

Evolution of instrumentation (Gauges to DCS & beyond)

DR.R.JAYAPAL

GAUGES



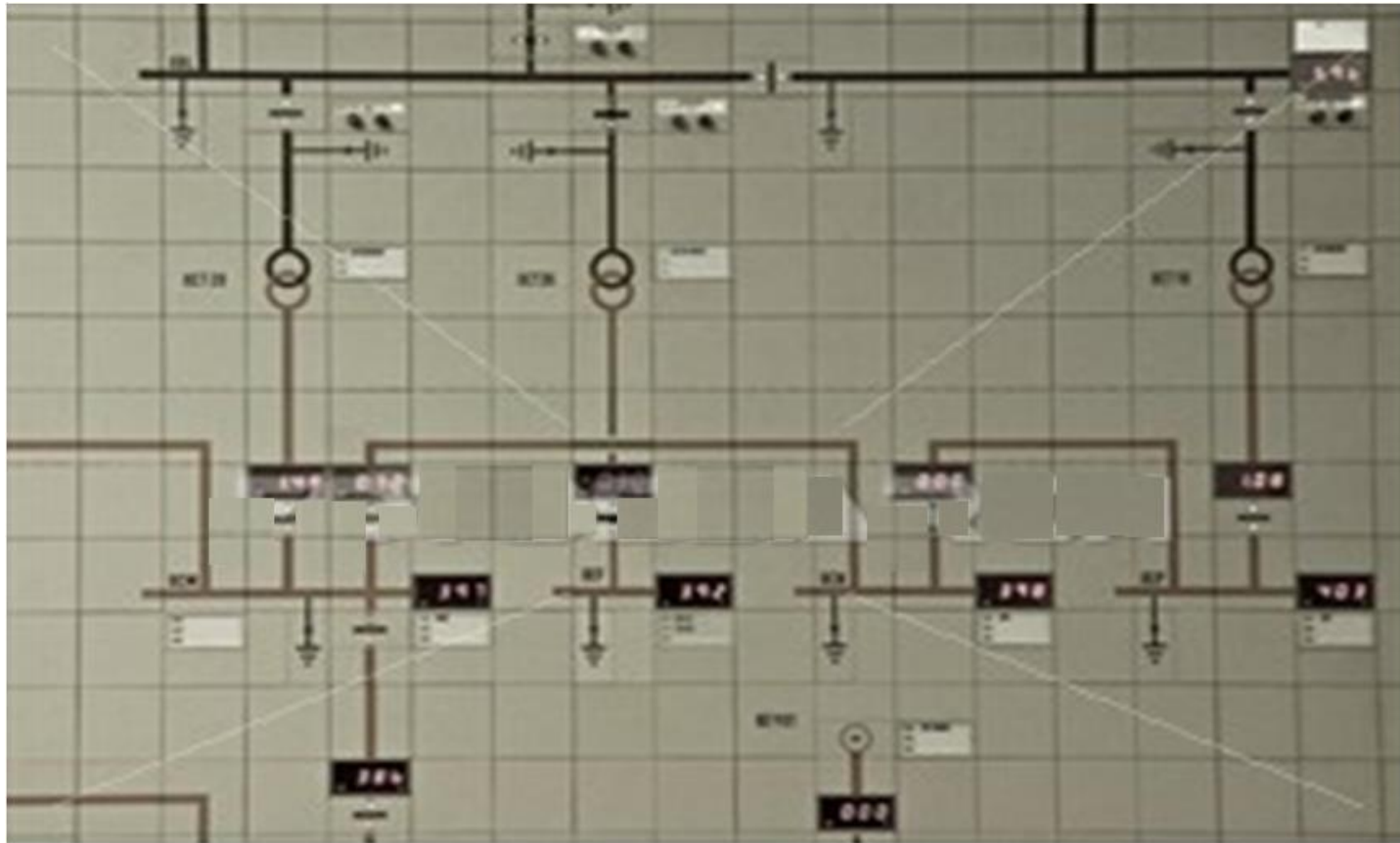
Dr.R.Jayapal

