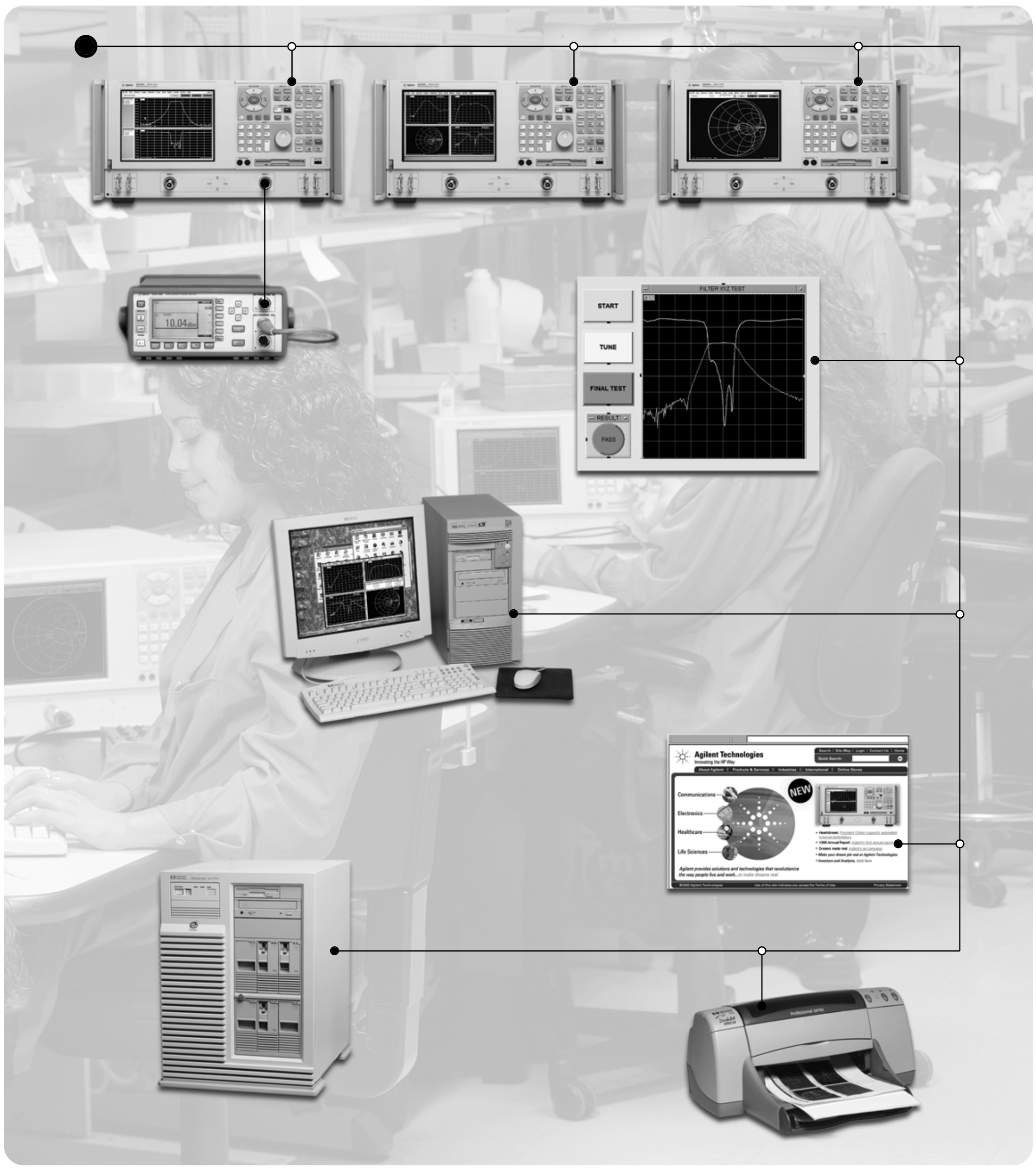
Agilent Connectivity Advances for Component Manufacturers

Product Note



Agilent Technologies

Innovating the HP Way

Introduction

Since the introduction of the IEEE 488 interface, computers have been used to control instrumentation and capture test data. Major strides in productivity and efficiency have been made as tools and standards have improved. Broadband computer networks have enabled the Internet and fundamentally changed the way information is used. The improvements in computation and communication are changing the expectations of how test and measurement data is collected and distributed.

