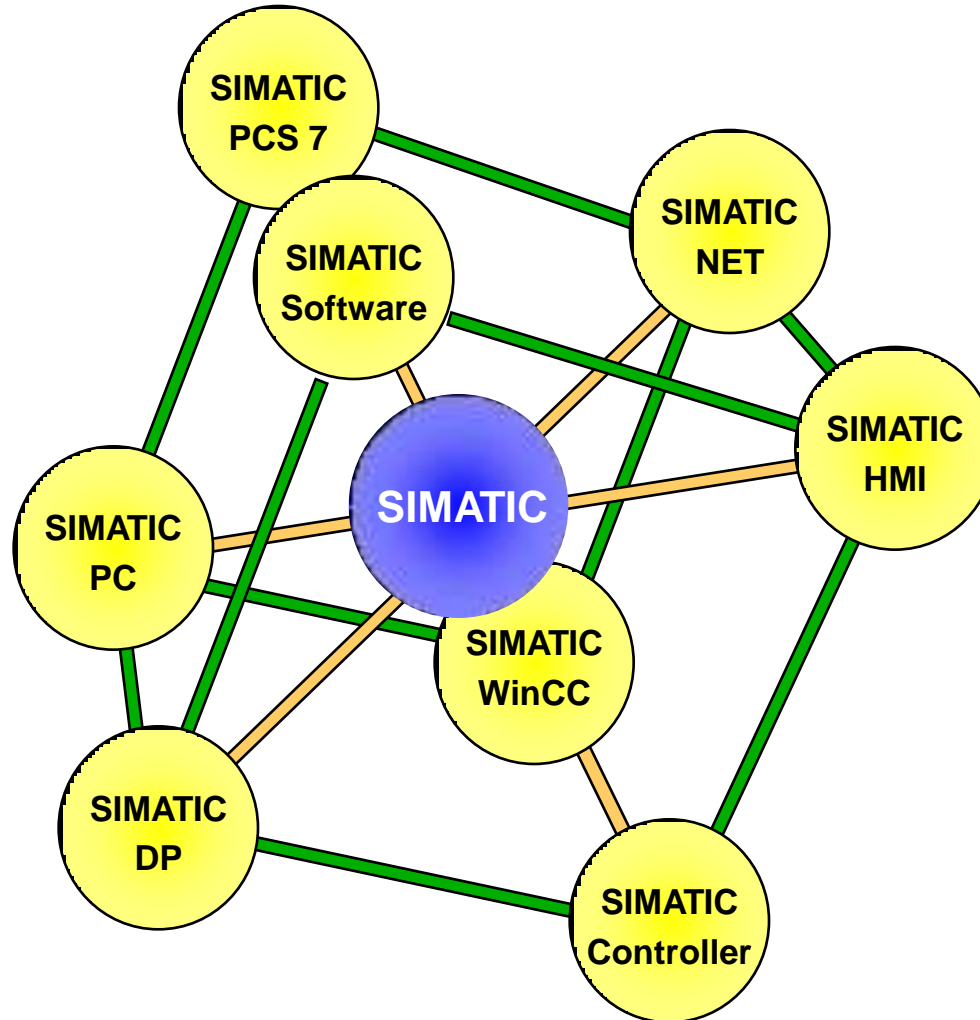
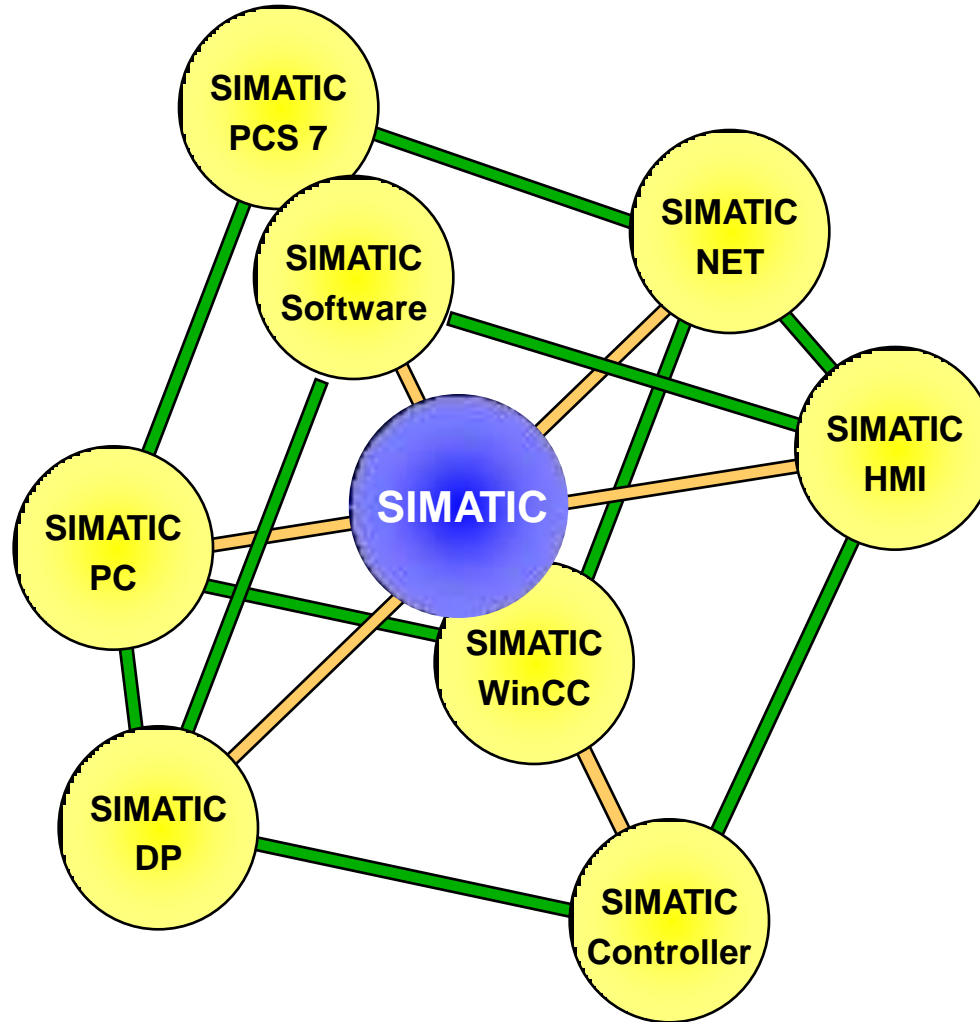


