Networks and *Connections* in the Counting Room

Ronald M. Keyser and Timothy R. Twomey
EG&G ORTEC
Oak Ridge, TN 37830

Abstract
The use of networks in the laboratory to connect PCs, printers and MCAs has many advantages in user operation, lower costs and convenience. In response to the demand for a reliable, secure, stable and well-documented network architecture, EG&G ORTEC developed *Connections*. *Connections* defines the interface between the user's application program and the MCA or MCB data collection hardware. Standard protocols are used for all network communication, enabling off-the-shelf operating systems (Windows™ 95/98/NT) and networking hardware to be used. Data security is provided for laboratory and field (mobile) units.

Introduction
A network consists of devices which are interconnected with various transmission media as well as the software that enables the devices to share databases, printers, files and computing power. The goal of a network is to help people and computers communicate with one another and to allow people to share resources. This definition is true for all sizes of networks — from the Internet to just two PCs.

A network allows servers, workstations and other devices to communicate and share resources.

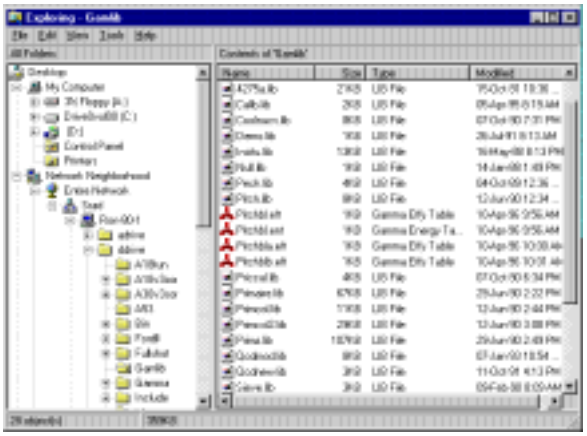

Figure 1 Networking in Windows.

Figure 1 shows how easy and integrated networks have become in the new Windows 95/98/NT systems. The network resources appear as local resources to every program on the PC.

Networks
Networks can be made with a large central unit (Fig. 2), called the network server, in which the software to operate the network resides. All the workstations use the resources of the server as their own.

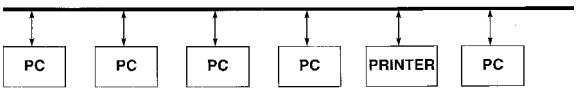

Figure 2 Peer to Peer Network.

For example, the printer, large disk storage, databases, and software are connected to, or stored, on the server and used by everyone.

Networks can also be made without a central unit. These networks are called peer-to-peer (Fig. 3) because all the devices on the network are equals. There is no central unit that has more resources or is more important.

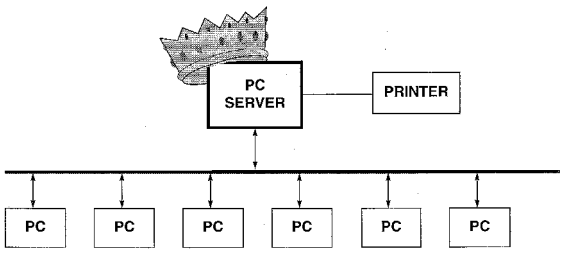

Figure 3 Server based network.

Small computer networks have advanced in the past few years to make their use in small and large laboratories possible and in many situations very easy to setup and

operate. The use of peer-to-peer networks, rather than server-based networks, allows even more flexibility as well as reducing the overall cost of implementation.

Figure 4 shows a typical use of a local network with the Gamma Spectroscopy system located behind a fence in a controlled zone. Both workstations have equal access to all the functions of the system.

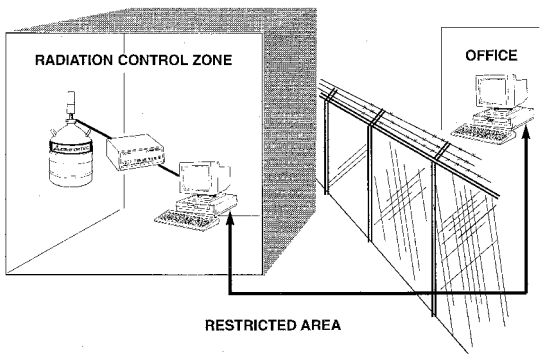

Figure 5 Typical Large System

Figure 5 shows a typical use of a small portable system "network". The user interface is the same for the large and small systems.

