DISTRIBUTED CONTROL SYSTEM

- Equipment making DCS is separated by functions and installed in two different work areas of processing installation.

1. Equipment that the operator uses to monitor process condition and to manipulate the set point of the process operation is located in a central control room.

2. The Controlling portions of the system which are distributed at various locations throughout the process area
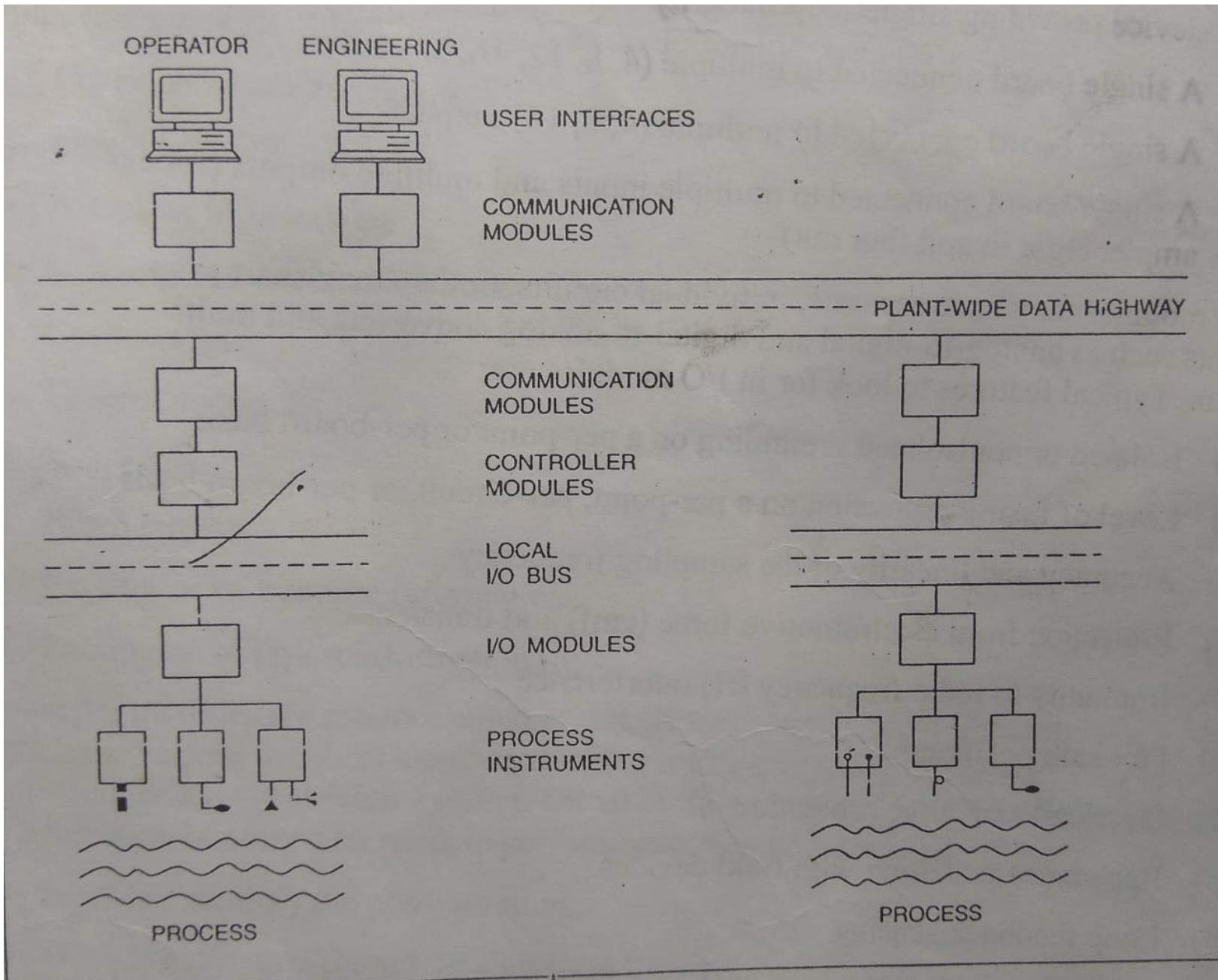
OPERATOR   ENGINEERING

USER INTERFACES

COMMUNICATION
MODULES

PLANT-WIDE DATA HIGHWAY

COMMUNICATION
MODULES

CONTROLLER
MODULES

LOCAL
I/O BUS

I/O MODULES

PROCESS
INSTRUMENTS

PROCESS

PROCESS

Figure 8-3.   Architecture of a Generic DCS

Architecture of Generic DCS

- Distributed Control System is a specially designed control system used to control complex, large, and geographically distributed applications in industrial processes. In this, controllers are distributed throughout the entire plant area.

