

# 4

# SMART / INTELLIGENT TRANSMITTERS AND ACTUATORS

---

**Dr. H. K. Verma**

Distinguished Professor (EEE)  
Sharda University, Greater Noida

(Formerly: Deputy Director and Professor of Instrumentation  
Indian Institute of Technology Roorkee)

# CONTENTS

---

1. Smart / Intelligent Transmitters
2. Smart / Intelligent Actuators

## 4.1

# Smart / Intelligent Transmitters

---

**Smart Transmitter:** It is a compact unit comprising a sensor (or sensors), analog signal processing unit, transmitter circuit and a communication port.

**Intelligent Transmitter:** It is a compact unit comprising a sensor (or sensors), analog signal processing unit, data processor, communication interface and a communication port.

### Variants:

A – Smart transmitter with analog output

B – Intelligent transmitter with digital wired input-output

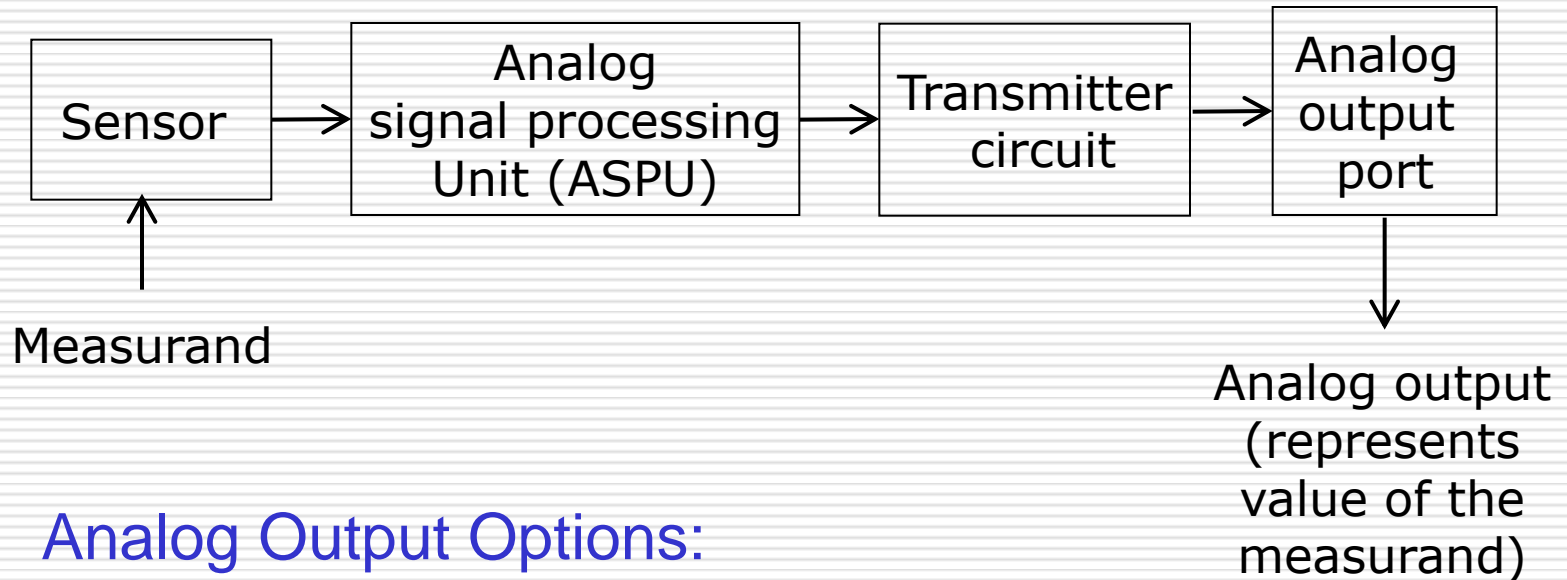
C – Intelligent transmitter with digital wireless input-output