CONTROL PANEL



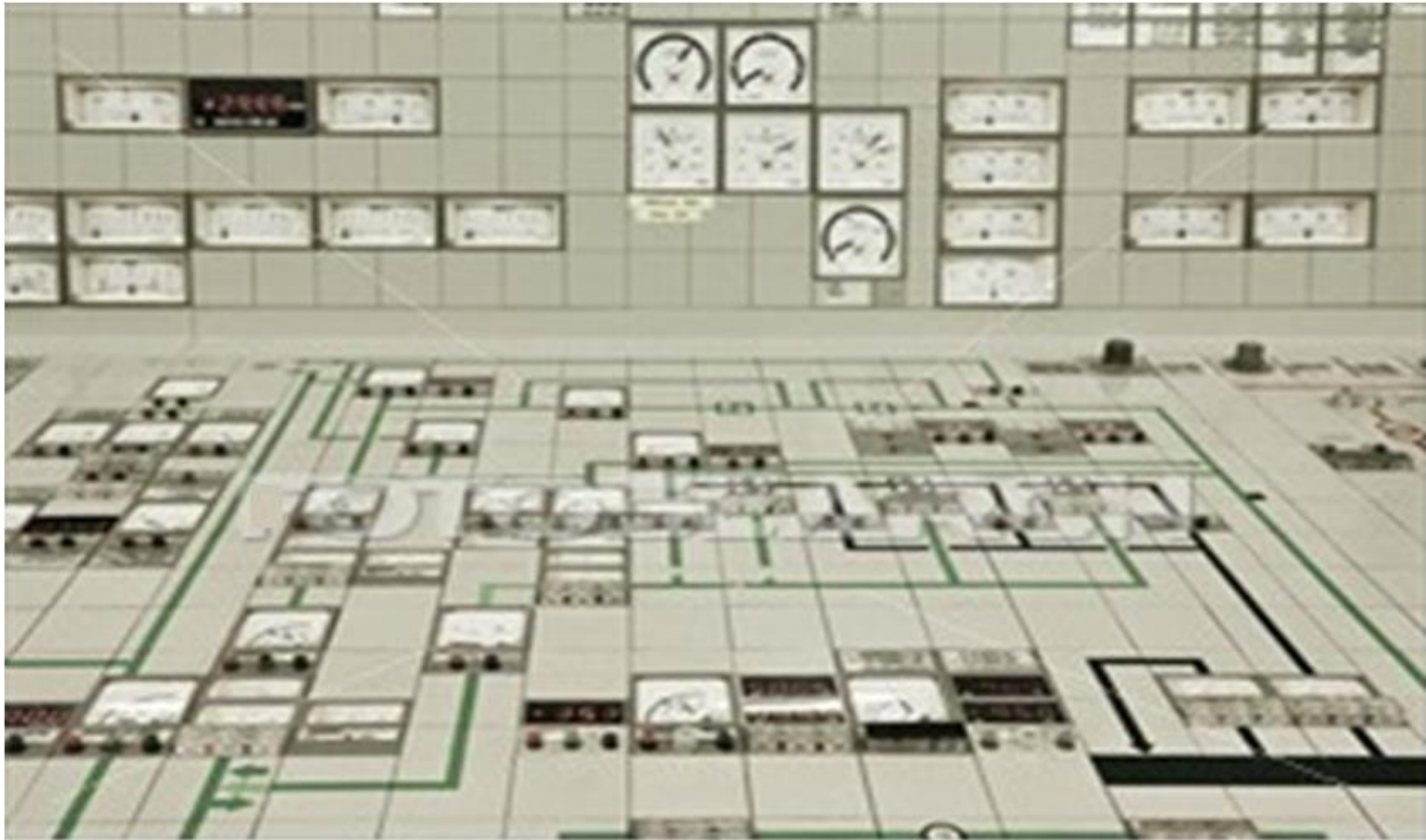
Dr.R.Jayapal

CONTROL PANEL



Dr.R.Jayapal

CONTROL PANEL (MOSAIC)



