Distributed control system

DEFINATION

A **distributed control system** (DCS) refers to a control system usually of a manufacturing system, process or any kind of dynamic system, in which the controller elements are not central in location (like the brain) but are distributed throughout the system with each component sub-system

DCS (Distributed Control System) is a computerized control system used to control the production line in the industry controlled by one or more controllers.

DCS is a very broad term used in a variety of industries, to monitor and control distributed equipment.

APPLICATION AREA

Electrical power grids and electrical generation plants
Environmental control systems
Traffic signals
Radio signals
Water management systems
Oil refining plants
Metallurgical process plants
Chemical plants
Pharmaceutical manufacturing
Sensor networks
Dry cargo and bulk oil carrier ships

Distributed Control Systems

- Collection of hardware and instrumentation necessary for implementing control systems
- Provide the infrastructure (platform) for implementing advanced control algorithms

History of Control Hardware

- Pneumatic Implementation:
  - *Transmission*: the signals transmitted pneumatically are slow responding and susceptible to interference.
  - *Calculation*: Mechanical computation devices must be relatively simple and tend to wear out quickly.

History (cont.)

- Electron analog implementation:
  - *Transmission*: analog signals are susceptible to noise, and signal quality degrades over long transmission line.
  - *Calculation*: the type of computations possible with electronic analog devices is still limited.

History (cont.)

- Digital Implementation:
  - *Transmission*: Digital signals are far less sensitive to noise.
  - *Calculation*: The computational devices are digital computers.

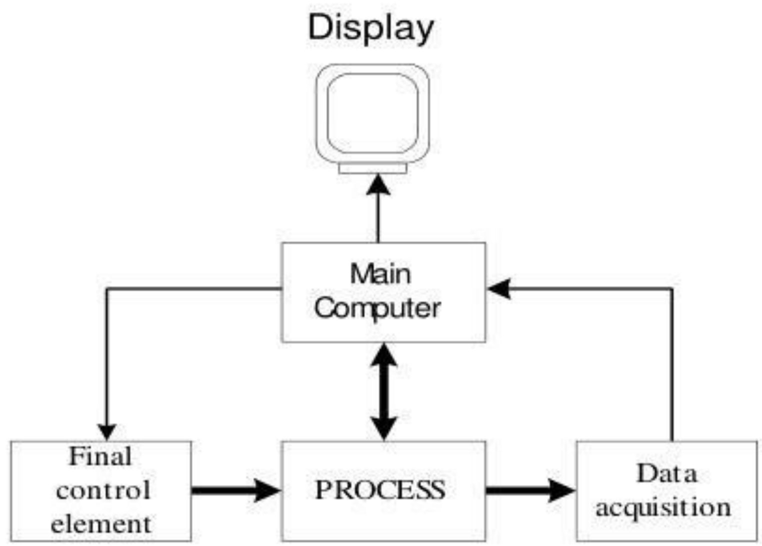
Advantages of Digital System

- Digital computers are more flexible because they are programmable and no limitation to the complexity of the computations it can carry out.
- Digital systems are more precise.
- Digital system cost less to install and maintain
- Digital data in electronic files can be printed out, displayed on color terminals, stored in highly compressed form.

Computer Control Networks

1. PC Control:

- Good for small processes such as laboratory prototype or pilot plants, where the number of control loops is relatively small



Computer Control Networks

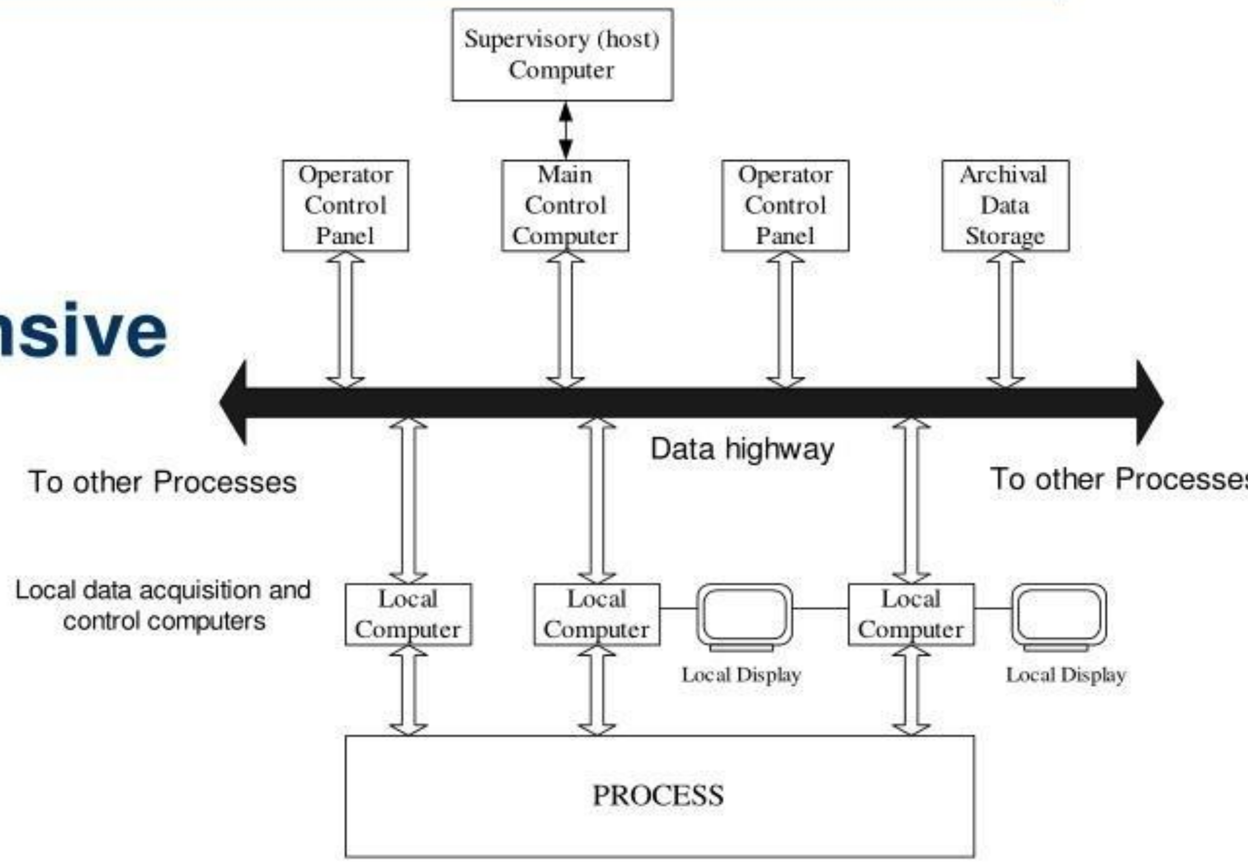
2. Programmable Logic Controllers:

- specialized for non-continuous systems such as batch processes.
- It can be used when interlocks are required; e.g., a flow control loop cannot be actuated unless a pump has been turned on.
- During startup or shutdown of continuous processes.

Computer Control Networks

3. DCS

- Most comprehensive



DCS Elements-1

- **Local Control Unit**: This unit can handle 8 to 16 individual PID loops.
- **Data Acquisition Unit**: Digital (discrete) and analog I/O can be handle.
- **Batch Sequencing Unit**: This unit controls a timing counters, arbitrary function generators, and internal logic.
- **Local Display**: This device provides analog display stations, and video display for readout.
- **Bulk Memory Unit:** This unit is used to store and recall process data.

DCS Elements-2

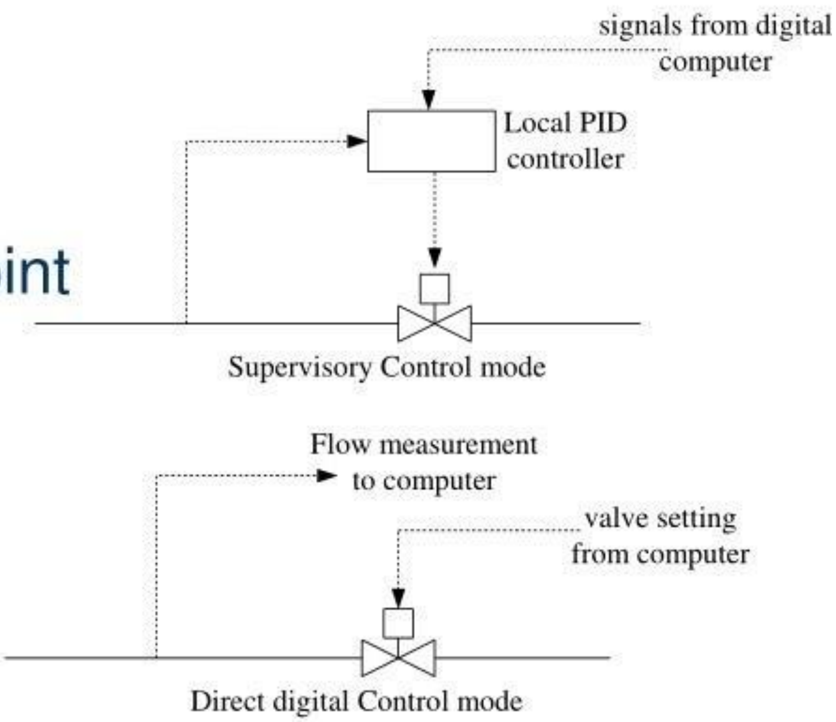
- **General Purpose Computer** : This unit is programmed by a customer or third party to perform optimization, advance control, expert system, etc
- **Central Operator Display**: This unit typically contain several consoles for operator communication with the system, and multiple video color graphics display units
- **Data Highway** : A serial digital data transmission link connecting all other components in the system. It allow for redundant data highway to reduce the risk of data loss
- **Local area Network** *(LAN)*

Advantages of DCS

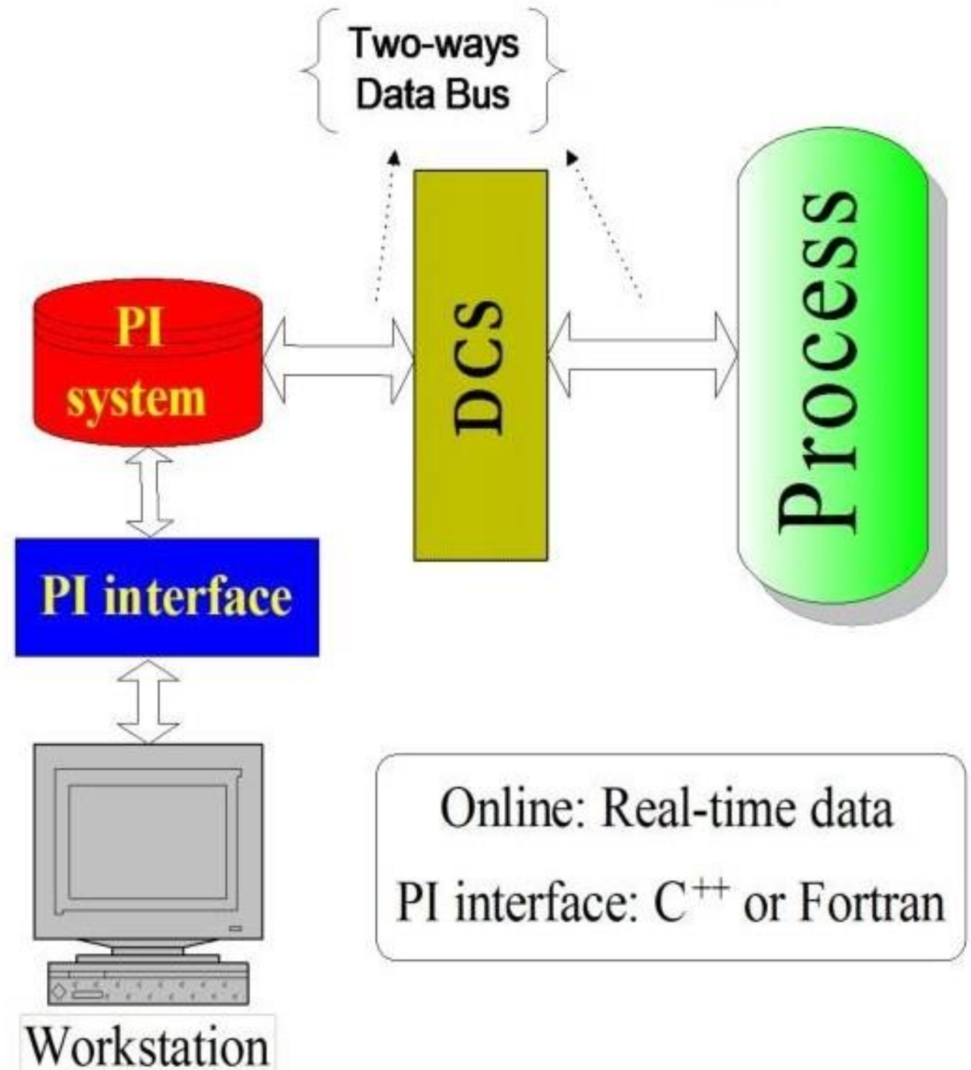
- Access a large amount of current information from the data highway.
- Monitoring trends of past process conditions.
- Readily install new on-line measurements together with local computers.
- Alternate quickly among standard control strategies and readjust controller parameters in software.
- A sight full engineer can use the flexibility of the framework to implement his latest controller design ideas on the host computer.