D – Intelligent HART transmitter

E – Intelligent HART transmitter with advanced features

# Smart Transmitter with Analog Output

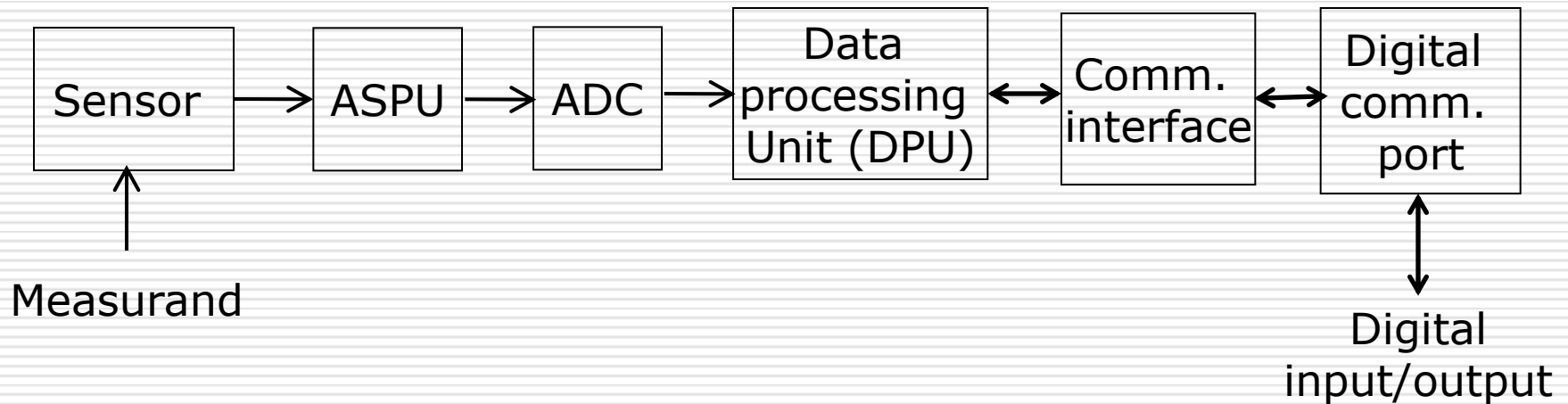
---



## Analog Output Options:

- Voltage or current
- Most common output: 4-20 mA

# Intelligent Transmitter with Wired Digital Communication

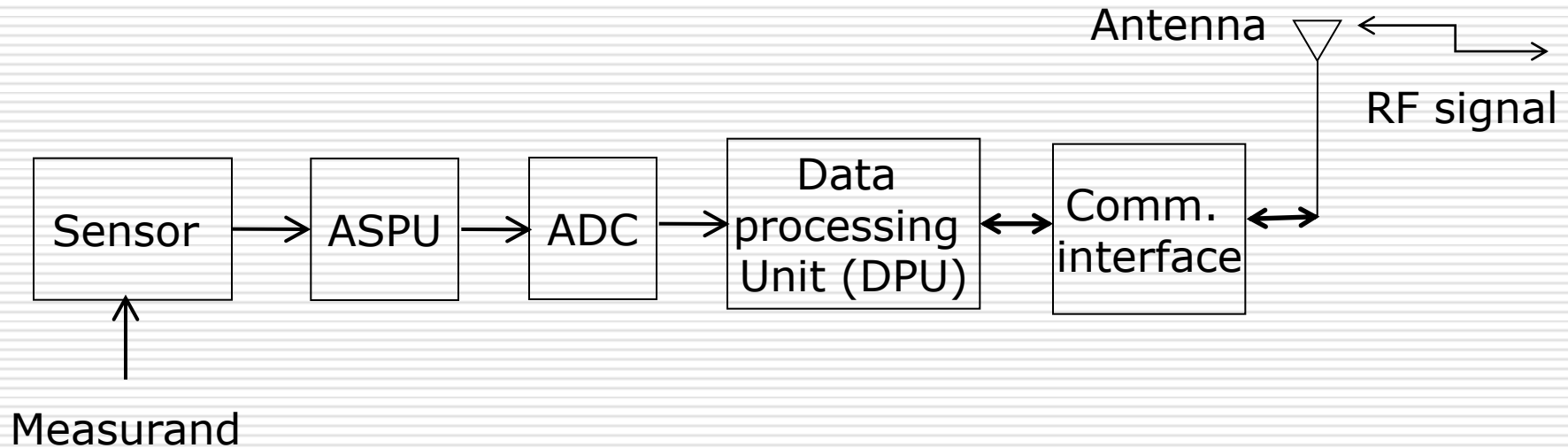


## Digital communication (comm.) options:

- Modbus over RS485
- Modbus over TCP/IP
- Ethernet
- Foundation Fieldbus
- CANBus, ProfiBus, etc.