# The SIMATIC S7 System Family



# The SIMATIC S7 System Family



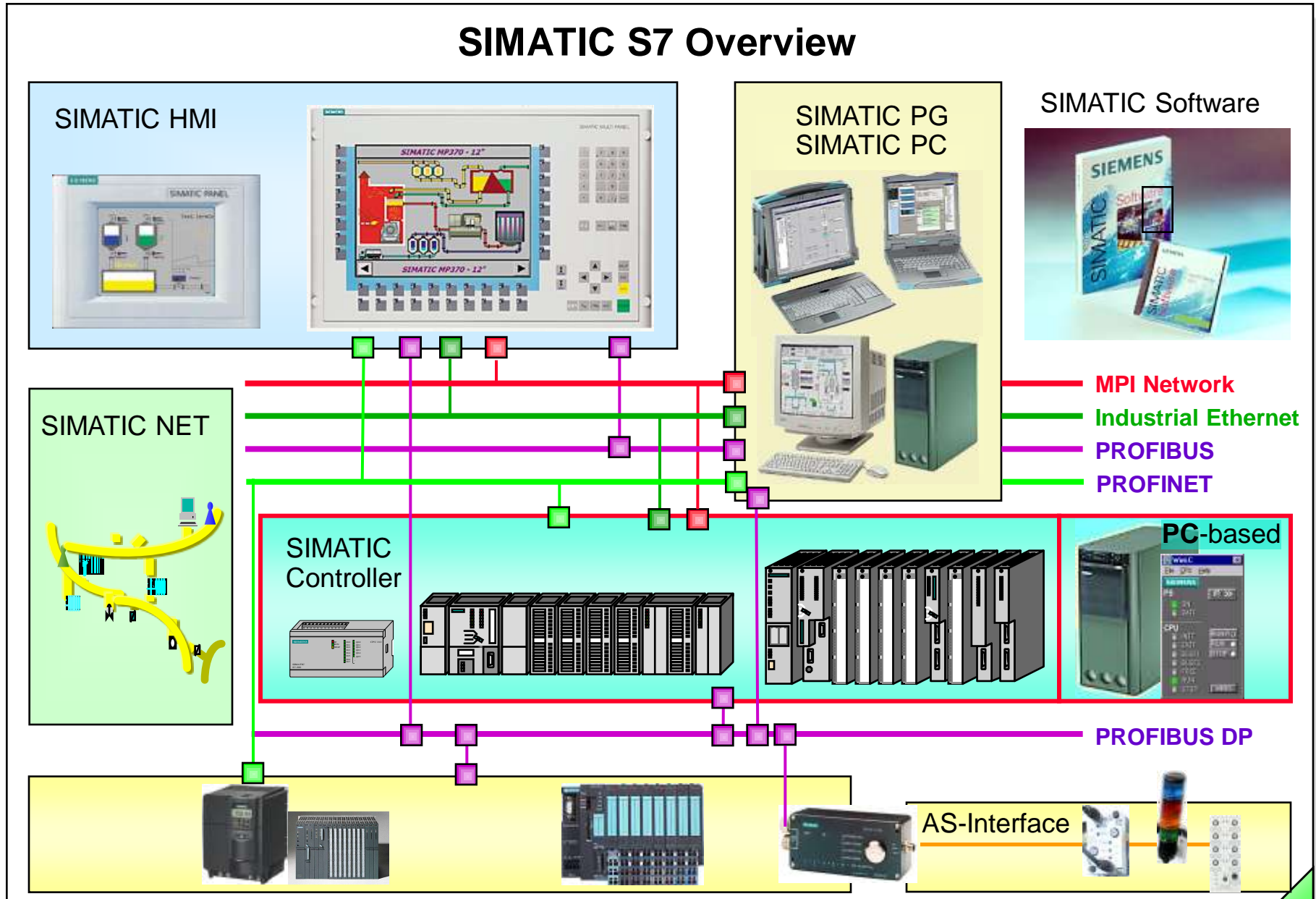
# Objectives

## Upon completion of the chapter the participant will ...

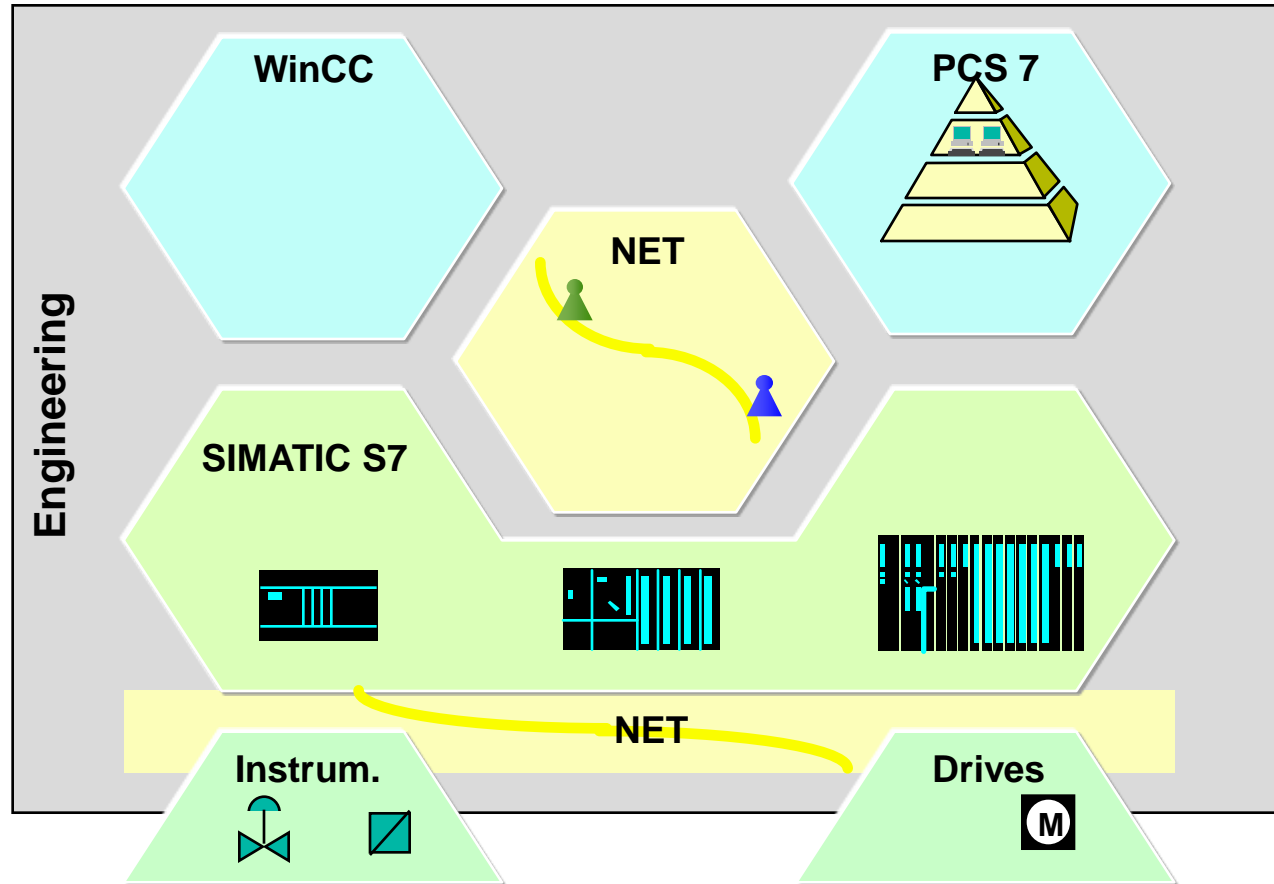
- ... have an overview of the SIMATIC S7 system family
- ... be familiar with the S7-300 and S7-400 automation systems
- ... have an overview of the modules available for these automation systems
- ... understand the concept of "Totally Integrated Automation" (T.I.A.)
- ... be familiar with the programming devices
- ... be familiar with the PC requirements for working with STEP7
- ... be familiar with the tools of the STEP7 basic programming package
- ... have an overview of the most important tools used in the T.I.A. concept



# SIMATIC S7 Overview



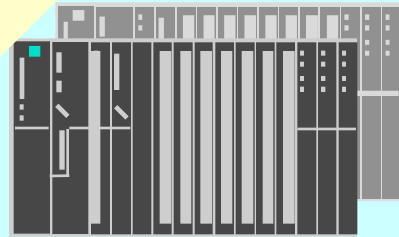
# What does "Totally Integrated Automation" Mean



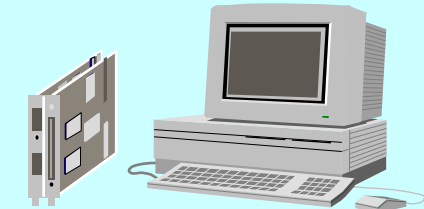
# The SIMATIC S7/C7 and WinAC Controllers

