

► BY JODY ROMANOWSKI



Run DNC and let your machine tools communicate.

Can We Talk?

A goal that all machine shop owners and managers share is the desire to produce good parts as efficiently as possible. One product that can help them achieve their objective is a DNC system.

DNC can mean either Direct Numeric Control (direct control of a machine from a PC) or Distributed Numeric Control (a system that distributes data to machines). Most machine shops use some form of networking to control machine tools. Approaches range from a direct link between a PC and a single machine to a PC/server network that links multiple machines, each with various levels of software sophistication.

Many of these systems incorporate old technology, both in terms of equipment and software, that no longer can be supported or upgraded. However, they do offer DNC capability, as limited and antiquated as it may be.

What DNC Offers

If you own or manage a machine shop, you might be asking yourself, "What will a modern DNC system do for me?" Plenty.

A DNC system can eliminate the manual transcription of NC data, as well as the downtime caused by shop floor personnel having to make programming entries and corrections, or having to leave their CNC machine to get a new set of programs from the programmer.

With a DNC network in place, there is no more wheeling around a computer, finding a communication device or manually flipping switches on a switchbox. All data is stored in one location on the network and can be easily and regularly backed up. DNC systems, with the addition of a BTR (Behind-the-Tape Reader), bypass the cassette tape medium and allow old equipment

to communicate on a DNC network via RS-232 communication.

A DNC system also can bypass memory limitations, eliminating the need to either purchase more control memory or cut programs into segments. Machine parameters, tool-setter information and any ASCII-based data sent into or out of a serial device can be stored and transferred via a DNC system.

Users say that DNC systems shorten their setup times, reduce scrap and lead to better organization of their programs. The reasons why are that a DNC system allows machine operators access to only approved, proven and optimized programs. Because a program is known to have run successfully in the past, few—if any—trial runs are necessary. And, variations in cycle times between runs of the same part are virtually eliminated.

A DNC provides a network that allows for the efficient exchange of data

among computers and machine controls. Traditionally, this was done through serial (RS-232) communication. But many other methods of data transfer can be found on the shop floor. These include FTP (File Transfer Protocol), Ethernet and various machine-specific protocols, such as Heidenhain Blockwise, Mazak Mazatrol, Bridgeport EasyLink, Fagor, Excellon and Xmodem. DNC software has the ability

Reducing Setup Time

Perlick Corp., a producer of brewery fittings and dispensing equipment, found that the installation of its DNC system produced a double benefit. According to Ron Laird, a manufacturing engineer at the Milwaukee firm, Perlick's DNC drastically cut production time while improving overall efficiency.

Prior to installation, Laird said engineers would walk a floppy disk or tape to one of Perlick's eight machines each time a new part was run. If problems were found in the program during the runoff, the engineer would have to either correct code at the control or output another part program from one of the CAM systems, put it on a floppy or tape, then return to the machine. If corrections were needed, it often took 30 to 40 minutes to change, reload and rerun the part.

Perlick's DNC system allows an operator to request a program from the shop floor using his machine control, and all of the data is distributed digitally without error. If there is a problem with a part program, the operator calls the engineering office for the correction, rather than taking the previous time-consuming route of walking from the machine to the office and back. After the call, engineering produces a revision with any one of its CAM systems, gets it in the control and has it running in no more than five minutes.