*(Digital output represents value of the measurand, Digital input is for configuring the device)*

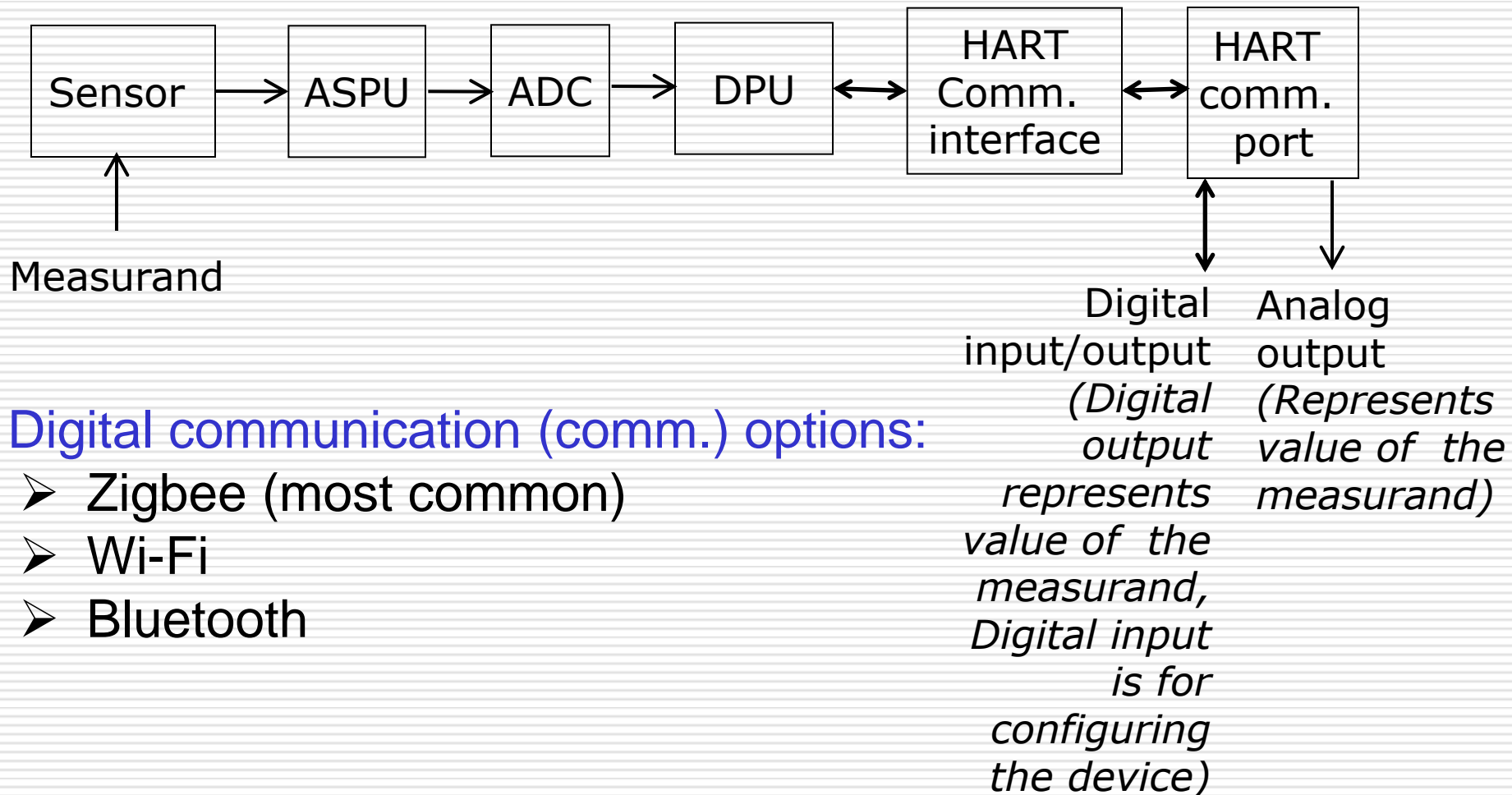
# Intelligent Transmitter with Wireless Digital Communication



