

Communication Protocols Used for Distributed Control System in Supercritical Thermal Power Plants

Shubhi Thatere*

Abstract : DCS is giant system with several signals which are been transferred to the field. Signals are transferred towards the field, inter panel transfer of signals and within the panel as well. But, for this different transmission of signals we need set of proper communication protocols. In this paper some communication protocols are discussed to transfer signals in a thermal power plant with its arrangement and signal transferring techniques in DCS. In order to execute the control and monitoring actions, the information has to be collected from utility and exchanged with the master station. Hence, communication protocols play a vital role in automation industries. In thermal power plant various applications has to be controlled like Turbine system, Burners, Boilers etc. and to safeguard these processes we need Distributed Control Systems. For a particular application DCS, it comprises of various panels with different I/O modules and controllers for transferring signals to the field. So to communicate between different panels or within the panel or to the field, there has to be different communication modules according to the feasibility.

Keywords : DCS, Turbine system, Burner, Boiler.

1. INTRODUCTION

There are various companies like Mitsubishi, Siemens etc who are developing there controllers for thermal power plants. The controllers can work with PLC, SCADA, and CPU etc. Here, the controlling with CPU and redundancy for the modules will be a special concern for discussion. In a DCS, first panel is always the controlling panel, which let the signals to transmit in rest of the panels and then to the field. The controllers are been fed with logics through flash cards. And these logics are been processed within the controller. This process is carried out with the help of different electronic components like Power supply module, terminal blocks, relays, power receiving circuits etc. And to communicate between these hardware units we have different communication protocols like, Controlnet, Ethernet, D-Ring communication network , Optical fiber cables etc. There are various other protocols which are used like Profibus ,communication modbus communication etc. But basically the selection of the protocol is based on the requirement and feasibility of the system. This control system configuration is a vast process and uses various communication techniques but this is just a small part of control system in power plant which is used in a DCS for a specifics task. Likewise same protocols for different such applications can be used with different panel arrangements.

2. BACKGROUND

The Control panel in a DCS needs four types of protocol. When the signals have to be transmitted within the components in the same control panel we use Controlnet protocol. For interpanel communication we use Ethernet, whereas when the slave panels have various I/O modules with terminal blocks, relays, and other components we use special arrangement for signal transmission *i.e.* D-ring network. From controller to field communication, signals

* M.Tech (Robotics Engineering) UPES, Dehradun, Uttarakhand, India Email- shubhithatere@gmail.com

has to travel a long distance hence, to avoid any data loss and noise we use optical fiber communication, which works on the principle of total internal reflection. Many DCS uses terminal blocks which are to transfer the voltage from field to panels, safely without any damage to the components. It acts as a bridge for same voltage transmission among other components in the panel. Also the Power supply unit for each panels are selected of different rating . mostly from 5 amps to 20 amps which depends upon the power transmission calculation *i.e.* consumption of power by all the components present in the panels.

3. COMMUNICATION NETWORKS

The Communication Network is based on redundancy to ensure the reliability of the network. Basically the two important protocols are Ethernet for outer communication and Ring network or Controlnet for inner communication based on the panel that whether it is master or slave. There are various protocols used by different manufacturer we are just considering one of them. Controlnet or ring network is also known as local area network. These protocols play a vital role in data transmission due to their speed and the system configuration as well.

