access can then take control and utilize the instrument resources.

## What about security?

The IEEE 802.11b standard stipulates an optional encryption scheme called wired equivalent privacy (WEP) which offers a mechanism for securing wireless LAN data streams. WEP uses a symmetric scheme where the same key and algorithm are used for both encryption and decryption of data. The goals of WEP include

- Access control – preventing unauthorized users (without a correct WEP key) from gaining access to the network
- Privacy – protecting wireless LAN data streams by encrypting them and allowing decryption only by users with the correct WEP keys (now at 128-bit encryption)

## Conclusions

Using the industry standards of networking for instrument control, Agilent Technologies has enabled its instrumentation to take advantage of the evolution taking place in the computer industry. With better support from operating systems, or IT departments, networking is the protocol of the future for the nalytical laboratory. Whether the lab is moving from wired to wireless or from 10 to 100 to gigabits/second, the future is limitless and being driven as fast as technology allows. This enables the lab to achieve  huge productivity gains by allowing low- cost limitless access to instrumentation and information by all laboratory professionals.

## Support from Agilent

Installation and setup of wireless network communications in an analytical laboratory are only supported by Agilent when the system is designed, planned and tested by the Agilent Professional Services Organization.

## Useful Internet Links

Federal Communications Commission (FCC):
www.fcc.gov

Institute of Electrical and Electronics Engineers (IEEE):
www.ieee.org

**www.agilent.com/chem/nds**



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