—J. Romanowski

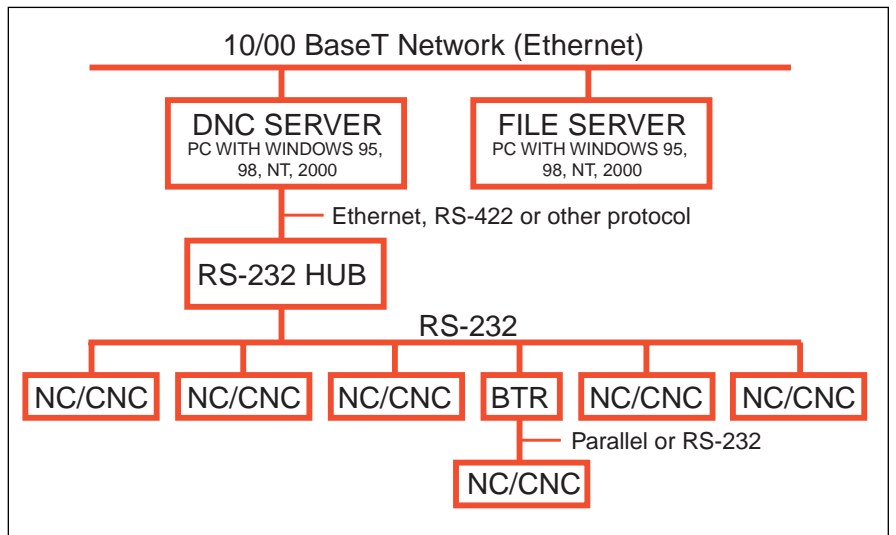


Figure 1. A common machine tool communication network consists of CNC machine tools connected via an RS-232 hub to a DNC server computer.

to support a wide variety of these data-transfer protocols, allowing users to learn one simple communication procedure for all the controls in a shop.

There is an assortment of features available to work with a DNC network. Some DNC systems have the ability to trigger external applications or send e-mail. The latter capability allows a machine operator to e-mail a request for assistance to setup personnel or engineers directly from his machine control.

Some systems have paging capabilities. This proves helpful for someone like a moldmaker, who could be paged upon completion of the mold his machine is producing.

Many DNC systems can log shop floor events to a database. This enables the user to record a wide variety of data, such as the date and time each program is uploaded or downloaded and the length of cycle times, setup times and machine downtime.

At some companies with DNC systems, part programs are converted—along with various levels of automation—to allow a single part to be produced on a variety of machine tools. This can be done by using the “find-and-replace” function to substitute the proper G-codes into a program.

Some DNC systems can find and replace on the fly as the data is sent to the machine. Others have VB, C++ or Java scripting capabilities in which a filter or translator can be written to take a generic G-code file and modify the data

as it's sent to a machine control.

Available Systems

A wide range of DNC systems are available, including a simple communication software feature that comes with CAM systems. However, since this is an add-on feature, the personnel tasked with bringing it online may be unavailable or untrained in machine communication. Or, the software itself may have limited functionality or may not work with some controls.

This type of DNC software generally only supports one or two machine hookups. To bypass this restriction, some shops make use of mechanical switchboxes, which add more complexity, points of failure and increase the likelihood of a system error occurring. Although this approach works well for shops with one or two machines and no special communication requirements, the more machines you try to control the more cumbersome the system becomes.

Portable communication boxes also are widely used. Devices like the Greco Mini-File or Mazak's Microdisk can be carried to the machine and plugged into its communication port each time data is transferred into or out of the control. Data is usually stored on a floppy disk, but also may be stored on cassette tape or on an internal hard drive. Again, these systems are cumbersome. Each upload or download requires that the portable device and media holding the

NC program must be located, taken to the machine and plugged in.

Shops that need to network two or more machines generally implement a shopwide DNC network (Figure 1). These systems complement a CAM system by picking up programs from a designated location on a network to which both the DNC server and programmers have access. The specific configuration depends on several factors, such as the type or types of controls the user has, shop layout, environment and specific goals.

DNC software can be configured to work with many different hardware configurations, making it possible to fit the needs of any shop. A DNC network also provides operators with one common interface for uploading and downloading programs. This shortens the training time needed for new employees or employees who operate different machines.

Companies already running software applications on their shop floor or that would like to provide operators with electronic access to offline editing, NC code viewing, directory listings, setup sheets, part drawings or other items, usually implement a DNC system that incorporates PCs on the shop floor. Often, a PC is shared by two to eight machines. Some shops prefer one machine per PC, which allows operators to prepare upcoming projects during long cycle times.