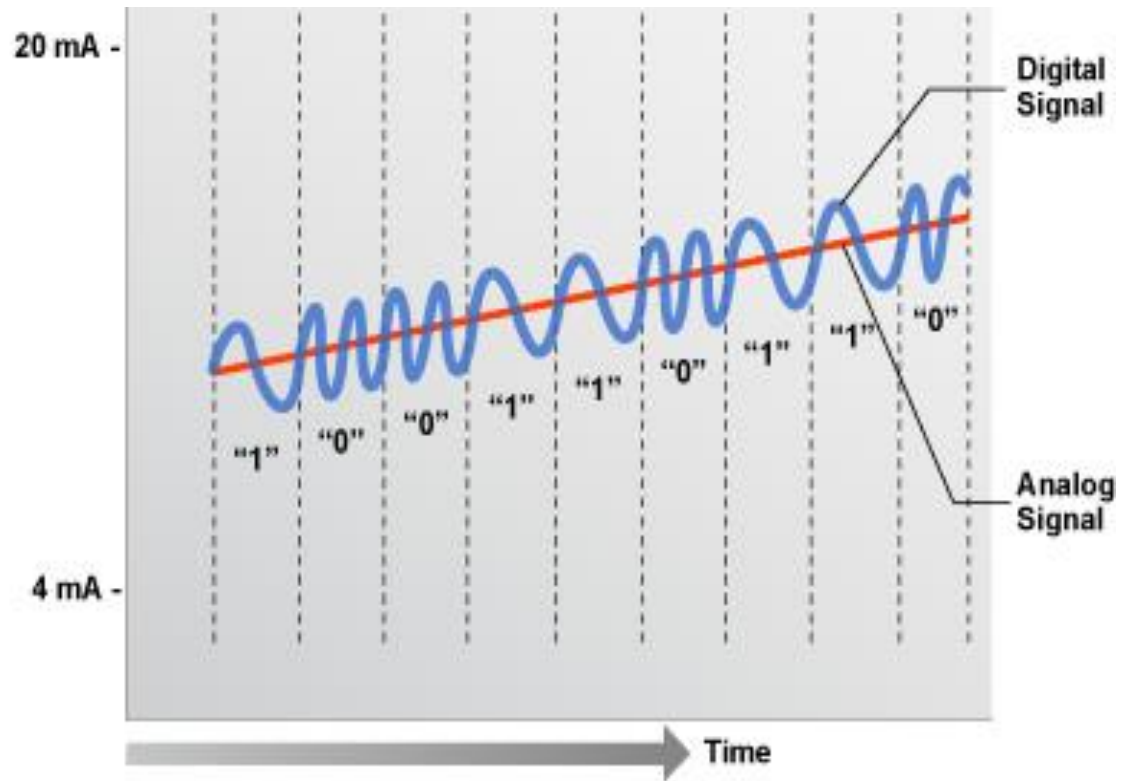
Dr.R.Jayapal

I&C SYSTEM COMPONENTS

- **FIELD SENSORS/SWITCHES**
- **GAUGES & RECEIVER INSTRUMENTS**
- **P/PI/PID CONTROLLERS**
- **RECORDERS**
- **ACTUATORS**

4 -20 mA current loop

- 2 wire transmitters. Enormous cable saving. Power supply is 24V DC.
- Power and signal go in same lines
- Only 2 wire goes from instrument to transducers
- 4 mA represents zero elevation to distinguish open circuit.
- Span is 16 mA.
- Only analog signal

