

IMPROVED PROGRAMMING AND OPERATING FEATURES

The flexibility of soft-wired control has led to many convenient programming & operating features, such as

- (1) Editing the part programs at the m/c.
- (2) Manual data input (MDI).
- (3) Local storage of more than one part program.
- (4) Graphic display of tool path.

DIAGNOSTICS

- NC m/c tools are complex & expensive systems.

The complexity increases the risk of component failures which lead to system downtime.

- CNC machines are equipped with a diagnostics capability to assist in maintaining & repairing the system.

Advantages of CNC

- (1) The past program tape & tape reader are used only once to enter the program into computer memory. (Tape)
- (2) Tape editing at the m/c site:-
(change of tool path, speeds & feeds) at the site of m/c tool.
- (3) Metric conversion:- CNC can accommodate conversion of tapes prepared in units of inches into the International System of units.
- (4) Greater Flexibility:-
provides opportunity to introduce new control options with relative ease at low cost.

Disadvantages of CNC-

- high initial cost
- higher maintenance cost
- skilled CNC personnel required
- m/cs have to be installed in air conditioned
- not suitable for long run applications

DNC (Direct Numerical Control)-

- DNC was the 1st computer control systems to be introduced in 1968. Computers were quite large & expensive. The advantage of DNC was it established a direct control link betⁿ the computer & the m/c tool, hence eliminating the necessity for using punched tape input.

(The tape & tape reader most unreliable components in conventional NC systems)

(DNC uses a larger computer to control a no. of separate NC m/c tools.)

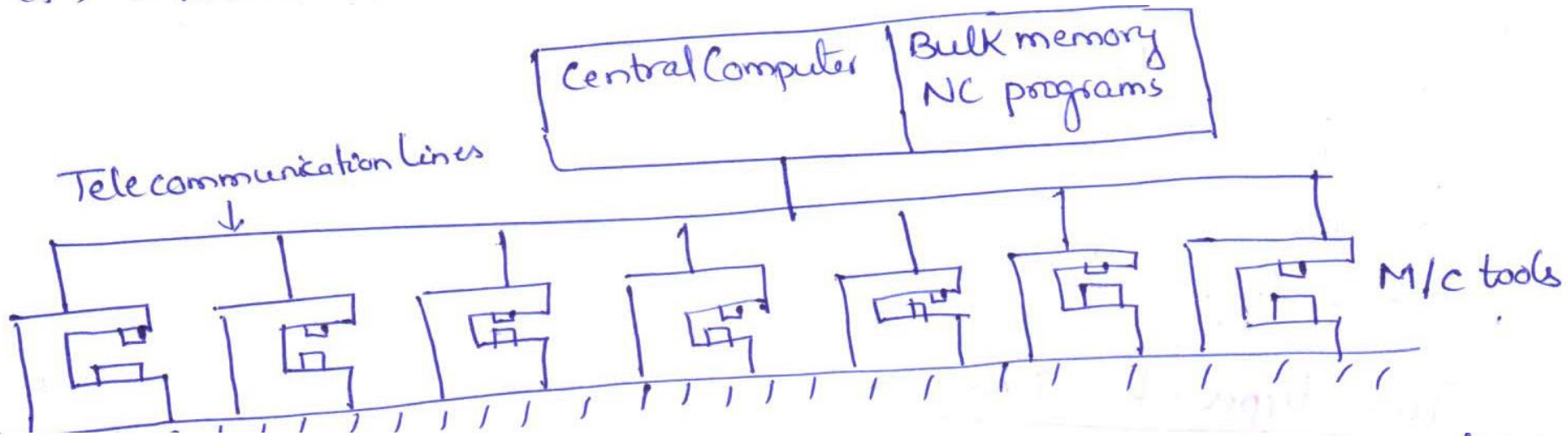
Manufacturing system in which a no. of machines are controlled by a computer through direct connection & in real time.

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The part program is transmitted to the m/c tool directly from the computer memory.

The DNC Computer is designed to provide instructions to each m/c tool on demand. DNC also involves data collection & processing from the m/c tool back to the Computer.