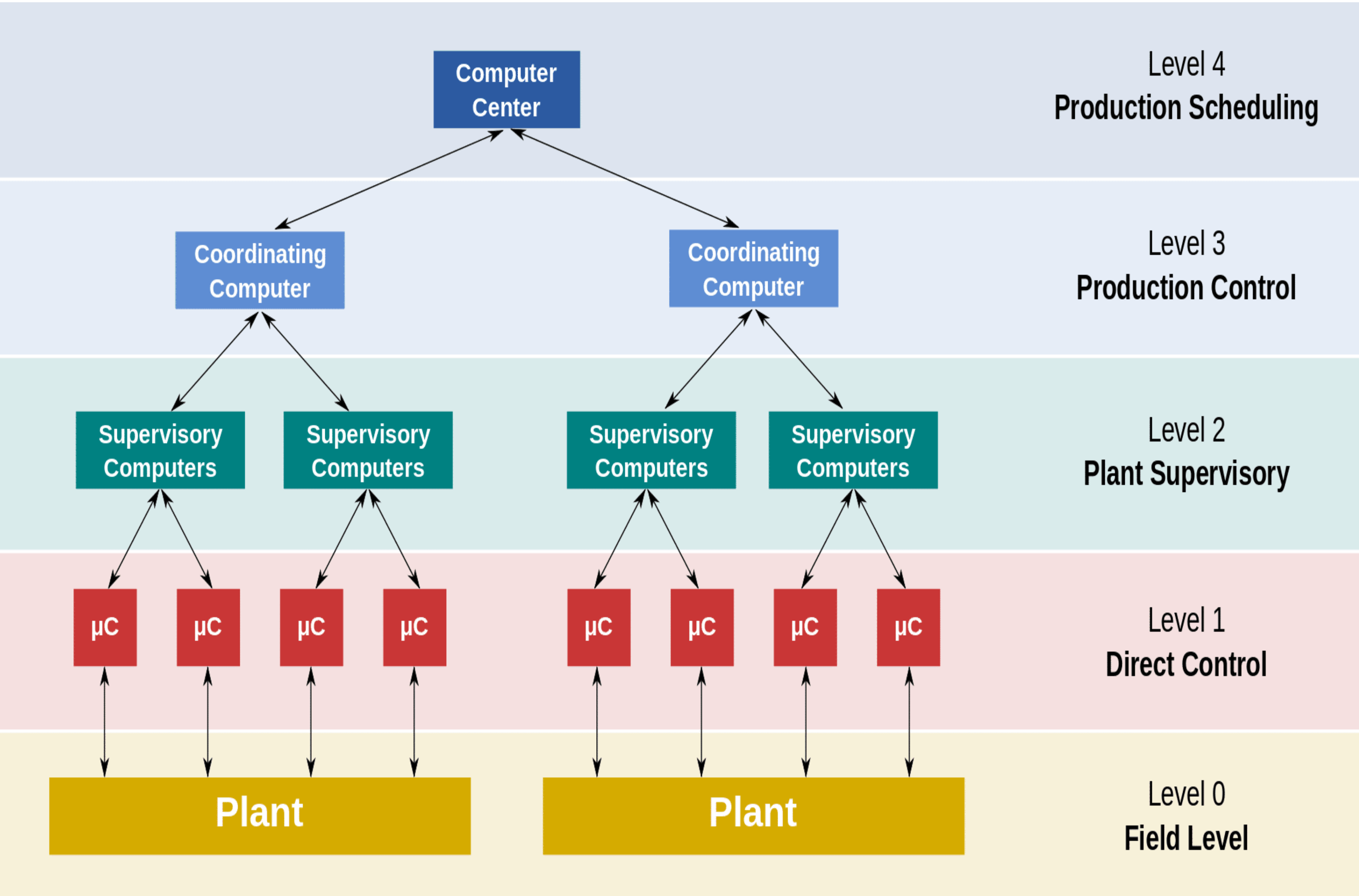
Modes of Computer control

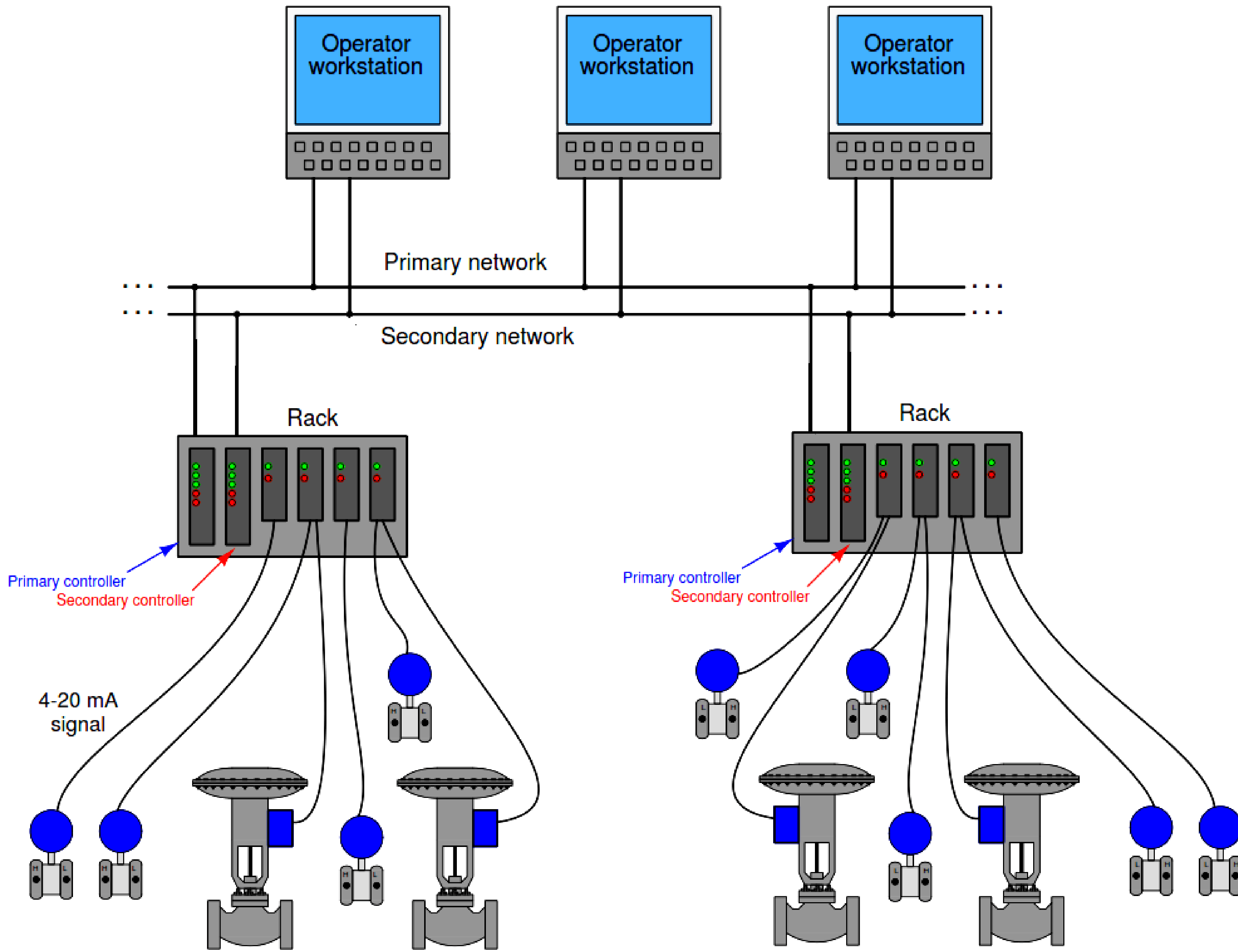
1. Manual
2. Automatic
   - PID with local set point
3. Supervisory
   - PID with remote set point (supervisory)
4. Advanced



Advanced control topology




Computer Center
Level 4
Production Scheduling
Coordinating Computer
Coordinating Computer
Level 3
Production Control
Supervisory Computers
Supervisory Computers
Supervisory Computers
Supervisory Computers
Level 2
Plant Supervisory
µC
µC
µC
µC
µC
µC
µC
µC
Level 1
Direct Control
Plant
Plant
Level 0
Field Level



Operator workstation
Operator workstation
Operator workstation
Primary network
Secondary network
Rack
Rack
Primary controller
Secondary controller
Primary controller
Secondary controller
4-20 mA signal

DCS Vendors

- Honeywell
- Fisher-Rosemont
- Baily
- Foxboro
- Yokogawa
- Siemens
- GE Fanuc Intelligent Platform
- Schneider Electrics
- ABB

Distributed control system (DCS):Application(Additional)

Agriculture.

Chemical plants.

Petrochemical (oil) and refineries.

Nuclear power plants.

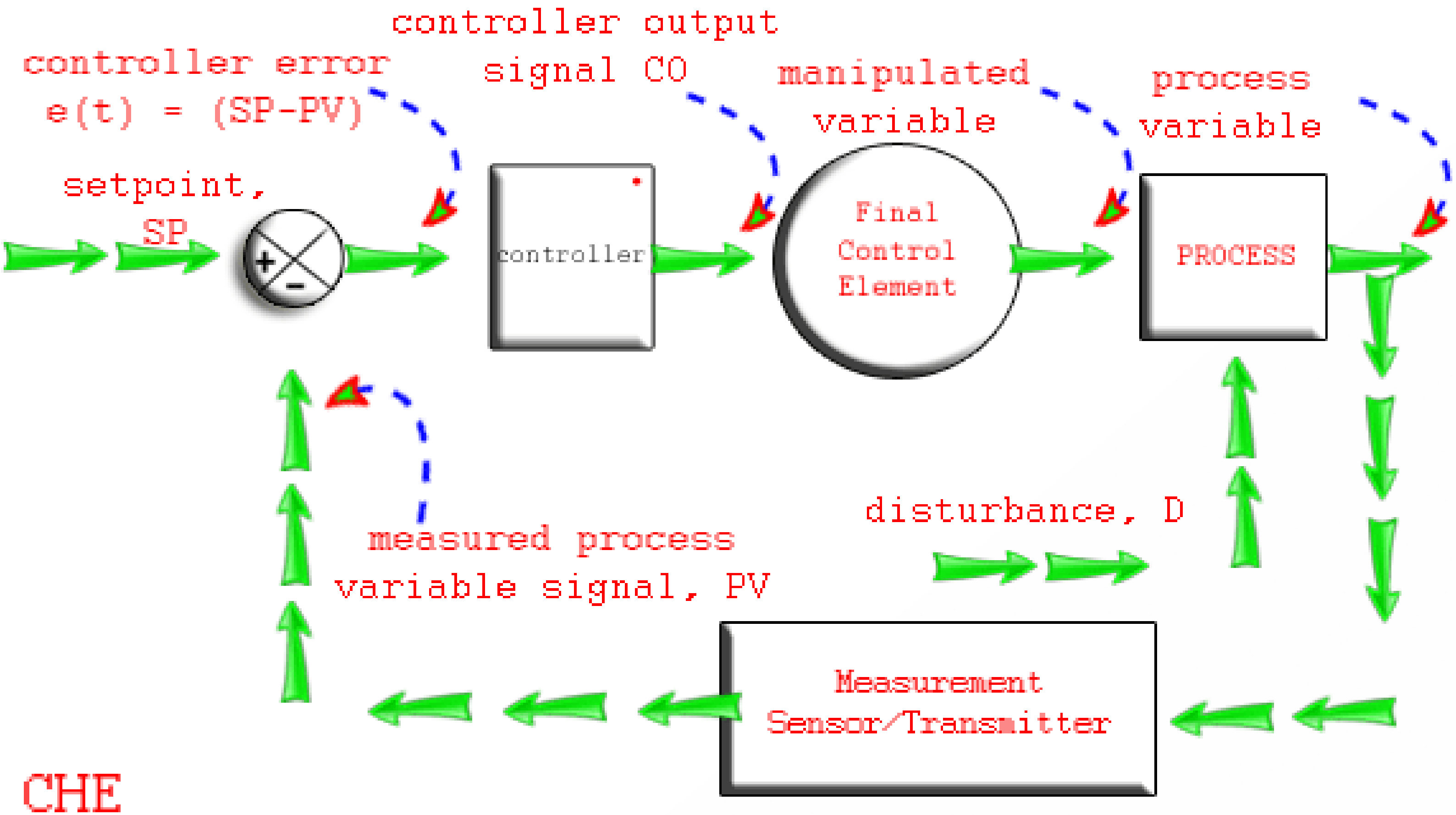
Water treatment plants.

Sewage treatment plants.

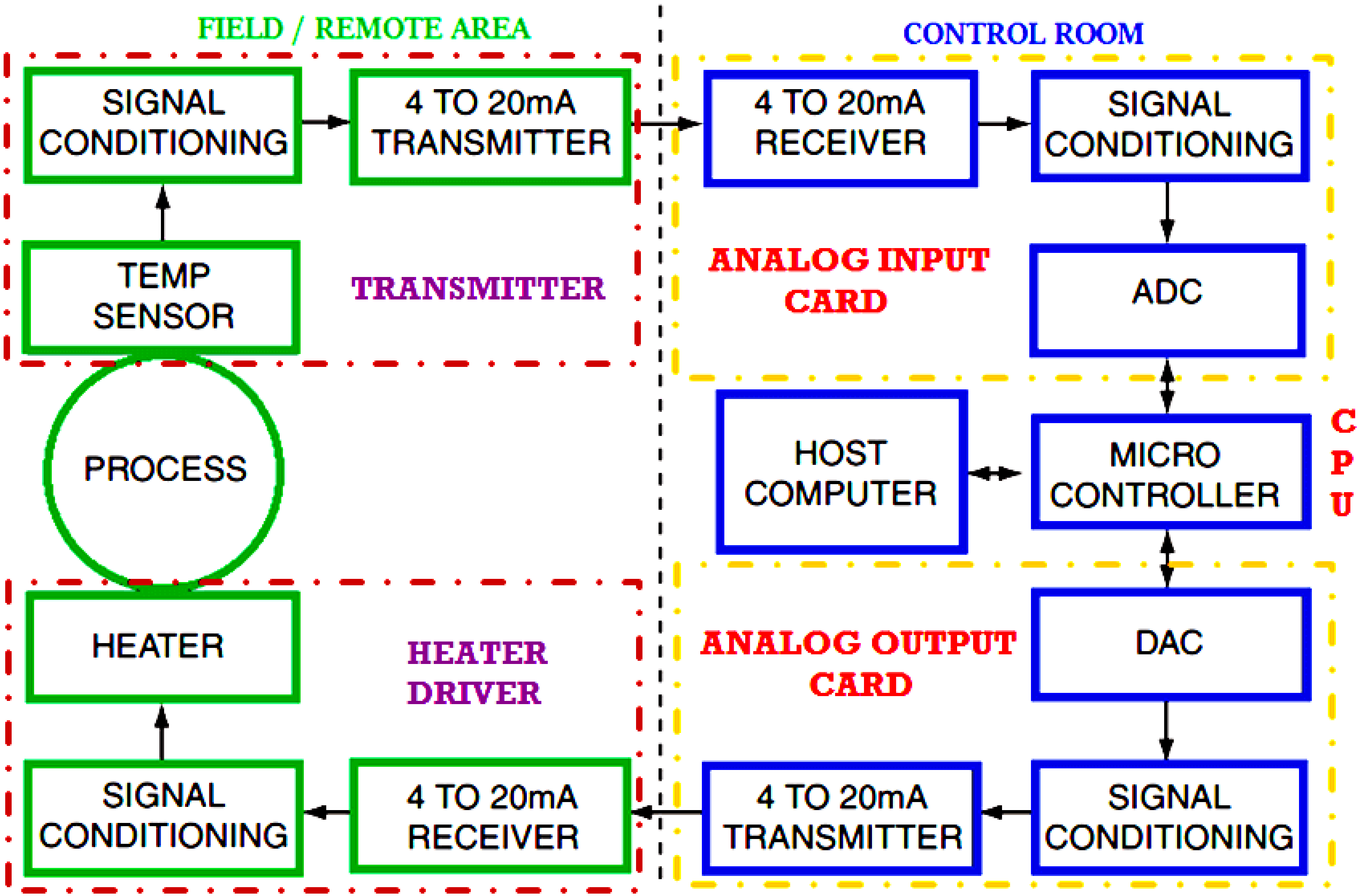
Food processing.