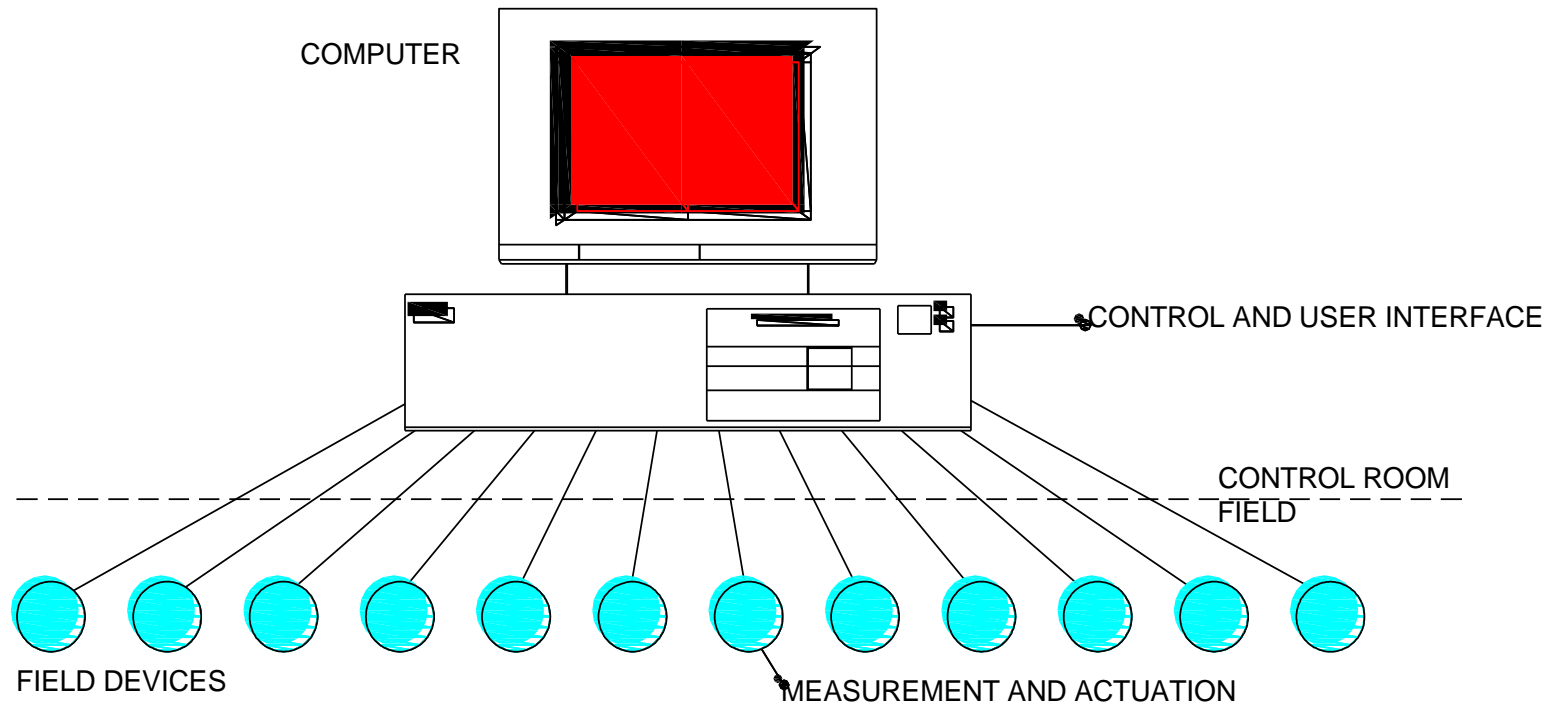


Note: Drawing not to scale

Digital over Analog
 (Analog and Digital Signal)

HART- HIGHWAY ADDRESSABLE REMOTE TRANSDUCER

Direct Digital Control (DDC) System



DIRECT DIGITAL CONTROL(DDC) SYSTEM

DIRECT DIGITAL CONTROL (DDC)