Most DNC systems also have a remote request (or call down) feature that allows a machine operator to request a program stored in the DNC computer from his machine's control. He never has to physically touch a PC. This capability is recommended for extremely dirty shops or where management wishes to limit access to PCs from the shop floor. With this type of configuration, one PC can provide data for up to 256 controls (the upper limit on communication ports in Windows NT).

System Implementation

In a modern DNC system, one or more PCs act as the server. The minimal requirement is a Pentium processor with 32MB of RAM and a 32-bit operating system (Windows 95, 98, 2000 or NT). The requirement rises with the number of machines to be networked and the

load that will be placed on the DNC system. Serial port expansion hubs and shielded cabling also are necessary components of the system. Your DNC vendor can assist you by recommending the proper PC configuration and by

cable lengths are kept to a minimum.

Because there is no error-checking capability built into the RS-232 protocol, it is important that data arrives at the machine uncorrupted. Electrical noise, which can be created by plasma

Bypassing Memory Restrictions

Dale McMahon, director of engineering at Ivex Packaging, Grant Park, Ill., cited "huge savings over memory upgrades" as the main reason his company purchased a DNC system. Explaining the cost difference between memory upgrades and the DNC system, McMahon said the cost of 1MB of RAM is \$1,000 for each of his company's machining centers. However, memory is only available in 4MB packages, which cost \$4,000 each.

Ivex runs programs as large as

40MB. So, to get all that into memory had required 10 4MB packages that cost \$40,000. With a \$5,000 price tag for the entire DNC package, the system was a bargain.

Additionally, the DNC saves time. Ivex programmers formerly had to cut complex G-code programs into segments that fit into a machine's limited memory. With the DNC system, they can feed all of the company's machining centers simultaneously—with no limits on program size.

—J. Romanowski

offering hub and cabling solutions.

Most vendors will recommend that they, or another qualified integrator, install the package. It's usually a good idea to heed this advice. There are many idiosyncrasies involved in machine communications. A professional installer will be familiar with them and will have a DNC system up and running in a fraction of the time that it would take to do it in-house.

If your shop has several machines and you are unclear about how your system should be laid out, your DNC supplier should be able to do a site survey, then make configuration recommendations based on your needs. Alternatively, recommendations can be made if you provide the vendor with a list of your machine controls and a scale drawing of your shop floor.

A DNC network configuration must take into account the lengths of any cable runs between your hubs, PCs and machine controls. RS-232 cable runs can be from 10' to 300' long, depending on the cable used. The most heavily shielded (lowest capacitance) cable available today has a recommended maximum length of about 300' for serial communication. A professional installer will configure the DNC network so that

cutters, arc welders, EDMs, lasers, overhead cranes or even electrical wiring, may cause communication problems. When an extremely long cable run is necessary or when cable is being run in an electrically noisy environment, the data is sent to the machine via RS-422, a more reliable data-transfer protocol. Then, a conversion device at the machine converts the data from RS-422 back to RS-232.

Dollars and Cents

Most vendors will quote a system based on the configuration they recommend and you agree to. This quote will generally cover installation, training of your system administrator, operator training, the DNC software and any necessary hardware, such as serial port hubs, cabling or BTRs.

You can generally expect a high-quality, basic DNC network to cost about \$600 to \$1,000 per machine. If the machine is not equipped for serial communication, a BTR (Figure 2) is required and the cost per machine will be closer to \$2,500. The average cost for a completely installed DNC system serving eight machines with serial communication capability is about \$6,000. A 16-machine system would start at about

\$9,000, excluding cabling.

Shielded cable can be purchased for as little as 35 cents per foot, in 1,000' rolls, plus the cost of terminators and labor. Modular, assembled cable that is designed for the shop environment and preconfigured for use with specific machine controls is available for about \$1.50 per foot.

