AYDIN
ADNAN MENDERES UNIVERSITY
FACULTY OF ENGINEERING
Department of Electrical and Electronics Engineering

EE441 – Programmable Logic Controller (PLC)

Prof. Dr. Yılmaz KALKAN



- Basic of Industrial Automation
- Understanding Automation & Control System
- History of PLC
- Basic Components of Automation
- Hardware / Software Classification Of Automation

outline

- Introduction to PLC
- Need of PLC in Designing
- Architecture of PLC
- Application and Advantage of PLC
- Automation Concept And Basic Design
- NO/ NC Concept

- PLC Programming
  - Introduction of Ladder Logic
  - Introduction of SFC
  - Introduction of Instruction list
- Creating & Editing Ladder Logic Program
- Different Types Of Sensors-Sinking, Sourcing, NPN, PNP
- PLC Fault Finding, Trouble Shooting
- Forcing I/O's
- Detailed Sequence of Wiring
- PLC Control Panel Wiring
- Interfacing With Relay Logics

What is Industrial Automation?







What is Industrial Automation?







What is Industrial Automation?







Generations of Automation Systems

- ✓Relay based controllers (40s – 50s)
- ✓Microprocessor based PLCs (70s)
- ✓Multifunctional PLCs
- ✓Industrial Networks
- ✓Internet of Things

Generation 0: Mechanical Regulators

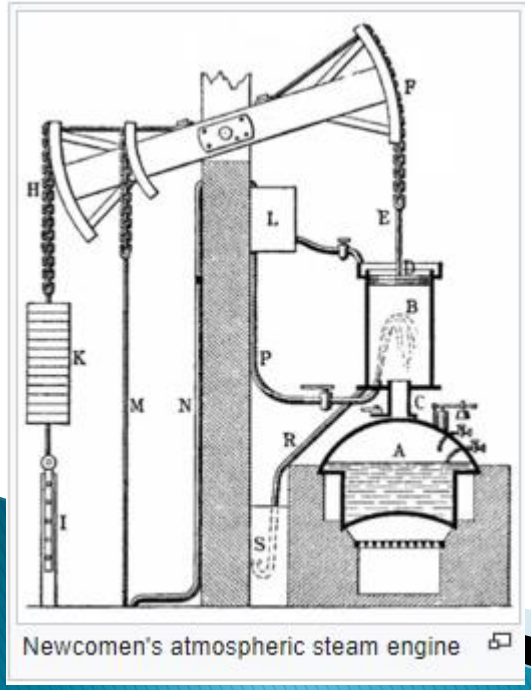


Mine in Cornwall equipped with first steam engine in 1790.

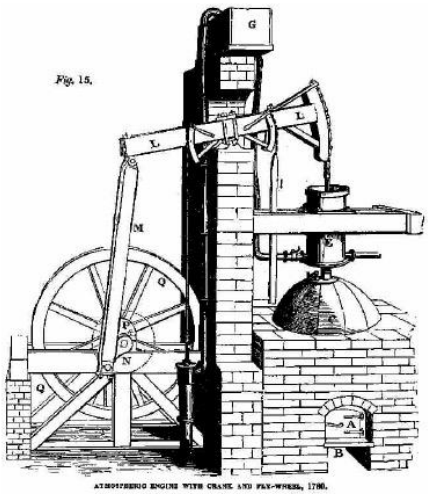
Generation 0: Mechanical Regulators

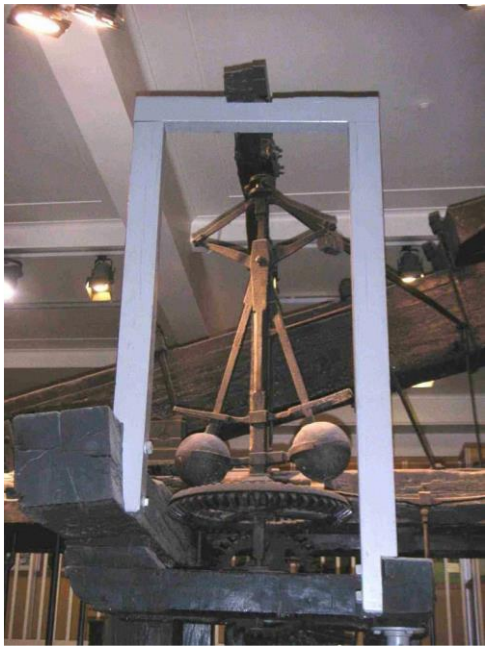
- ✓ The first practical mechanical steam engine was introduced by Thomas Newcomen in 1712.

- ✓ A fundamental change in working principles was brought about by James Watt. With the close collaboration of Matthew Boulton, by 1778 he had succeeded in perfecting his steam engine which incorporated a series of radical improvements; notably, the use of a steam jacket around the cylinder to keep it at the temperature of the steam and, most importantly, a steam condenser chamber separate from the piston chamber. These improvements increased engine efficiency by a factor of about five, saving 75% on coal costs.



Newcomen's atmospheric steam engine

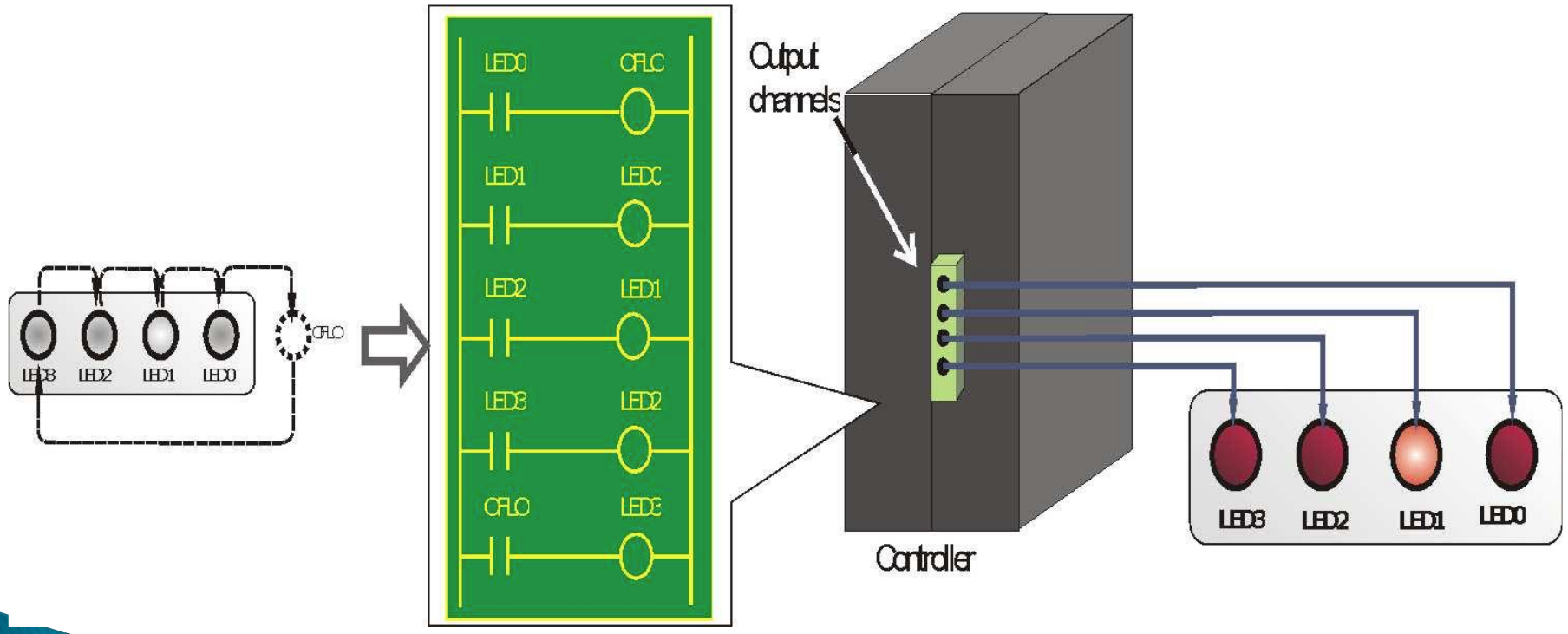




First industrial regulator invented by James Watt to keep the wheel's speed constant.

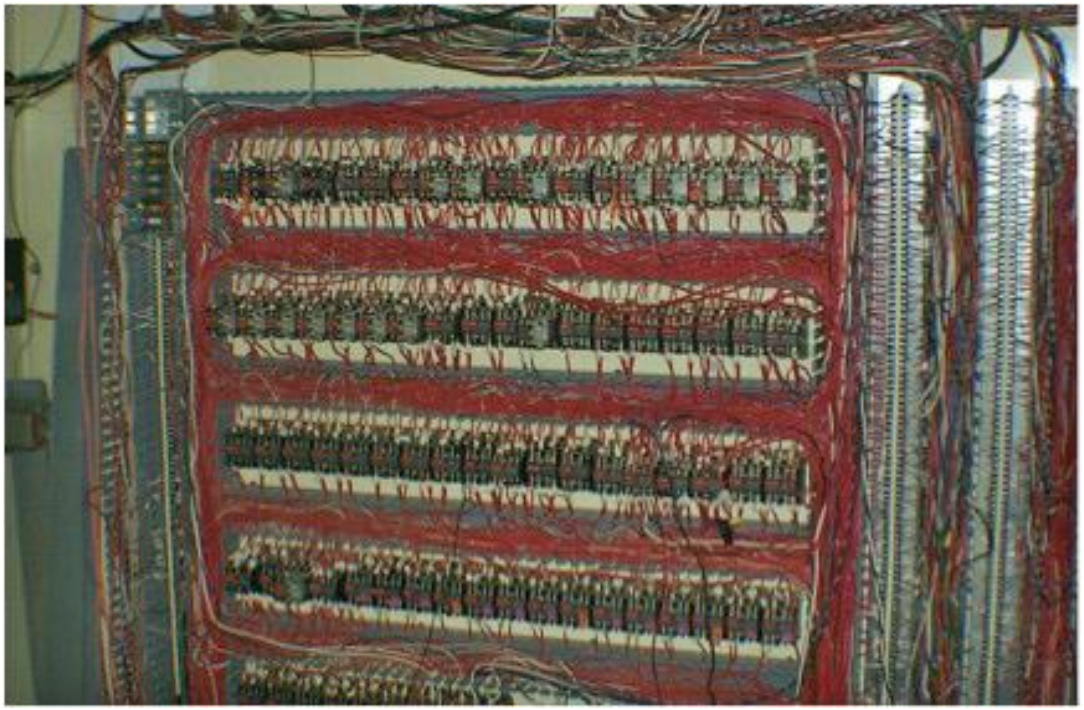
Generation 1: Relay Ladder Circuits

- ✓ Hard-wired ladder logic circuits were widely used to control industrial equipment.
- ✓ This explains current popularity of the Ladder Diagram language for programming industrial controllers