Upper and middle performance range

modular



**SIMATIC S7 - 400**



**SIMATIC WinAC Slot**

Lower and middle performance range

modular

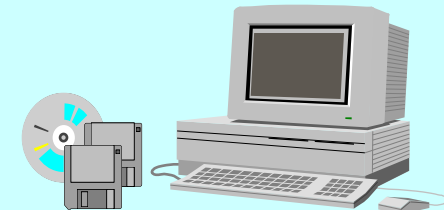


**SIMATIC S7 - 300**

complete



**SIMATIC C7 - 6xx**



**SIMATIC WinAC Basis**

Micro PLC

compact

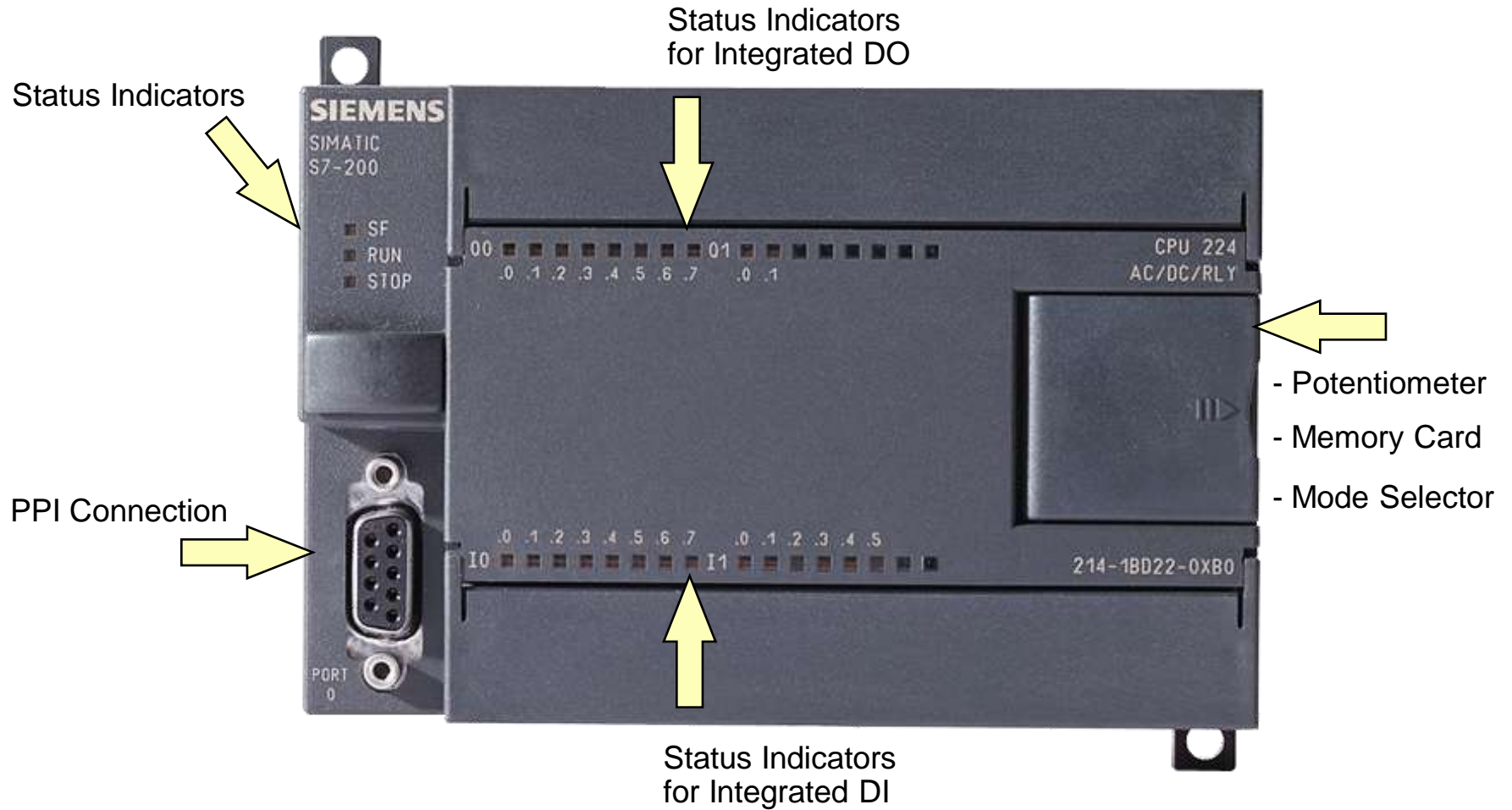


**SIMATIC S7 - 200**



**Logo**

# S7-200 Micro Controller



# S7-200: Modules / Expansion Modules (EM)



I / O Modules

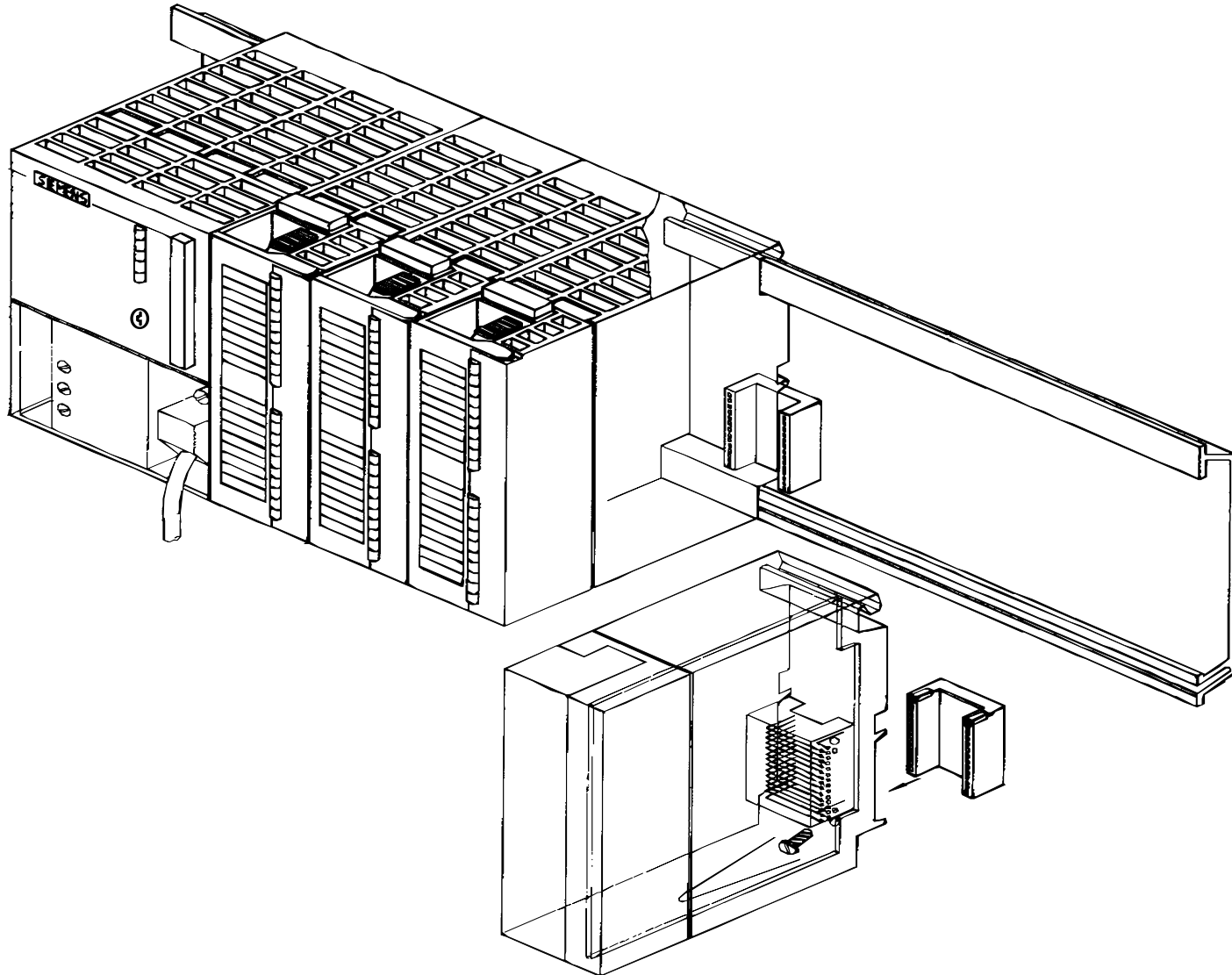


Function Modules (FM)

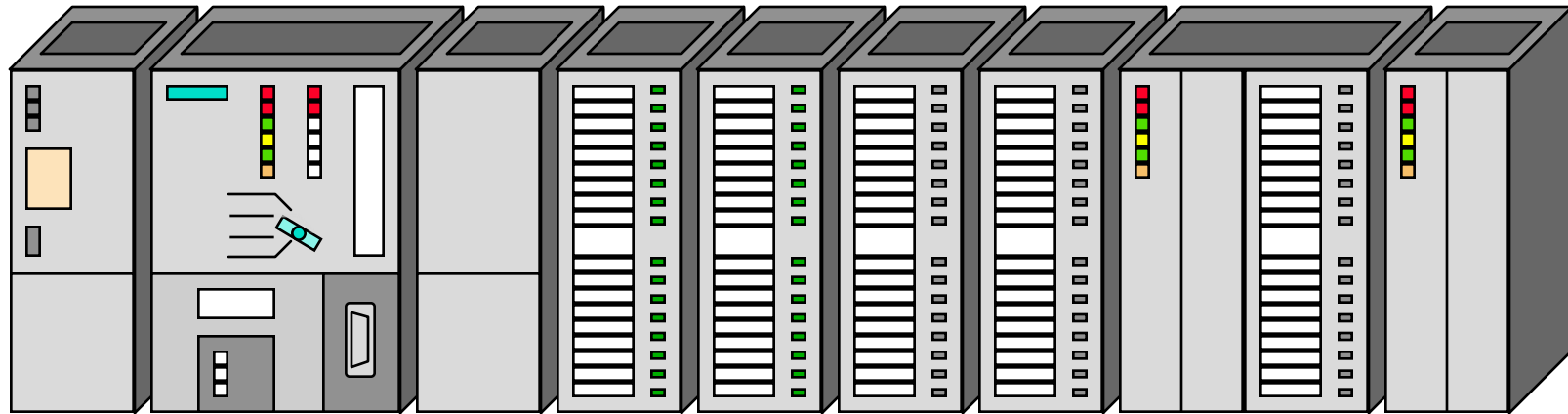


Communications Processors (CP)

# S7 - 300 Automation System



# S7-300: Modules



**PS**  
(optional)



**CPU**



**IM**  
(optional)



**SM:**  
**DI**



**SM:**  
**DO**



**SM:**  
**AI**



**SM:**  
**AO**



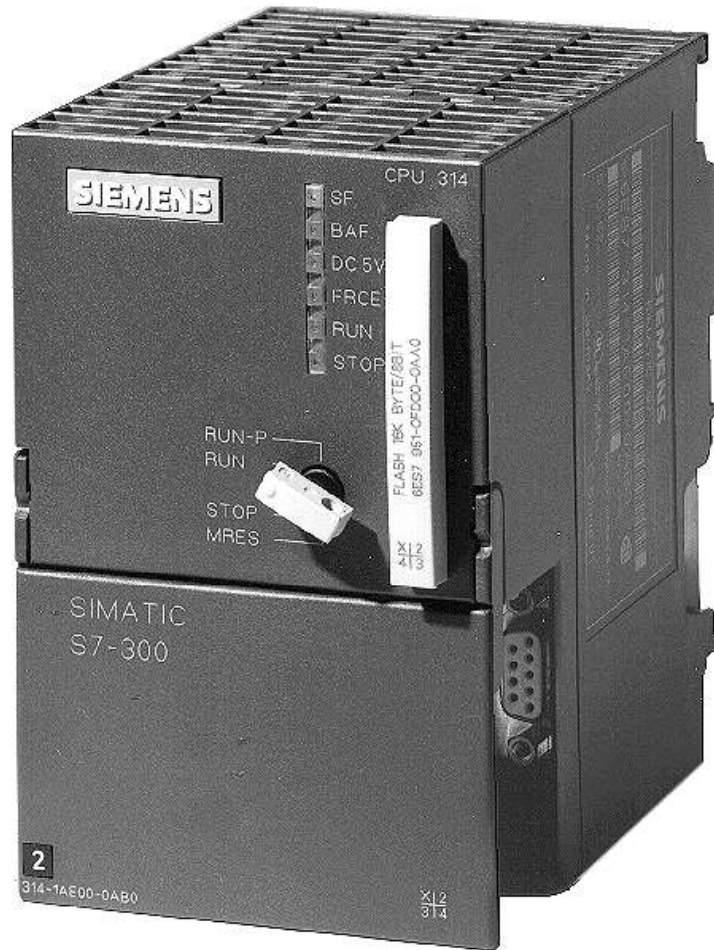
**FM:**  
- Counting  
- Positioning  
- Closed-loop control