Automobile manufacturing.

General Control Loop Block Diagram

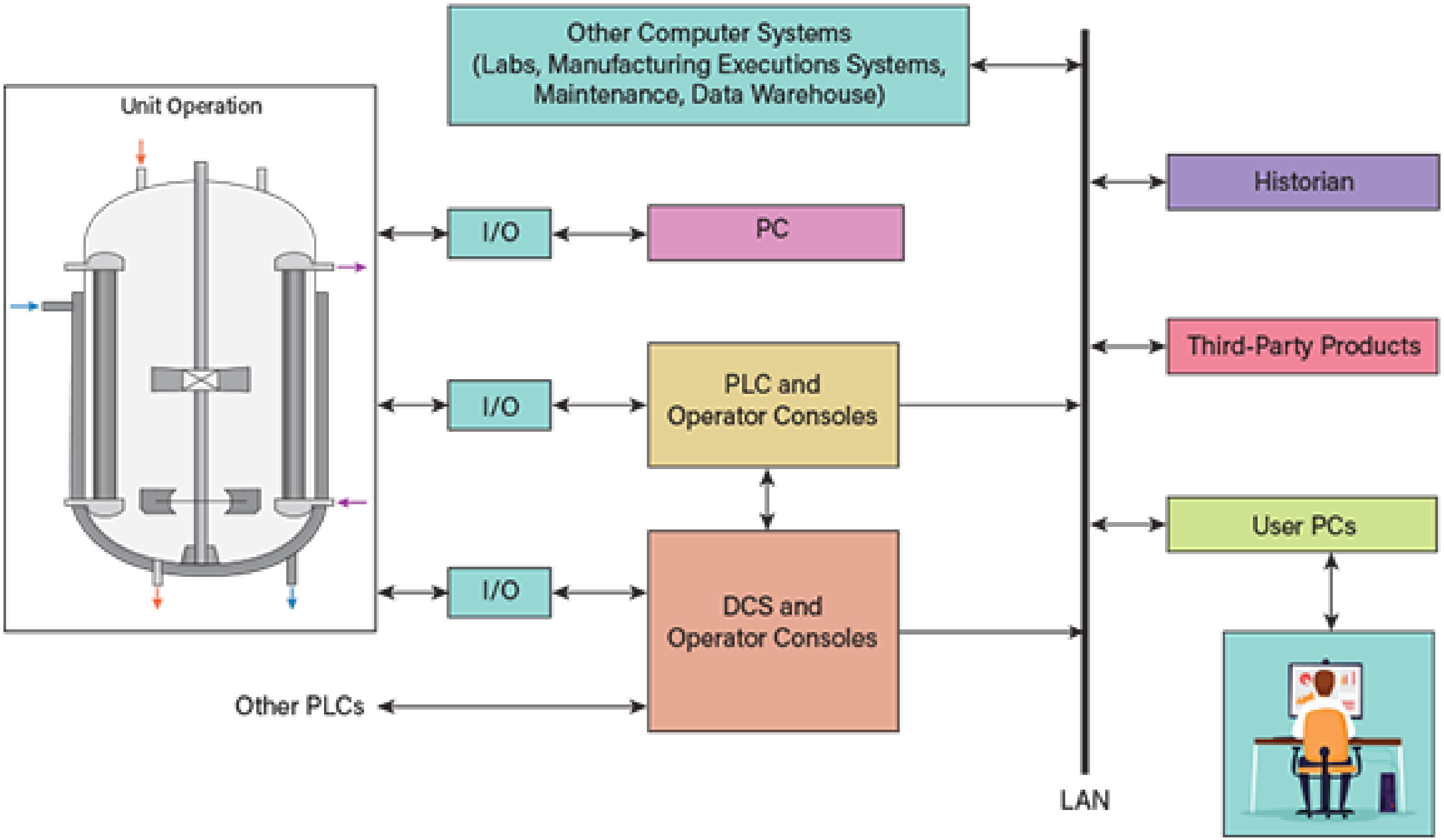


CHE

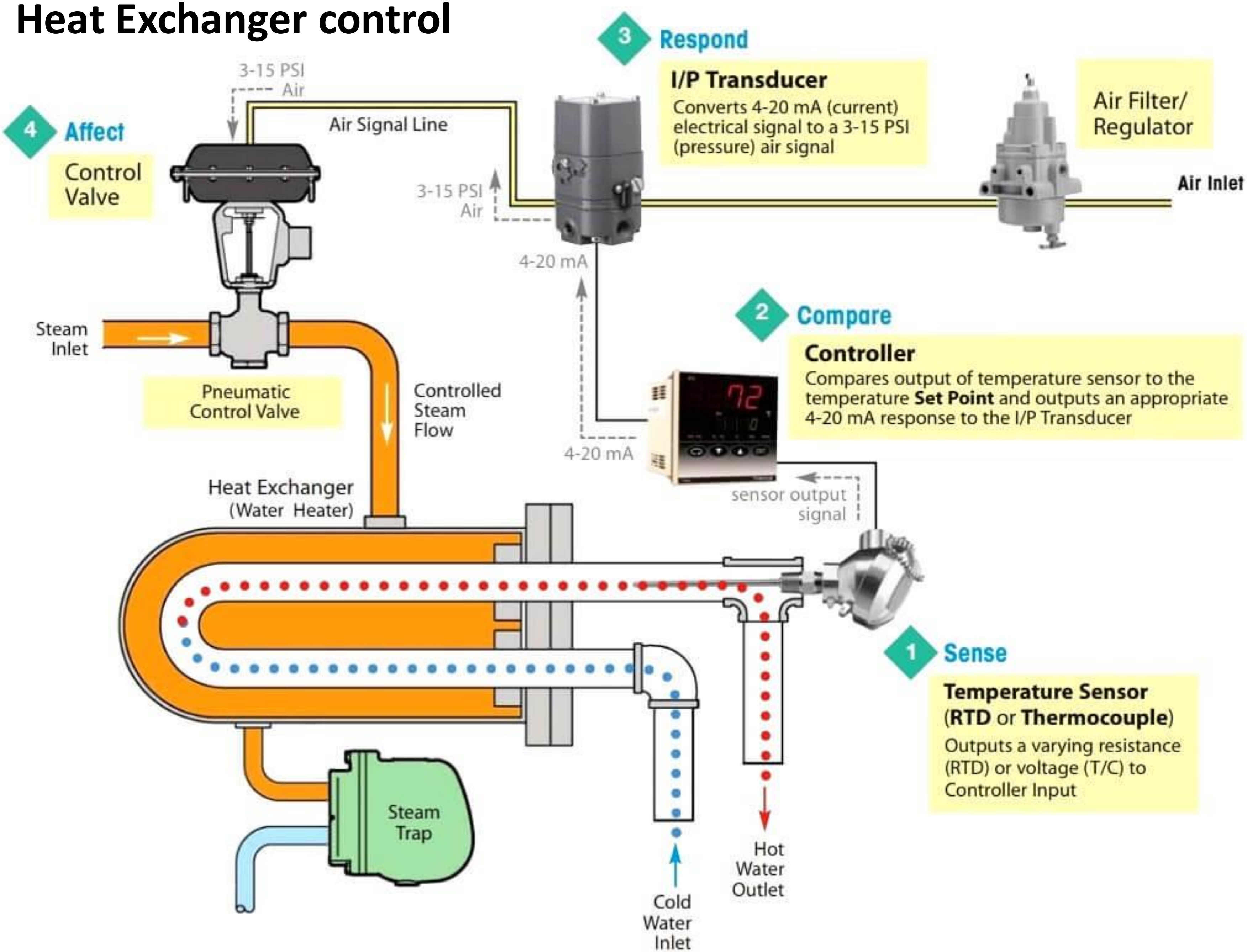


Typical Process Control Loop

CSTR CONTROL



Heat Exchanger control



IOT

Welcome to The World of Internet of Things

All Information Which You Want To Know About Internet of Things

Created By

CDN Mobile Solutions

Mobility Division of CDN Solutions Group

CDN MOBILE SOLUTIONS

Mobile Division of CDN Solutions Group

What You Are Going To Know

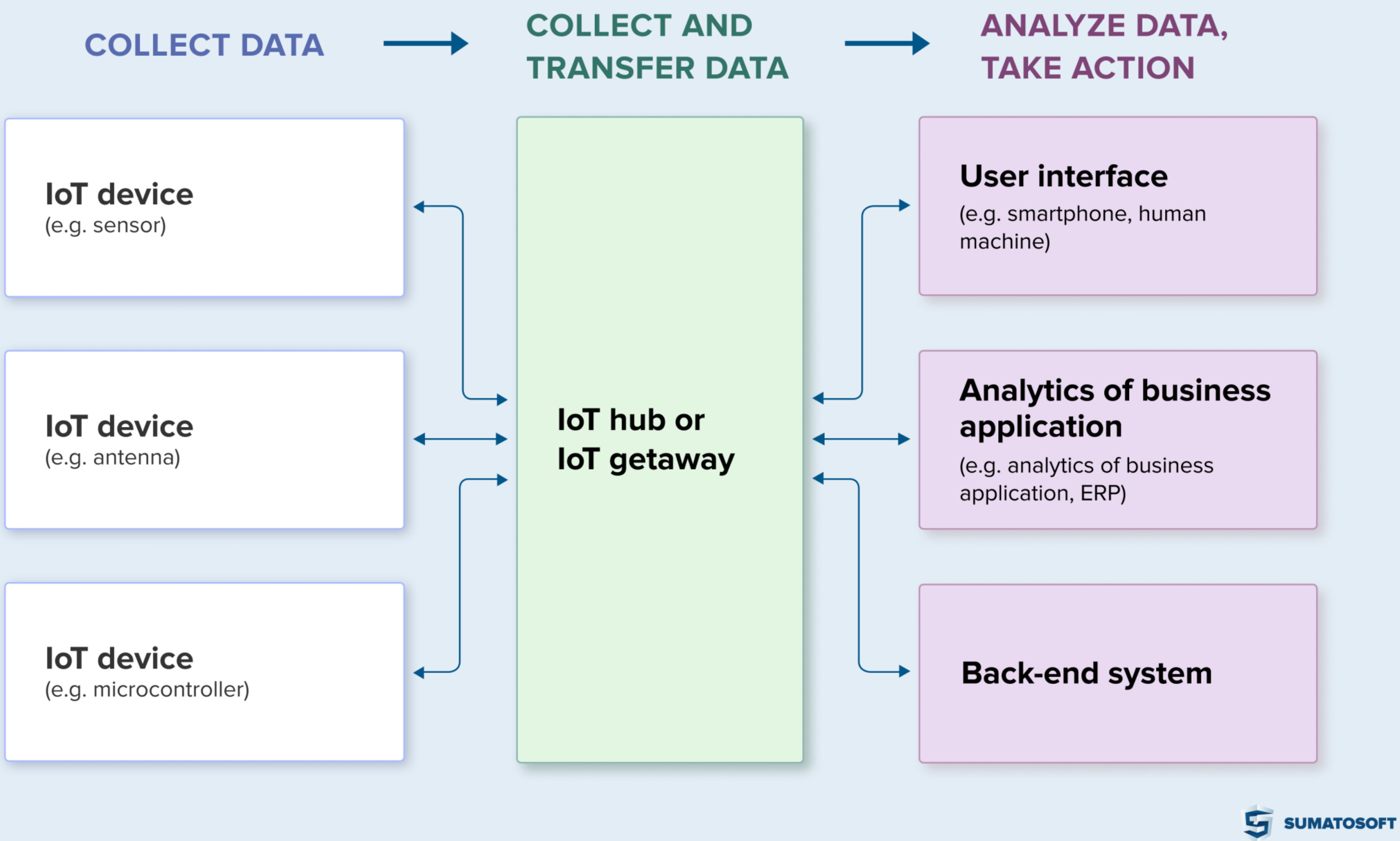
- What Is Internet of Things
- Applications of Internet of Things
- Challenges of Internet of Things
- Future of Internet of Things

What is Internet of Things

The Internet of Things (IoT) is a computing concept that describes a future where everyday physical objects will be connected to the Internet and be able to identify themselves to other devices. We can say that IoT is a network of physical objects which embedded with software, electronics, sensors and connectivity to enable it to achieve greater value and services by exchanging data with the manufacturer, operator or connected with other devices.

IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communication and covers a variety of protocols, domains, and applications

Example of an IoT system



Applications of Internet of Things

Enviornmental Monitoring – There are several IoT medical devices, able to keep record of remote health monitoring, blood pressure, heart rate, sugar and major changes in your body.

Transportation – IoT enables smart parking, smart traffic control, electronic toll collection systems, vehicle control, logistic management and road safety assistance.