The next step requires the integration of test with information technology to achieve higher levels of productivity and quality. The ability to integrate test with IT infrastructure will have a profound impact on how data will be acquired and utilized. Measurement data from a production line may no longer exist as islands of information. The tools used to generate reports and documentation must work seamlessly with instrumentation. Test data must be made available to stakeholders within the organization and to customers to enable good technical and business decisions.

This paper explores the exciting possibilities LAN-enabled instruments provide within the component manufacturing and test environment. The new Agilent PNA Series of vector network analyzers, built on the Windows® 2000 operating system, integrates a high performance vector network analysis with PC tools and connectivity. The operating system features, along with an elegant application interface, make it easy to share and use measurement data.

Synergy and connectivity

LAN-enabled instrumentation is a new tool within the test and measurement community. While there have been several products that integrate instrumentation with personal computers, network connectivity is enabling new possibilities for the use of information generated by manufacturing test. The synergy between measurement, computation, and communication will dramatically enhance productivity on the production floor.

What is connectivity? The word 'connectivity' refers to the ability to communicate with another device. This communication is important for both hardware and software interfaces to make the connection appear seamless and simple. The emergence of the Internet as the standard for network communication has forced the industry to agree on standards for connectivity. The Internet has enabled explosive growth in products, tools, and technology. Building instruments using tools and operating systems that support Internet connectivity provide the inherent capabilities of this expanding technology. A Windows 2000 operating system meets these requirements.

The Agilent PNA Series of network analyzers runs as an application under Windows 2000. Windows allows the user to interact with the instrument using a mouse and keyboard with dropdown menus or by using the traditional hardkey/softkey interface. The network analyzer behaves like any other Windows application. It allows the user to copy a screen image from the network analyzer to the clipboard and then paste it into another application. Drag and drop file transfer and drive mapping are supported. The instrument graphical user interface has a familiar look and feel so PC-users can instantly be familiar with a scientific test instrument.

LAN connectivity provides new capabilities for the network analyzer. The Windows 2000 operating system bundles networking software which supports common LAN protocols. This feature enables the instrument to sit on the corporate LAN and export control and data to any other PC on the network. Instrument automation is available via LAN through its COM interface. The LAN interface can replace the GPIB interface without the need for special cards or cables. Applications such as antenna ranges that used GPIB extenders can now use LAN to provide remote computer control. Network resources such as printers and file servers may be used directly from the instrument.

The tools that are provided by Windows 2000 enable the user to work with others using the network (Figure 1). If the LAN is connected to the Internet, the user may access it using the Internet Explorer web browser. Outlook Express provides access to email and newsgroups. Using NetMeeting, the user can share the network analyzer screen with many others to collaborate on a problem or share solutions.

Figure 1. Agilent PNA Series network analyzers with LAN interface and Windows 2000

Building a common operating environment for manufacturing

In many corporations, the Information Technology (IT) department provides a common operating environment for users of personal computers. The IT department procures and installs an operating system and core applications on each computer. Each user has a consistent set of applications and tools. New software installation and upgrades are provided through the network, eliminating the need to distribute CD-ROMS or floppy disks. Documentation, computer-based training, and help files are posted and maintained in one location, yet available to everyone on the network. The concept of a common operating environment can be applied to LAN-enabled instruments in manufacturing.

The idea is to use a central server to automatically deliver software and documentation to every test station in the network. The server will provide a central location for the latest revisions of the test programs and documentation. During instrument boot-up, a script may be executed that checks the revision dates of the files stored locally against the revision dates of the files on the central server. When a new file is found on the server or when a file is found with a revision date more recent than the file on the local drive, the new files can be automatically copied to the local drive. This process insures the latest revision of automation software is installed on every instrument.