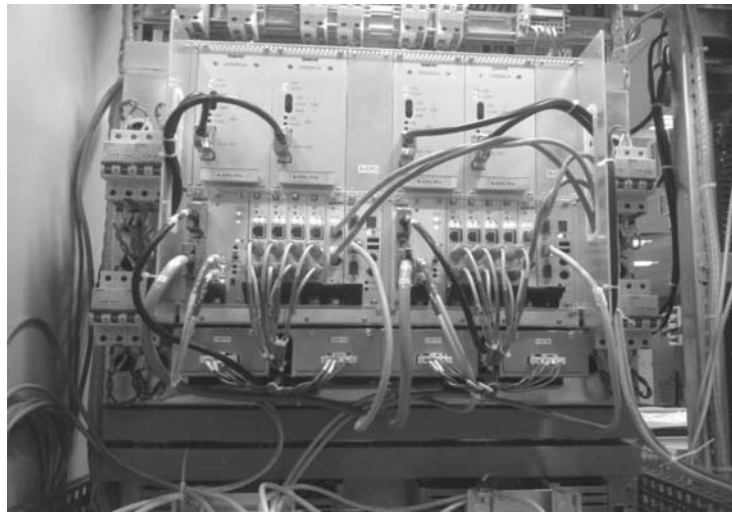


Fig. 1. Redundant CPU control system arrangements

4. BLOCK DIAGRAM

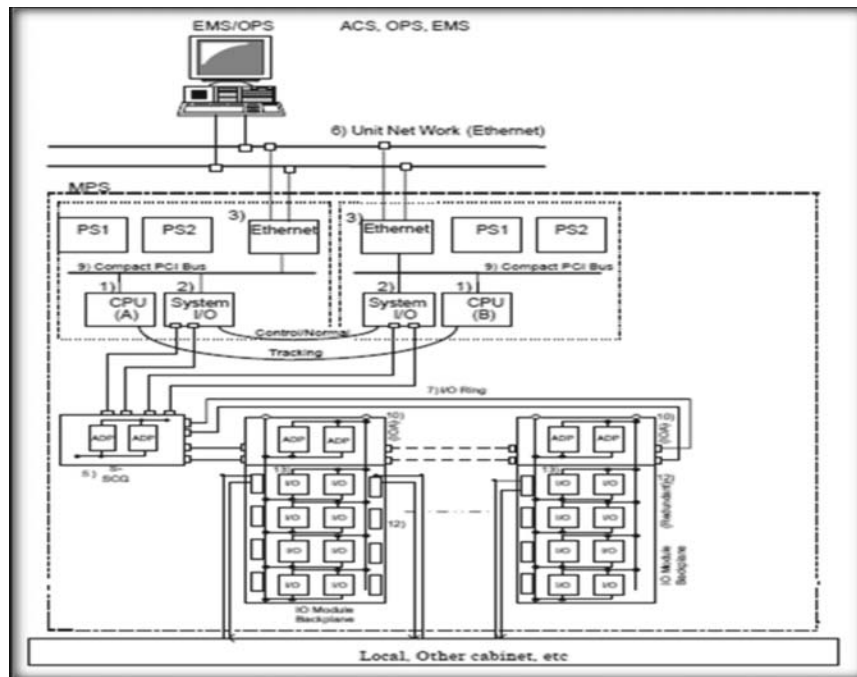


Fig. 2. Communication Network for transmission of signals into different levels of a control system.

This block diagram shows the complete communication procedure which takes place at different levels in control panels. The signal transmission takes place from engineering and maintenance station(EMS) and operator station(OPS) to Multiple process station(MPS) which helps in monitoring and operating MPS for controlling the plant. Within MPS the redundant units of monitoring system are present which has redundant power supply ethernet,CPU and Input/Output system for controlling and tracking of system. Also inside a single panel several I/O modules has been arranged in which the communication takes place with the help of D-Ring network. Likewise the communication takes place between different panels or within the panel or to the field, there has to be different communication modules according to the feasibility.

A. CONTROLNET

The Controlnet is applied to the redundant inner network of DCS . Each CPU card is connected to the controlnet card and communicates with modbus module. Even if one of the two line is unavailable, control can be continued without any influence on control. Control net works with the speed of 5Mbps.