Generation 1: Relay Ladder Circuits

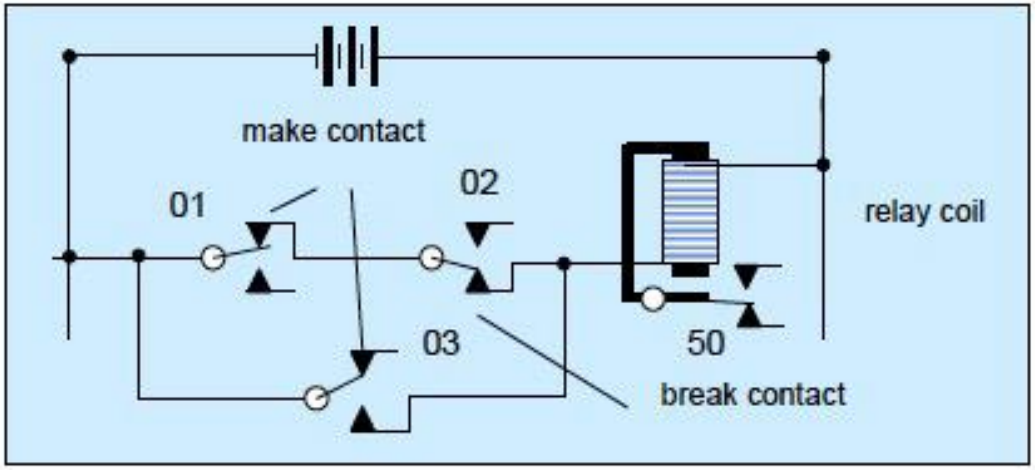
Relay Ladder Logic

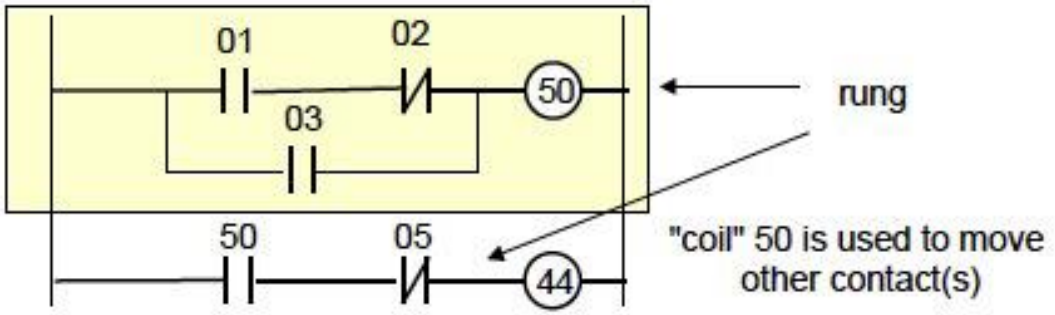


Control logic implemented as hard-wired **relays**

Generation 1: Relay Ladder Circuits

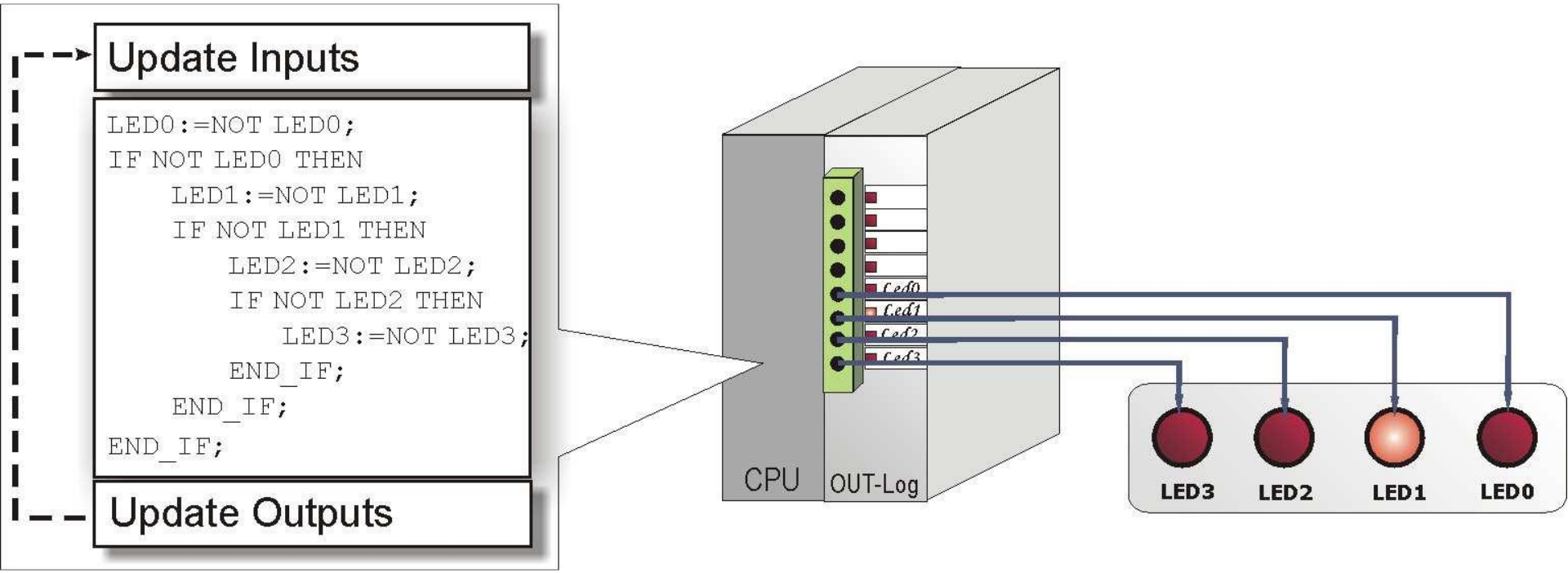
Electric Circuit and Ladder Diagram





Generation 2: Programmable Logic Controllers (PLCs)

- ✓ PLCs – specially hardened industrial computers - tremendously improved flexibility of automation systems



Generation 2: Programmable Logic Controllers (PLCs)

Programmable Logic Controllers

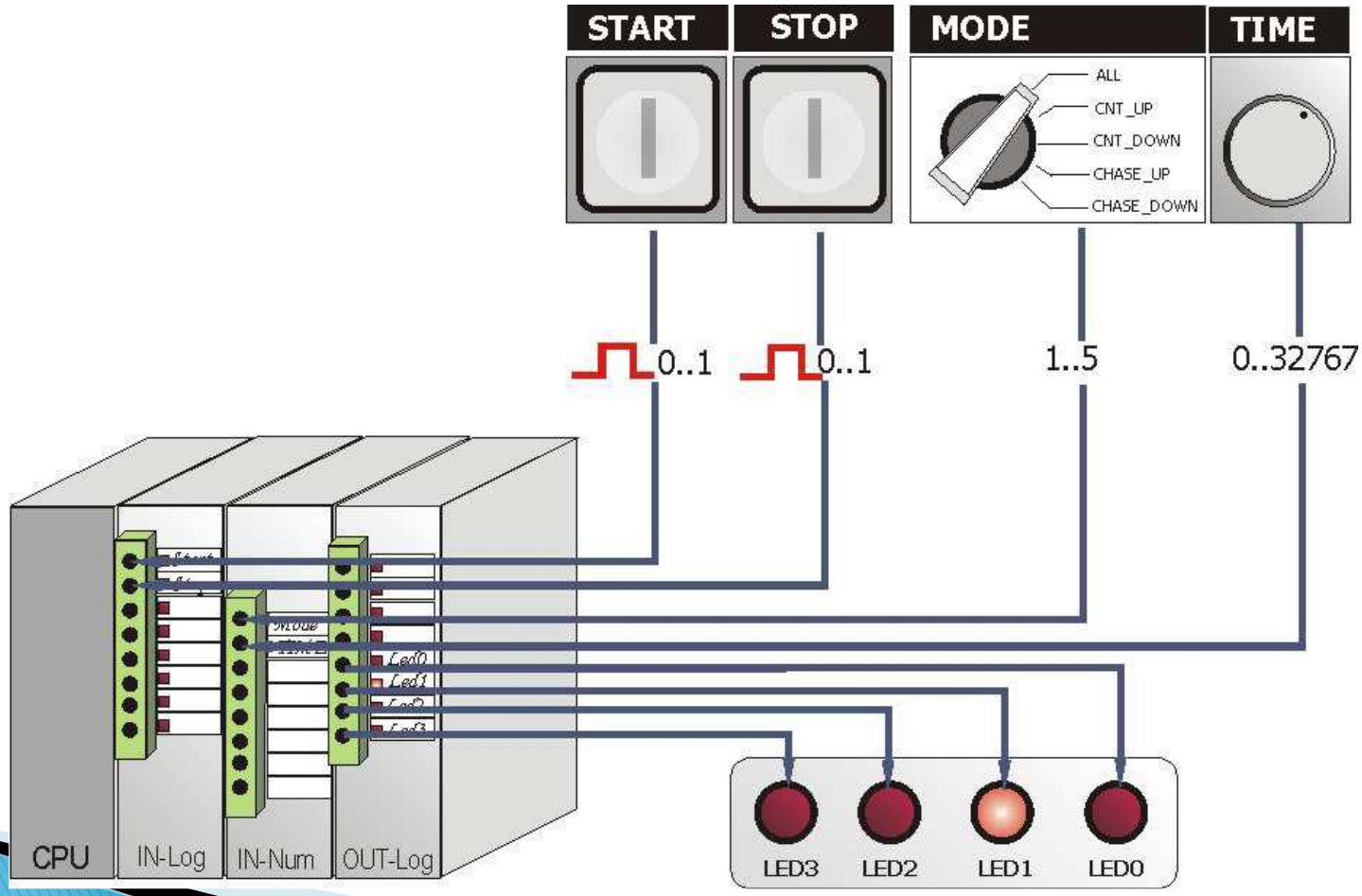
- ✓ Dick Morley is considered as the father of PLC as he had invented the first PLC, the Modicon 084, for General Motors in 1968.