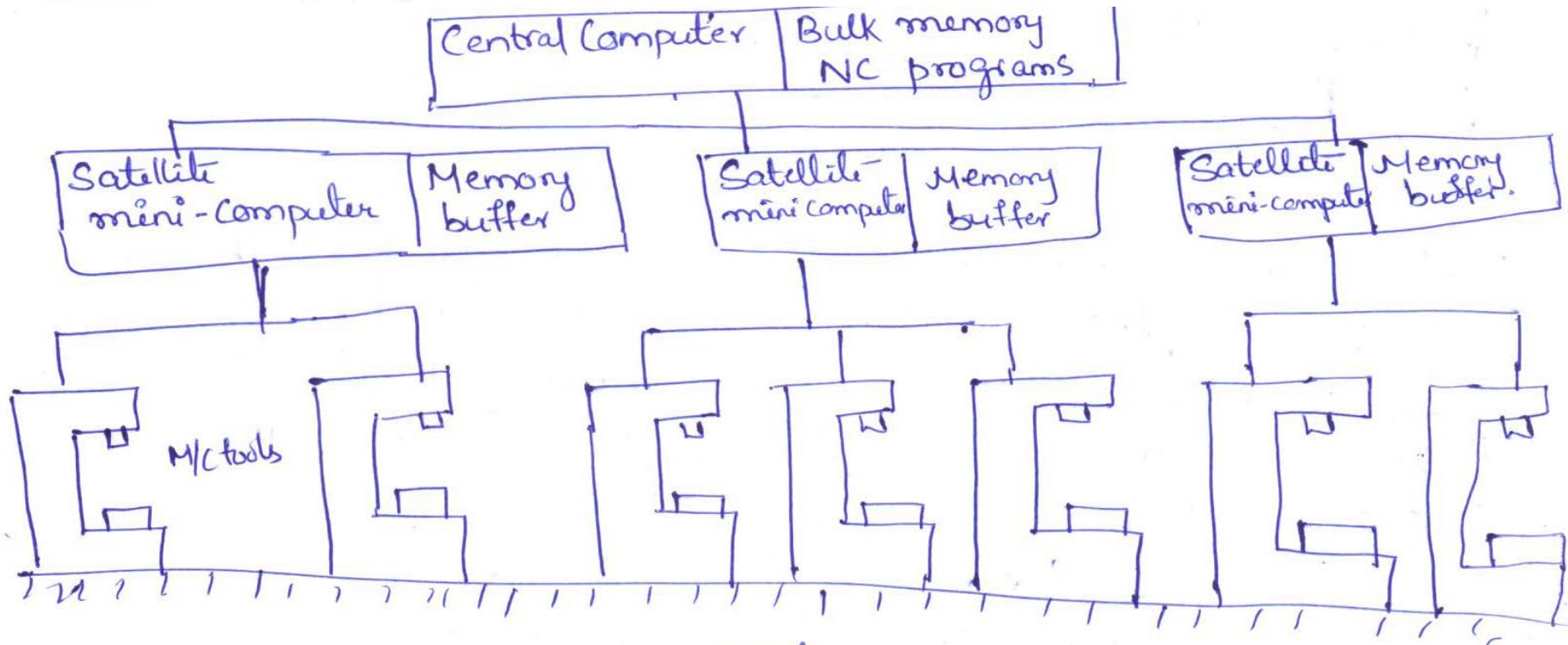
Basic components of DNC system-

- (1) Central Computer
- (2) Bulk memory, which stores the NC part programs
- (3) Telecommunication Lines
- (4) Machine tools



The computer calls the part program instructions from bulk storage and sends them to the individual machines as the need arises. It also receives data back from the machines.

Similarly, the Computer must always be ready to receive information from the machines and to respond accordingly.



DNC with satellite mini-computers.

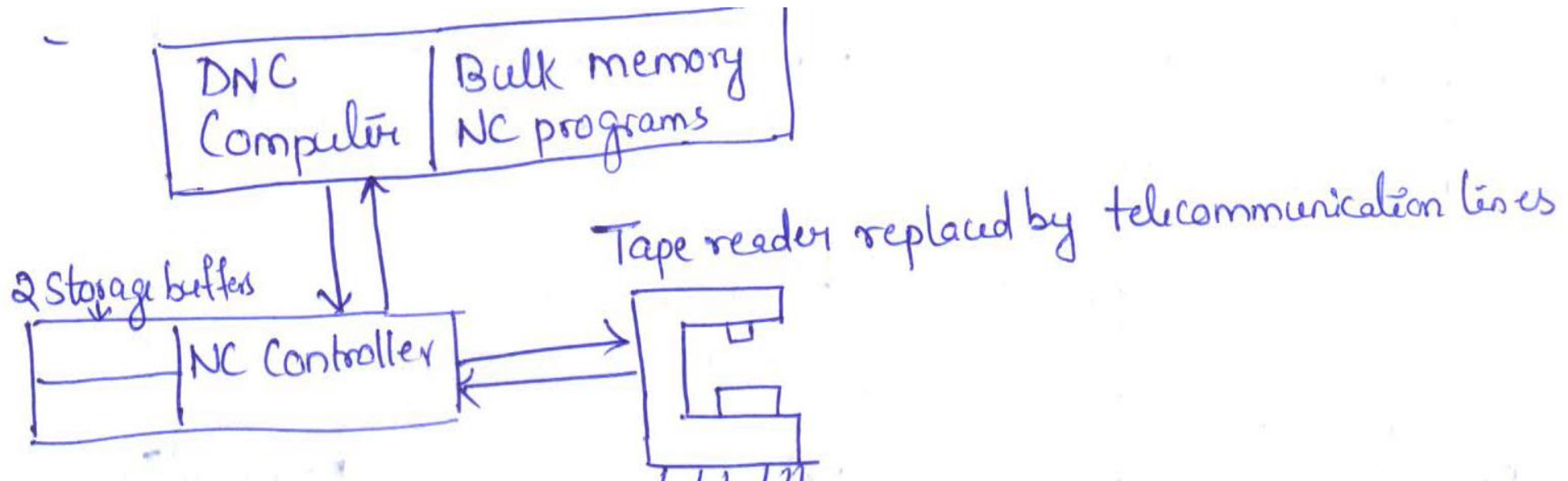
Sometimes, it is necessary to use satellite computers. These satellites are mini-computers and they take some of the burden off the central computer.

