

## AN OVERVIEW OF DIRECT OR DISTRIBUTED NUMERICAL CONTROL IN COMPUTER NUMERICAL CONTROL APPLICATIONS

Yudianto<sup>1,2</sup>

<sup>1</sup>Gas Process Plant, *PT Pertamina, Prabumulih*, South Sumatera, Indonesia

<sup>2</sup>Mechanical Engineering Department, *Sriwijaya University*, South Sumatera, Indonesia

### ABSTRACT

Direct numerical control or distributed numerical control (DNC), is a common manufacturing term for networking computer numerical control (CNC) machine tools. On some CNC machine controllers, the available memory is too small to contain the machining program (for example machining complex surfaces), so in this case the program is stored in a separate computer and sent directly to the machine, one block at a time. If the computer is connected to a number of machines it can distribute programs to different machines as required. Usually, the manufacturer of the control provides suitable DNC software. However, if this provision is not possible, some software companies provide DNC applications that fulfill the purpose. The DNC networking or DNC communication is always required when Computer-Aided Manufacturing (CAM) programs are to run on some CNC machine control. Wireless DNC is also used in place of hard-wired versions. Controls of this type are very widely used in industries with significant sheet metal fabrication such as: the automotive, appliance, and aerospace industries. A DNC system has to fulfill two basic tasks such as first guaranteeing secure, timely data transfer from and to the CNC controllers, secondly administering many thousands of NC programs.

Keywords: DNC, CNC, CNC machine controller.

### 1 INTRODUCTION

Smart factory is the new stage of modern factory informatization. On the basis of digital factory, Internet of Things (IoT) and monitoring technology are adopted to strengthen the level of data management and service for manufacturing information. The scheme aims to enhance the controllability of manufacturing process, to reduce the manual intervention on the production lines, to correctly collect the monitoring data in real time, and to formulate reasonable production planning and schedule. The term “smart factory” includes such pivotal characteristic: smart machine, stable and fast connection, effective data analysis, and diversiform visualization means [1].

Shop floor machining, which is characterized with a variety of products in small batch sizes require dynamic control and monitoring capabilities, real-time responsive and adaptive to fast change of the capabilities and functionality

of production. Especially true when the manufacturing system as the manufacturing system is distributed and re-configured combined with the concept of e-manufacturing. In the near future, controlling the numerical control computer (CNC) multi-processors and controllers sensors ‘sensor smart plug-and-play powerful will be powerful enough and intelligent to handle a lot of exceptions runtime and are ready to serve the raw data during the operation of the machinery. However, the infrastructure is very efficient that can integrate the pieces of automated equipment together and link it directly to the e-manufacturing is still not there. Therefore, a new technology that allows required to bring the CNC machine tools of traditional on-line with the ability of monitoring and controls combined. Without it, factory automation advanced can hardly be practical in the environment of the factory floor distribution distributed next generation [2].

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\*Corresponding author’s email: [yudikalidawir@gmail.com](mailto:yudikalidawir@gmail.com)

In a manufacturing environment currently, each type of system integrated with a computerized system. This a computer system already engaged in the manufacturing environment. The manufacturing system is controlled by the numbers, letters and symbols, which is called Numerical Control System (NC System). This system got progress with the role of the computer and efficient system was created, called Computer Numerical Control System (CNC System) and back is enhanced by the central computer system, called Numerical Control system Directly (System DNC). Now, to get the numerical control system very efficiently with precision and accuracy beyond human ability, a new system introduced, which is called Distributed or Direct Numerical Control System, which is the progress in CNC / DNC System. Thus, this journal presents the progress of Numerical Control Systems Distributed over a System of CNC / DNC [3].

The CNC machines in colleges and universities is the basic material that is needed for they teaching practice, scientific research, training personnel and social services. The CNC management system of the machine tool at the university using internet technology plus modern because the CNC machines share information on various the management platform . Through the internet, the network of CNC machines connected to system DNC, where it is can know the management of the relevant policy to publish the name of the CNC machine that is open and shared, model specifications, technical indicators, area services, administrator information, opening hours, the cost of the test and so on.

### 1.1 Internet Plus

The internet plus is a series of information technology-based internet (including the mobile internet, cloud computing, technology, big data, etc.), economic activity, social life in Indonesia various sectors of the proliferation and application of different sectors. The internet plus is the essence of the industry online, data, online work. The internet is the infrastructure to information processing, has the characteristics of openness, equality and transparency, so that the the potential of information / data that can be pressed in an industrial society can explode and transformed into productivity incredible. In the era of the Internet, the information back to the information "as the core" of this essence.

Although the concept of internet plus not long, but based on the understanding above, it is of the practical significance of a great to further promote the management of CNC machine in college and university.