## Digital communication (comm.) options:

- Zigbee (most common)
- Wi-Fi
- Bluetooth

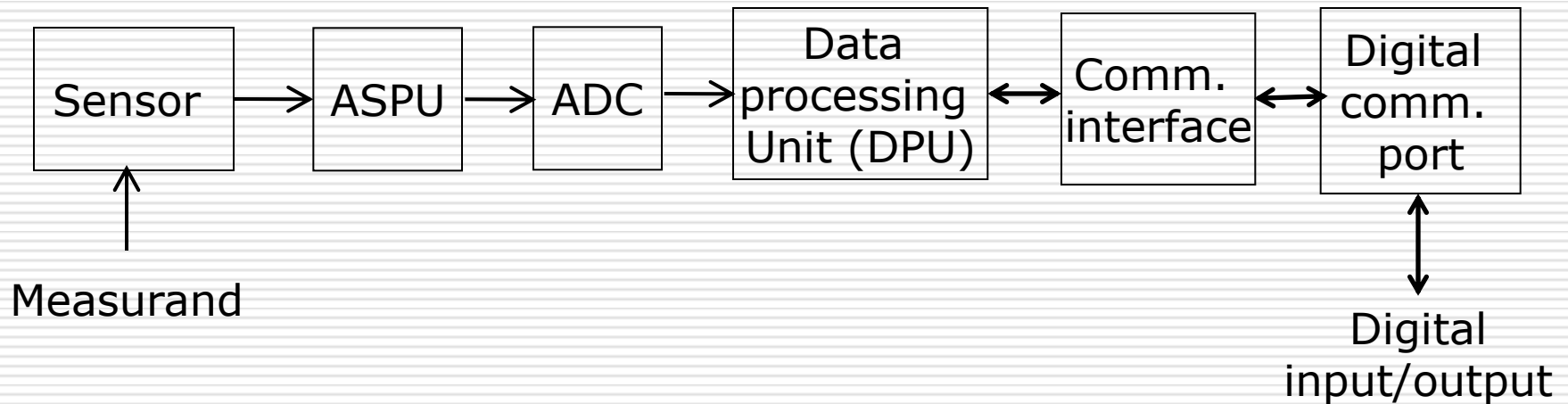
# Intelligent HART Transmitter



## Digital communication (comm.) options:

- Zigbee (most common)
- Wi-Fi
- Bluetooth

# Intelligent HART Transmitter



## Digital communication (comm.) options:

- Zigbee (most common)
- Wi-Fi
- Bluetooth

*(Digital output represents value of the measurand, Digital input is for configuring the device)*



# Functions of Microprocessor in Intelligent Transmitters

---

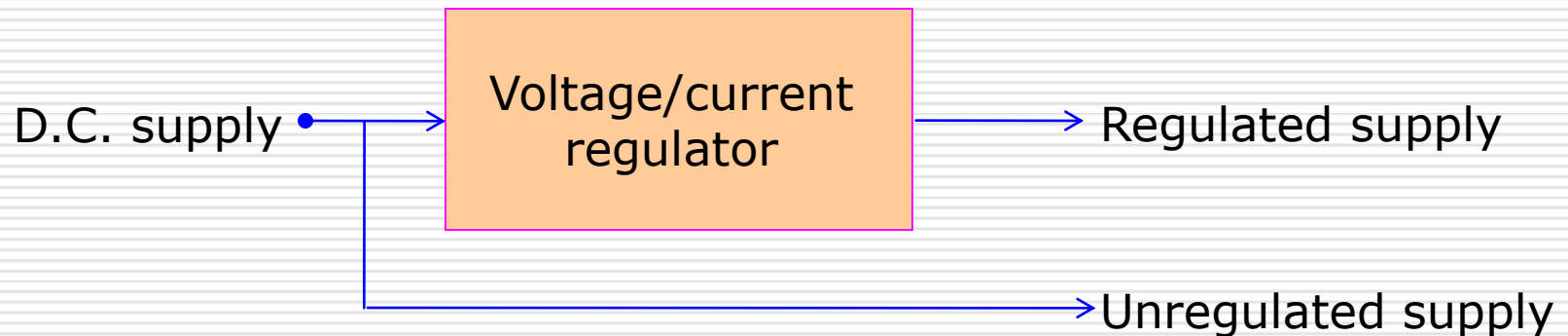
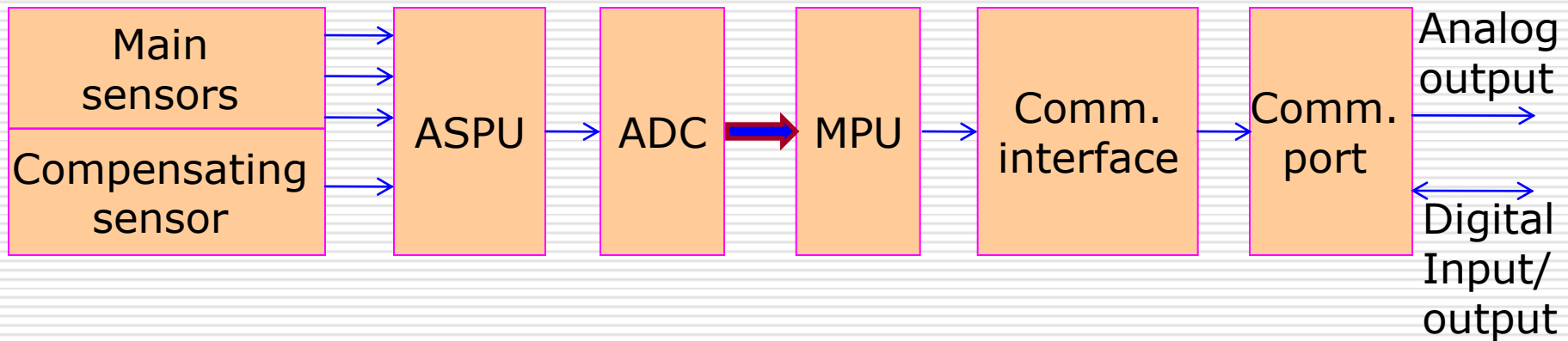
## ❖ Data Processing Functions