**CP:**  
- Point-to Point  
- PROFIBUS  
- Industrial Ethernet control

# S7-300: CPU Design

CPU 314 until Oct. 2002



CPU 314 after Oct. 2002



# CPU Memory Areas

**Load Memory**

---

User Program  
Hardware Configuration

**Work Memory**

---

Executing Program

**System Memory**

**Address Areas**

---

Inputs (I)  
Outputs (Q)  
Bit Memories (M)  
Timers (T)  
Counters (C)  
Temporary Local Data (L)  
Data Block (DB) (DI)  
Peripheral Inputs (PI)  
Peripheral Outputs (PQ)

**Registers**

---

Accumulators  
Address Registers  
Status Word  
MCR Stack  
Nesting Stack

**System Messages**

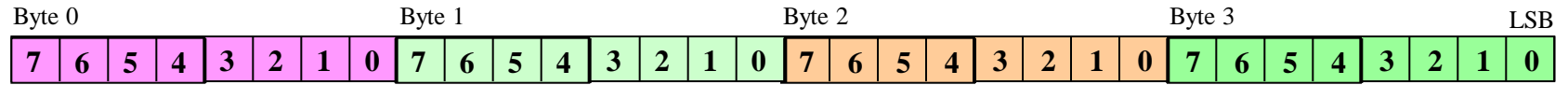
---

Diagnostic Buffer  
Interrupt Stack  
Block Stack

**Communication Buffer**

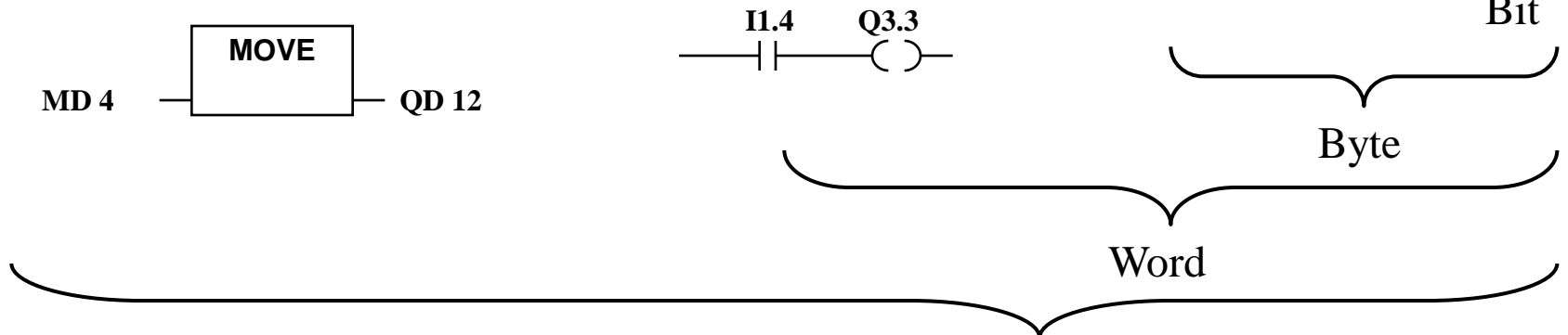


# Addressing



MSB

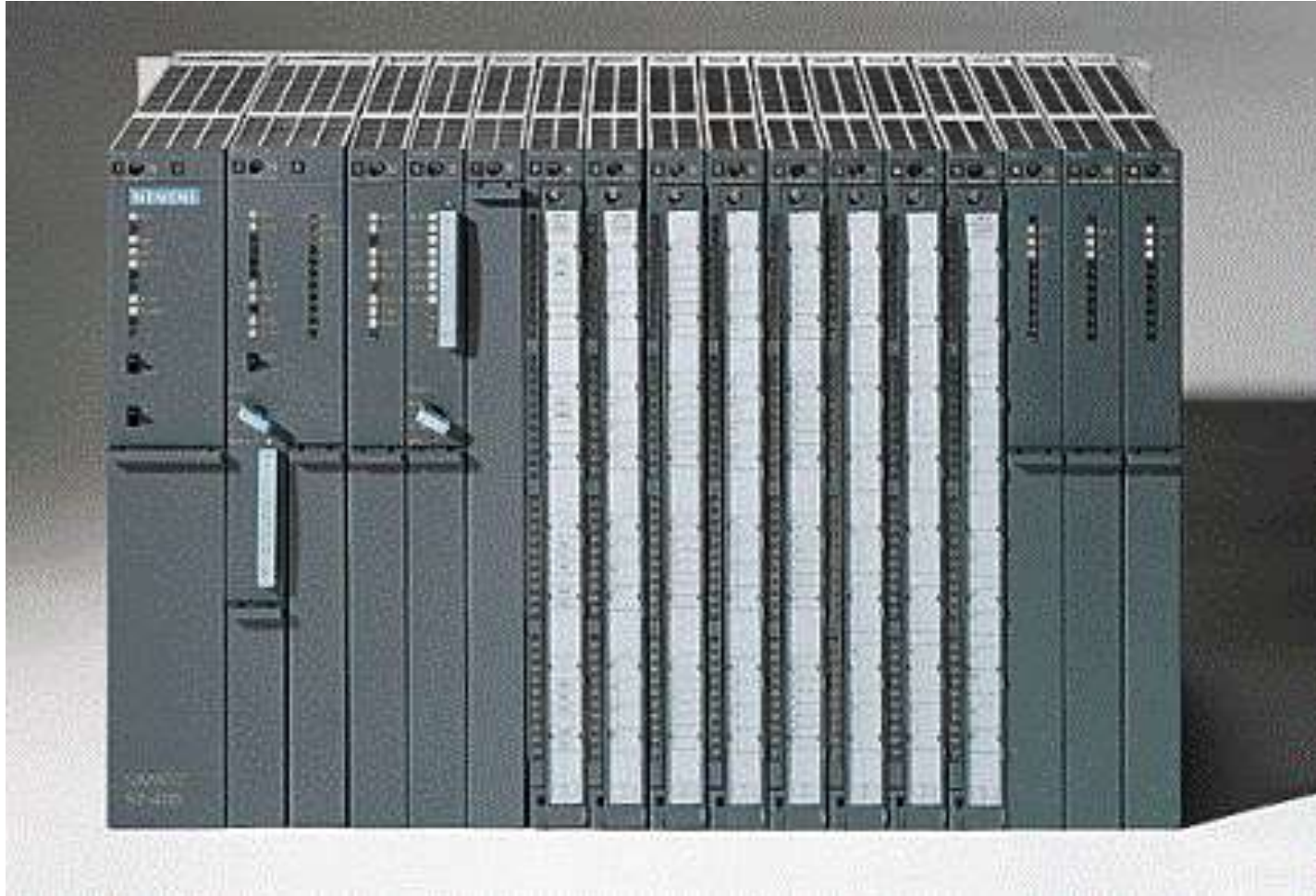
Bit



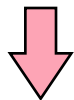
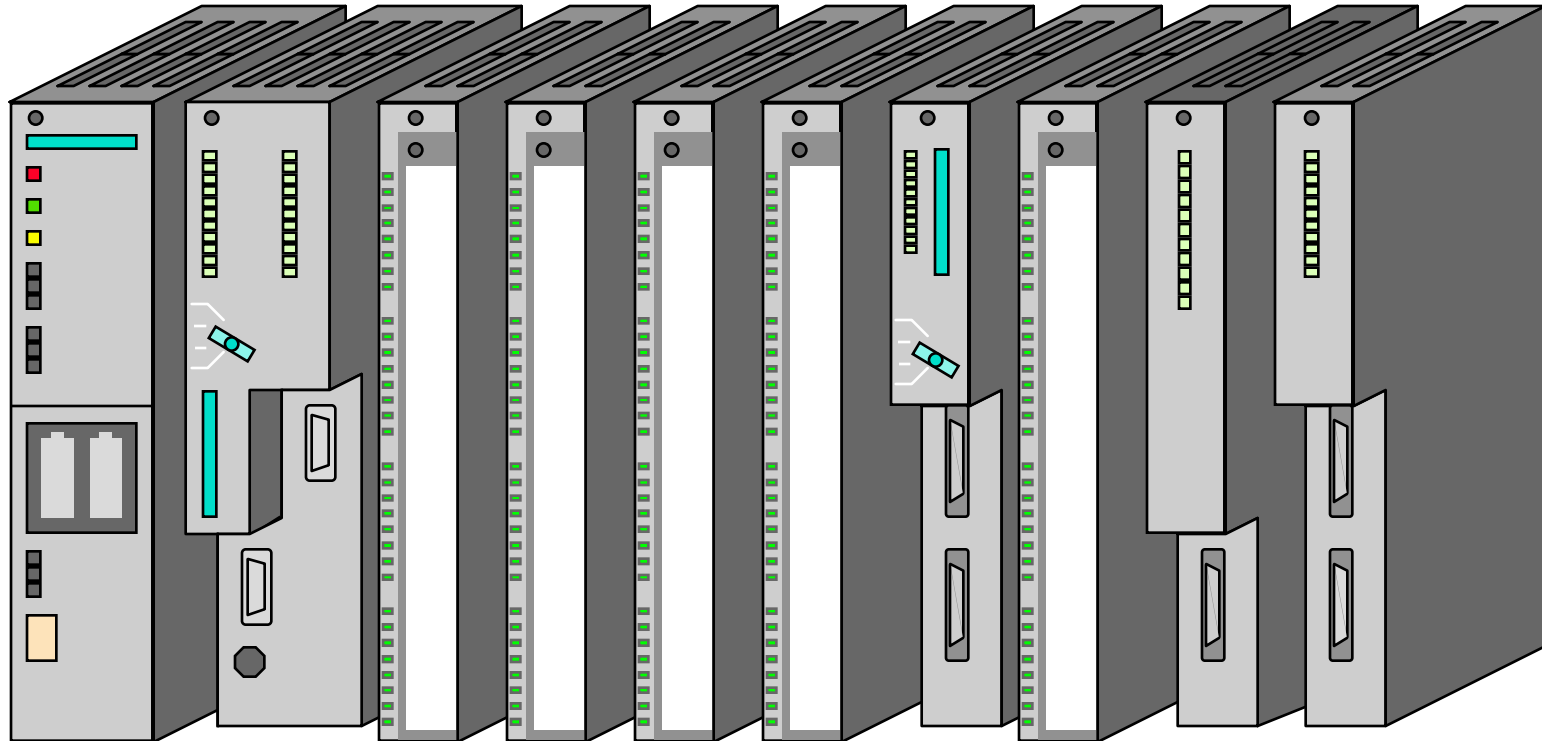
Control Statement					
A	I 3.4				
Operational Part	Address Part				
A	I 3.4				
	<table border="1"> <tr> <th>Address Identifier</th> <th>Parameter</th> </tr> <tr> <td style="text-align: center;">I</td> <td style="text-align: center;">3.4</td> </tr> </table>	Address Identifier	Parameter	I	3.4
Address Identifier	Parameter				
I	3.4				