Generation 3: Multifunctional PLCs

- ✓ Modern PLCs know many programming languages and have versatile and easily expandable architecture.



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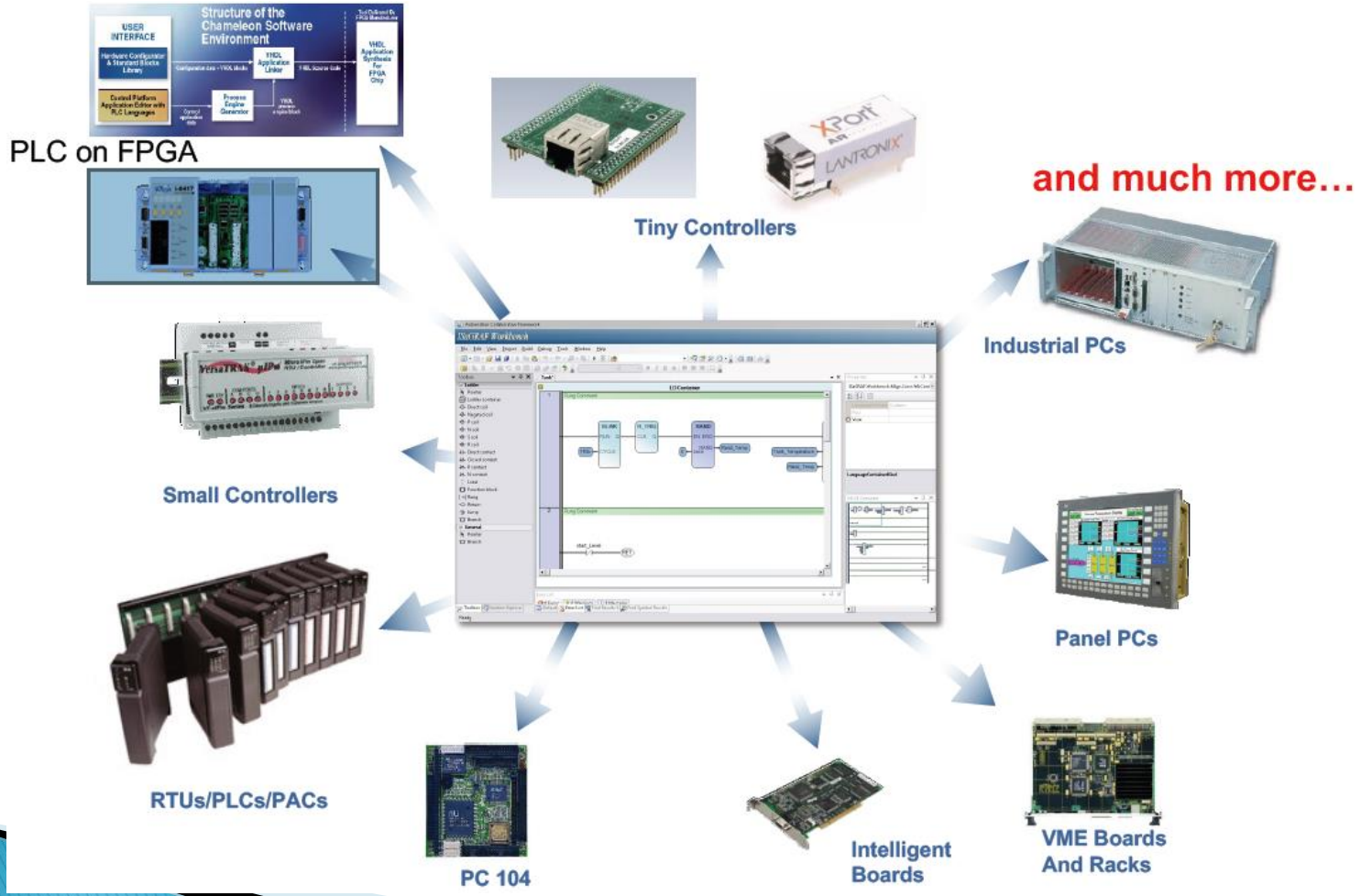