1. Conversion of electrical units to engg. units
2. Noise reduction
3. Linearization of response
4. Auto-calibration

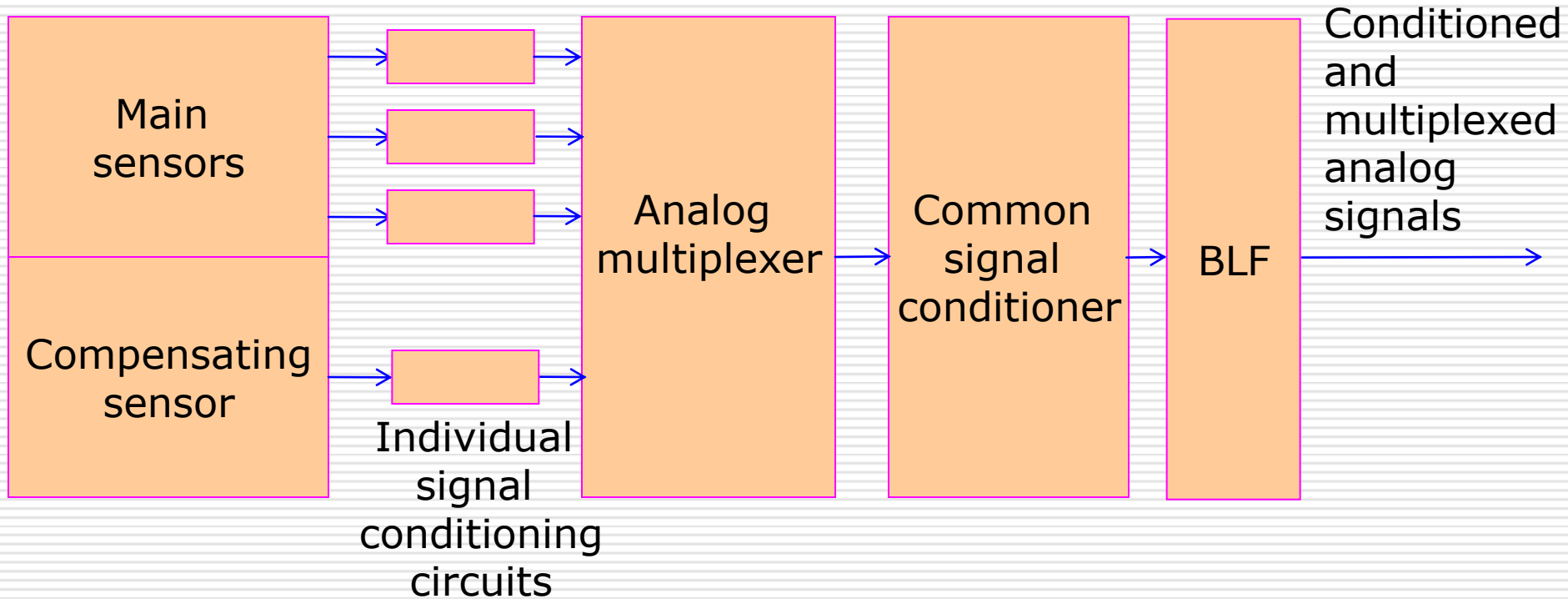