Parameter = Byte Address and Bit Address

# S7-400 Automation System



# S7-400: Modules



**PS**



**CPU**



**SM:  
DI**



**SM:  
DO**



**SM:  
AI**



**SM:  
AO**



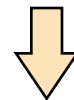
**CP**



**SM**

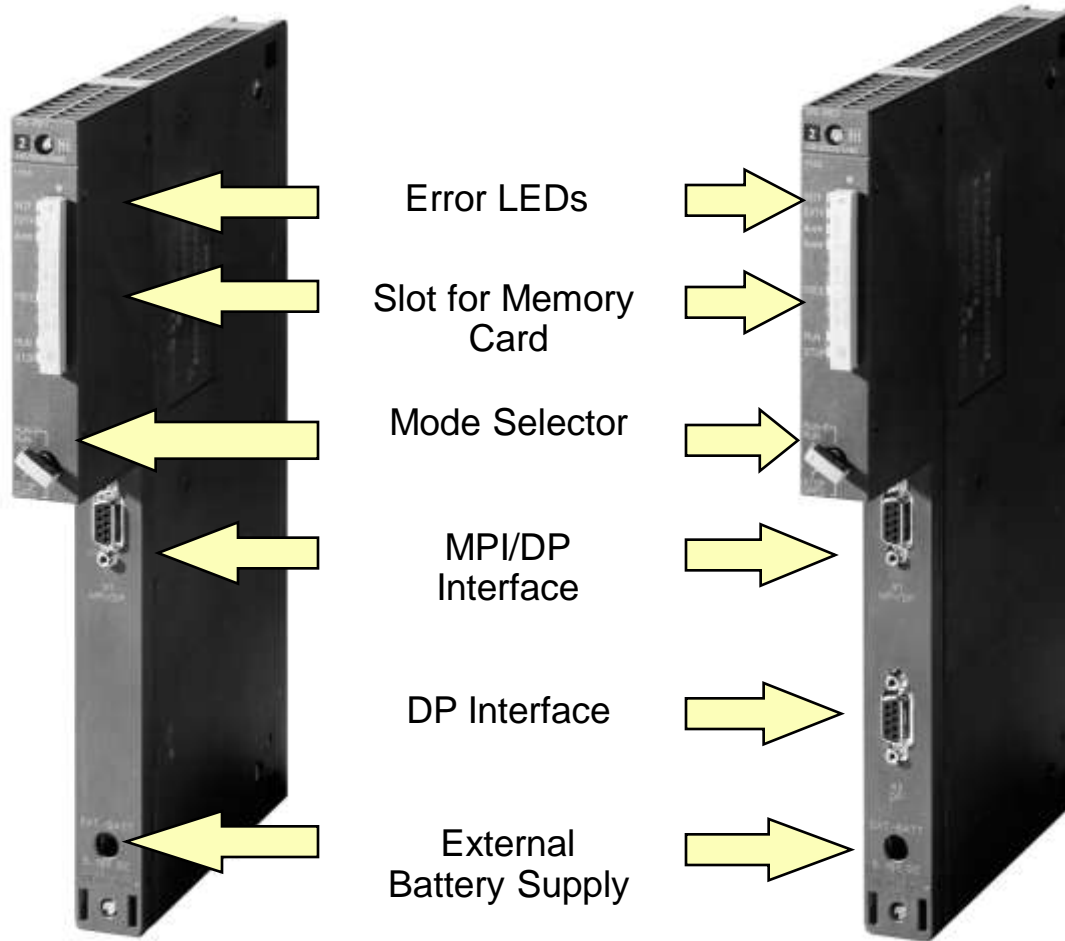


**FM**



**IM**

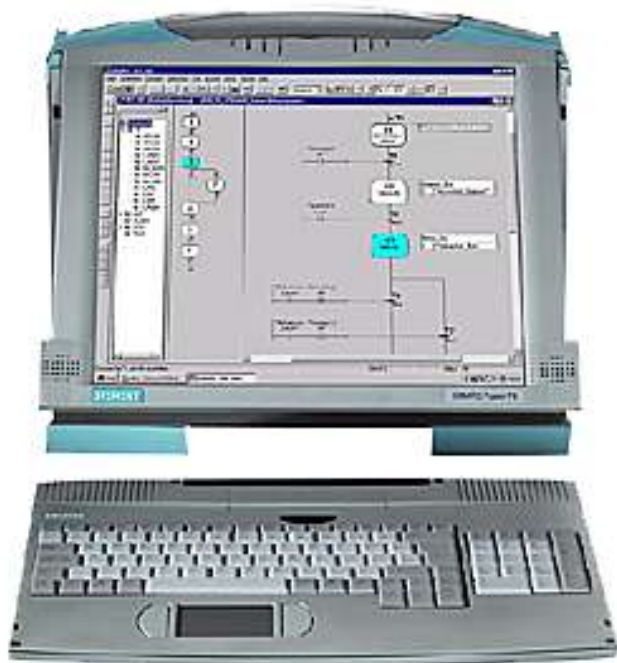
# S7-400: CPU Design



## PG/PC Requirements for Installing STEP 7

**Operating Systems:** Microsoft Windows 2000 Professional

Microsoft Windows XP Professional



**Memory on the Hard Drive:**

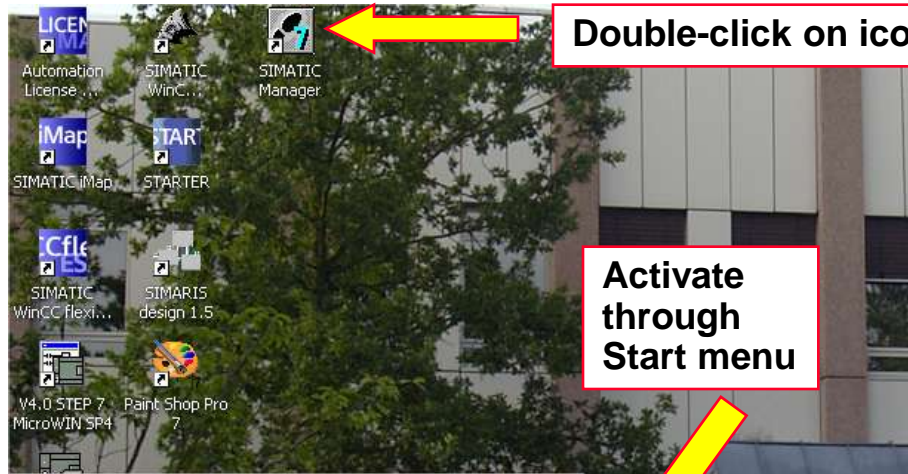
Depending on the installation, between 400 MB and 800 MB