- Minicomputers used in process control (1959-74)
- First industrial computer DDC used in TEXAS Refinery in 1959
- IBM 1800, PDP11 widely used

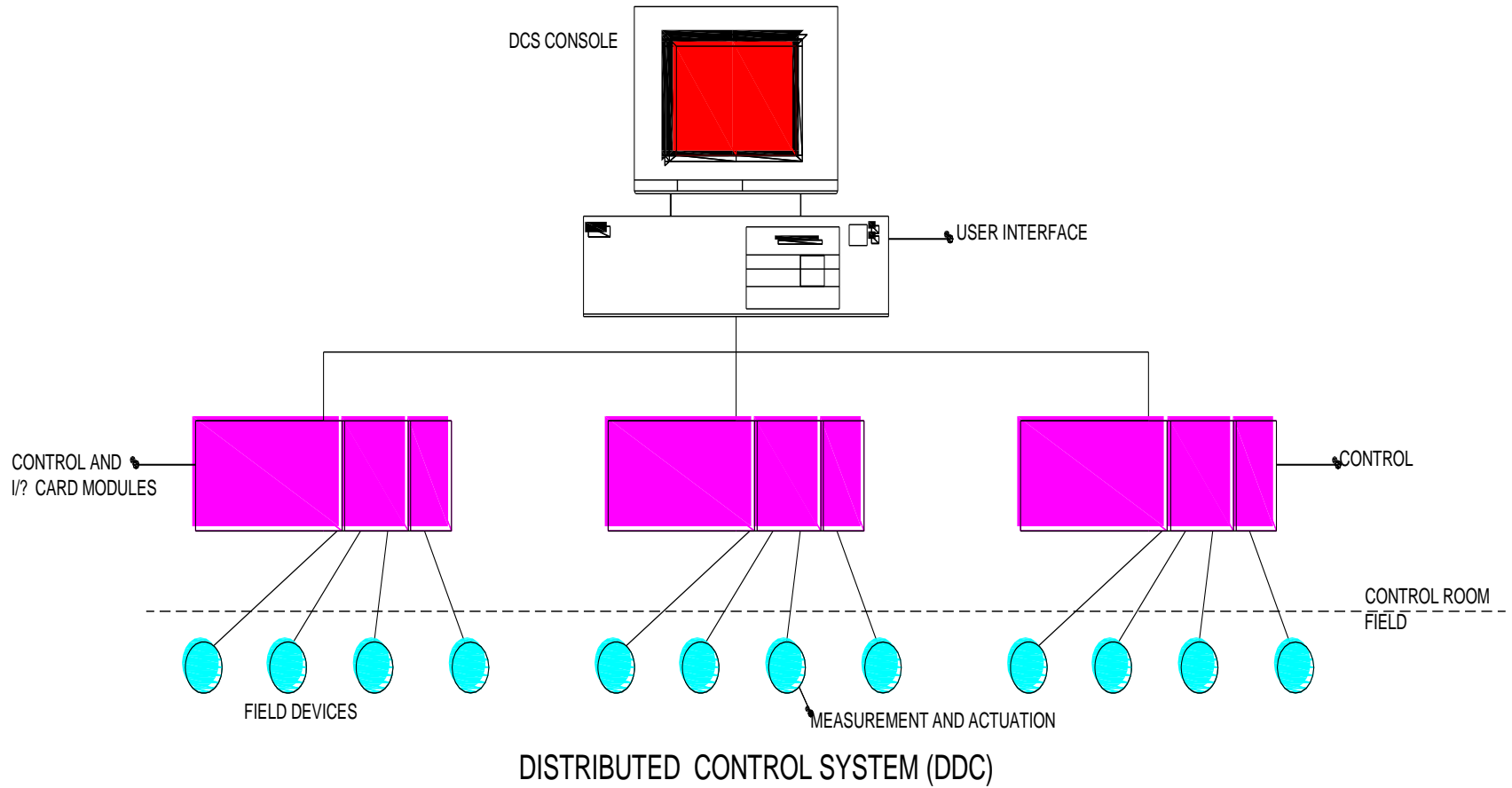
DDC COMPONENTS

- **I/O MODULES**
- **CPU MODULES (SINGLE/REDUNDANT)**
- **MEMORY MODULES**
- **POWER SUPPLY**
- **PANELS**
- **DISPLAY MONITORS /KEY BOARD**
- **SYSTEM SOFTWARE**
- **APPLICATION SOFTWARE (TABLE DRIVEN)**