## ❖ Communication Functions

1. Data formatting
2. Error control
3. Timing control
4. Networking

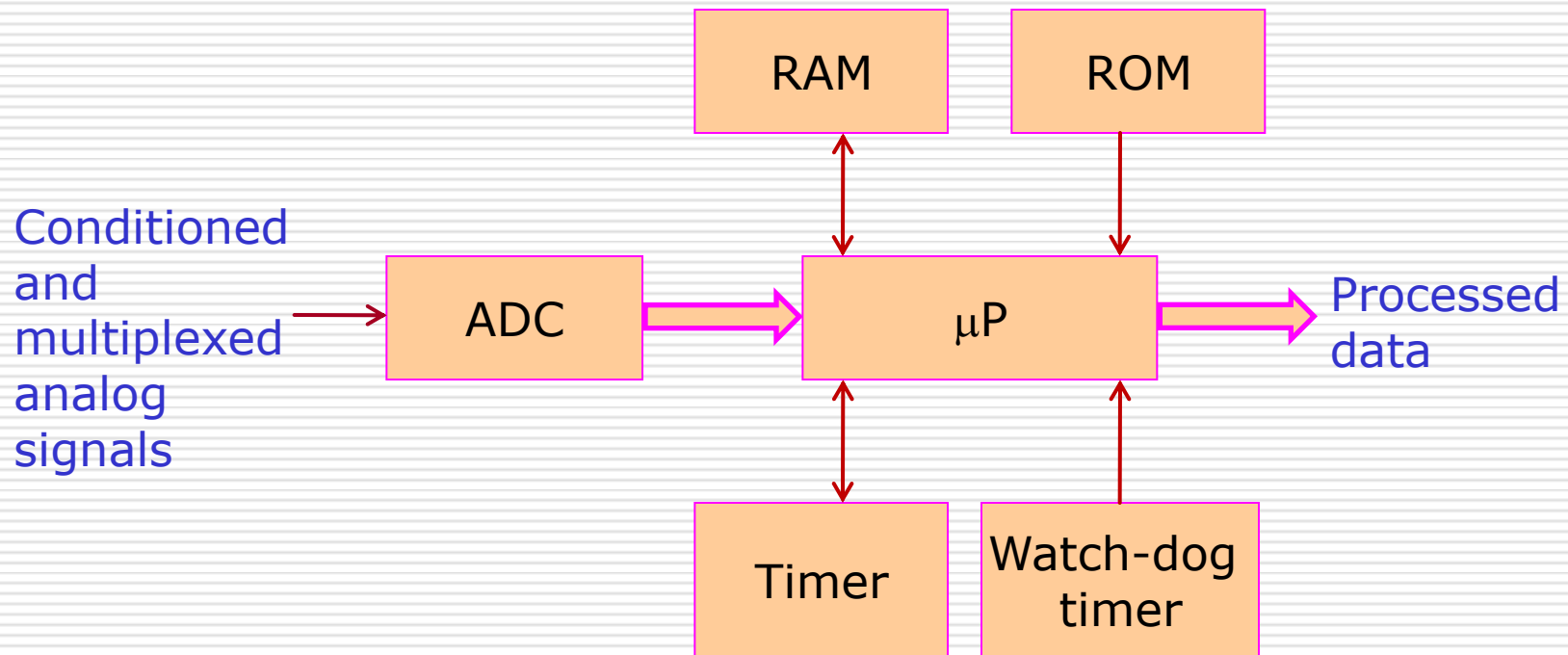
# Intelligent HART Transmitter with Advanced Features