**Mouse:** Yes

**Interfaces:**

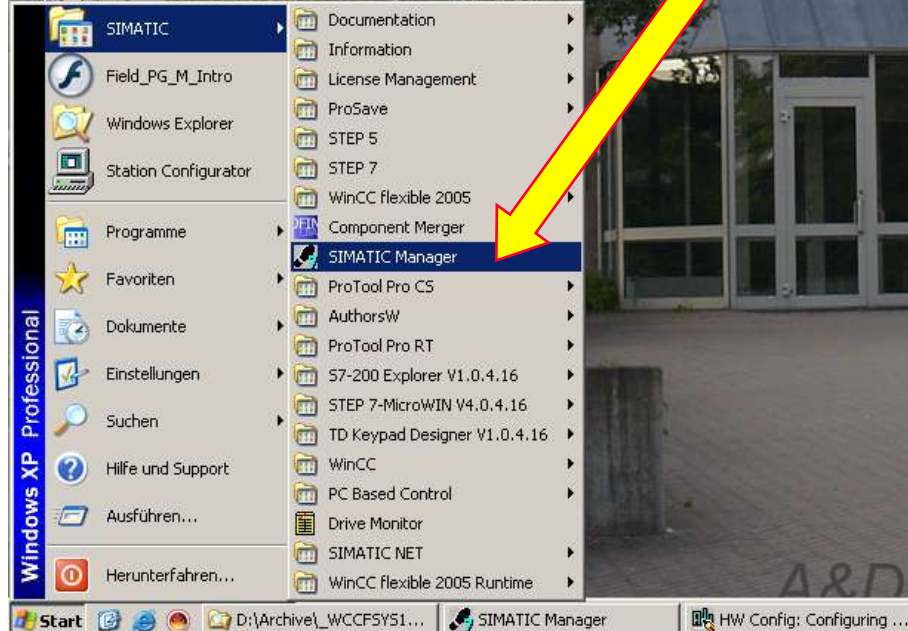
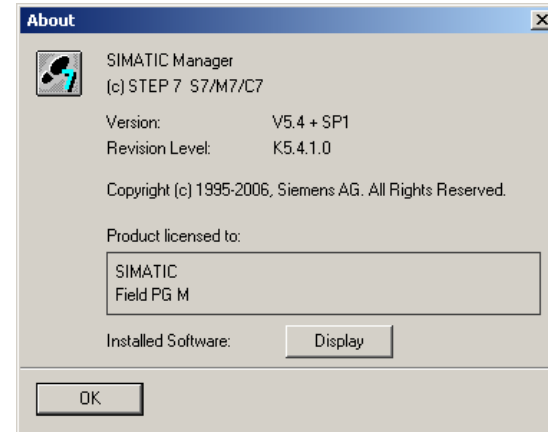
- CP5611 (PCI) or
- CP5512 (PCMCIA) or
- PC adapter (USB)
- Industrial Ethernet Interface (NIC)
- Programming interface for Memory Card (optional)

# Installing the STEP 7 Basic Package




















Double-click on icon

Activate through Start menu



## STEP 7 Tools

-  NCM S7
-  CFC - Interconnect blocks
-  Configure SIMATIC Workspace
-  Converting S5 Files
-  LAD, STL, FBD - Programming S7 Blocks
-  Memory Card Parameter Assignment
-  NetPro - Configuring Networks
-  PID Control Parameter Assignment
-  S7 SCL - Programming S7 Blocks
-  S7-GRAPH - Programming Sequential Control Systems
-  S7-PDIAG - Configuring Process Diagnostics
-  S7-PLCSIM Simulating Modules
-  Setting the PG-PC Interface
-  TI 405-S7 Converting TI Files
-  TI 505-S7 Converting TI Files
-  S7-HiGraph - Programming State Graphs
-  STARTER

# STEP 7 Software Packages (Examples)

## Which PLC?

## Necessary

## Options

**SIMATIC S7-200**



**STEP 7  
Micro/WIN**

**SIMATIC S7-300**



**STEP 7 Lite**



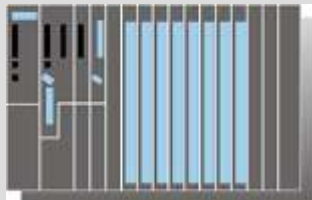
**SIMATIC S7-300**



**STEP 7**



**SIMATIC S7-400**



**STEP 7 Professional**

**STEP 7**

Tele Service

S7- PLCSIM

S7- SCL

CFC

S7- GRAPH

S7- HiGraph

Fuzzy Control

Standard PID Control

Modular PID Control

DOCPRO

TeleService

S7- PDIAG

S7- PLCSIM

PRODAVE MPI

**S7- SCL**

**S7- PLCSIM**

**S7- GRAPH**

# If You Want to Know More about the Topic “TIA”



# More Information

Download

The screenshot shows a Siemens website on the left with a navigation menu and a 'Download' button. The main content area displays 'S7-300 and M7-300 Programmable Controllers Module Specifications'. A PDF viewer window is open, displaying 'Adobe Acrobat Professional - [S7-300\_Module\_Specification.pdf]'. The PDF content includes a table of contents, a search bar, and a detailed technical specification for 'CPU modules - CPU 315-2 DP'. The specification lists features such as high processing performance, PROFIBUS DP interface, and I/O configurations. A note indicates that a micro memory card is required for operation of the CPU.

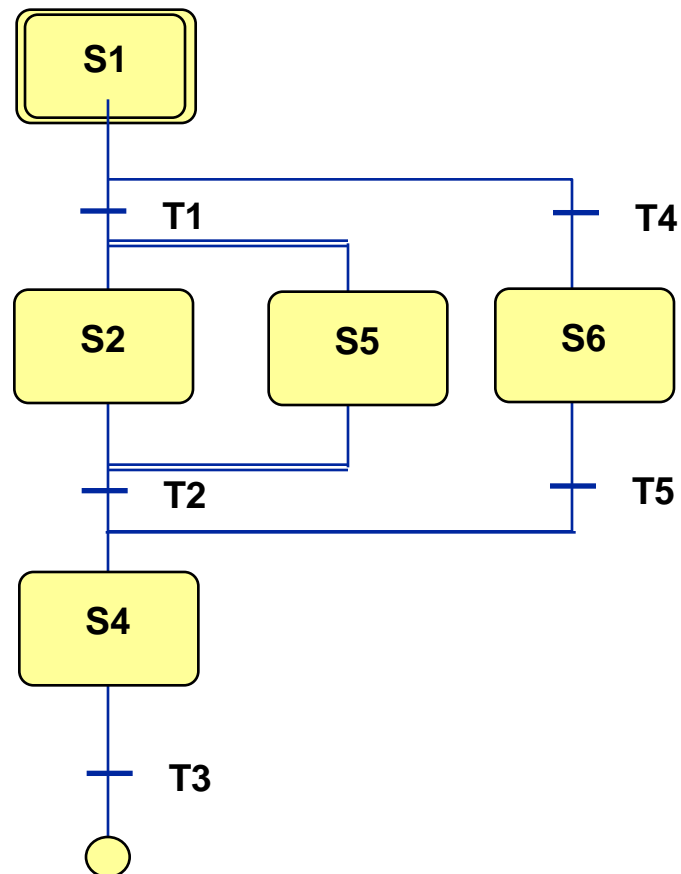
# Programming Sequence Control Systems with S7- GRAPH

## □ S7-GRAPH: The tool for programming sequence cascades

- Compatible with DIN EN 6.1131-3
- Designed for the requirements of production engineering
- Graphic division of the process into steps and transitions
- Steps contain actions
- Transitions check the conditions for switching to the next step

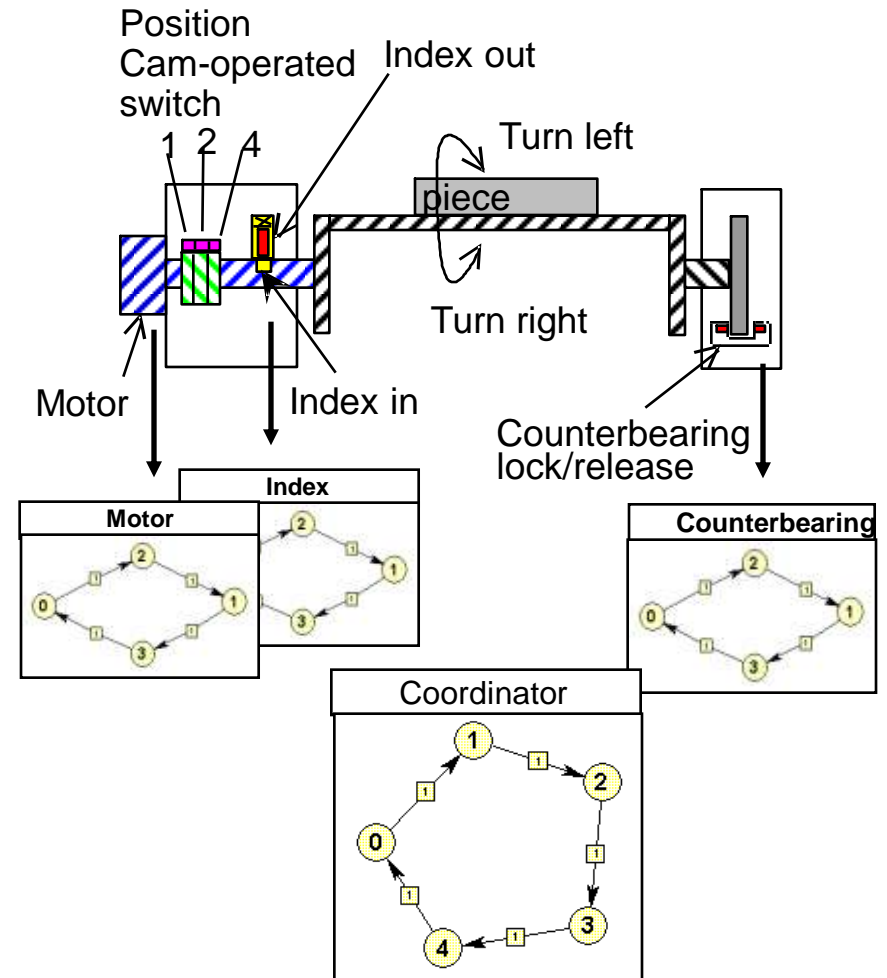
## □ The following phases of automation can be optimized with S7-GRAPH:

- Planning, Configuring
- Programming
- Debugging
- Commissioning
- Maintenance, Diagnostics



## The State Diagram Method S7- HiGraph

- **S7-HiGraph: The tool for programming using State Diagrams**
  - Division of the machine into functional units
  - Creating state diagrams for every function unit
  - States contain actions
  - State diagrams communicate using messages
- **The following phases of automation can be optimized with S7-HiGraph:**
  - Planning, Configuring
  - Programming and Debugging
  - Commissioning
  - Maintenance, Diagnostics
  - Supports reusability



## Programming in the High Level Language S7- SCL

- **S7-SCL: High level language for creating PLC programs**
  - **Compatible with DIN EN 6.1131-3 (ST=Structured Text))**
  - **Certified according to “PLC open“ Base Level**
  - **Contains all the typical elements of a high level language, such as operands, terms, control statements**
  - **PLC specifics are integrated, such as I/O access, timers, counters...)**

### Advantages:

- **Well structured, easy to understand program**
- **For those knowledgeable in high level languages**
- **For complex algorithms**

```

FUNCTION_BLOCK Integrator
VAR_INPUT
  Init      : BOOL;    // Reset output value
  x         : REAL;    // Input value
  Ta       : TIME;    // Sampling interval in ms
  Ti       : TIME;    // Integration time in ms
  olim     : REAL;    // Output value upper limit
  ulim     : REAL;    // Output value lower limit
END_VAR

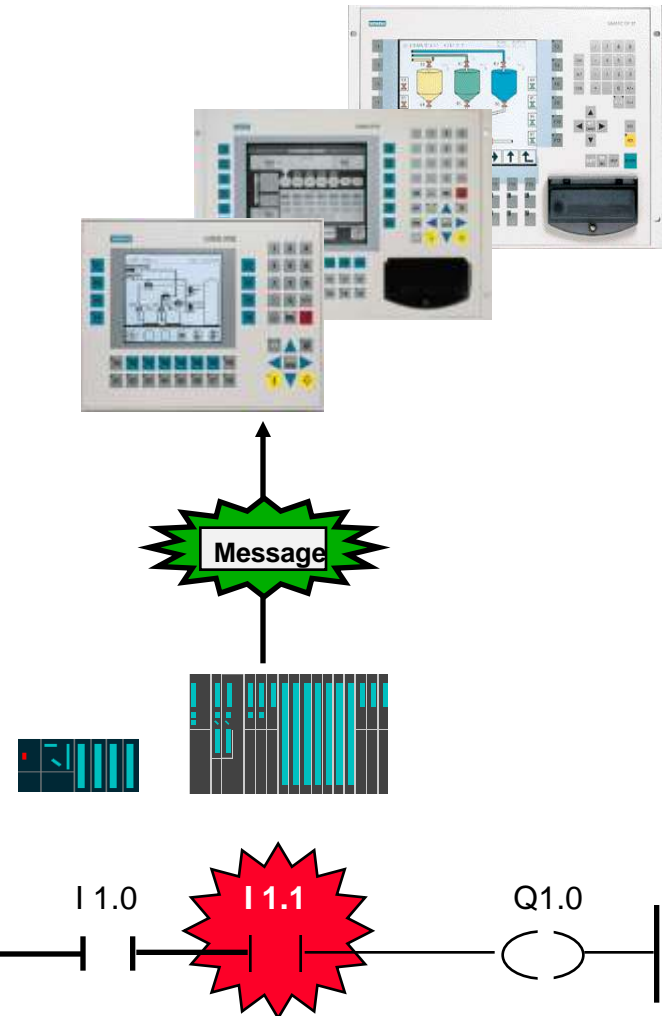
VAR_OUTPUT
  y : REAL:= 0.0;    // Initialize output value with 0
END_VAR

BEGIN
  IF TIME_TO_DINT(Ti) = 0 THEN    // Division by ?
    OK := FALSE;
    y := 0.0;
    RETURN;
  END_IF;
  IF Init THEN
    y:= 0.0;
  ELSE
    y := y+TIME_TO_DINT(Ta)*x/TIME_TO_DINT(Ti);
    IF y > olim THEN y := olim; END_IF;
    IF y < ulim THEN y := ulim; END_IF;
  END_IF;
END_FUNCTION_BLOCK
  
```



## Process Diagnosis with S7- PDIAG

- ❑ **Process diagnosis: Detection of faults occurring outside the PLC**
  - Sensor/actuator defective, movement faulty, ...
- ❑ **S7- PDIAG: Tool for configuring the fault definition in STL, LAD, FBD**
  - Integrated in the development environment
  - Simple formulation of fault monitoring and message texts (during and after the program session)
  - Fault detection and criteria analysis are conducted automatically
  - Comprehensive information for the operator on:
    - type of fault
    - location of fault
    - cause of fault
- ❑ **Reduction of down-time**



## Testing User Programs with S7- PLCSIM

### □ S7-PLCSIM: Simulation software for offline testing of PLC programs

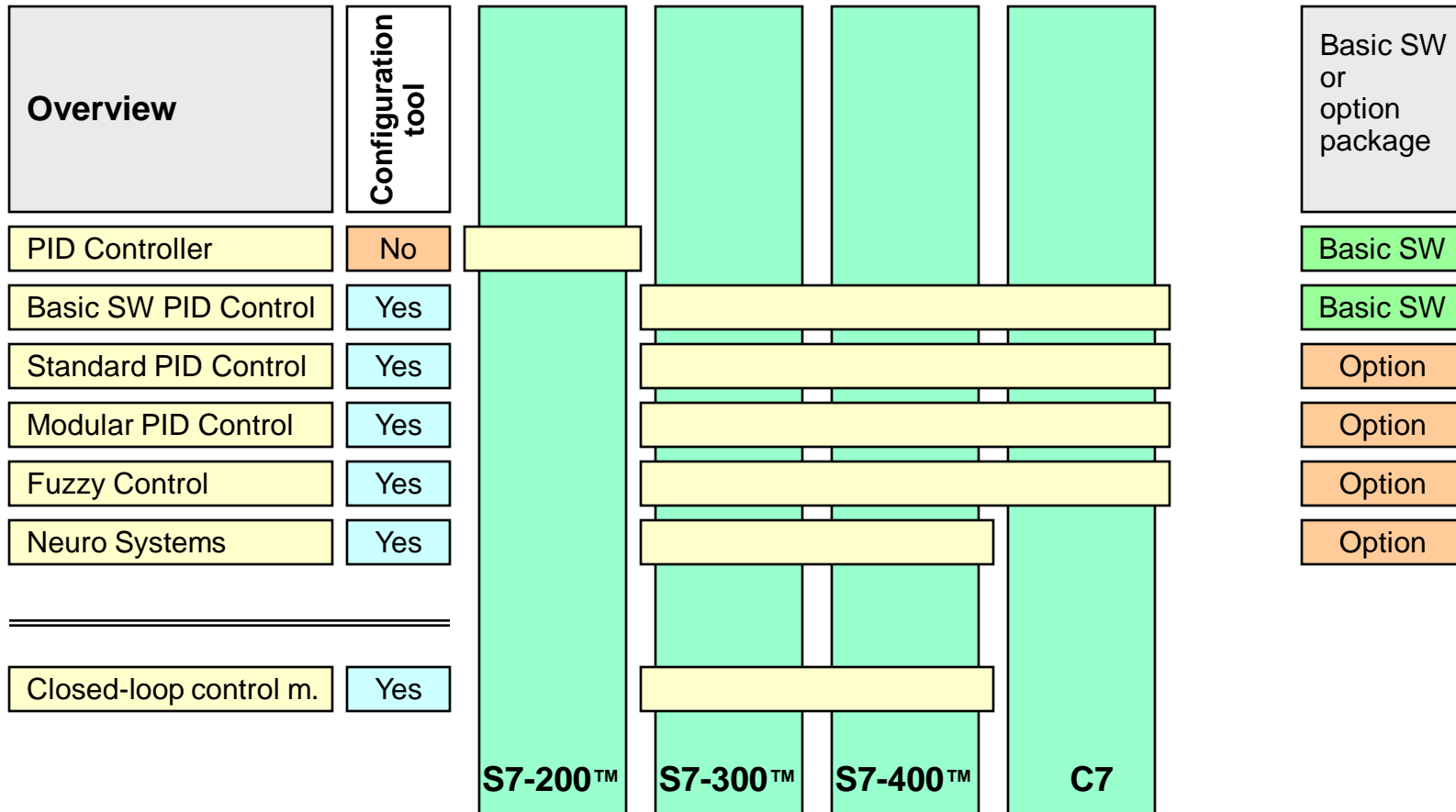
- Functional program test
  - on a simulated CPU
  - with display/modify I/O
- Testing of user blocks in
  - LAD, FBD, STL, S7-SCL,
  - S7-GRAPH, S7-HiGraph, CFC
  - S7-PDIAG, WinCC