Several benefits are obtained by implementing a common operating environment in manufacturing. Every test station will have a consistent set of applications and automation software. Posting files in a single common location will enable installation of new software or upgrades to old software. Web pages containing test procedures, troubleshooting procedures and on-line help can be maintained on the central server and accessed at each test station using the web browser on the instrument. Measurement data can be stored on the central server, enabling the back up and archival of data. Configuration control for the entire manufacturing site can be insured.

To enable a common operating environment, several tasks must be completed. Network connections must be made available for each test station through a local hub or switch. Each LAN-enabled instrument must be configured to operate within the local network. A PC with a large hard disk drive to store test configurations, documentation, and test data should be designated as the system server. A web server application may be installed and a local web site developed to distribute help files and documentation. A printer may be installed on the server and made available to users on the network. The central server becomes the hub for information distribution and collection.

Figure 2. A common operating environment in manufacturing

How connectivity will change manufacturing

Integrating instrumentation with PC technology will change how information is obtained, distributed, and used in manufacturing. The same computer and information technology that improved productivity and efficiency in the office is now moving into the manufacturing environment (Figure 3). This disruptive technology will crown new winners for those companies that embrace the change and use it to drive quality and efficiency to higher levels.

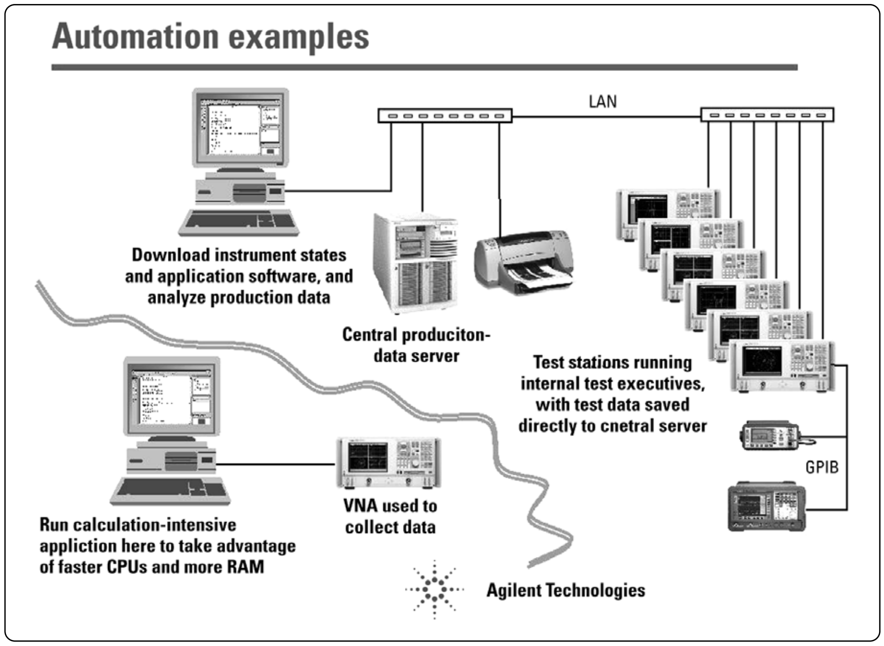


Figure 3. Common operating environment on the manufacturing floor

Knowledge vs. data

Having a set of numbers that describe the performance of a component does not represent knowledge… it is only data. The data must be processed to extract the information, which can then be used to establish quality control processes. This manipulation is often done using markers on trace data within an instrument. Measurements such as 3 dB bandwidth, passband ripple, and stopband rejection may be obtained directly from the measured data using markers. However, there are types of knowledge that require the manipulation of large sets of data. The ability to capture and manipulate measurements from many units taken over a period of time provides a different perspective on the performance of a production line. Process monitoring and statistical quality control are built upon this type of information.

For manual processes the archival of data may be accomplished using floppy disks. The measured data is saved to a floppy disk and the disk put away in a safe place. The idea is to pull the information saved on the floppies into a database and use the information to study historical test data. Unfortunately, often the data is simply stored in a file cabinet and never looked at again.