- These distributed controllers are connected to both field devices and operating PCs through high-speed communication networks

- Discrete field devices such as sensors and actuators are directly connected to input and output controller modules through a communication bus. These field devices or smart instruments are capable of communicating with PLC's or other controllers while interacting with real-world parameters like temperature, pressure, etc.

- Controllers are distributed geographically in various sections of the control area and are connected to operating and engineering stations which are used for data monitoring, data logging, alarming, and controlling purpose via another high-speed communication bus.
- These communication protocols are of different types such as foundation filed bus, HART, Profibus, Modbus, etc. DCS provides information to multiple displays for the user interface.

Distributed Control System continuously interacts with the processes in process control applications ones it gets instruction from the operator. It also facilitates variable set points and opening and closing of valves for manual control by the operator. Its human-machine interface (HMI), faceplates, and trend display give the effective monitoring of industrial processes.

DCS Vendors with systems

- Yokogawa- CS 1000
- Honeywell-TDC 2000
- Emerson - Delta V
- Siemens - PCS7

BLOCK DIAGRAM OF DCS.

Console or HLOI (high Operator interface) can Include 2-5 crt's with keyboard , disc , tape, trend recorder and printer units , communications controller and associated electronics

Supervisory Computer Interface Package

PLC Interface Each DCS supplier limits the number of DI/DO points and the rates of communication to different values

Traffic director Each DCS supplier limits the number of devices per system and the distance between them

Shared communication facility (data highway), can be redundant

Dedicated loop Controller Each card controller can have analog and digital I/O , can be provided with hardware faceplate , similar to that of an analog controller . Groups of these are connected to the highway by a data concentrator

Multi-loop operators Controller (local Control unit)= LCU An LCU can from 8 to 32 loops or up to about 100 I/O cards with 4-8 I/O points per card . An LCU can also include a low level operator's interface (LLOI)

Multiplexer Generally used for monitoring functions only although it can also perform PID loop control by using the main console . generally up to 100 I/O cards can be Accommodated in each , with 4-8 I/O points per card .

COMPONENTS OF DCS

1)   CENTRAL CONTROL UNIT

.   Console or high level operator interface (HLOI)

.   Supervisory computer interface package

.   PLC interface

2)   COMMUNICTAION

.   Traffic Director

.   Data Highway

3)   REMOTE CONTROL UNIT

.   Dedicated loop controller

.   Multi-loop operator controller (local control unit)

.   Multiplexer

CONSOLE OR HIGH LEVEL OPERATOR INTERFACE (HLOI)

- The work centre for the operators.

- Connected through a shared communication facility (data highway) to several distributed system components.

- Provides process data to the operator in useful and understandable manner which helps the operator in deciding on the action to be taken by him .

- The HLOI includes 2 to 5 CRT'S with Keyboard , Discs ,Tape , Trend recorder and Printer units communication controller and association electronics.

SUPERVISORY COMPUTER INTERFACE PACKAGE

- Application of supervisory control improves the performance of any process due to digital computer and its capability to perform complex mathematical calculation and to make logical decision.

FUNCTIONS

- Determines the process constraints such as a "DISTILLATION COLUMN FLOODING CONDITION" or "COMPRESSOR SURGE CONDITION".

- Determine the present operating state of the process , based on real-time information from the distributed system.

- Determines the present optimum control strategies based on real-time information to achieve the control by the adjustment of the manipulated variables of the DCS level.

- Anticipating alarm conditions in advance of the process reaching this condition is a vital function of SUPERVISORY COMPUTER

PLC INTERFACE

- Gives a superior man-machine interface.

- PLC system has excellent processing capability and the DCS on the other hand has excellent color display system in the form of an operator station.

- To take advantage of this robust and user friendly interface it is necessary to have the PLC'S and DCS share information

- PLC provides the status of controlled devices to the DCS and DCS provides the PLC with the control signals which will start or stop a particular motor or open and close valves

TRAFFIC DIRECTOR

- The function of the Traffic director is to grant transmitting privilege based upon polling various stations or highway.

- Each DCS package limits the numbers of devices per system and the distance between them depending on the capacity of the traffic director.

- Decides which device should talk first in case of several devices requesting to talk simultaneously.

DEDICATED LOOP CONTROLLER

- Used for the I/O of most critical loops.

- Should keep functioning even if the central processor or data highway fails , should be connected to the dedicated card controllers.

- Group of dedicated card controllers are connected to the highway by a data concentrator

- If the central processor of DCS fails or data highway fails , only the communication link is lost to the card controller but the control loop itself continues functioning

MULTI-LOOP CONTROLLER(LOCAL CONTROL UNIT {LCU})

- The most critical loops are usually placed in dedicated card controllers and the rest of the control loops are placed is unit operation controllers (UOC)

- An UOC is dedicated to a unit operation of the process such as chemical reactor or a distillation column .