### 1.2 CNC Machine Tool, DNC Networking Technology

The Direct Numerical Control or Distributive Numerical Control (DNC) are control digital direct or digital control technology of distributed. The DNC is the use of CNC machines are computer controlled to control the direct interface system. To connect the computer and the CNC machine through the DNC interface. This connection to achieve direct communication between the computer and the machine, the NC program directly to the system of the CNC machine, direct control CNC machine. The DNC can use the resources fully, to maximize the productivity of heavy equipment, more from one machine on the control the same time, is to achieve CAD / CAM and database CIMS.

In According with hierarchical manufacturing systems integrated computer system, the DNC is effective means to set the NC unit. Since it can coordinate operation of the entire production workshop, and realize all the task processing, including process documents, production process, machine the status of all information managed. Therefore, the DNC is the basis for the realization of information, integrated manufacturing, can be used alone, but can also be extended to FMS and CIMS. Although The shape of the DNC is different, however the essential components are similar. Figure 1 illustrates the basic structure of the system the DNC.

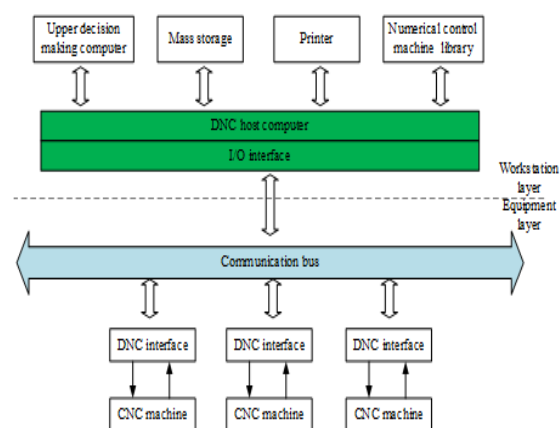


Figure 1 Basic structure of the DNC system

The choice of hardware and software systems DNC should consider two factors namely: (1) the size of the system the DNC (a small system through the computer DNC controlling a small number of CNC equipment, and large system to control the whole production workshop); (2) the complexity of the system the DNC. While the factors system configuration DNC include: DNC calculate the labor cost of the task, the shop floor, computer system management, the level of information that is being processed, the amount of CNC, the number of CNC workshop and engine load coating workshop and the flexibility required. Usually put the needs of specific companies, as the main the function of the application system; the level of automation, production management model of the company, communication of information, the level of structure of the computer and other factors.

### 1.3 Design and Implementation of CNC Machine Networking DNC System

According to the statistics of the network of CNC equipment from the laboratory in our school, there are 42 existing machine is a recent purchase, of which 19 sets of CNC lathe machine, 13 sets of CNC milling machine, 10 sets of processing center, workshop type of the CNC system is all with the RS232 port. Implemented as shown in Figure 2. Main technology used is the control of the multi-level and wireless.

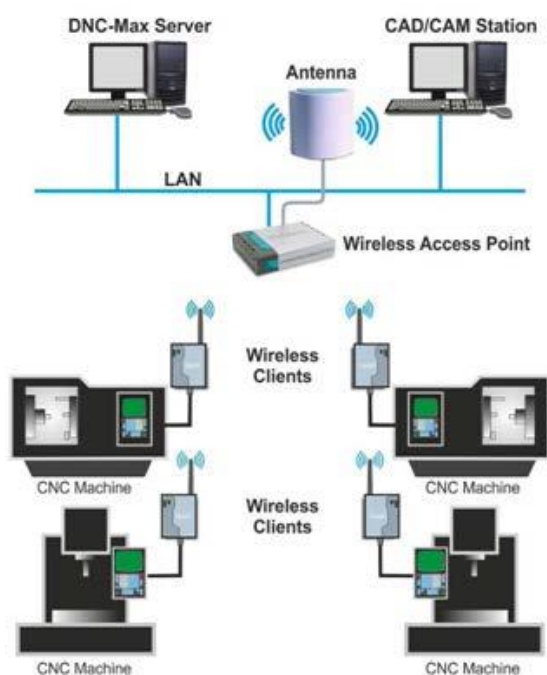


Figure 2 Implementation of CNC machine networking DNC system of the laboratory

#### 1.3.1 Design and Implementation of CNC Machine Networking DNC System

DNC control structure of multi-level, generally a tree structure. It the top used to control and coordinate the operation of the entire system, while the lower part is used for completing the task specified. The system size determine the size of the DNC layout. In the architecture of the multi-level, the root node is a small computer that can be programmed automatically or graphics. The root node have management system, the MPP and MRP and other functions.

Node is a microcomputer, its role is to receive information from the top level of the system, in accordance with the next level of processing equipment feedback status back to the data information, the task processing for the decomposition and scheduling, the task of processing real-time set for each device. The end nodes typically form machine numerical control unit. He receives a processing instruction and control information from the upper level to aware of the movement of the bait cutting and of additional functions of the machine tool, and feed information to the top level at the same time(Figure 3).