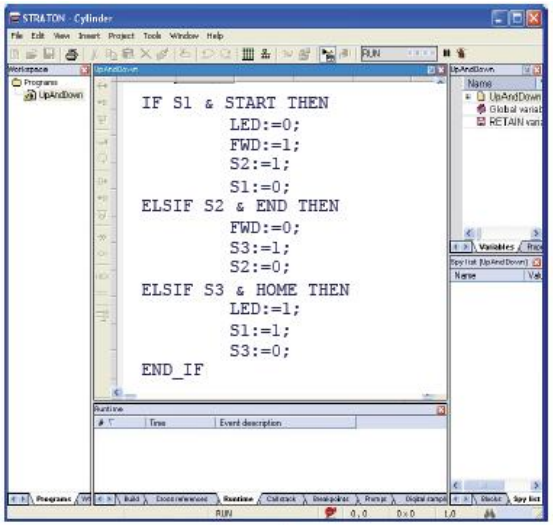


Generation 3: Multifunctional PLCs

Programmable Logic Controllers: Form Factors

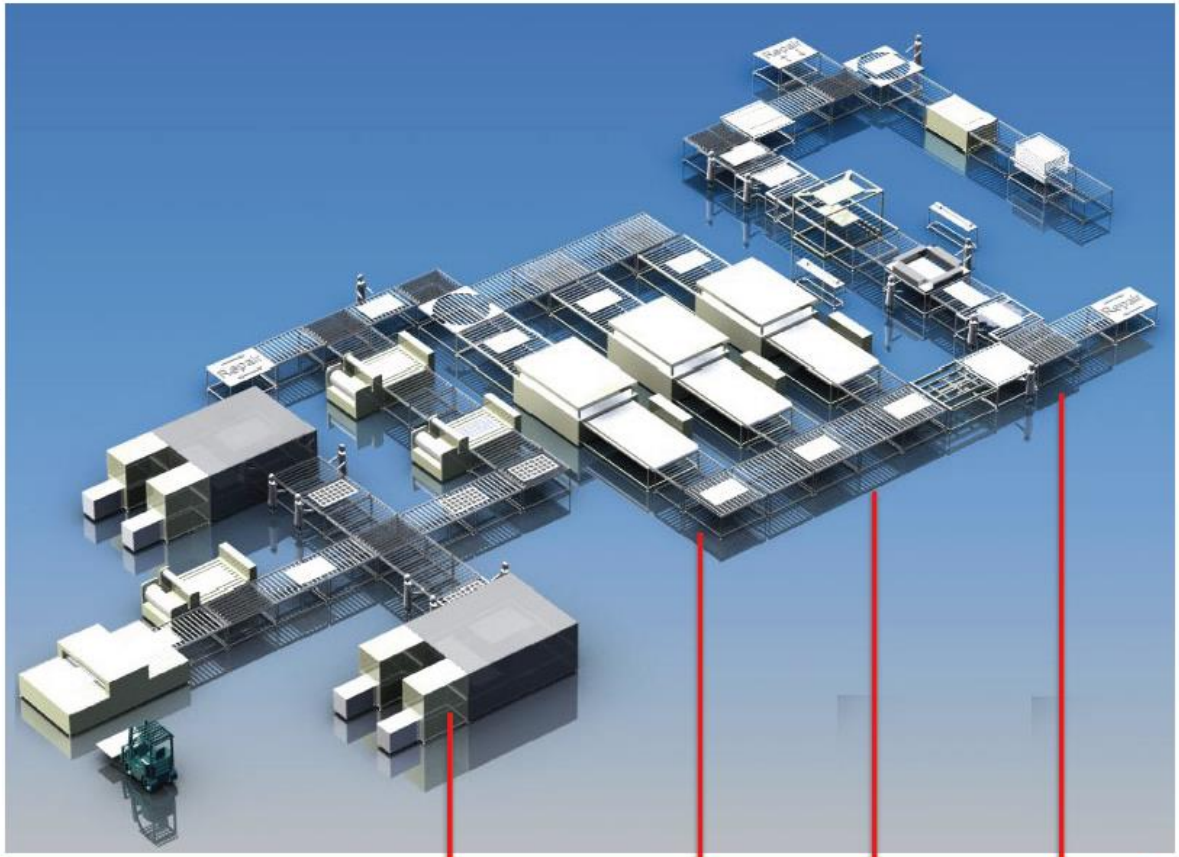


Generation 4: Industrial Networks

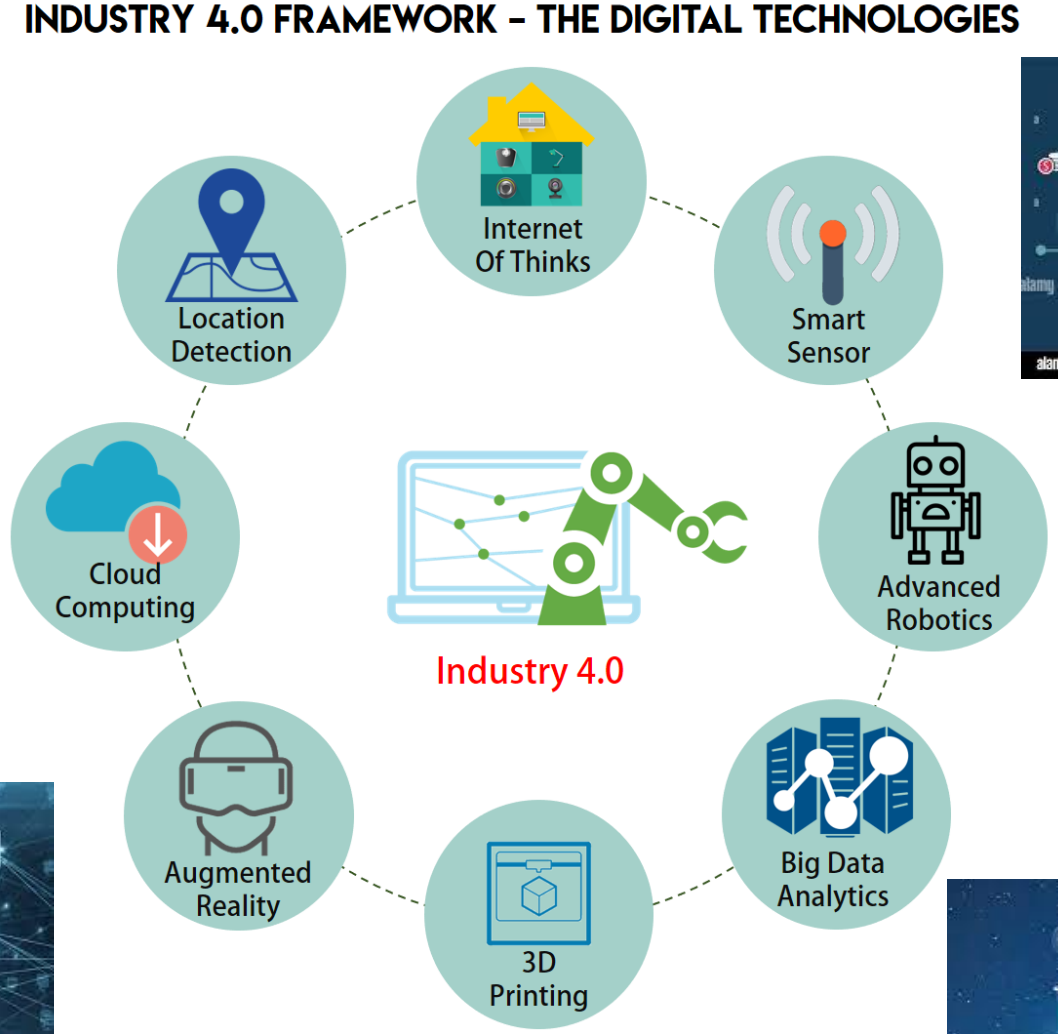


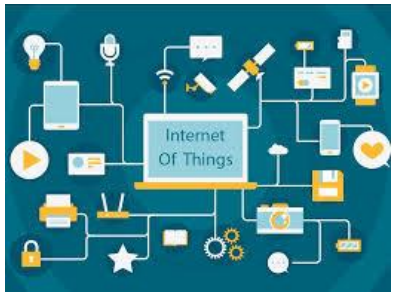


PLC



Generation 4: Internet of Things (IoT)