For automated processes, a program must be written to set up the instruments, measure the device, and archive the data. For statistical quality control (SQC) purposes, either a special program must be developed or a special tool purchased to manipulate the database and extract the desired information. Often the extra effort required to integrate SQC tools into the production environment is not expended for several reasons. The integration of tools requires the attention of the technical people, which is in great demand as a product nears production. The tools tend to be written for a specific production line and require modification for future products. The data formats used by instruments tend to be uncommon and require detailed knowledge to export into database applications. These activities take time and cost money.

How connectivity will change manufacturing

Imagine the impact of easily being able to save measurement data in a common format on a central network server without special programs directly from the measurement instrument. The measurement data becomes immediately available to anyone with a PC and a network connection. Quality assurance engineers can import the information into spreadsheets and re-format the data to monitor the stability of the manufacturing process. Design engineers can review the performance of their design in manufacturing and ask “what if” the specification tolerances change or “what if” the parts are modified. Unexpected manufacturing problems can be researched and resolved. Production management can generate custom reports from the data highlighting trends and identifying costs. The measurement data becomes both a technical and business tool to improve quality and reduce cost.

Providing information for your customers

The Internet in conjunction with LAN-enabled instruments will enable vendors to provide customers with a rich library of measured data to feed simulation tools and product designs. As it becomes easier to acquire and save device measurements, it seems reasonable to assume that more component measurement data will be saved in an electronic format.

Because this data is valuable to customers, component manufacturers could make this data available through the Internet. Designers will work with real data to develop statistical models for the components actually delivered. The availability of this data should improve product designs by enabling designers to deal with normal specification variations.

Remote troubleshooting

In today’s global business environment, component manufacturing companies tend to have sites distributed worldwide. Having manufacturing sites in other parts of the world seems to be the rule rather than the exception. In addition to taking advantage of potential cost savings, manufacturers need to be located near potential emerging markets. This generates major logistical issues when manufacturing problems occur and the design engineers are a long airplane flight away. FAX machines and telephone calls have been successfully used to communicate both problems and solutions, but there are times when the static plot of a network analyzer screen simply does not convey the problem. For example, when a filter design can not be tuned to pass final test, it is critical to see how the filter shape develops as the individual resonators are tuned. The design engineer needs to touch the network analyzer and see real time screen updates.

LAN-enabled instrumentation provides this type of connectivity. The network analyzer screen and remote control may be provided across the Internet using tools such as Microsoft NetMeeting or AT&T Virtual Network Computing (VNC). NetMeeting requires that the local user and remote user share control of the analyzer. VNC enables the remote user to directly control the front panel of the instrument from a PC with a VNC installed. Working with the technician over the phone to tune the filter, the engineer can see the results of tuning in real time. This capability enables a level of remote troubleshooting sufficient to resolve many difficult problems.

With the availability of e-mail on each test station, it becomes quick and easy for a test technician to communicate problems and solutions to remote members of the team. When problems or questions arise, the test technician may document the problem through writing and by using cut-and-paste from the network analyzer screen. Using an approved distribution list, the information may be sent to other technicians on the production line, technicians working other shifts, test engineers, and managers. Often someone working on the line has already seen the problem and can provide a solution. For remote test engineers and managers, the e-mail serves as a flag for the problem and provides a record of events.

How connectivity will change the team

The learning organization

The rapid change in technology requires companies to develop a “learning organization” mentality. Learning organizations are groups that consistently develop and apply knowledge to improve the way work is done. Management within a learning organization provides abundant opportunities for formal education and training. Mentoring and cross training is common. The organization recognizes employees that take advantage of the programs and improve their work performance. The employees tend to be more productive, the work processes more efficient, and the organization more profitable.

Employee retention and the learning organization

With the rapid expansion of wireless technology markets, there is a developing shortage of technical talent in the RF/Microwave arena. To succeed in the marketplace it is becoming increasingly important for companies to attract and retain technical employees. Learning Organizations naturally provide the environment that good employees seek.