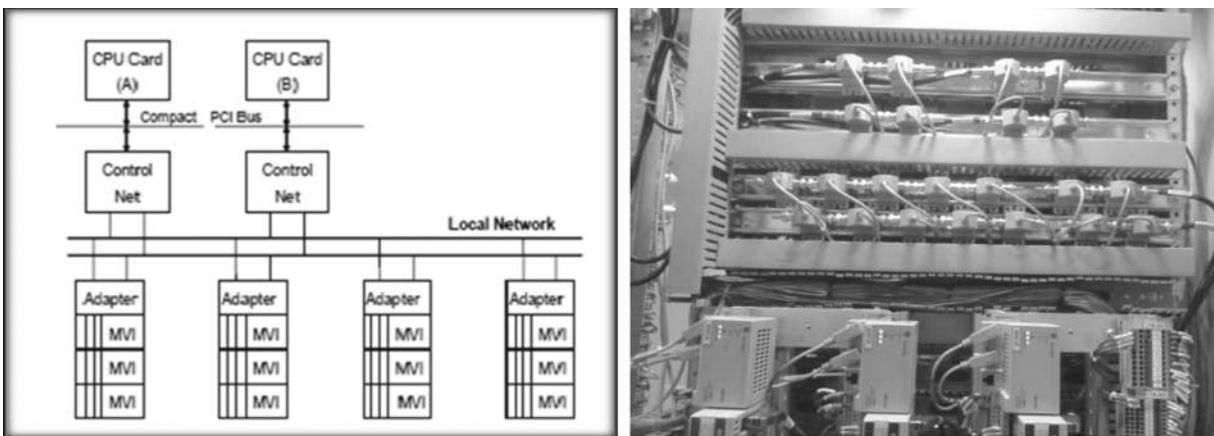


Fig. 3. Redundant control network and Controlnet connections

B. ETHERNET

Ethernet is applied to redundant Unit network connecting external systems of DCS. Redundant network has adapted reliability. Each CPU in DCS is connected to Ethernet card via PCI bus and communicates with Engineering Management System.

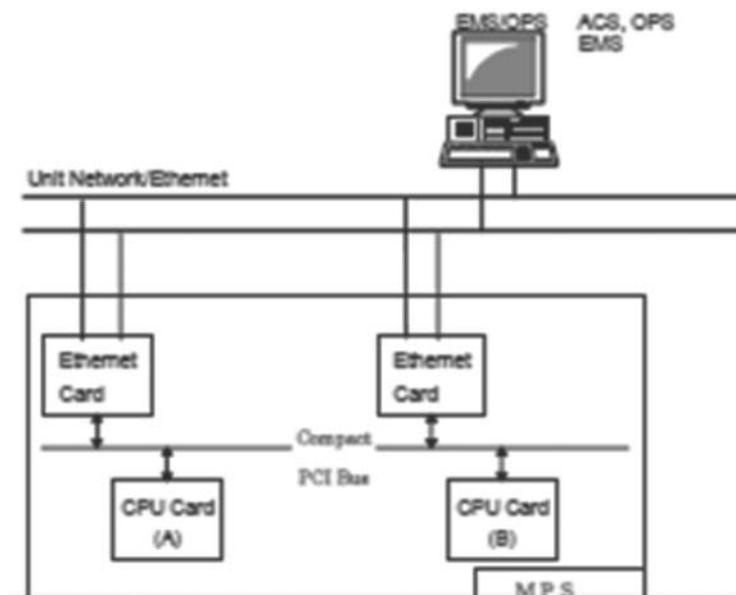


Fig. 4. Ethernet arrangements for signal transmission

C. I/O RING NETWORK

I/O ring is a local network inside the DCS system, where I/O modules communicate with CPU through two hardware modules i.e. Super scanner gateway and I/O adaptor. Ring configuration is made using Giga Bit Ethernet. At the maximum I/O signals, module scan time is 5sec, hence; its communication speed is very high.

In all the above block diagrams we have come across with the term i.e. EMS, OPS, MPS these are the external governing system of DCS It is named as Engineering and Maintenance station, Operating station and multiple process station. These controls the complete process like, EMS controls the logic development and maintenance of system. OPS operates the complete process and MPS is the DCS for controlling the Plant functioning. These Systems other than MPS are basically the computer System with the dedicated software for logic development and operation controlling. In which one is the master system and rest are slaves.



Fig. 5. I/O ring Network into the panels for controlling signals of a control system.

5. CONCLUSION

Data transmission is the major point of concern for any of the controller. It may be either a simple module for microcontroller operated system or for the giant processes like thermal power plants which are controlled by DCS. All these protocols are to be selected with their transmission rate and the distance of transmission, with some more parameters of consideration. System configuration for different protocols and their synchronization with other modules is very crucial for Controlling. Hence the protocols that we have discussed above are very reliable and opted by several industries for controlling their systems.

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