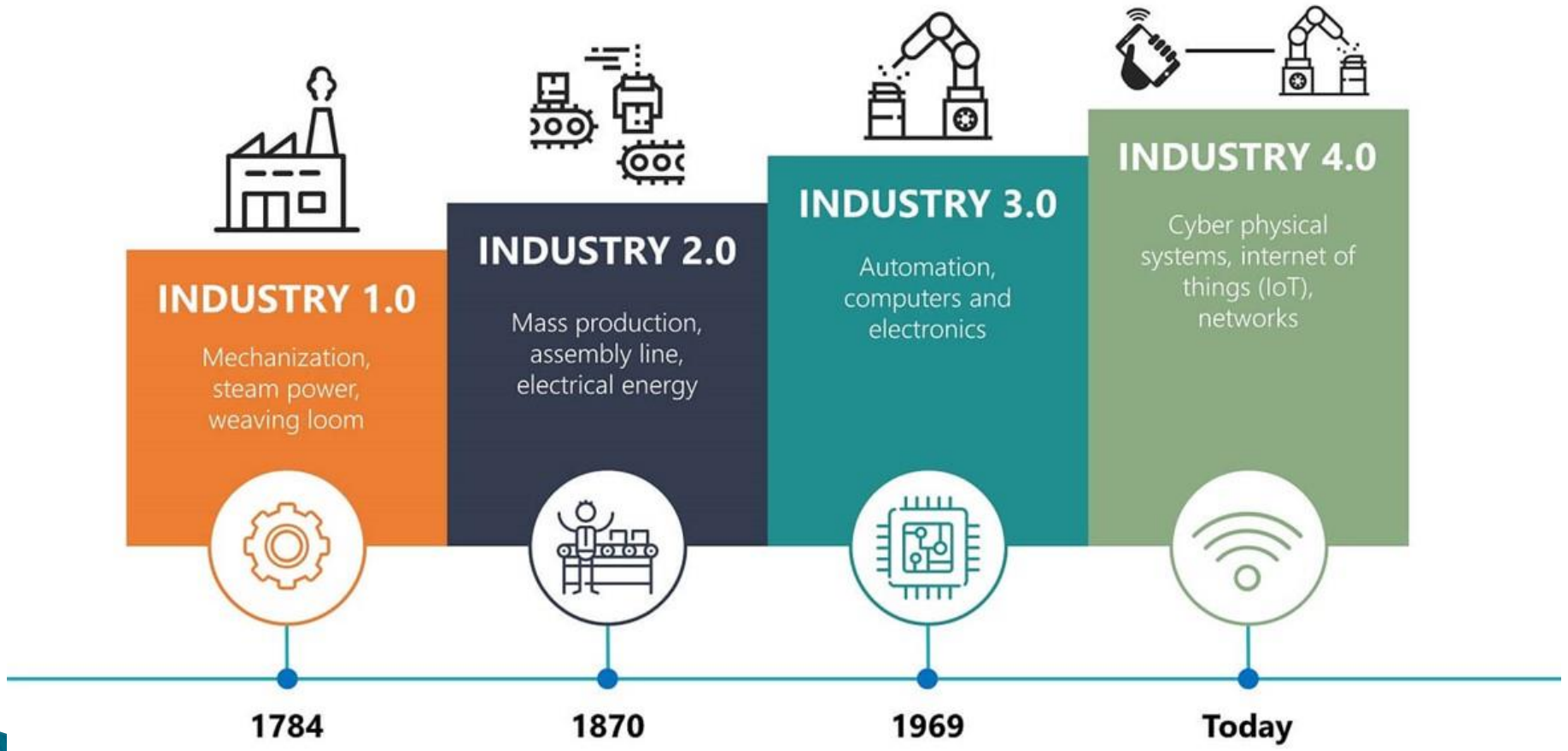




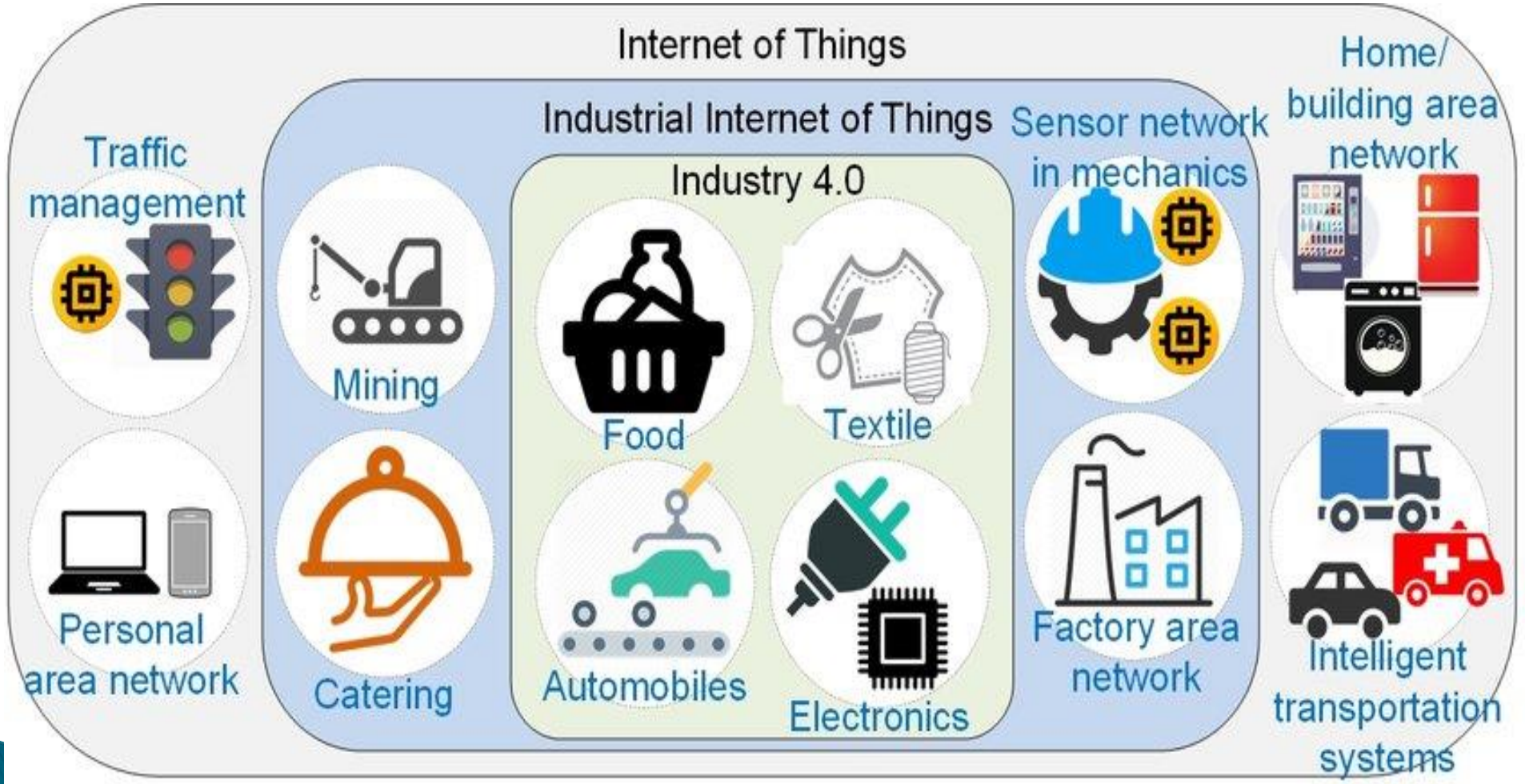




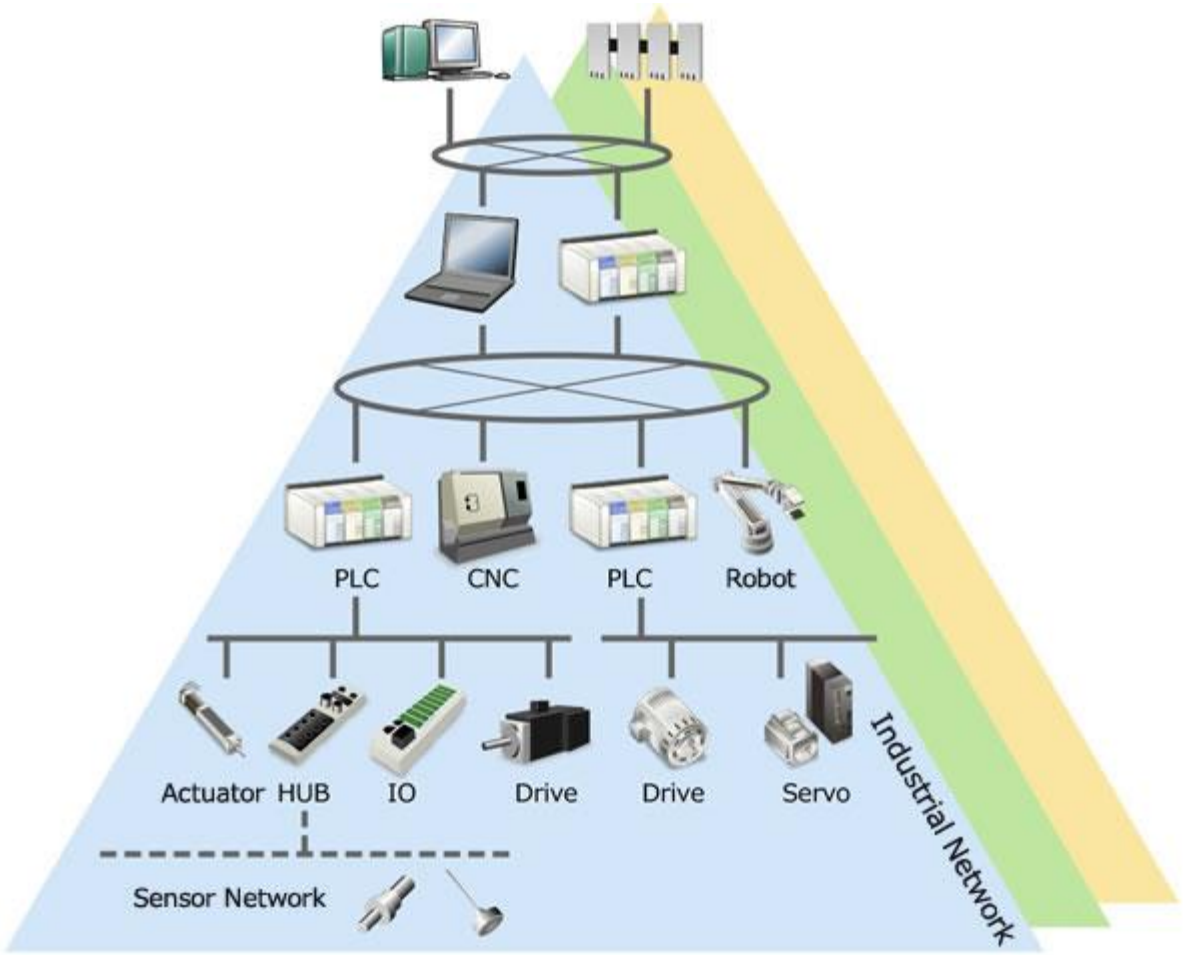
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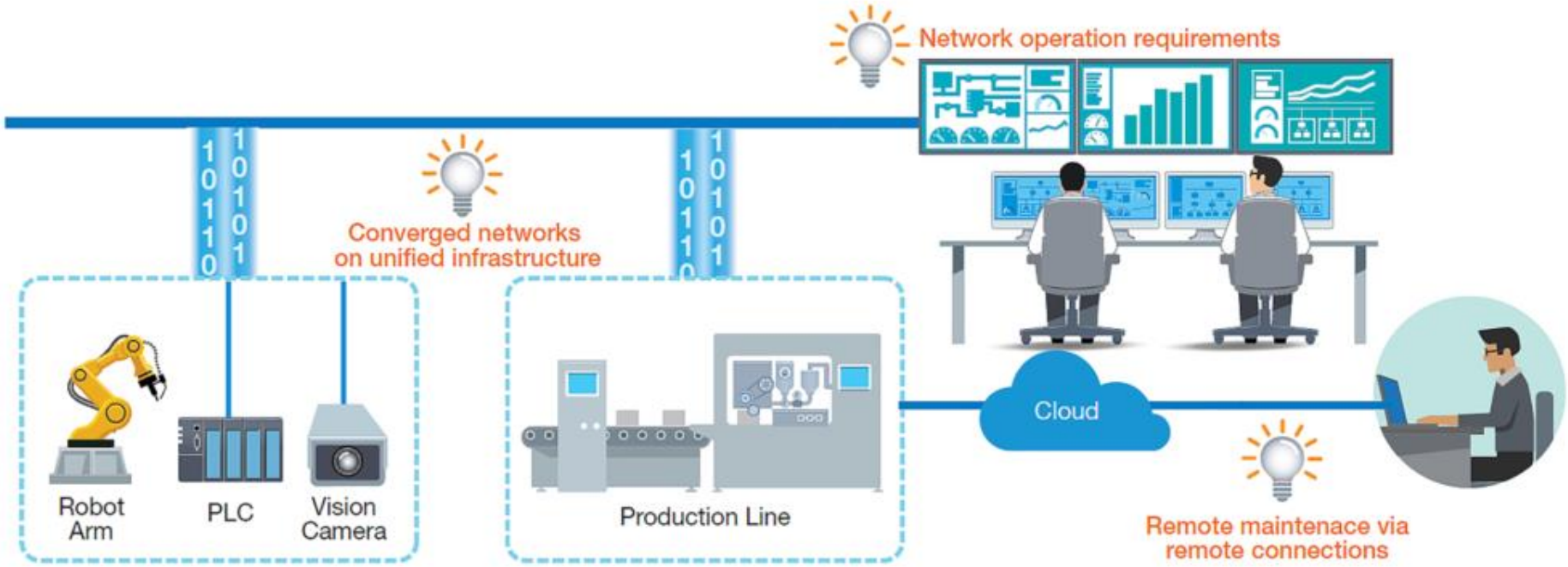
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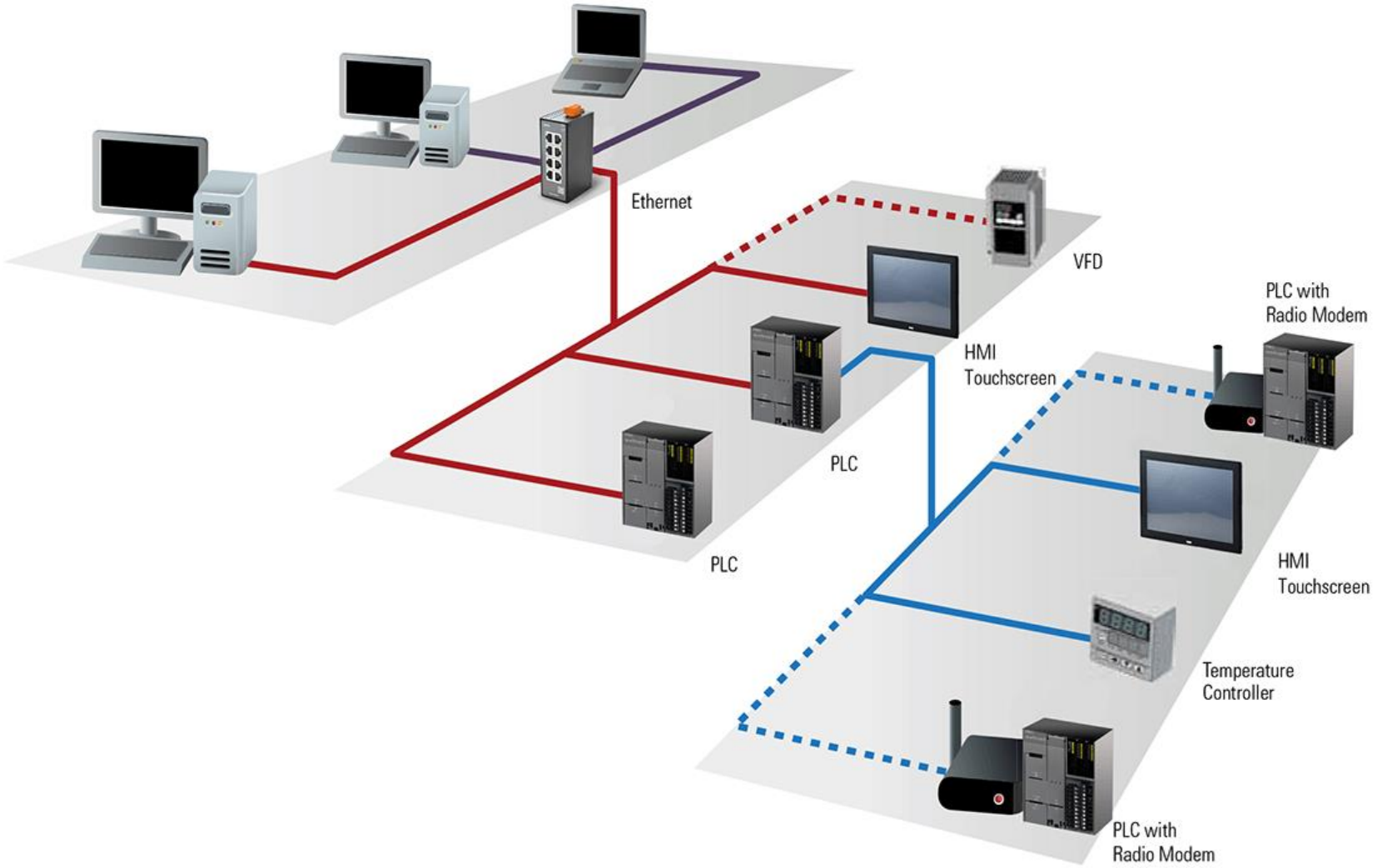
PLC as Integration Program