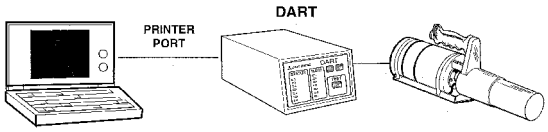

Figure 5 Typical Small System

Connections

importance of networks in the laboratory and started the development of a networking architecture for Multichannel Analyzers, called *Connections*. *Connections* first operated with Windows for Workgroups (16-bit system) and was upgraded to 32-bit operation for Windows 95 in 1996, Windows NT in 1997 and Windows 98 in 1998. The *Connections* architecture is "open," allowing it to be used by any systems developer.

Connections
16-bit Windows 3.1 - 1992
32-bit Windows 95 - 1996
32-bit Windows NT - 1997
32-bit Windows 98 - 1998

Connections is not actually a product, but an interface scheme and support software that are used in the development of applications software products and hardware products. The design requirements for *Connections* were to 1) operate on standard operating systems, 2) use standard protocols, 3) provide system-wide access and control (even over WANS) for spectroscopy workstations and hardware, 4) give multiple, simultaneous access to detectors, 5) have identical user interface for local and remote detectors, 6) give the same calibration and description for all programs, 7) protect the data from unauthorized use, 8) provide easy upgrade path for new and additional equipment, 9) be stable and reliable, and 10) be well-documented.

Connections Design

Standard Networks
Standard Protocols
System-wide Access
Multiple Access to MCB
Same User Interface
Easy to Expand
System-wide Calibration
Data Protection
Stable and Reliable
Well Documented

In addition, when the upgrade to NT (32-bit only system) was designed, one requirement was to have mixed network operation of the older 16-bit systems with the new 32-bit systems. This design philosophy of backward compatibility is carried through all of the system hardware and software -- current hardware and software will operate with hardware and disk files (spectra, results, libraries, calibrations, certificate and correction) from 1983 as well as today.

Supports old and new hardware and data files.

Open Architecture

Figure 6 shows a typical design of an application. The major parts are shown along with the communication paths. The documentation on the communication syntax and protocol for each part is shown.

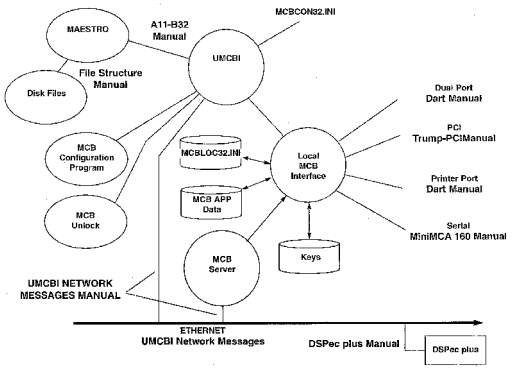

Figure 7 Application Design.

To make it easy for external developers to use *Connections* "standalone," a toolkit is available to support C and Visual Basic.