# ASPU Details

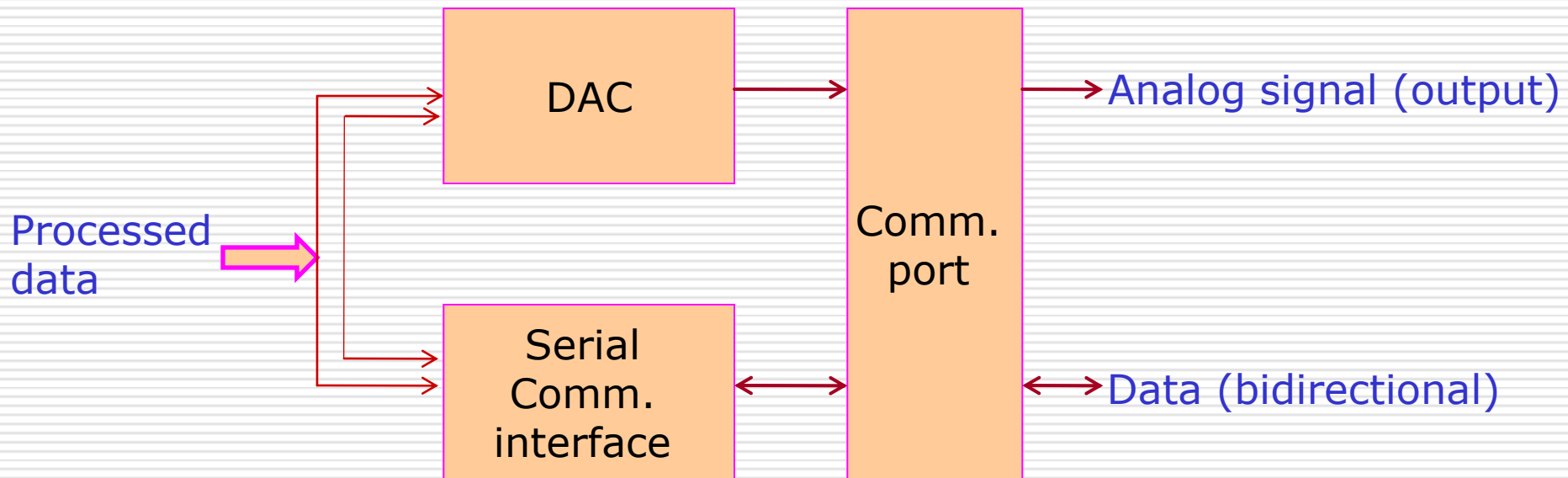


# ADC & MPU Section Details



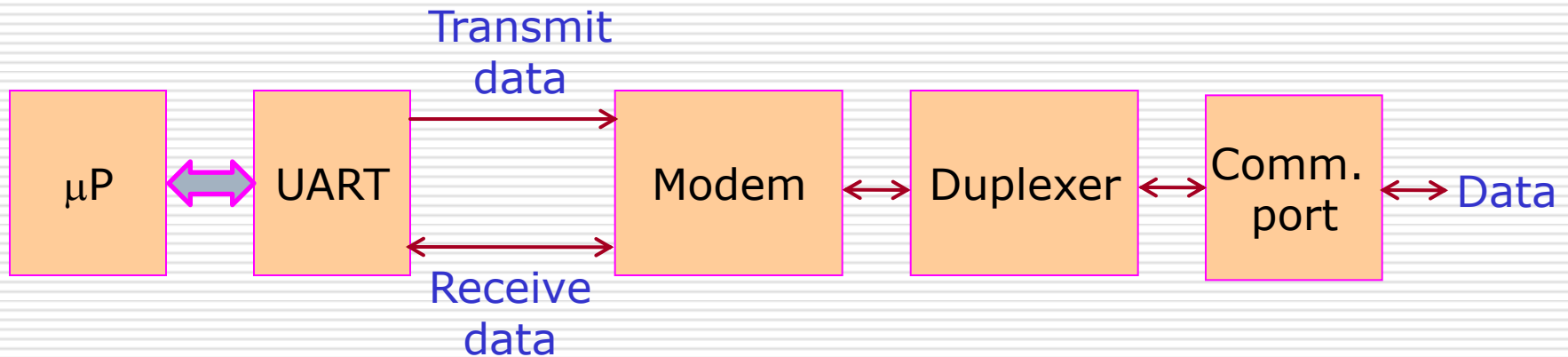
# Communication Section Details

---



# Serial Communication Interface Details

---



**Smart Actuator:** It is a compact unit comprising an actuator and its driver circuit.

**Intelligent Actuator:** It is a compact unit comprising an actuator, its driver circuit, a digital controller, communication interface and a communication port. A feedback sensor may also be included as an optional component.

*Because of their widespread use in industry, these actuators are mostly linear or angular motion actuators.*