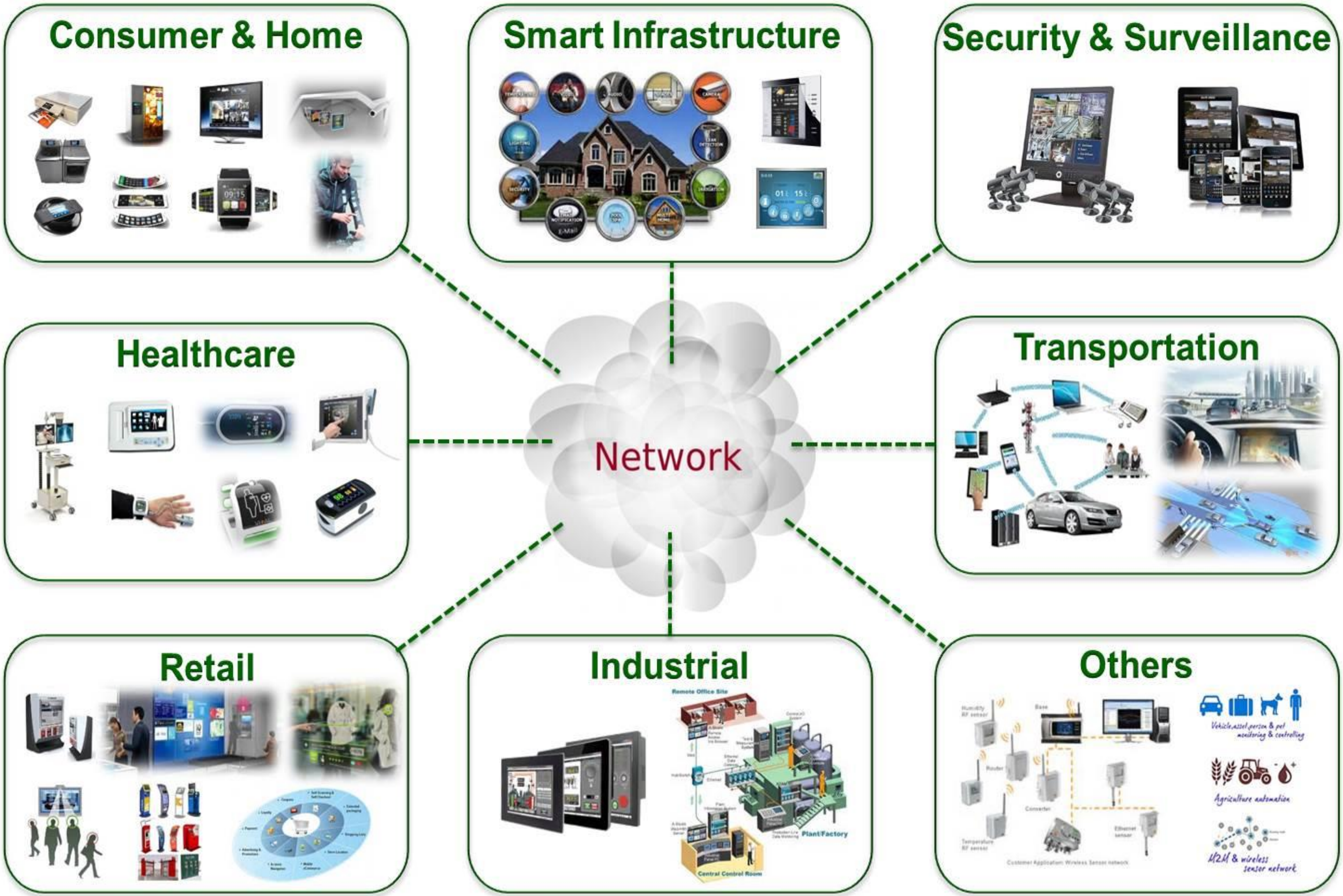
Medical Systems – You can get more accurate information of air quality, water quality, soil conditions and atmospheric changes. IoT devices in this application typically span a large geographic area and can also be mobile.

Applications of Internet of Things

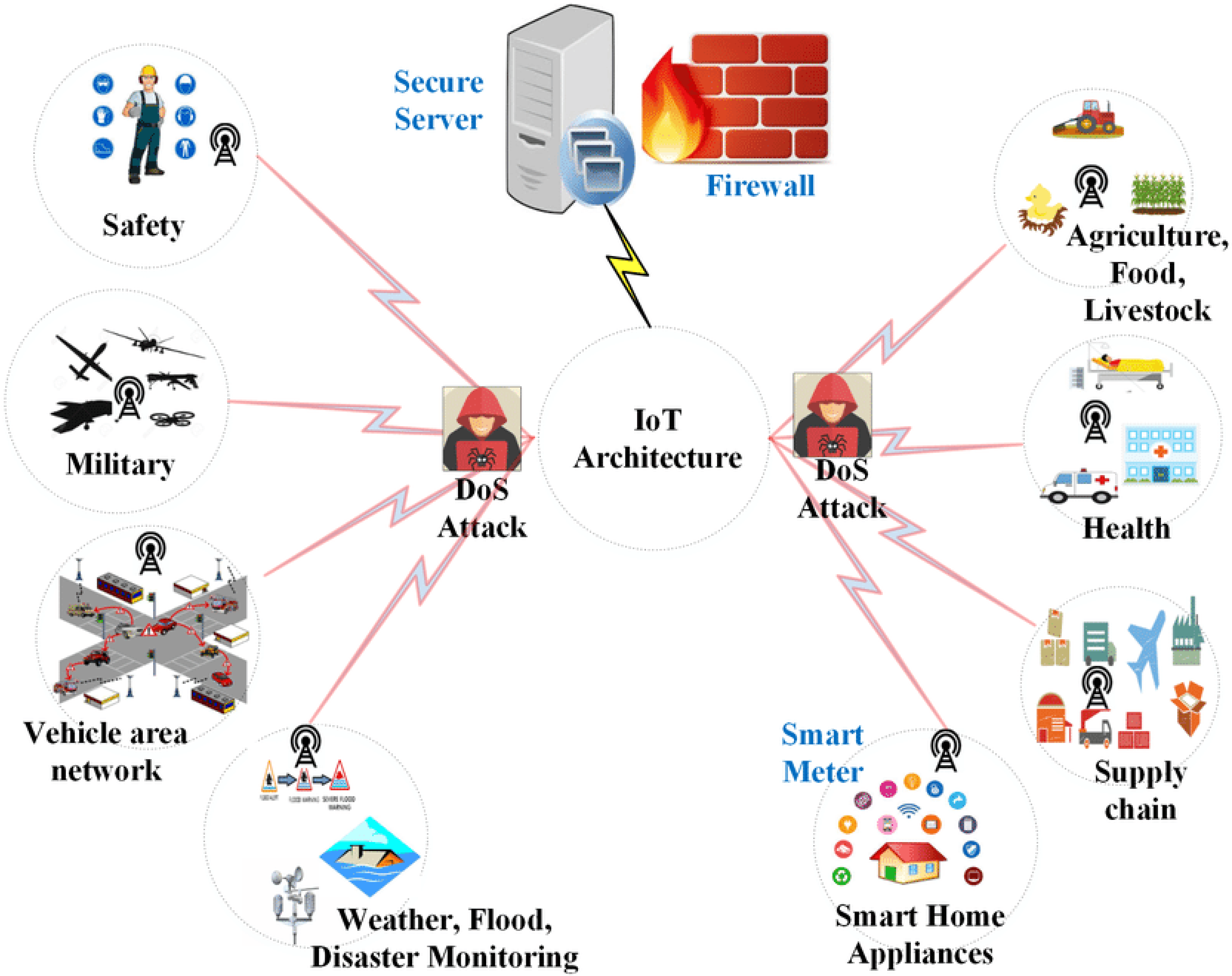
Manufacturing – IoT enable rapid manufacturing of new products, real-time optimization of product manufacturing, dynamic response of product demand.

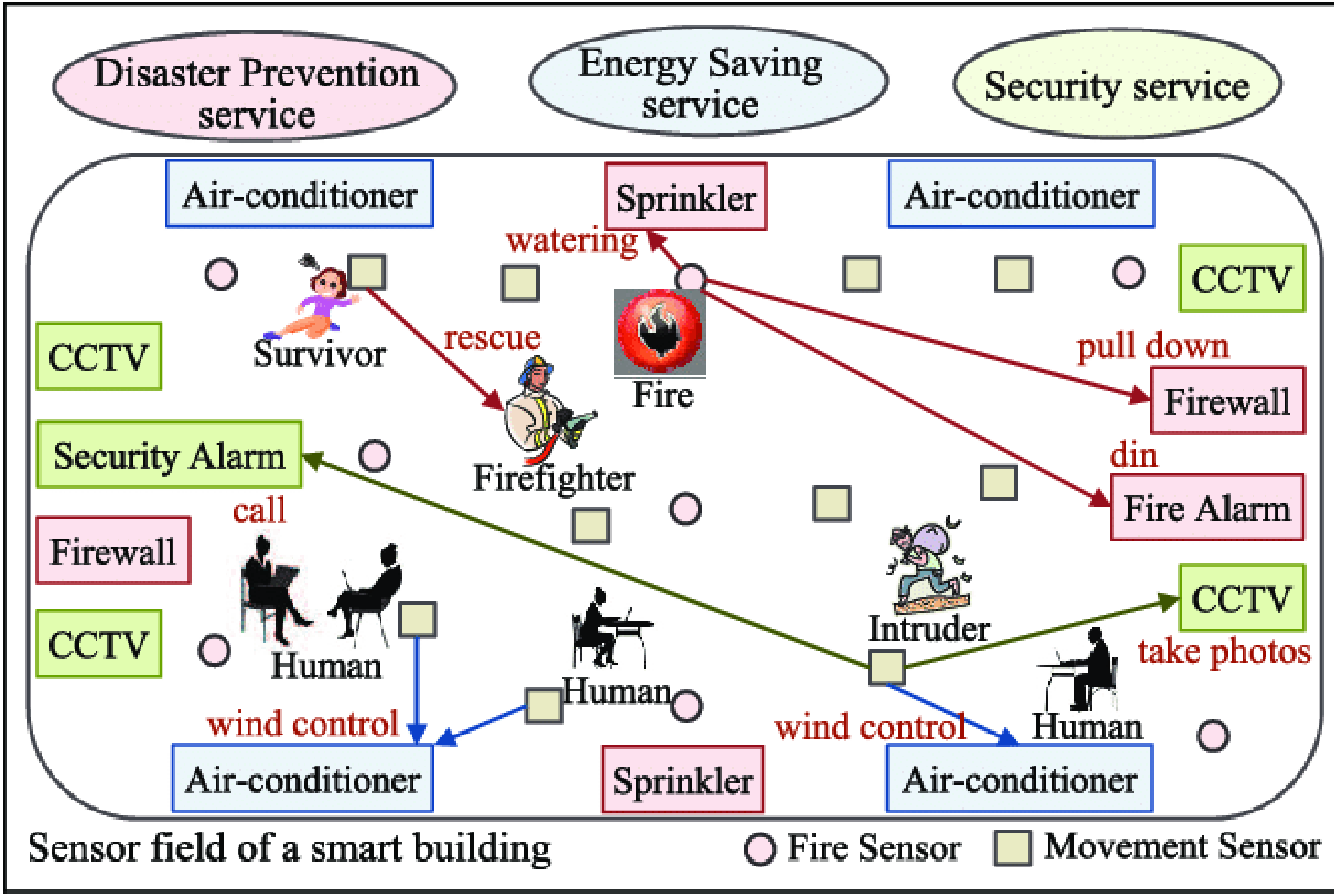
Energy Management – With the help of IoT electronic appliances you can save energy and reduce energy consumption in your home or office.

Infrastructure Management – Big projects of urban and rural infrastructures like highways, bridges, railway tracks IoT can play an important role



Consumer & Home
Smart Infrastructure
Security & Surveillance
Healthcare
Network
Transportation
Retail
Industrial
Others
Vehicle,asset,person & pet monitoring & controlling
Agriculture automation
M2M & wireless sensor network


Secure Server
Firewall
Safety
Military
Vehicle area network
Weather, Flood, Disaster Monitoring
DoS Attack
IoT Architecture
DoS Attack
Agriculture, Food, Livestock
Health
Supply chain
Smart Meter
Smart Home Appliances


Disaster Prevention service
Energy Saving service
Security service
Air-conditioner
Sprinkler
Air-conditioner
watering
CCTV
CCTV
Survivor
rescue
Fire
pull down
Firewall
Security Alarm
Firefighter
din
Fire Alarm
call
Firewall
Intruder
CCTV
CCTV
Human
Human
take photos
wind control
wind control
Human
Air-conditioner
Sprinkler
Air-conditioner
Sensor field of a smart building
Fire Sensor
Movement Sensor

Challenges of Internet of Things

Security – Security is a major challenge of IoT. If we are applying IoT in major parts of our life then it has become more important that security should be of very high level. For example, what good is a smart home if anyone can unlock your doors?

Presence Dedection – It is tough to find that when an IoT device goes offline and when an IoT device comes back online. So, it is an another challenge for IoT technology and it is very important to find the status of all IoT devices. It helps us to monitor well.

Signaling – In IoT connections, signaling is crucial phase for collecting and routing data between IoT devices or between IoT device and server. In that way, IoT data streams comes into play. It should be 100% sure that stream of data is going to arrive at its destination every time.

Challenges of Internet of Things

Bandwidth – In addition to security and signaling, bandwidth usage is an another challenge for Internet of Things connectivity. On a cellular network, bandwidth is expensive and it becomes more complex when hundreds of thousands of IoT devices sens/receives signals to the server.

Power Consumption – When hundreds of IoT devices send or receive data between one another, then it takes a lot of power consumption as well as CPU consumption. So, you can't use 100% IoT devices with low power consumption and minimal battery drain.

Complexity – IoT application development is still very complex for the developers as well as experts. It is also the major challenge for the IoT application developers. IoT will be very effective with less complexity.

Future of Internet of Things

According to the Pew Research Center, “By 2025, there will be a global, immersive, invisible, ambient networked computing environment built through the continued proliferation of smart sensors, cameras, software, databases, and massive data centers in a world-spanning information fabric known as the Internet of Things."