DISTRIBUTED CONTROL SYSTEM (DCS)

- FIRST DCS IN 1975
- HONEYWELL TDC 2000, YOKOGAWA CENTUM, BRISTOL UCS 3000 IN 1975
- IBM 1800, PDP11 widely used

Distributed Control System (DCS)



DCS COMPONENTS

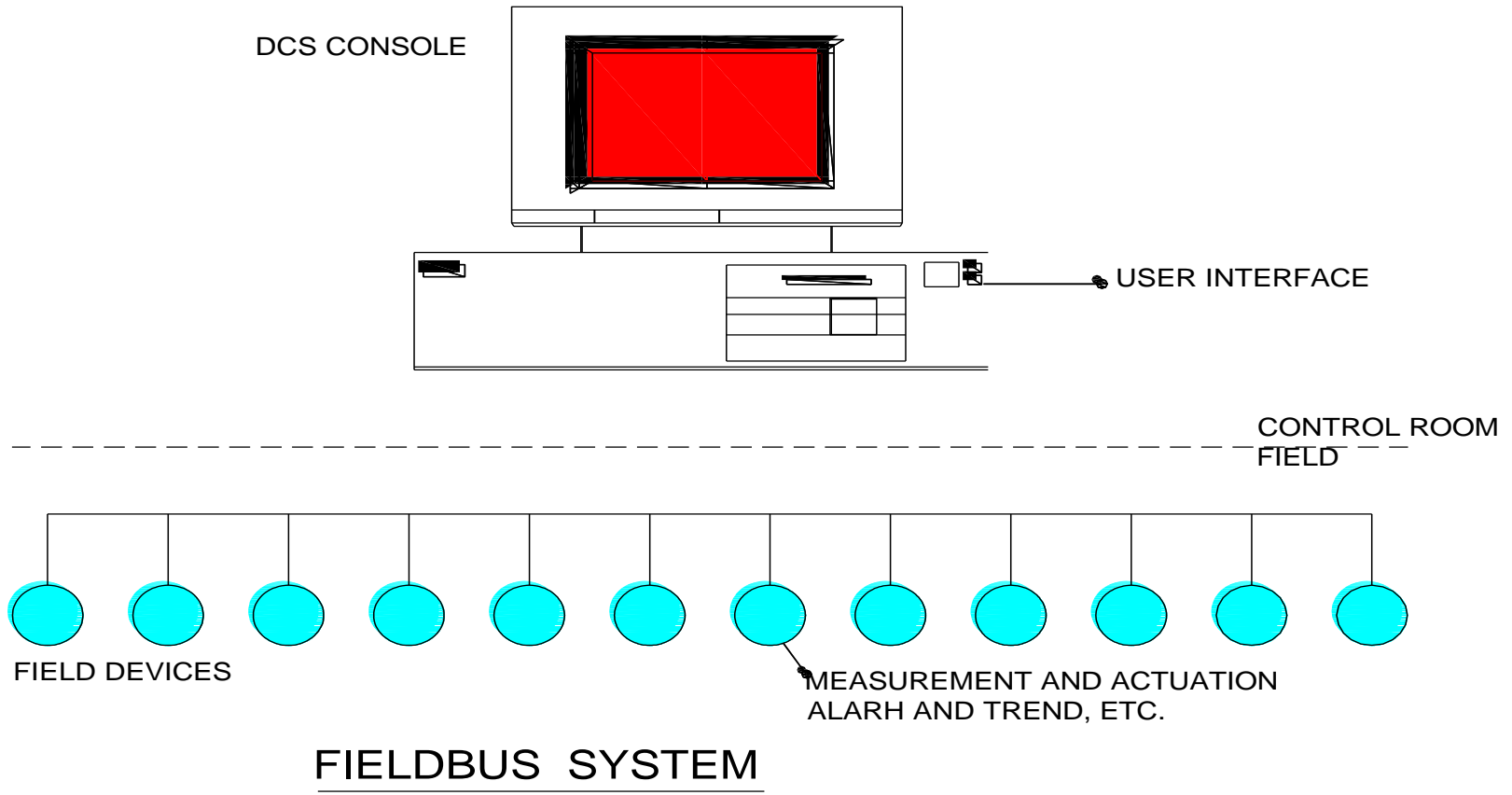
- CPU,I/O,MEMORY MODULES IN PANEL
- A NUMBER OF SUCH PANELS
- NETWORK CABLE (COPPER/FIBRE OPTIC)
- PC BASED HMI
- SYSTEM SOFTWARE
- APPLICATION SOFTWARE (FUNCTION BLOCKS)