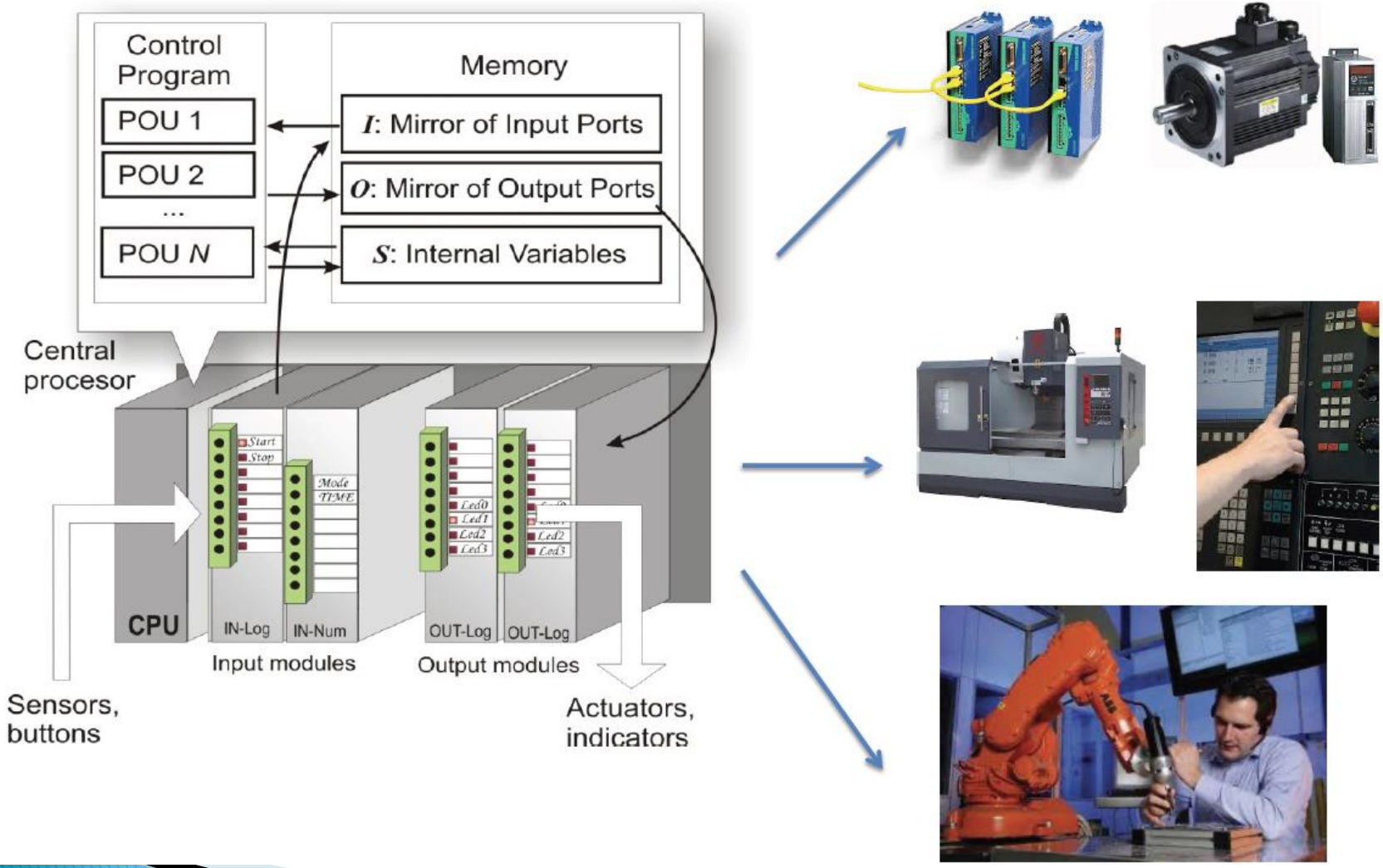
PLC as Integration Program



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PLC as Integration Program

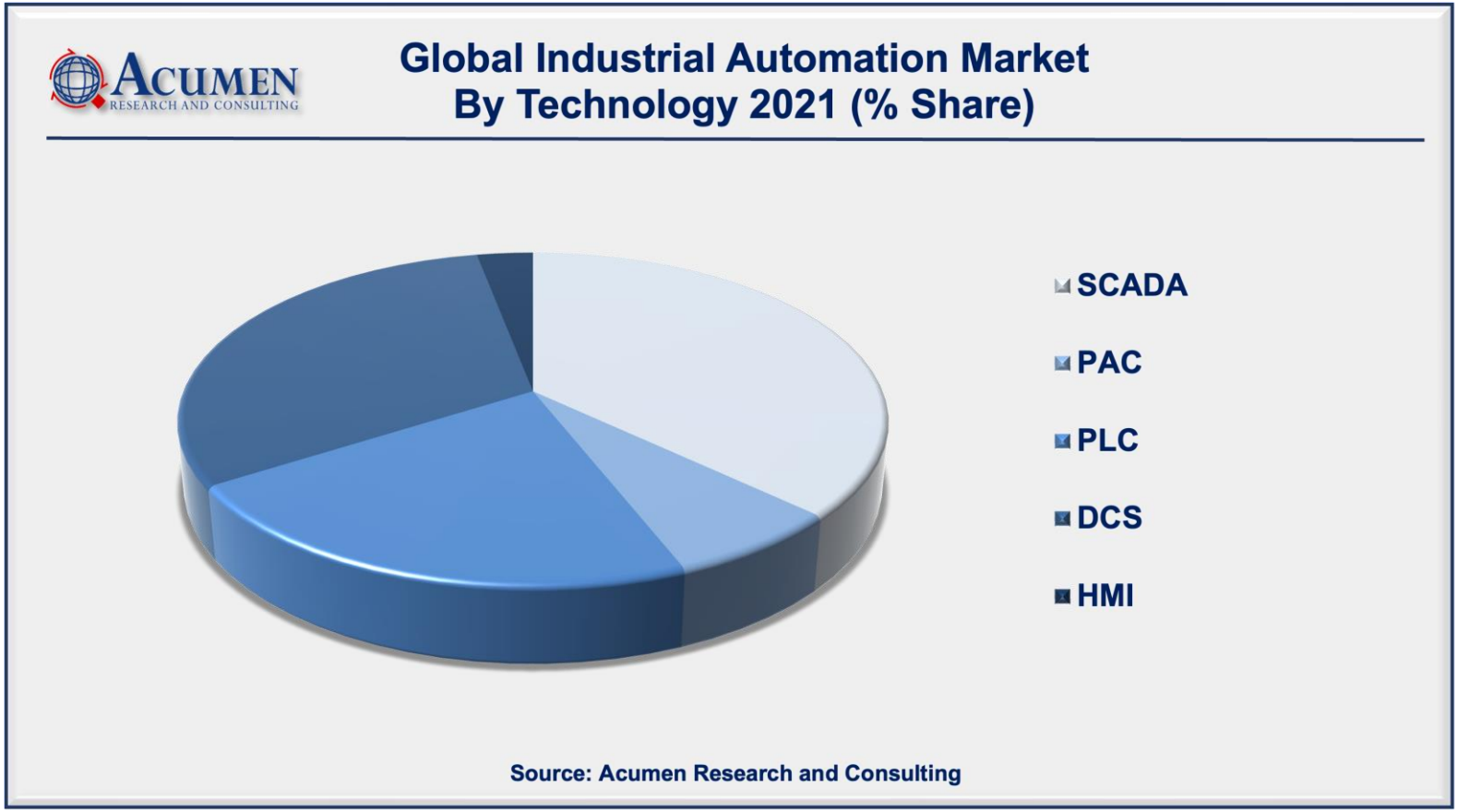
- ✓ The application of advanced automation control systems is one of the critical reasons that will drive the industrial automation market in **chemical and petrochemical industry.**

- ✓ There is an increase in the need for **fast and accurate systems** in the process and discrete industries. This is resulting in the emergence of technologically advanced automation control systems.