- Each satellite controls several machines. Groups of part program instructions are received from the Central Computer and stored in buffers. They are then dispensed to the individual machines as required.
- Feedback data from the machines are also stored in the satellite's buffer before being collected at the Central Computer.

Two types of DNC-

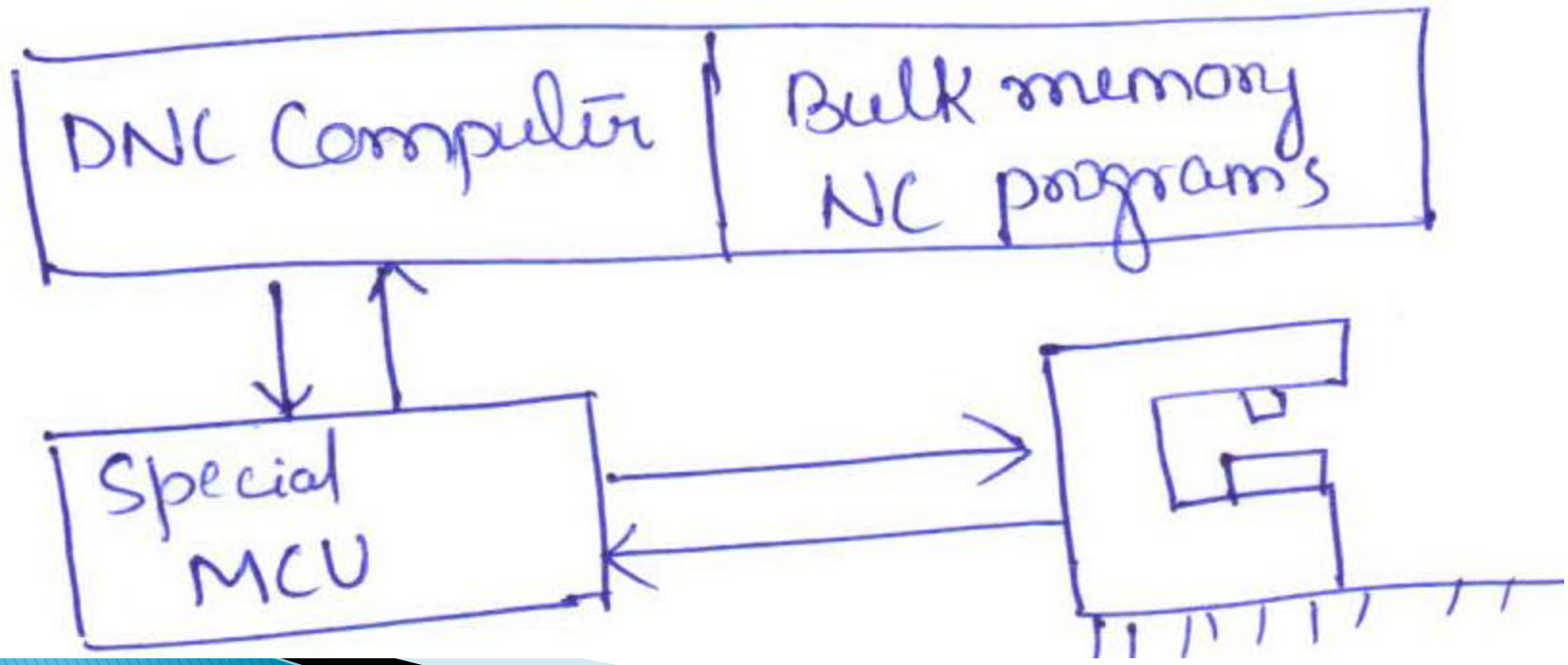
- 1-Behind the tape reader sys(BTR)
- 2-Specialised machine control units