Pew Research Center released this statement after the detailed overview which was based on the thoughts of the almost 1600 technology experts and IoT experts. So, by 2025 Internet of Things and wearable tech will start to play a major impact globally. Obviously our daily life will also affected by this revolutions of Internet of Things. It means the world will become “smart world” to live with high level technology.

Future of Internet of Things

But, some impacts of IoT we can see soon in near future. Lets check out that type of devices.

Smart Couches – How will you feel when your couch heats up so that you have a warm place to sit down and the same concept applies to the dining chairs.

Smart Fridges -- Imagine if your fridge could analyze what is in it, and then build you a shopping list based on your previous food-buying habits. or even order the groceries for delivery on its own or if it could sense when you're going to be home from the GPS signal on your phone and put a frozen pizza in the oven through a little door in the side.

Future of Internet of Things

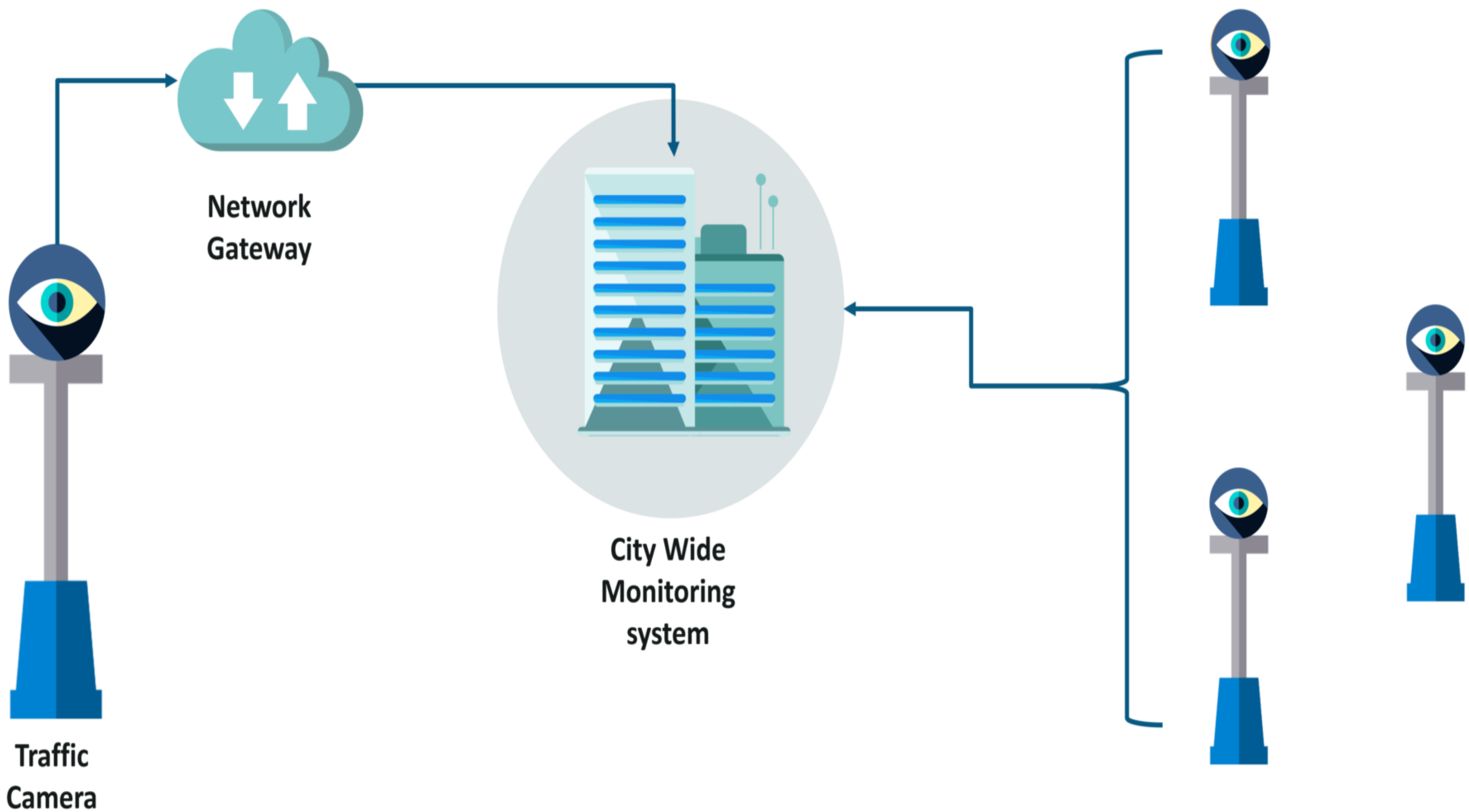
Smart Cars – Imagine a car that can sense when you are about to exit the mall and drive up to the curb with heated seats and music playing, to pick you up.

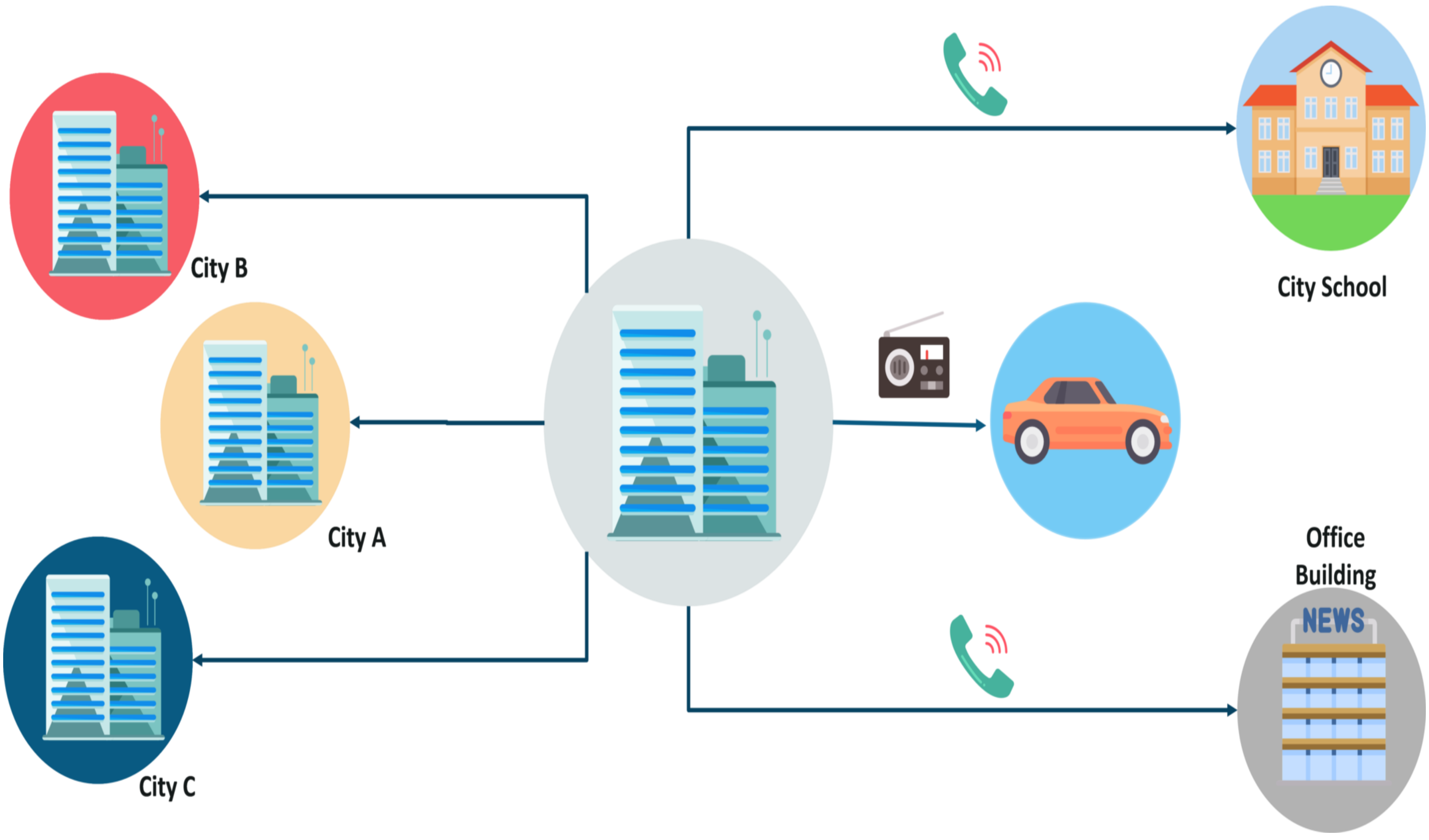
Smart Plates, Bowls and Cups – Smart plates, bowls and cups will help to improve diets and make waves in the health system as well. These are able to track what we're eating? It surely cheap your health insurance.

Smart Toothbrushes -- One day, our toothbrushes will be able to detect the healthiness of your teeth, telling the user when it is time to go to the dentist. Even it will go one step further with some more extra ordinary features.

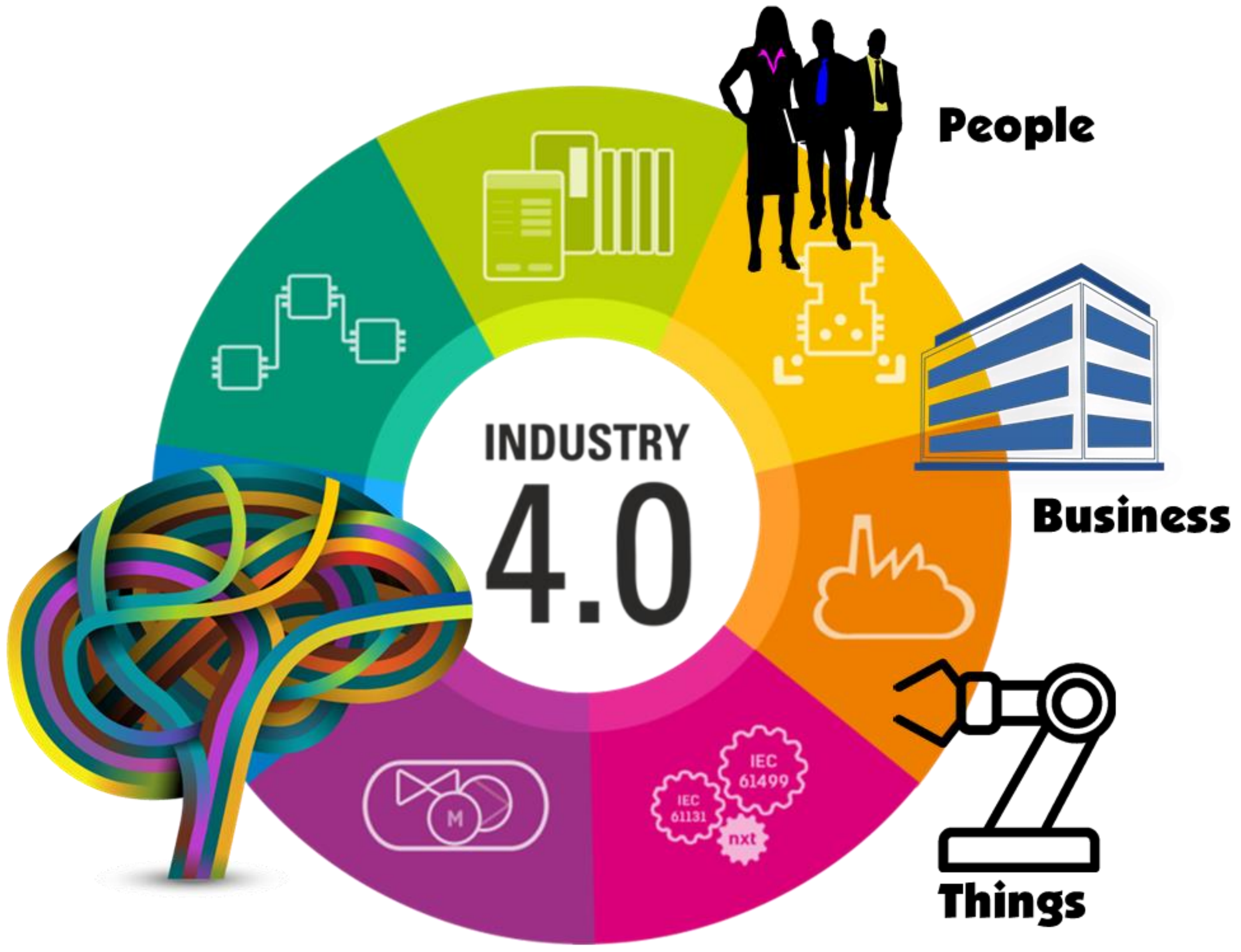
Traffic Management System

The Traffic Management System can analyze data acquired and derive routes around the project to avoid bottlenecks. The system could also convey live instructions to drivers through smart devices and radio channels. Meanwhile, the city schools and workplaces near the project could also be called to adjust their schedules.