Supported by programmer toolkits

Hardware

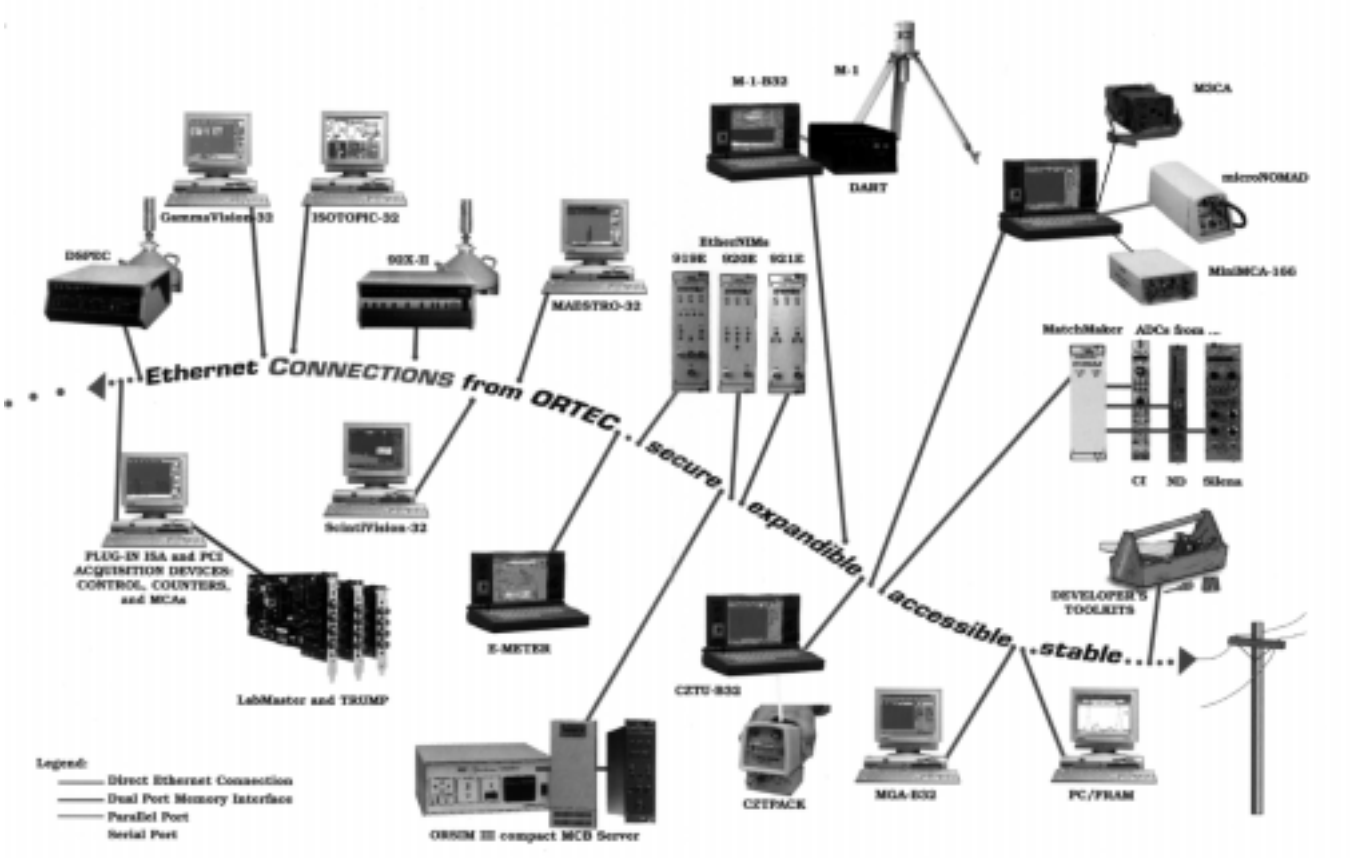

Figure 7 Hardware Supported

The hardware products currently using the *Connections* scheme (Fig. 7) are the complete ORTEC MCB family (including the DART™, DSPEC™ Plus and MatchMaker™), the newer ORTEC MCS models, the LabMaster digital interface module, the Los Alamos M3CA, the Rosendorf MiniMCA-166 and the Seiko 7700 MCA. *Connections* is implemented in full 32-bit mode for use on Windows 95, 98 and NT.

There are different methods for connecting the data collection hardware to the PC: dual port memory (interface is in PC memory map), printer port, ethernet and serial port. The software interface for all these hardware interface methods is the same. That is, the hardware interface details are hidden from the application program. This brings a great advantage to the applications developer in that a single applications program can address any of the attached hardware anywhere in the network without changes.

Interface Methods

- Dual Port Memory
- Printer Port
- Ethernet
- Serial Port
- PCI Bus

The LabMaster is a non-MCB device that uses the *Connections* communications. This brings the scalers, digital input/output and voltmeters of the LabMaster into the same programming scheme as the MCB data. Figure 8 shows a LabMaster system. One major advantage of the LabMaster over other types of plug in digital input/output cards is that it automatically works on the network in just the same way as the MCBs. This allows complete remote control of every aspect of the measurement.