1-Behind the tape reader sys(BTR)



- The connection ^{with} ~~bet~~ the computer is made betⁿ the tape reader and the controller unit - behind the tape reader.
- The controller unit uses two temporary buffers to receive blocks of instructions from the DNC computer and convert them into m/c actions.
- While one buffer is receiving a block of data, the other is providing control instructions to the m/c tool.

2-Specialised machine control units



- DNC with
- The other strategy in DNC is to eliminate the regular NC controller and replace it with a special MCU.
 - This special MCU is a device that is specifically designed to facilitate communication betⁿ the m/c tool and the computer.
 - The special MCU configuration achieves a superior balance betⁿ accuracy of the interpolation and fast metal removal rates than is generally possible with the BTR system.
 - The special MCU is soft-wired, while the conventional NC controller is hard-wired.
 - The advantage of soft-wiring is its flexibility. Its control functions can be altered with relative ease to make improvements. It is much more difficult to make changes in the regular NC controller because rewiring is required.
 - BTR cost is less, since only minor changes are needed in the conventional NC system to bring DNC into the shop.
 - BTR systems don't require the replacement of the conventional control unit by a special MCU.

Functions of DNC-

- (1) NC without punched tape
- (2) NC part program storage
- (3) Data collection, processing & reporting
- (4) Communications

1-NC without punched tape

- Several of the problems with conventional NC are related to the use of punched tape (unreliable tape readers, paper tape, difficulties in making corrections & changes in the program contained on punched tape, etc)
- There is also the expense associated with the equipment that produces the punched tape.
(so it is eliminated)

2-NC part program storage

- A second important funⁿ of the DNC system is concerned with storing the part programs.
- First, the programs must be available for downloading to the NC m/c tools.

- Second, the subsystem must allow for new programs to be entered, old programs to be deleted and existing programs to be edited as the need arises.
- Third, DNC software must accomplish the post processing function.
- Fourth, the storage subsystem must be structured to perform data processing & management functions such as file security, display of programs, manipulation of data, etc.

DNC program Storage Subsystem consists of an active storage & a secondary storage.

- Active storage used to store NC programs which are frequently used. The active storage can be readily accessed by the DNC computer to drive an NC m/c in production.
- Secondary storage could be used for NC programs which are not frequently used.
Ex:- Magnetic tape, floppy disks, punched tape.

3) Data Collection, Processing & Reporting

- DNC involves the transfer of data from the m/c tools back to the Central Computer. DNC involves a two-way transfer of data.
- The basic purpose is to monitor production.

4) Communications :-

- A communications network is required to accomplish the previous 3 functions of DNC.
- Communication among the various subsystem is a funⁿ that is central to the operation of any DNC system.
- The essential communication links in DNC are betⁿ the following components of the system.

Central Computer & m/c tools

Central Computer & NC part programmer terminals

Central Computer & bulk memory, which stores the NC programs.

Advantages of DNC

- (1) Elimination of punched tapes & tape readers:
- (2) Greater computational capability & flexibility:
- (3) Convenient storage of NC part programs in computer files :- (punched tapes used in conventional NC)
- (4) Reporting of shop performance :-
It collects, processes and reports about the production performance data from the NC machines.
- (5) Establishes the framework for the evolution of future Computer-automated factory.

Combined DNC/CNC Systems

- The combination of DNC & CNC provides the opportunity to add new capabilities & refine existing capabilities in these computerized manufacturing systems.
- The combination of CNC & DNC → resulted in elimination of the use of punched tape as the input media for CNC machines.
- The DNC computer downloads the program directly to the CNC computer memory.
- The second advantage of combining CNC & DNC is redundancy. If the central DNC computer fails, this will not necessarily cause the individual machines in the system to be down. It is possible to provide the necessary backup to permit the CNC machines to operate on a stand-alone basis.

* This backup capability consists of two elements. The first is a file of punched tapes which duplicate the programs contained in the DNC computer files.

* The second is that each CNC m/c must be equipped with a tape reader for the purpose of entering the program from the punched tape.

- The third improvement that develops from combined DNC/CNC systems is improved communication betⁿ the central computer and the shop floor.

It is easier for computers to communicate with other computers than with hard-wired devices.