The state-of-the-art control room in the Simhadri Thermal Power Project

Dr.R.Jayapal

Field Bus System



FOUNDATION FIELD BUS

- **H1 FOR DIGITAL REPLACEMENT OF 4-20 MA ANALOG SIGNAL .(UPTO 2 KM)**
- **H2 FOR HIGH SPEED DEVICES(UPTO 500 METERS)**

PROFIBUS

- **PROFIBUS –FMS (FIELD BUS MESSAGE SPECIFICATION)**
- **PROFIBUS –DP(DECENTRALISED PERIPHERY)**
- **PROFIBUS-PA (PROCESS AUTOMATION)**

FIELD BUS MEMBER COMPANIES IN INDIA

(AUTOMATION SYSTEM MANUFACTURERS)

- **ABB,CHEMTROLS,CHINO LAXSONS**
- **EMERSON PROCESS,ENDRESS+HAUSER**
- **FORBES MARSHALL,FUJI ELECTRIC**
- **INVENSYS,LARSON&TOUBRO**
- **MTL,PEPPERL+FUCH**
- **ROCHWELL,HONEYWELL**
- **YAMATAKE,YOKAGOWA**
- **BHEL**

MODBUS

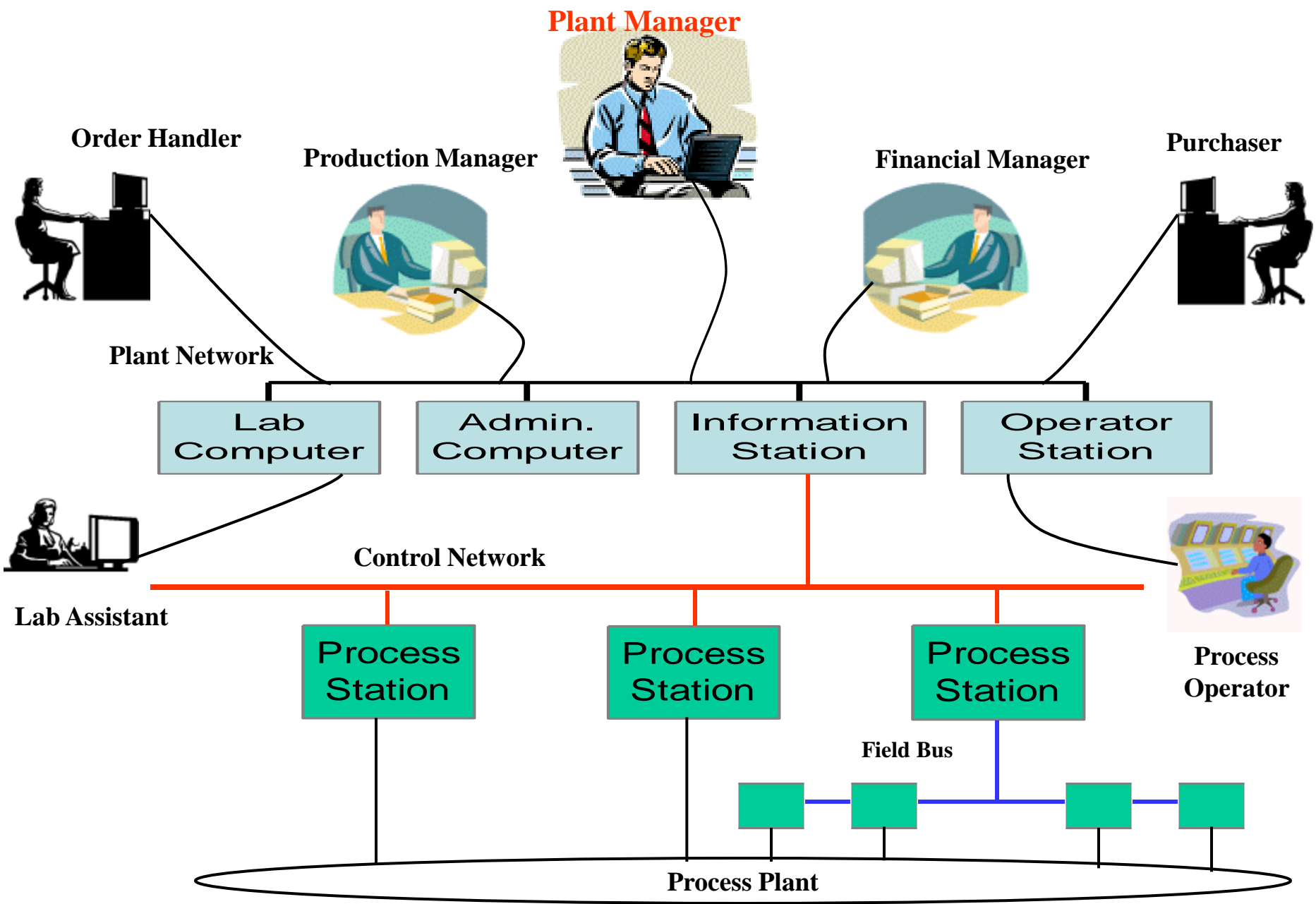
- ONE OF THE OLDEST BUSSES BY MODICON
- MASTER-SLAVE COMMUNICATION