- ✓ These systems have features such as **faster processors and increased memory capacity.** They are extensively used to **perform complex production processes** carried out in the chemical and petrochemical industry.

- ✓ Also, issues such as **space limitation and process complexity** with conventional PLCs can be overcome with the help of customized PLCs for small, medium, and large machines used in this industry.

PLC as Integration Program



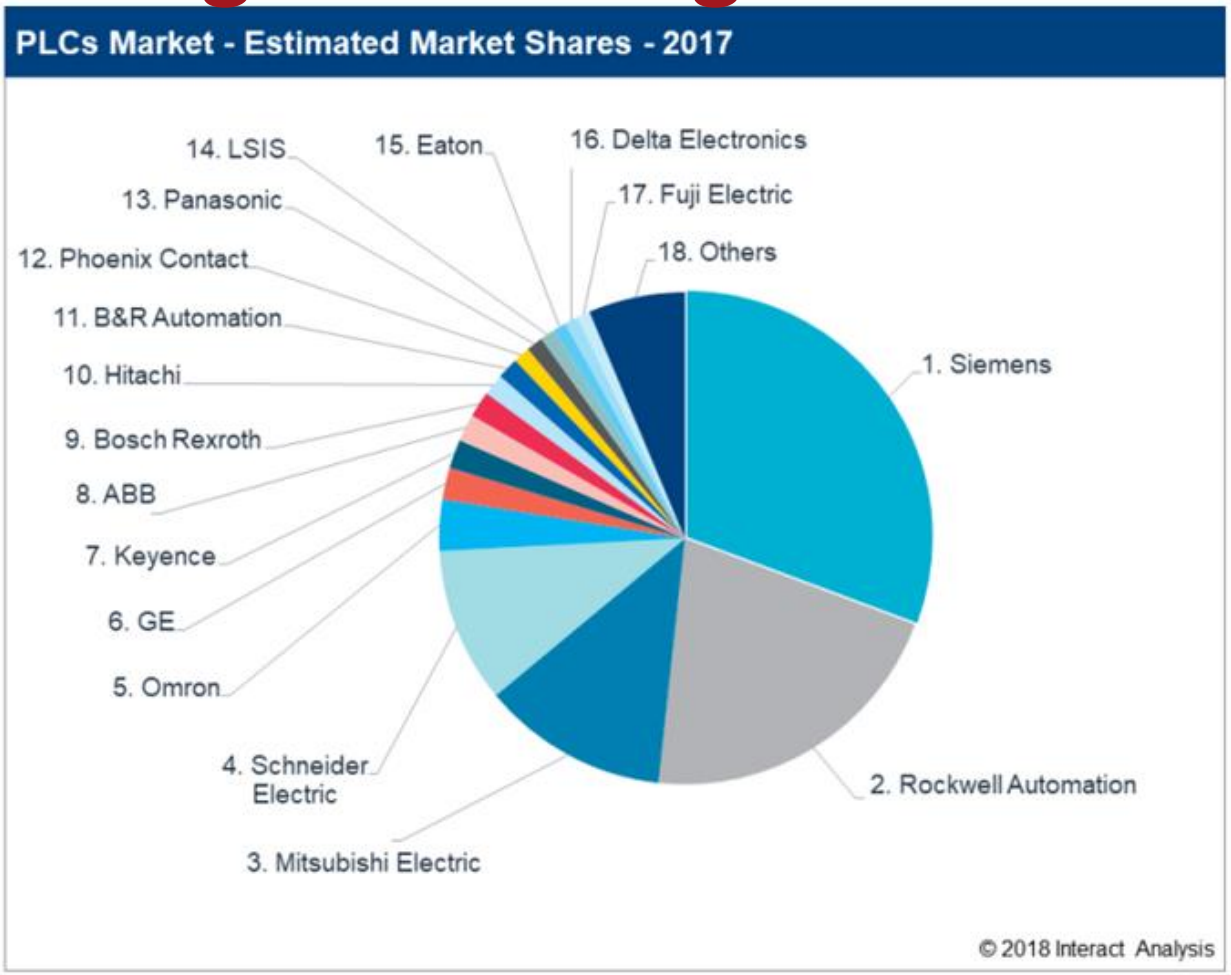
SCADA – Supervisory Control and Data Acquisition System
PAC - Programmable Automation Controller
PLC – Programmable Logic Controller
DCS - Distributed Control System

PLC as Integration Program

- ✓ The programmable logic controller (**PLC**) **market** was valued at USD 3897.36 million in 2019 and is expected to reach USD 4292.66 million by 2025.