City B
City A
City C
City School
Office
Building
NEWS

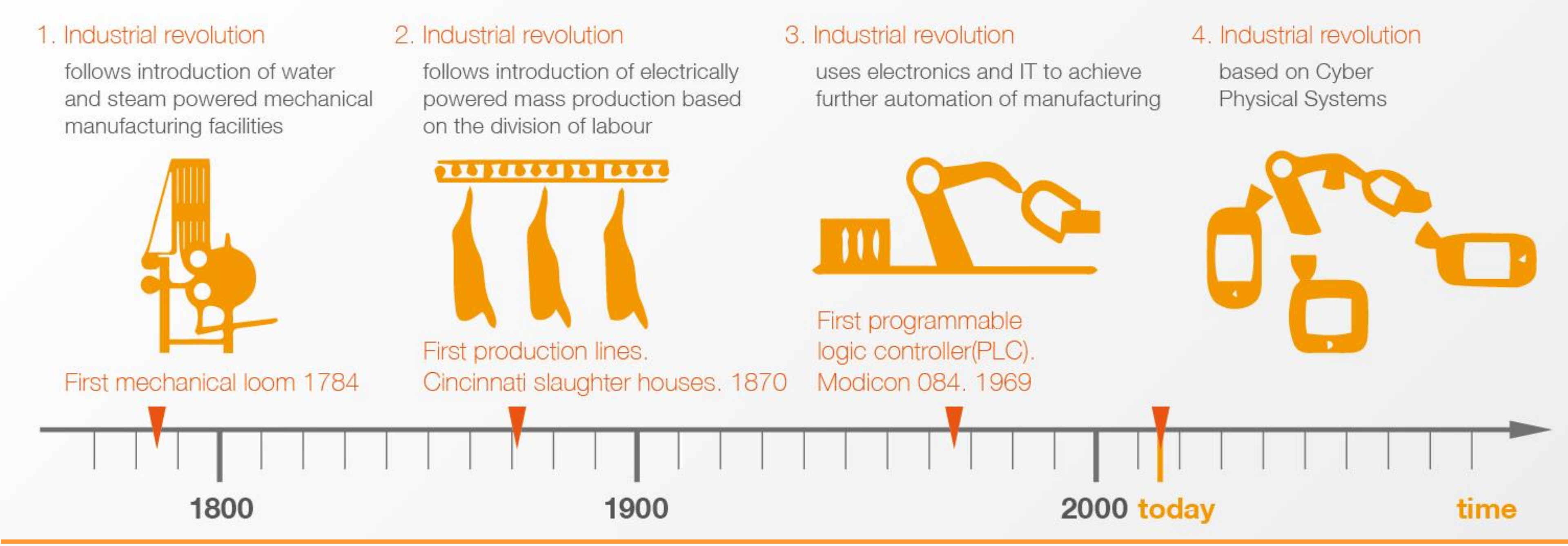
INDUSTRY 4.0



INDUSTRY 4.0

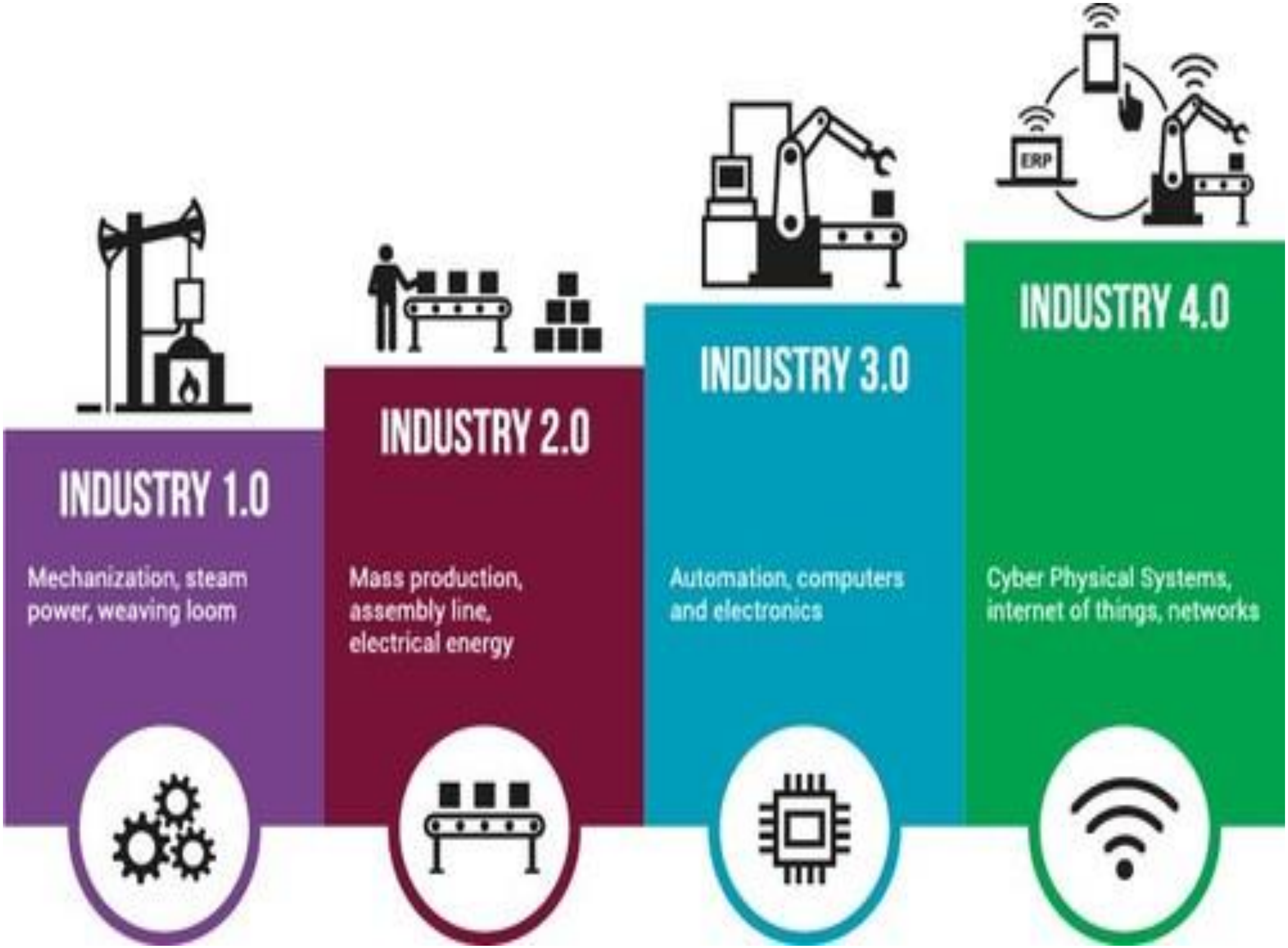
I N D U S T R I E 4.0

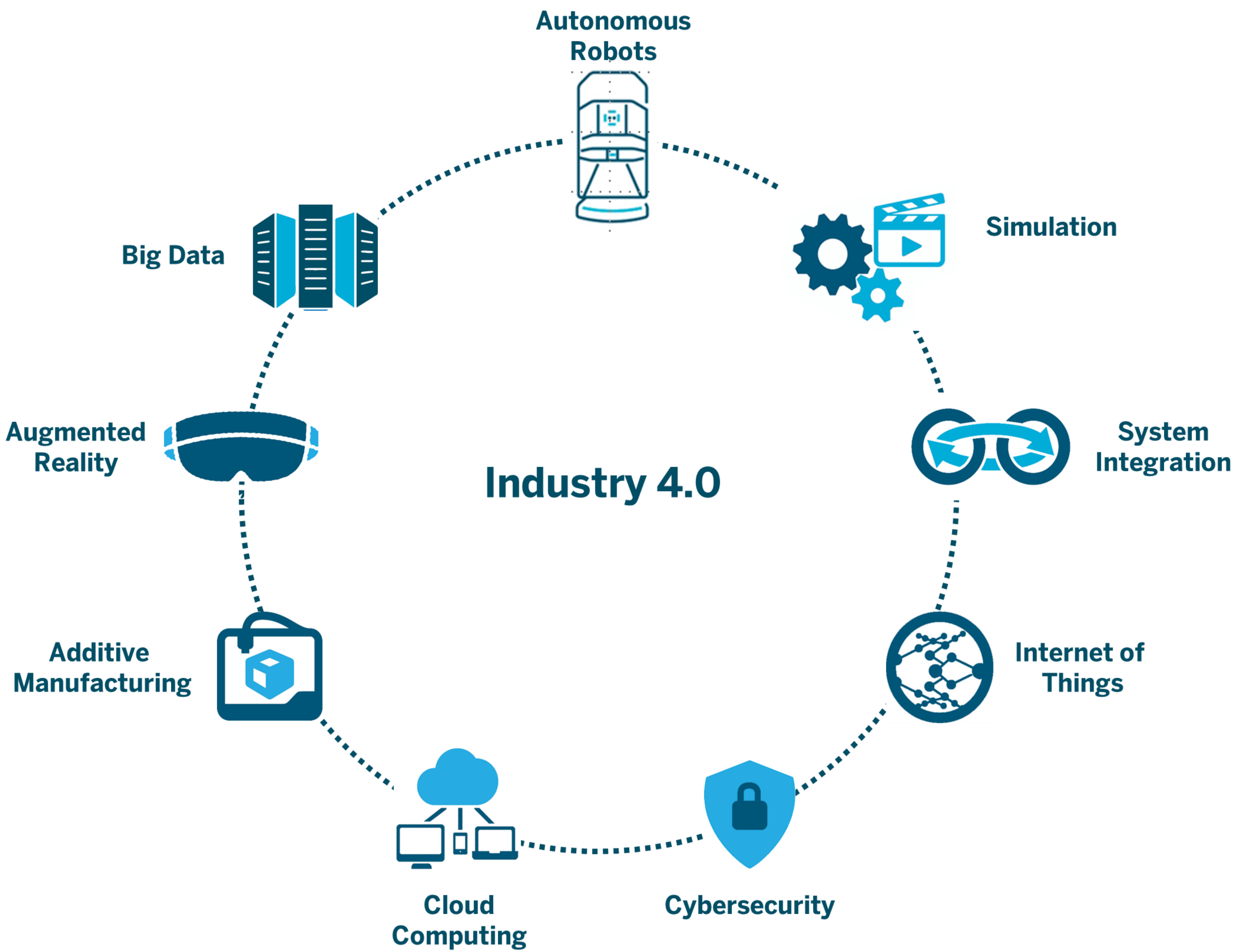
Major trends in industrial evolution

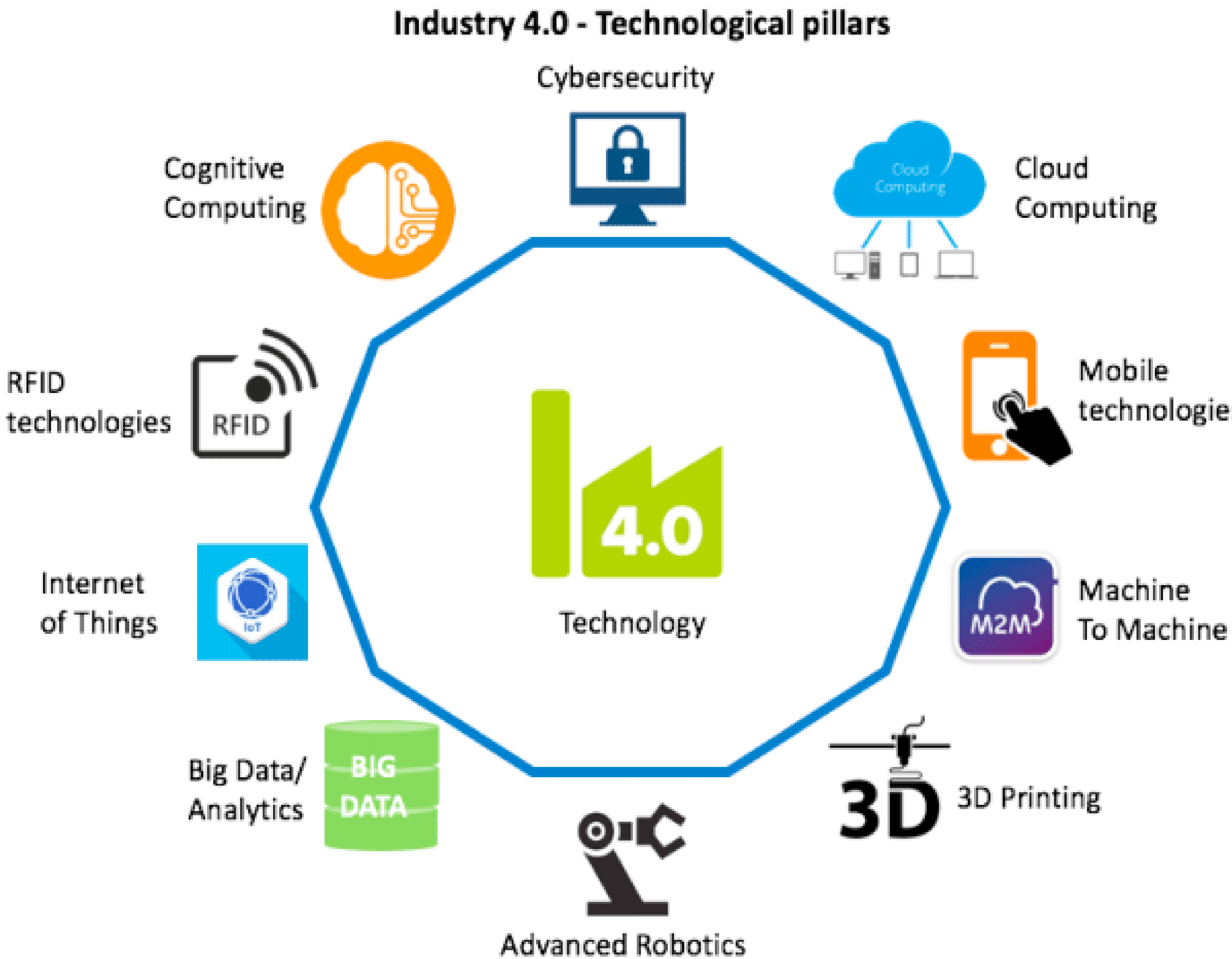


McKinsey & Company

"Industry 4.0 is more than just a flashy catchphrase. A confluence of trends and technologies promises to reshape the way things are made."