### □ Advantages

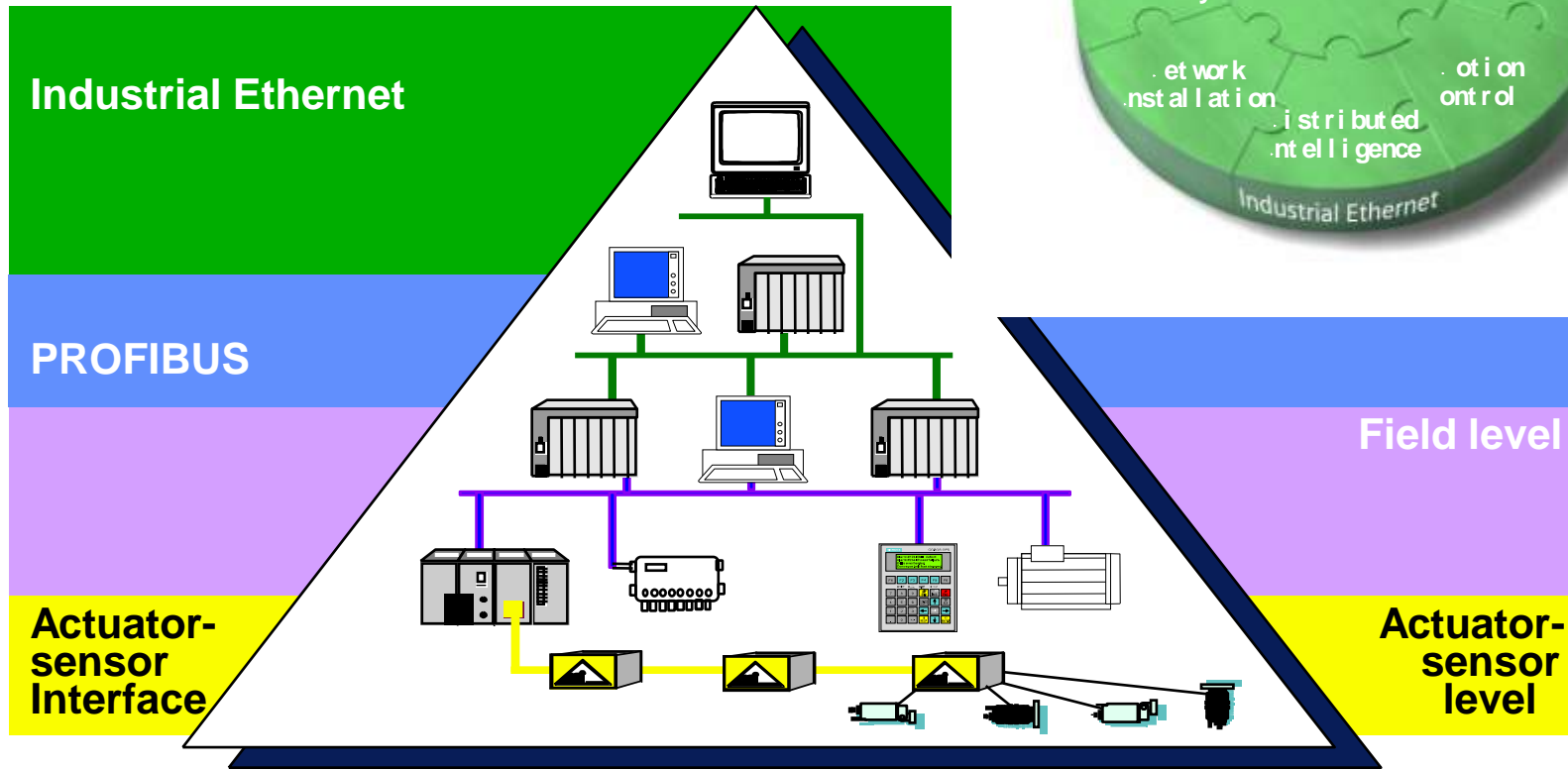
- Faults can be detected early and eliminated
- Many tests are already possible in the office without the final hardware



# Runtime Software for Closed-loop Control Engineering Tasks



# Communicating with SIMATIC NET



# Operator Control and Process Monitoring with SIMATIC® HMI

**Process visualization  
system  
SIMATIC WinCC**

**Process visualization  
system  
SIMATIC WinCC flexible**

**SIMATIC PG, PC**

**SIMATIC Panels, PGs, PCs**



# Process Visualization and Operator Control with WinCC



Motor	on
Valve	closed
Flap	up

**Alarm Logging  
(Message System)**

```
anzahl ()
float zae
begin
if wert > 0
begin
zae = zae + 1
end
```

**Programming  
Interfaces**



**Tag Logging  
(Archiving)**

**Process visualization**



**Standard  
Interfaces**

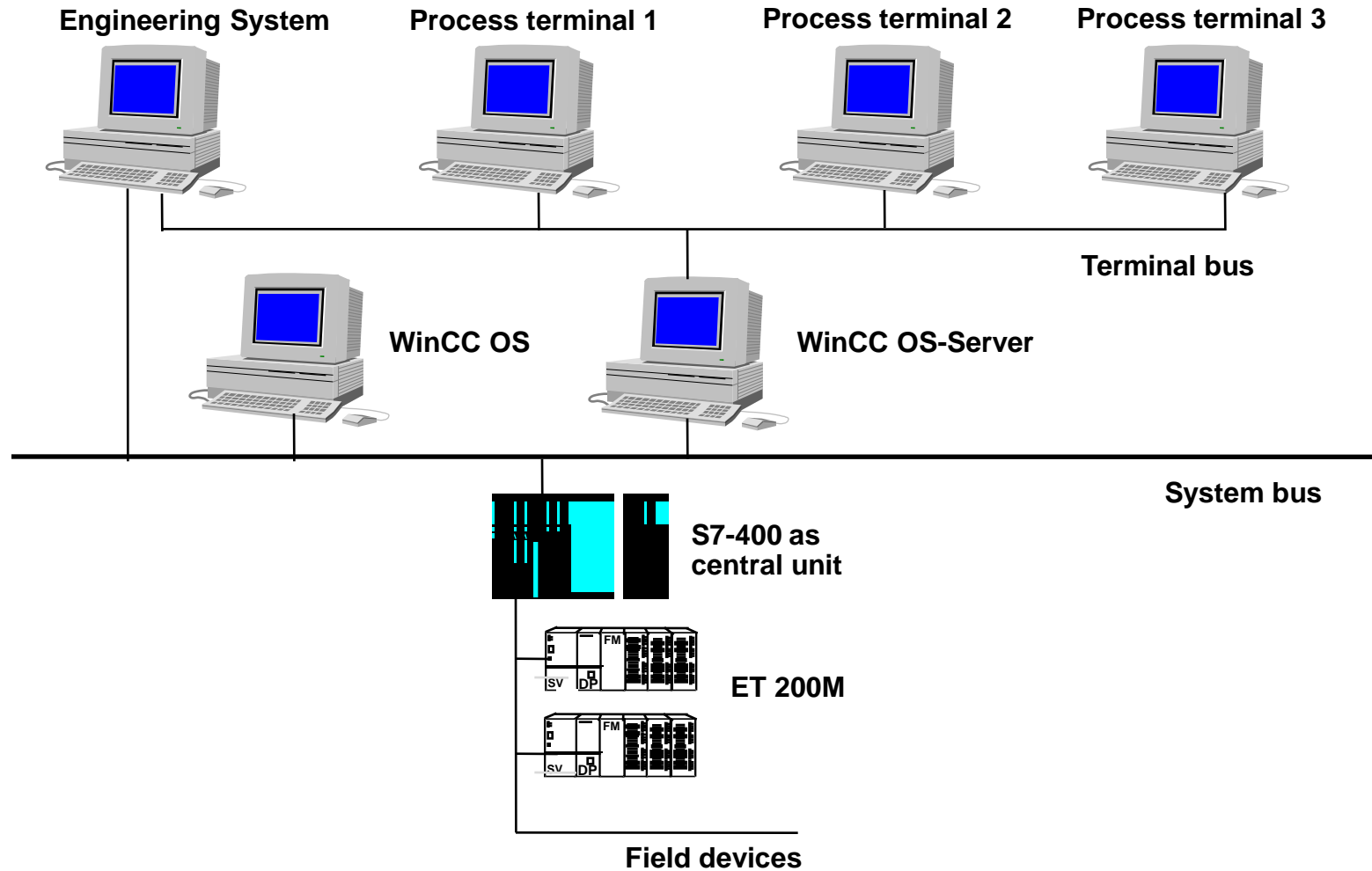


**Report Designer  
(Report System)**



**PLC  
Communication**

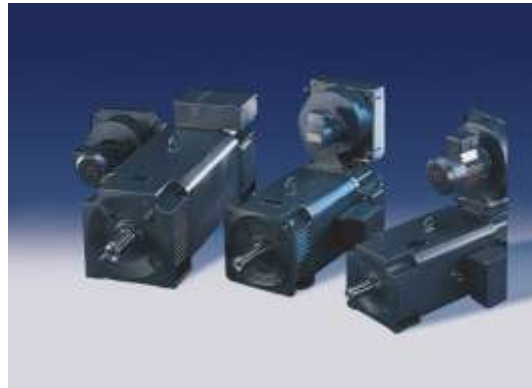
# Process Automation with SIMATIC<sup>®</sup> PCS 7



## DRIVES Technology

Consistent drives spectrum for all applications

- ❑ **From standard drives with 100 W up to large drives with 50 MW**
- ❑ **Motion and vector control**
- ❑ **Technology-specific closed-loop controllers**



# SINUMERIK® and SINAMICS Drives