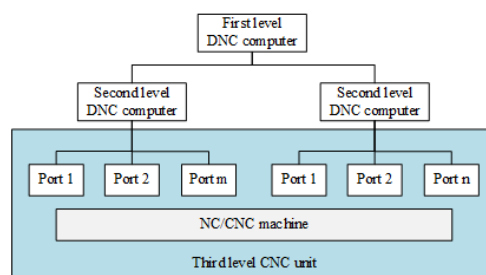


Figure 3 DNC Multi-level control structure

#### 1.3.2 Wireless network DNC system

The wireless network in this program refers to the use of IEEE802.11b / g network protocols ethernet wireless. Using a serial device wireless network server can connect the device CNC with a serial port to the network IEEE802.11b / g for access local area network the factory through a wireless router or switch. The structure of the system shown in Figure 4 .

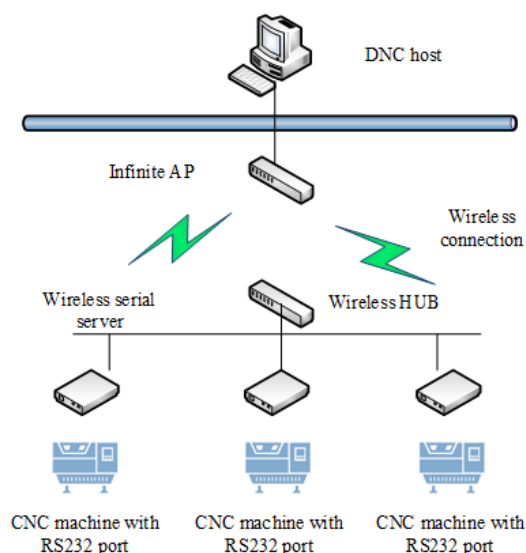


Figure 4 DNC network using wireless

The use of the wireless network to establish a system of DNC has the following characteristics:

1. All The connection machine all using a wireless way, eliminating the need wires and cables long damage of aging, reduce the cost,
2. Easily expanded. All the machines are wireless access, then the new machine is acquired, just need to add the recipient wireless network and corresponding settings, no additional cables,
3. The entire store wireless, the Server can be placed anywhere location,
4. Easy detection of errors. A wireless device to reduce the link error detection, only needs to detect the main equipment can,
5. Easy to control, the server computer connected to a local area network is not subject to any local in any location in the workshop, can be accessed through the wireless network to the ethernet to access the machine , understand the status of the machine, send the procedure and so on.

Through careful analysis, considering the hardware interface and system of CNC machine tool itself, and the easy implementation of the integrated control of the DNC, and to ensure the stability of the system of the DNC. The training center decided to use the program the Ethernet access network cable to achieve the transformation of the network of NC machine tool [4].

## 2 DESIRED USING DNC SYSTEM

The DNC system have many advantages, many advancements, and many implementations which are:

### 2.1 Advantages of DNC System

The advantages provided by the system of the DNC such as: (1) Programming is easy and effective using software DNC, (2) The decision-making level higher, (3) The real-time control of various machine tools, (4) The first step that gives experience for the future expansion, (5) Elimination of the Tape Punched Tape Reader, (6) CLFILE-A convent and more general way of program storage, (7) Removal of the unit controllers that are embedded on some systems, (8) Greater productivity, and (9) Convenient storage of the part program NC.

### 2.2 Advancements of DNC System

Numerical Control system distributed have a lot of more progresses from a System of CNC / DNC namely: (1) The ability to connect and maintain the entire computer right sequentially, (2) The level of manage, (3) The requirements of inspection equipment machine reduced, (4) The feedback system is powerful, (5) Data storage, (6) Backup system for data and information, (7) Reduce non-productive time, (8) Accuracy and greater repeatability, (9) The scrap rate is low, (10) The possibility of the geometry of the parts is more complex, (11) Engineering changes can be accommodated more with graceful, (12) Supplies a more simple required, (13) Waiting time for manufacture is short, (14) Reduce the inventory of spare parts, (15) Less floor space required, and (16) The requirements of the skill level of the operator is reduced.

### 2.3 Implementations of DNC System

In modern manufacturing distributed numerical control system plays an important role, there are a lot of its implementations such as: (1) Wrapping machine electric wire, (2) The machine insertion of components, (3) Machine the compiler, (4) Coordinate measuring machine, (5) The machine laying tape for polymer composites, (6) Winding machine filament for polymer composites, (7) Cutting machines, knitting and riveting, (8) The production of sustainable and flexible, (9) Operation the geometry of complex parts, (10) A lot of machining operation separately on the section,

(11) Of the machine thermal cutting, and (12) Sheet metal and machine-based curvature etc.

### 3 CONCLUSIONS

Two basic tasks of DNC such as: (a) Guaranteeing secure, timely data transfer from and to the CNC controllers, and (b) Administering many thousands of NC programs. DNC system is required to design a system, which is highly efficient, take lower production time with higher precision and accuracy. The concept of the DNC is the first step in the development of the production plant which will be managed by the computer systems which sets framework for the evolution of the factory-the factory automatic computer

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