ERP
INDUSTRY 1.0
Mechanization, steam power, weaving loom
INDUSTRY 2.0
Mass production, assembly line, electrical energy
INDUSTRY 3.0
Automation, computers and electronics
INDUSTRY 4.0
Cyber Physical Systems, internet of things, networks


Autonomous Robots
Simulation
System Integration
Internet of Things
Cybersecurity
Cloud Computing
Additive Manufacturing
Augmented Reality
Big Data
Industry 4.0



Industry 4.0 - Technological pillars
Cybersecurity
Cognitive Computing
Cloud Computing
Cloud Computing
RFID technologies
RFID
Mobile technologies
4.0
Technology
Internet of Things
IoT
Machine To Machine
M2M
Big Data/ Analytics
BIG DATA
3D
3D Printing
Advanced Robotics

The Impact of Information and Communication Technology

Web — Hypermedia: Interlinked Documents

World Wide Web

Web 1.0 — Multimedia: Interlinked Media

Java, UML, XML

Web 2.0 — Social media (1): Interlinked People

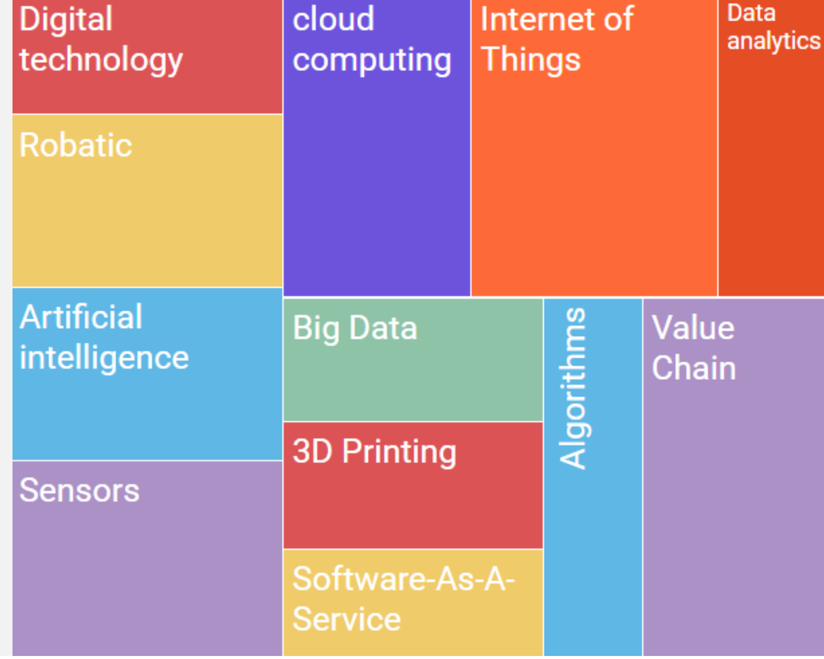
Web Services

Web 3.0 — Social media (2): Interlinked Enterprises

App Technologies

Web A.B — Cyber-Physical Media: Interlinked Systems

IoT, IoS, IoP

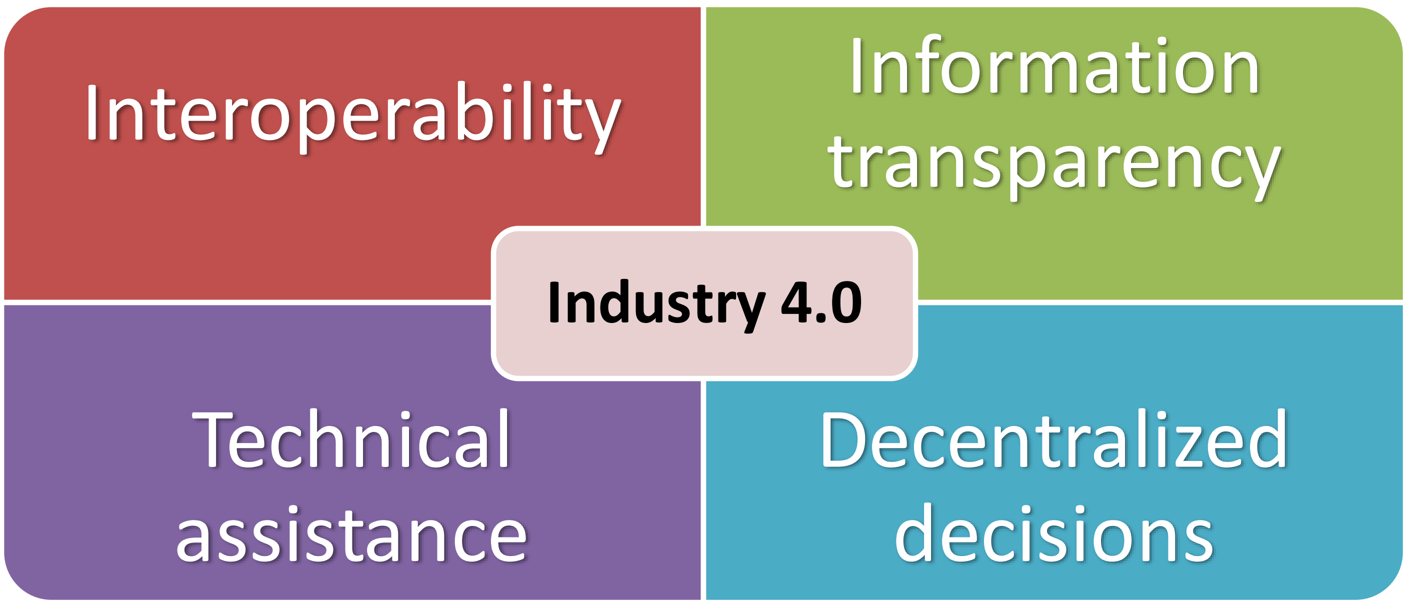


The term Industry 4.0 refers to the combination of several major innovations in digital technology, all coming to maturity right now, all poised to transform the energy and manufacturing sectors. These technologies include advanced robotics and artificial intelligence; sophisticated sensors; cloud computing; the Internet of Things; data capture and analytics; digital fabrication (including 3D printing); software-as-a-service and other new marketing models; smartphones and other mobile devices; platforms that use algorithms to direct motor vehicles (including navigation tools, ride-sharing apps, delivery and ride services, and autonomous vehicles); and the embedding of all these elements in an interoperable global value chain, shared by many companies from many countries.

Design Principles

Internet of Things (IoT)
Internet of People (IoP)

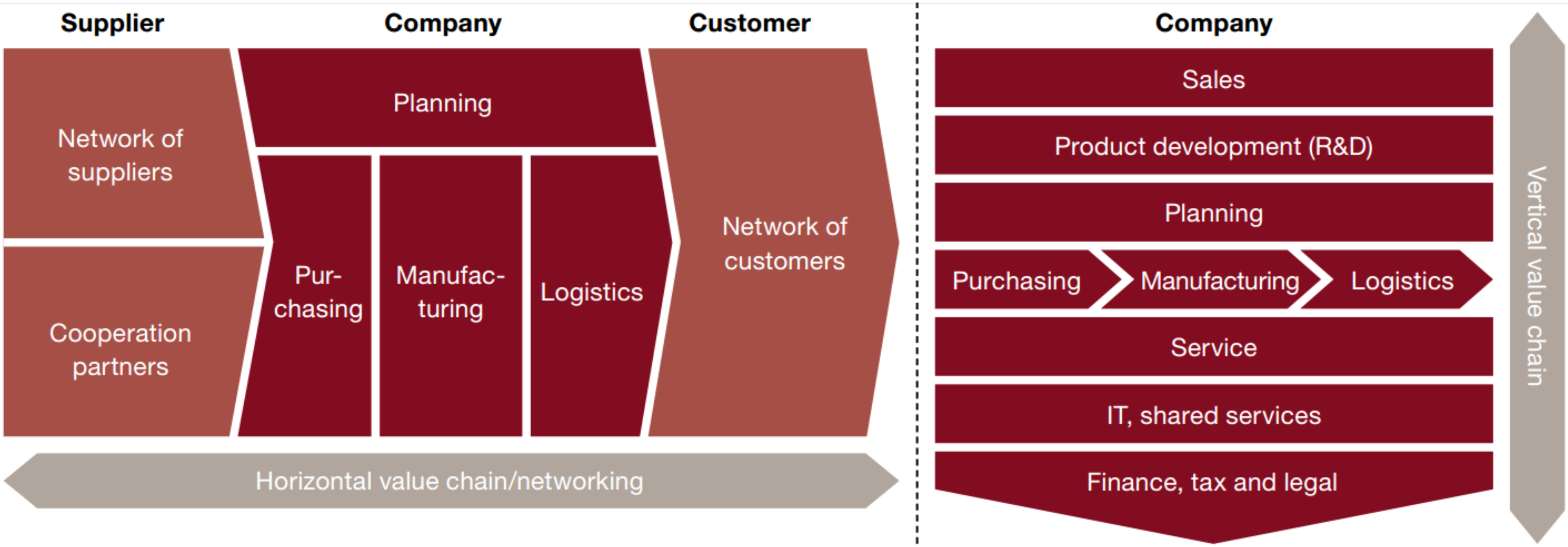
Digital plant models
virtual copy of the physical world



The ability of cyber physical systems to physically support humans by conducting a range of tasks.

The ability of cyber physical systems to make decisions on their own and to perform their tasks as autonomous as possible.

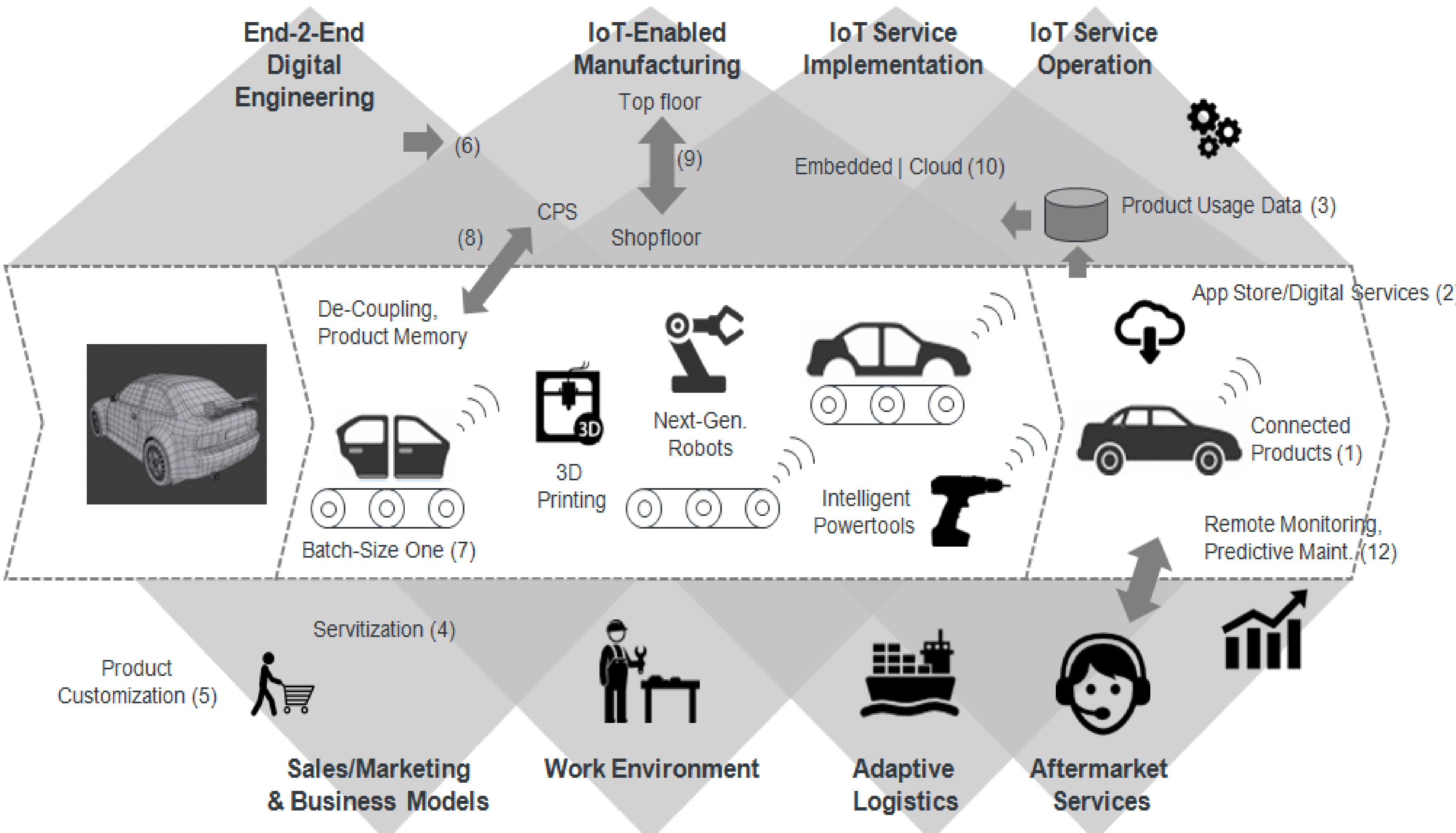
Industry 4.0 requires comprehensive digitization of the horizontal and vertical value chains



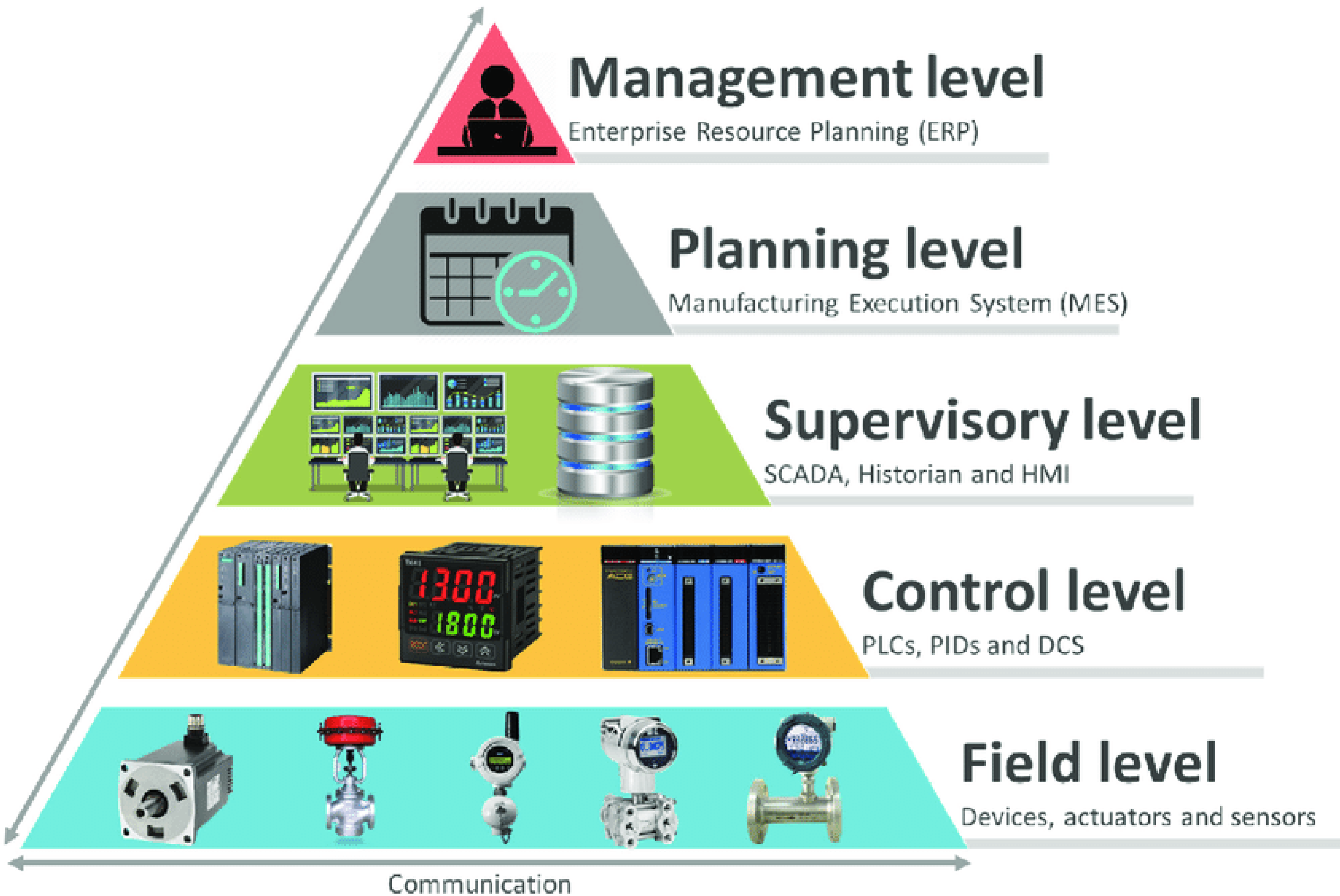
Some of improvements may result from the digitization of processes and value chains:

- Focusing on core areas in the individual value chain • Reduction of redundancies in processes
- Minimizing quality losses
- Making processes more flexible and coherent

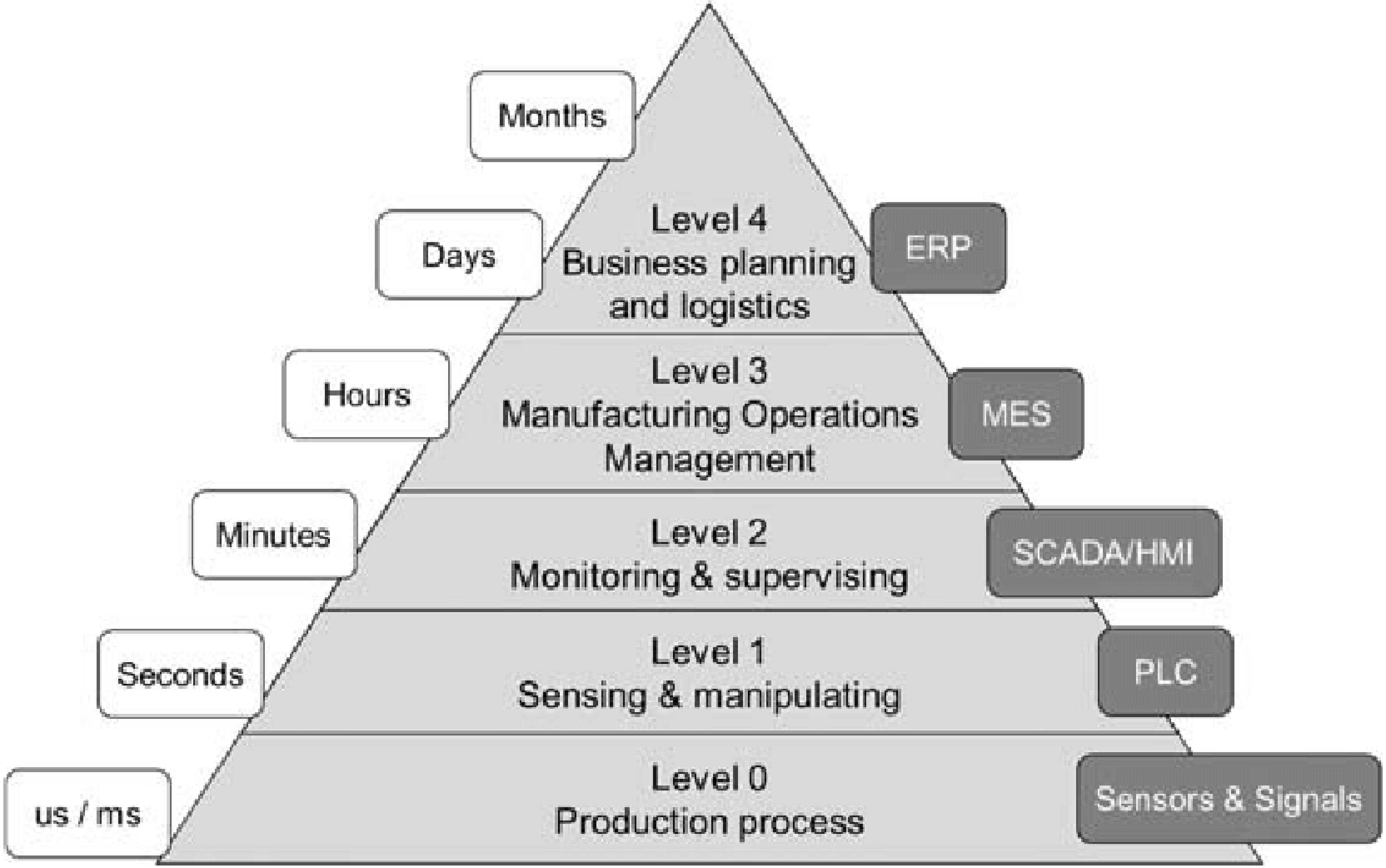
Industry 4.0: Value Chain

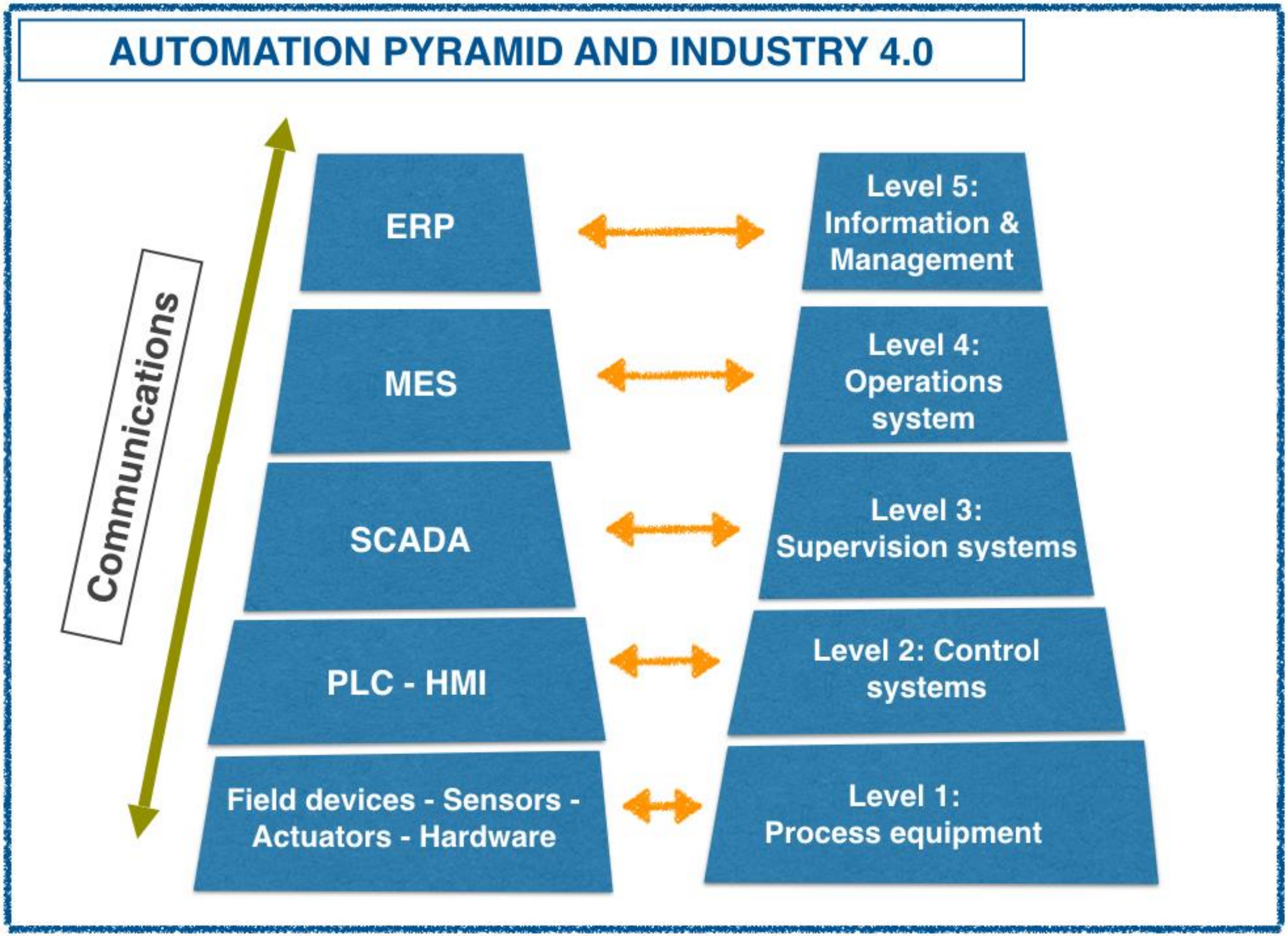


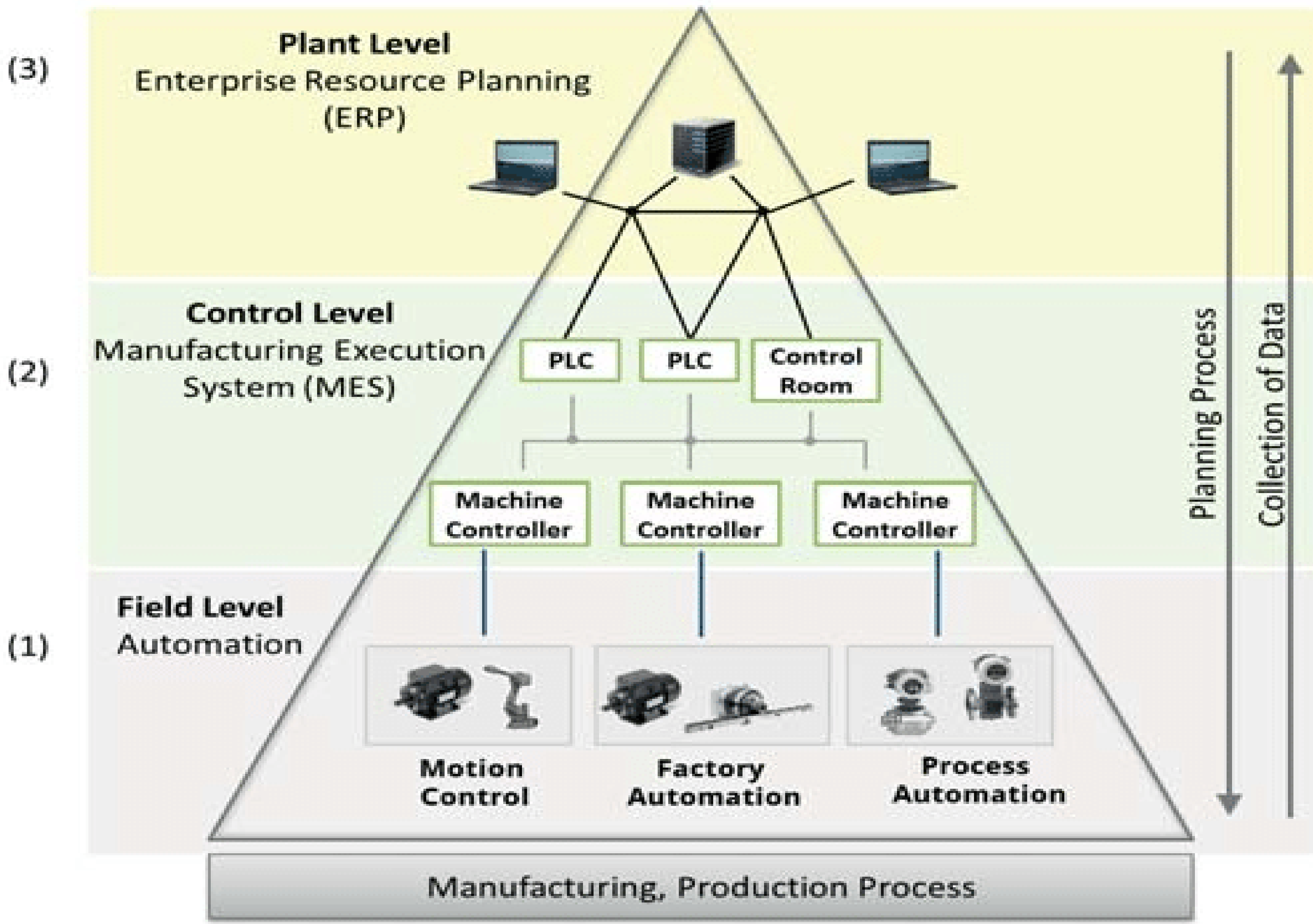
Automation Pyramid



Automation Pyramid




AUTOMATION PYRAMID AND INDUSTRY 4.0
Communications
ERP
MES
SCADA
PLC - HMI
Field devices - Sensors - Actuators - Hardware
Level 5: Information & Management
Level 4: Operations system
Level 3: Supervision systems
Level 2: Control systems
Level 1: Process equipment


(3)
Plant Level
Enterprise Resource Planning
(ERP)
(2)
Control Level
Manufacturing Execution
System (MES)
PLC
PLC
Control Room
Machine Controller
Machine Controller
Machine Controller
(1)
Field Level
Automation
Motion Control
Factory Automation
Process Automation
Planning Process
Collection of Data
Manufacturing, Production Process

Numerical Based on

1.Errors

2.Temperature

3.LVDT

4.Strain Gauge

5.PLC(Gates, Timer, Counters)

THANK YOU

&

Best Wishes for ESE