- If the UOC fails then will interrupt the controls of only one unit operation while the rest of the plant remains unaffected.

LOCAL MULTIPLEXER

- It is a type of LCU which doesn't execute any control functions ; it only transmits I/O to and from the central processor .

- Multiplexer may be analog or digital types implementing either electro-mechanical or solid state switching between the various I/O.

# Example: Emerson's PlantWeb (Delta V)

You can choose the level of redundancy your application requires, including:

- Redundant Ethernet network communications
- Redundant controllers
- Redundant power supplies
- Redundant H1 FOUNDATION fieldbus interface and bus power
- Redundant digital HART I/O
- Redundant MODBUS and other RS485 serial communications
- Redundant workstations

Rugged control and field interfaces

Built to mount anywhere—minimizing your installation costs and ensuring safety. Meets:

- Class 1, Div. 2
- Zone 1* and 2
- Intrinisically safe options
- G3 corrosion resistance
- -40 to 70°C*.
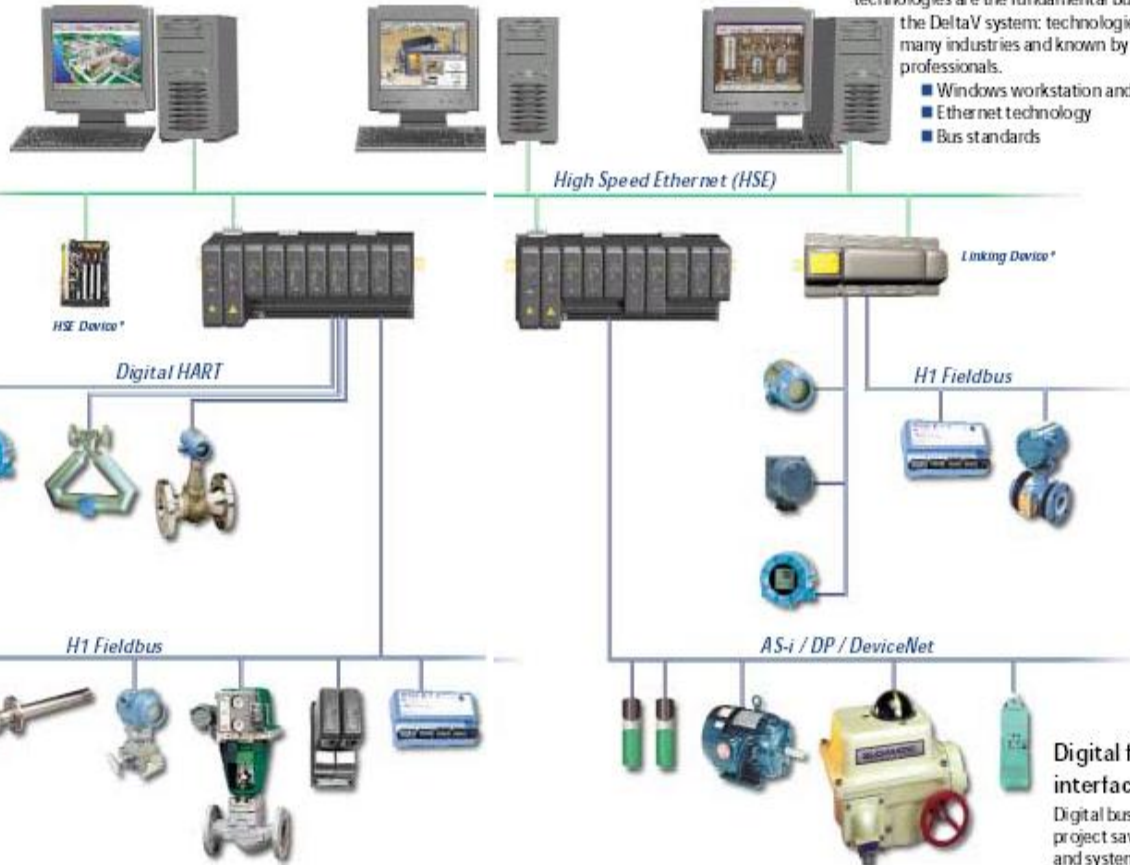
Commercial off-the-shelf technologies

Proven, low-cost, easily integratable commercial technologies are the fundamental building blocks of the DeltaV system: technologies proven across many industries and known by a wide pool of professionals.

- Windows workstation and server-based PCs
- Ethernet technology
- Bus standards

High Speed Ethernet (HSE)

HSE Device*

Digital HART

Linking Device*

H1 Fieldbus

H1 Fieldbus

AS-i / DP / DeviceNet

Digital field interfaces

Digital busses deliver big project savings in wiring and system footprint. Digital communications include:

- FOUNDATION fieldbus
- AS-i
- DeviceNet
- Profibus
- HART