- USES SERIAL PORT
- MODBUS TCP/IP USES TCP/IP & ETHERNET

WIRELESS NETWORKING

- INFRA RED
- RADIO FREQUENCY (BLUE TOOTH,ZIGBEE)
- CELLULAR
- SATELLITE

STANDARD BUS-APPLICATION

<u>BUS</u>	<u>APPLICATION</u>	<u>SPONSOR</u>
CAN	Automotive,Process control	CLA,OVDA, Honeywell
Profibus	Process control	Siemens, ABB
LON Works	Building Automation	Echelon, ABB
Ethernet	Plant Bus	Many
Interbus-S	Manufacturing	Phoenix contact
Foundation field bus, HART	Chemical Industry	Fisher-Rosemount, ABB
ASI	Building systems	SIEMENS
Modbus	Obsulete; Point to Point	Many
Control net	Plant bus	Rockwell Automation



NETWORK CAPABILITY HIERARCHY

- ENTERPRISE BUS (ETHERNET)
- CONTROL BUS (HSE,CONTROLNET)
- FIELD BUS (FOUNDATION FIELD BUS,PROFIBUS)
- DEVICE BUS (DEVICENET,PROFIBUS,INTERBUS-S)
- SENSOR BUS (CAN,ASI,SERIPLEX,LON WORKS)