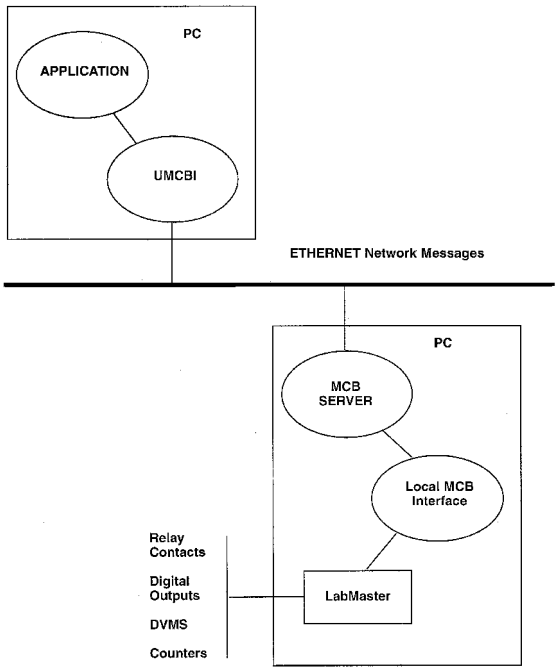

Figure 9 LabMaster System.

Protocols

The contents of the messages sent between stations (called packets) is defined by the communications protocol. A protocol is a set of conventions or rules used by an operating system or program to establish communication between two or more stations. Some common protocols are TCP/IP (Transmission Control Protocol/Internet Protocol), IPX/SPX (Internetwork Packet eXchange/Sequenced Packet eXchange), and NetBEUI (NetBIOS Extended User Interface). Protocols can be mixed on a network, even on a single computer, but for two devices to communicate, they must have at least one protocol in common. In other words, the two devices must speak the same language to talk to each other.

Protocol is the language used by the stations on the network to communicate with each other.

The standard Windows 95, 98 or NT supports multiple simultaneous protocols. This means that the email system can use TCP/IP at the same time that another program is using IPX/SPX. Nothing needs to stop and wait for a "protocol", the network software operates the protocols simultaneously. *Connections* can use both TCP/IP and IPX/SPX protocols.

Connections uses any Windows Protocol; such as IPX/SPX or TCP/IP

System Configuration

The number of MCBs, their type, and computer node in the system is automatically determined by the automatic configuration program. The MCB server program runs in every PC to supply network data to other applications running on the network. An unlimited number of applications can connect to the MCB Server simultaneously. The *Connections* can be to either separate MCBs on the PC or to the same MCB

Automatic configuration for all MCBs and PCs

on the PC. An unlimited number of applications (same or different) can be running on a single PC connecting to different MCBs or to the same MCB.

Security

For security, all the devices (MCBs, LabMaster, external MCAs) can be locked to preserve the data. For the DART portable MCB, the lock is internal to the hardware, so it stays locked even when removed from the network and reconnected to the same or a different network.

Detector locking for data security

Conclusion

Connections has been in use at ORTEC for several years in more than 10 software products. The applications interface has remained constant over this time even though several new MCBs have been added to the available hardware. Thus it has proven to be a stable programming platform for applications. We are continuing to expand the use of *Connections* into non-spectroscopy applications. The EG&G ORTEC MCS and timing products have been integrated as well as other devices such as the new AMSR.

We have made *Connections* the basis for all of our workstations -- Gamma Germanium Spectroscopy, Gamma Scintillation Spectroscopy, Alpha Spectroscopy, Whole Body Counting, Chemical Weapons Analysis, Digital Failed Fuel Monitor, Sentinel, NDA and Safeguards and will continue to use it. *Connections* has been made to be as easy to use as possible for anyone wishing to make a nuclear spectroscopy system or workstation. Developers outside of EG&G ORTEC have used *Connections* to make their own systems; such as PC/FRAM, the TGS, the K-edge Densitometer all from Los Alamos National Laboratory, MGA and U235 from Lawrence Livermore National Laboratory, monitoring systems at Pacific Northwest National Laboratory, HMS3 holdup system from Oak Ridge National Laboratory, as well as several special systems by Allison Technical Services, BNFL - Sellafield, ANTECH, Marschelke Ingenieurbüro and Gammadata - Sweden.

Benefits of Networks and ***Connections***

- Resource sharing (printers, disk storage)
- Communication among people
- Remote control of MCBs (including dial up)
- Shared control of MCBs
- Shared calibrations and sample descriptions
- Shared data travels with portable MCBs
- Secure data files and MCB data
- Common user interface for all programs
- Multitude of MCB types (one for every need)