Retaining employees typically involves monetary compensation, individual self worth, and team success. Compensation is ultimately limited by productivity within the workplace. Personal contribution and self-improvement impact self worth. Improving quality while reducing cost enhances the chance of success in component manufacturing. All of these elements are present within a learning organization striving to achieve continuous process improvement.

The environment within a learning organization is positive. Workers are involved in improving the manufacturing process. Employees develop new capabilities as they improve the way work is accomplished. Product quality improves as morale and commitment increase. The improvements in productivity allow the company to pay competitive wages. Everything moves in an upward spiral.

Enabling continuous process improvement within a learning organization

A learning organization strives to increase the skill of each individual, enhance synergy between team members, and improve the way work is accomplished. Continuous process improvement is a technique used to drive forward the learning process. Process improvement is achieved by:

- Documenting a process
- Measuring the performance of the process
- Changing the process to improve the measured characteristic
- Measuring the process again to evaluate the impact of the change

Test and measurement is the key to enable process improvement. The ability to measure the key performance characteristics of a process is the foundation to establish the baseline performance and to evaluate the impact of changes. Tests are implemented at various stages of the production process to measure critical performance parameters. The data is integrated and processed to monitor the performance of the processes used in manufacturing. The tests may be performed on every device or sampled using statistical methods.

The result, of using test as a process monitor, is a controlled manufacturing environment with consistent production output. Problems can be flagged quickly and corrective action taken based on measured data. Trend analysis may be performed to identify problems before they become failures. Trends in the process performance may be communicated to all members of the team to prove their effort impacts the outcome.

LAN-enabled instrumentation makes process improvement much easier (Figure 3). The ability to map drives and save measured data in a central location makes it easier to implement process monitoring and to perform trend analysis. Common data formats make it easy to manipulate the information using spreadsheets to test ideas and assumptions. The ability to read e-mail at every test station makes it easy to communicate results and submit ideas.

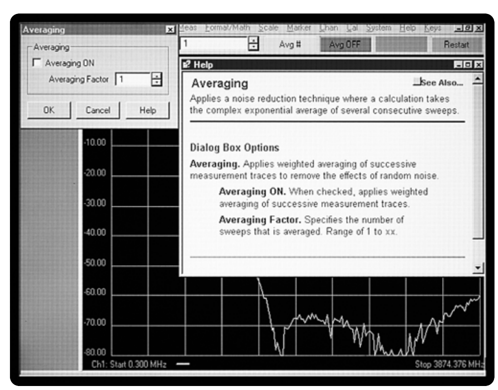


Figure 3. Familiar Windows drop-down menu

Remote Training

The most obvious features of a learning organization are the availability of training. Training generates a common basis of knowledge for the organization. It reduces the time spent learning a new process or developing a new skill. Appropriate training helps employees become more productive.

NetMeeting, which is part of Windows 2000 and included with the Agilent PNA Series of network analyzers, provides a platform for the delivery of training. NetMeeting allows a trainer and students to share a common computer screen. The trainer can deliver a PowerPoint presentation remotely with a student at every test station. Audio is best shared through a conference call. The trainer may demonstrate how to operate the instrument or how a problem would appear on the network analyzer. NetMeeting provides a shared whiteboard, which works well with a graphics tablet for drawing and explanations. Remote training reduces costs, eliminates travel, and makes scheduling easier for both the trainer and students.

Final thoughts

As with any computer connected to the Internet, precautions must be taken to protect the machine from viruses. Virus protection software should be installed on the computer within the instrument and updated on a regular basis.

When using a Precision Network Analyzer for high-speed measurements, be aware that applications running on the computer within the network analyzer may reduce the speed and throughput of the instrument. To obtain the highest speed from the instrument, close all applications other than the network analyzer application.

Summary

Connectivity is changing test and measurement in component manufacturing. The challenge is to use this technology to produce a competitive advantage. The companies that embrace the opportunity will be rewarded with improved quality, reduced costs, and a more effective organization.