A DNC system that's properly designed and installed is extremely easy to use. Training operators in the basics of uploading and downloading programs usually takes less than an hour. When written instructions are provided, operators can be expected to use the system even sooner.

Administrator training can take from an hour to several days, depending on the level of knowledge you wish to have in-house. Administrator training, at a minimum, should include a review of how to recover from a system failure and the basics of how to navigate the system software.

What to Look For

There are many important factors to consider when selecting a DNC system. Ask yourself the following questions during the selection process.

Does it meet your requirements? Outline your needs and make sure the system under consideration meets those needs. If it doesn't, or if costly modifications are needed in order for it to conform to your needs, check out other systems.

What type of DNC company are you dealing with? Ask about the software company's long-term vision and determine if it meshes with where you believe your company is headed. Find out how many developers the company has working on the product. In addition, obtain information about the size of its customer base.

What type of distributor or supplier are you dealing with? Find out if the supplier has completed a training or certification process.

Is intelligence built into the software? If the intelligence is built into the software, updates and improvements are implemented by simply upgrading the software.

Is it easy to use? Find out how much training is required to operate the system and who conducts the training. The more accessible the training resources, the better.

Does it work with open-architecture hardware? Proprietary hardware is costly to upgrade and parts can be discontinued, making them difficult and expensive to acquire. Use of nonproprietary hardware will save you money and frustration in the long run.

Ideally, your vendor should use standard serial port hardware. Then, should your hardware go out of production, it can be replaced easily by whatever is available.

Make sure standard data-transfer protocols and hardware are used for all terminals, touch screens, bar-code readers and other input devices. Also, if a database is incorporated, make sure it is "open-database-compliant." This will simplify the transfer of data from other areas of your business.

Is the system upgradeable? You'll want to know if extra capacity or added functionality is available if you outgrow your current system. The DNC system, and your supplier, should be able to

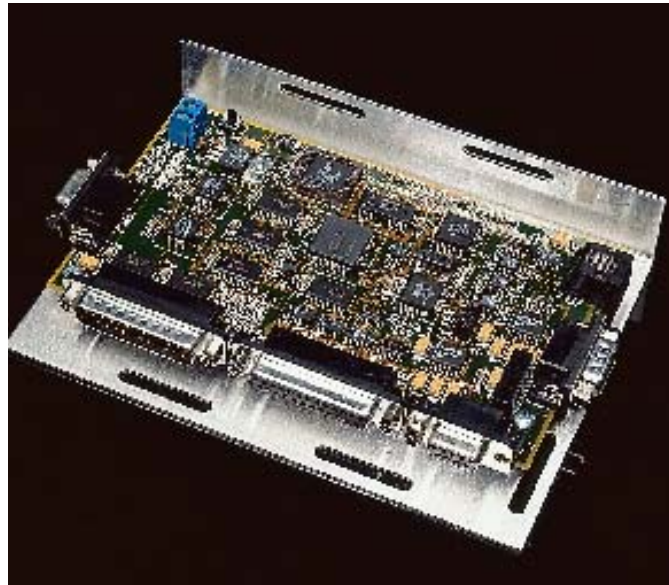


Figure 2. A behind-the-tape reader is an electronic interface that allows older paper-tape NC/CNC machine tools to receive and execute programs using the modern RS-232 interface.

grow with your company.

Is local service and support available? Purchase from a stable company, one with an extensive service and support structure. Know what the delivery time is for receiving replacement parts. Understand the policy for part replacement and find out if the supplier repairs failed parts or can overnight you a new replacement. Carefully read the hardware warranty to find out what may void it.

Sound overwhelming? Perhaps. But the main point to remember is that today's DNC products have a wide range of capabilities. Therefore, it's important that you clearly understand what you want your DNC system to do and that you take the time to research and find a supplier qualified to make the system perform to expectations.

About the author

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