**Variants:**

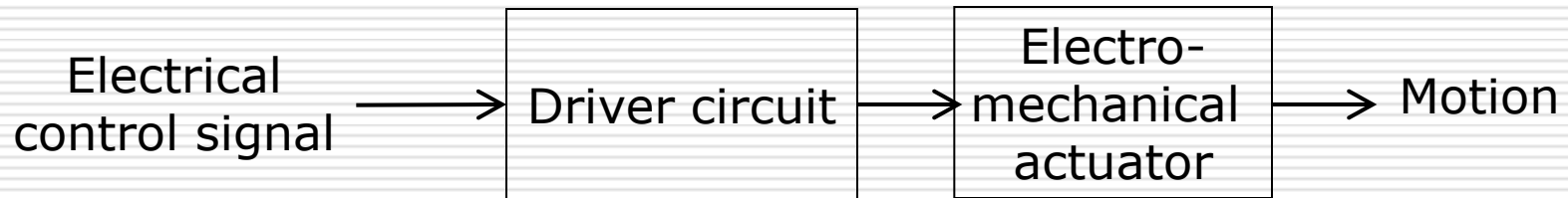
A – Smart actuator

B – Intelligent actuator without feedback sensor

C – Intelligent actuator with feedback sensor

# Smart Actuator

---

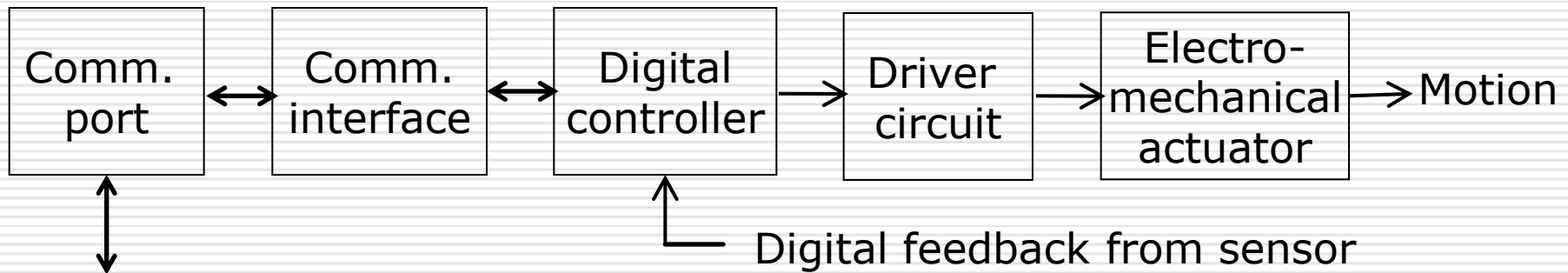


## Options:

- Motion: Linear or angular
- EM Actuator: Servo-motor or stepper motor
- Driver circuit: Servo-motor driver or stepper-motor driver



# Intelligent Actuator without Feedback Sensor

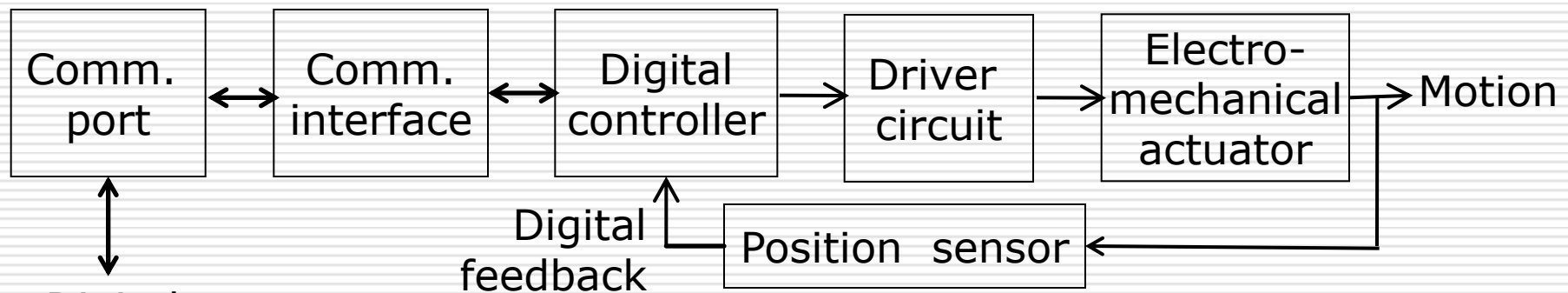


Digital  
input/output  
(From/to  
supervisory  
control system)

## Options:

- Motion: Linear or angular
- EM Actuator: Servo-motor or stepper motor
- Driver circuit: Servo-motor driver or stepper-motor driver
- Digital controller: Microprocessor or microcontroller
- Communication: Modbus over RS485, Modbus over TCP/IP, Ethernet, Foundation Fieldbus, CANBus, ProfiBus, etc.

# Intelligent Actuator with Feedback Sensor



Digital  
input/output  
(From/to  
supervisory  
control system)

## Options:

- Motion: Linear or angular
- EM Actuator: Servo-motor or stepper motor
- Driver circuit: Servo-motor driver or stepper-motor driver
- Digital controller: Microprocessor or microcontroller
- Position sensor: Linear or angular position encoder
- Communication: Modbus over RS485, Modbus over TCP/IP, Ethernet, Foundation Fieldbus, CANBus, Profibus, etc.

# Functions of Microprocessor in Intelligent Actuators

---

## ❖ Control Functions

1. Comparator (Error detector)
2. Control action generator

## ❖ Communication Functions

1. Data formatting
2. Error control
3. Timing control
4. Networking