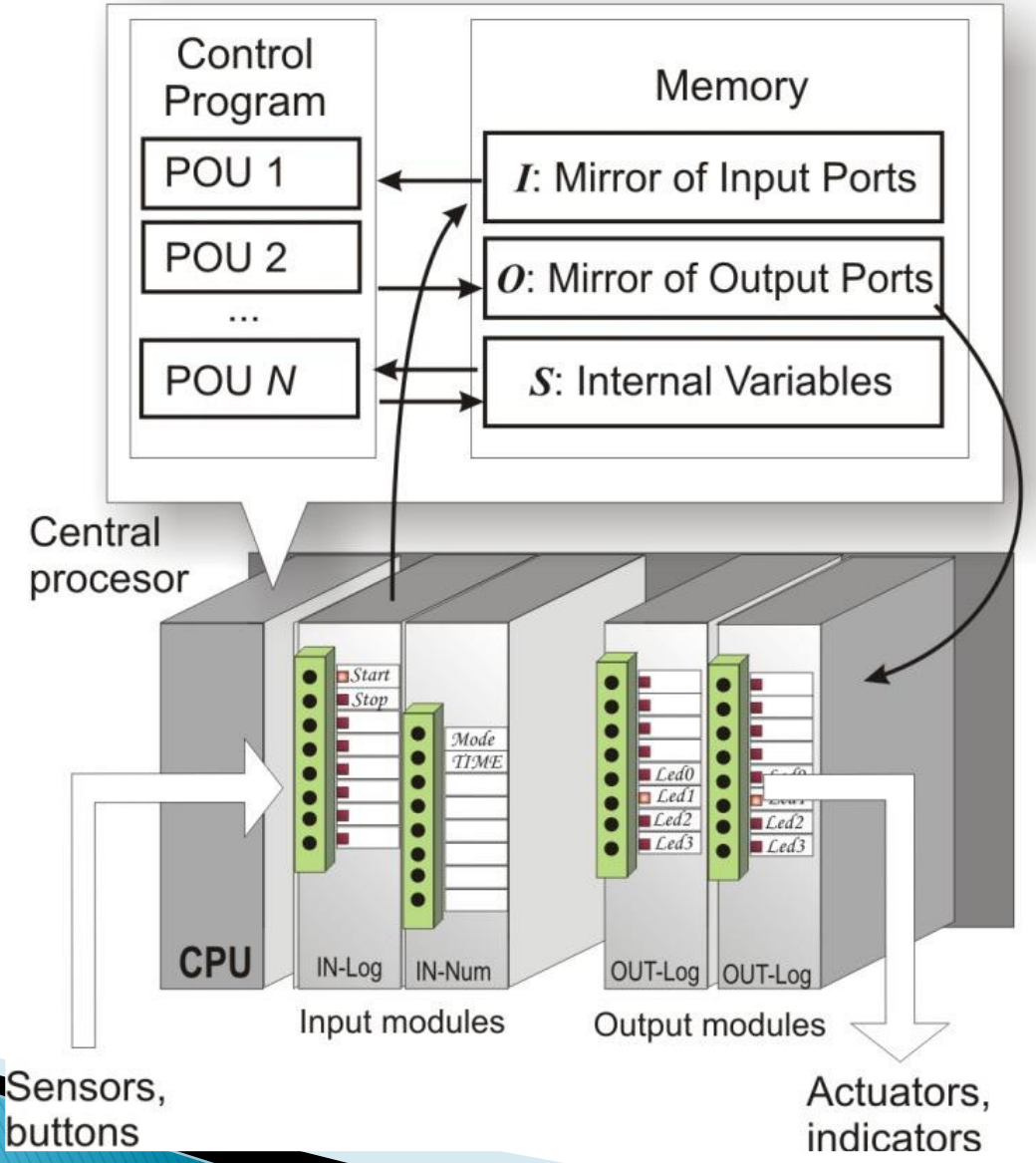


PLC as Integration Program

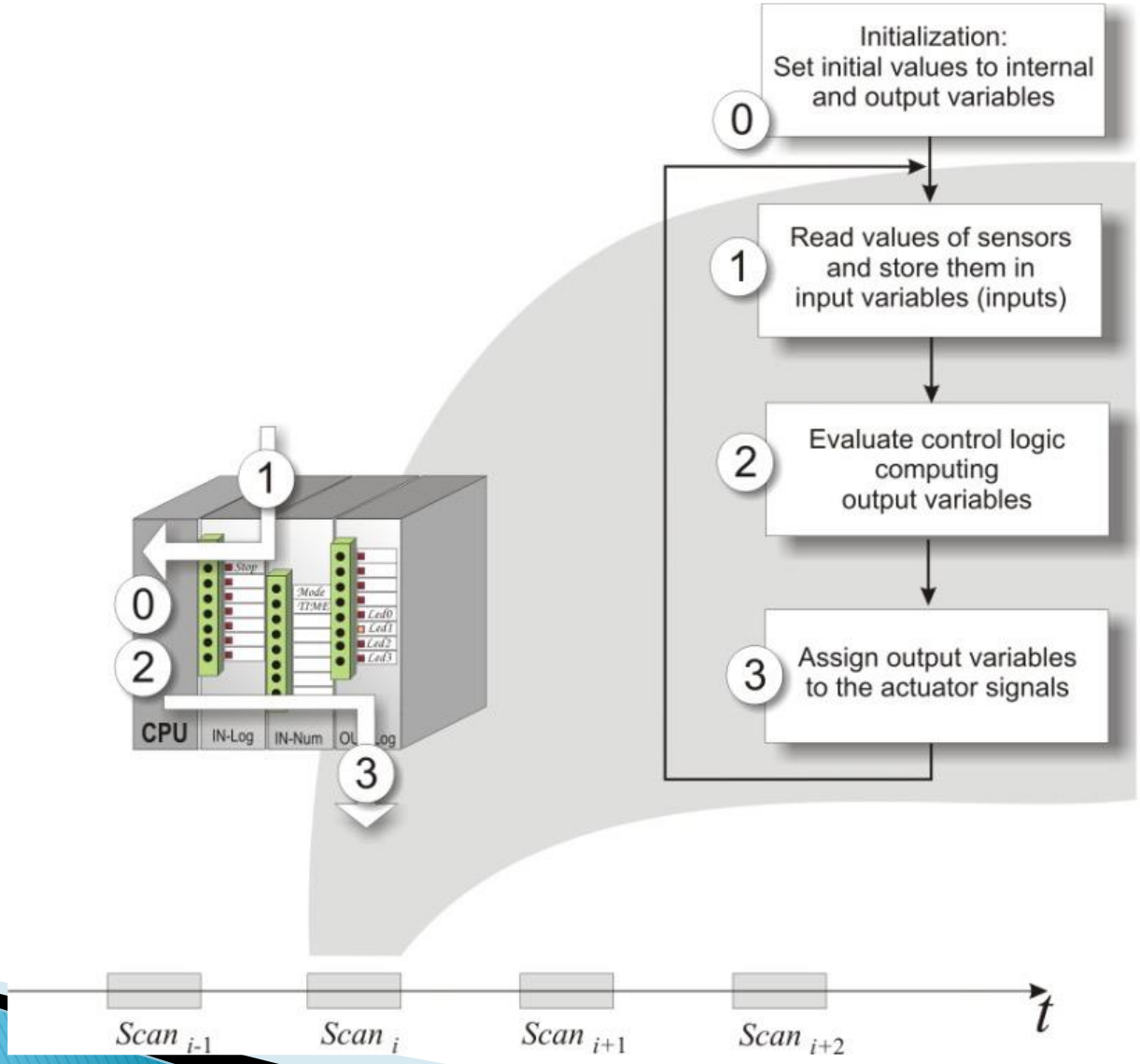


https://www.mordorintelligence.com/industry-reports/programmable-logic-controller-plc-market

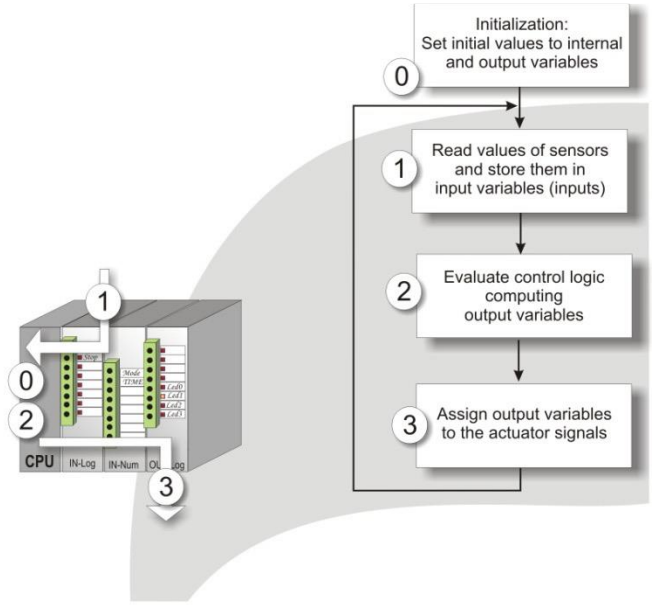
Computations in Controllers - PLC

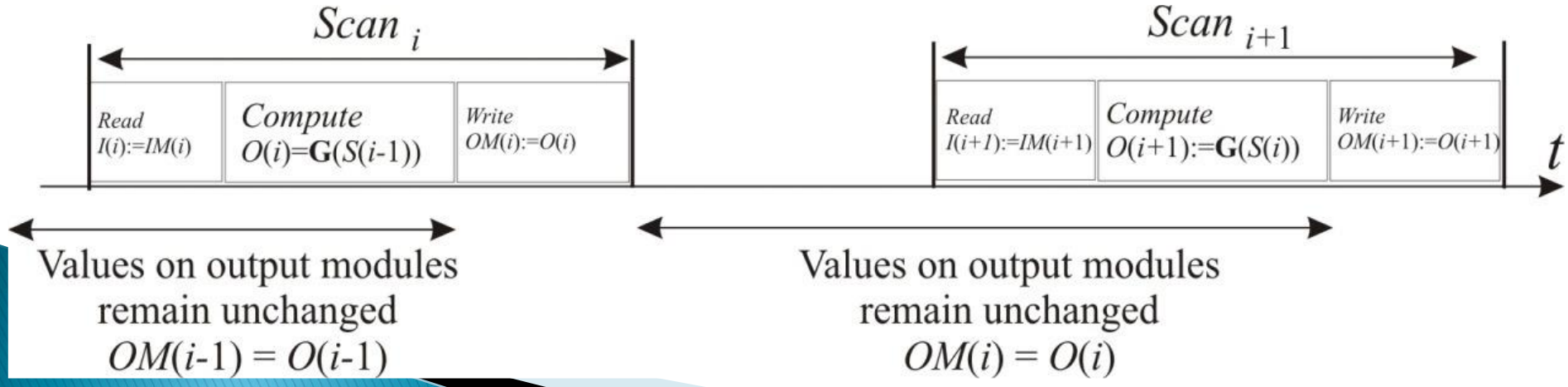


Computations in Controllers - Cyclic Program Execution

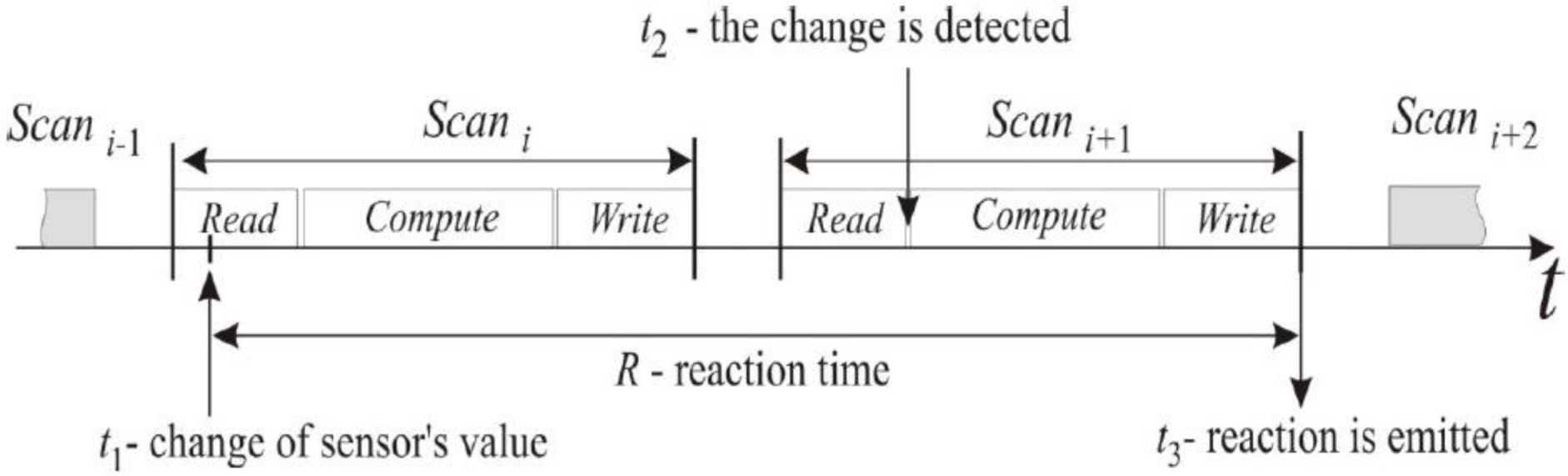


Computations in Controllers - Cyclic Program Execution





Computations in Controllers – Reaction of PLC



Computations in Controllers – Why PLCs are around?

- ✓ Less wiring
- ✓ Wiring between devices and relay contacts are done in the PLC program
- ✓ Easier and faster to make changes
- ✓ Troubleshooting aids make programming easier and reduce downtime
- ✓ Reliable components make these likely to operate for years before failure

END OF CHAPTER 1

Dr. Yılmaz KALKAN