# ITH508 컴퓨터망

## Introduction & Overview

Hwangnam Kim
hnkim@korea.ac.kr
School of Electrical Engineering
Korea University

# Today's Agenda

- Instructor information
- Course information
- Course policy & schedule
- Overview about computer networks
- Trends in current wireless technologies

# Course Information

- **Required Textbook**
  - James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, **7th edition** or **8th edition**
- **Class Website**
  - Blackboard

# Course Information (cont.)

- **Office hours**
  - Hwangnam: will be shortly announced
- **Email of inquiry**
  - Allowed for 7 days a week and 24 hours a day,
  - Reply may be a little delayed from time to time

# Lecture Format

- **Help you understand important and hard Computer Networking concepts, Internet**
  - You are strongly recommend to read the relevant textbook sections before lecture
  - Exam could be from anywhere in the textbook sections covered in class
  - Your best strategy is to read all material referred to in lecture.
- **You should periodically check announcements at Blackboard**

# Lecture Format

- **There are rules**
- **Attend every lecture**
- **Read textbook and slides**
  - This is basic rule for slides:
    - Slides will be announced before the class
- **Submit everything (HWs, projects, exams) on time**
- **Don't cheat.**

# Grading

- **Attendance, Etiquette, Participation: 20%**
  - Quiz or summary report will be arranged depending on class atmosphere
  - You should visit TA's office at least three times throughout the semester
    - Email inquiry is not counted.
  - Visit first TAs, then visit instructor.
- **Midterm Exam: 50%**
  - One midterm examination
  - Tentative Schedule is April 25, 2023
- **Final Exam: 50%**
  - One final examination
  - Tentative Schedule is June 20, 2023.
- **Final grade**
  - Mean/deviation/high-low scores/gaps will all be taken into account

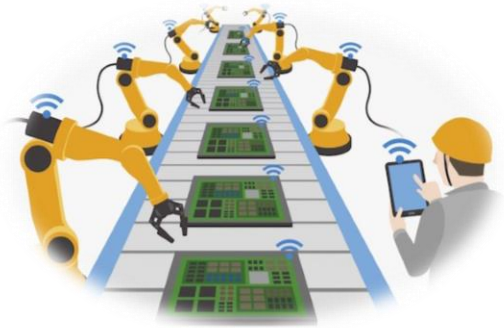
Macroscopic view

# CURRENT TRENDS

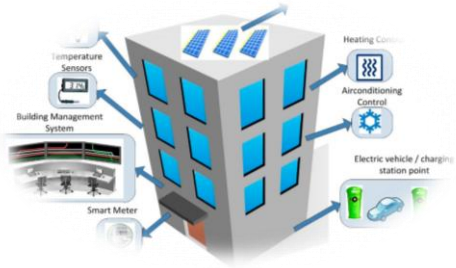
# Current Hot Trend

Smart grid

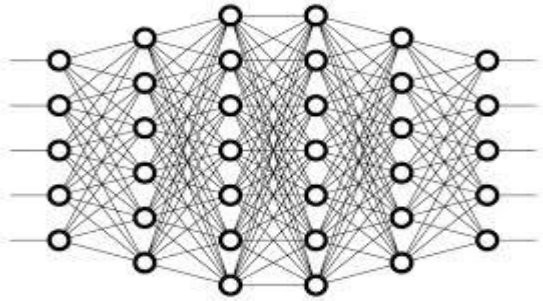
Auto Driving/Pilot

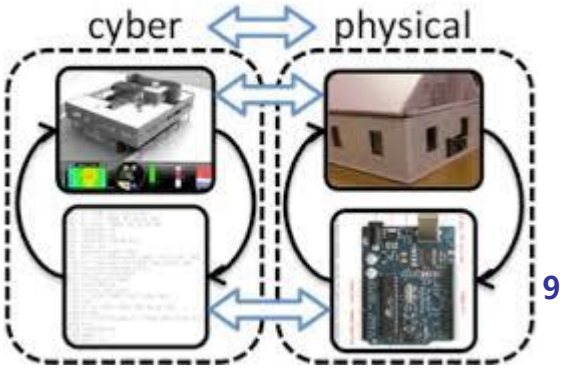


Industry 4.0



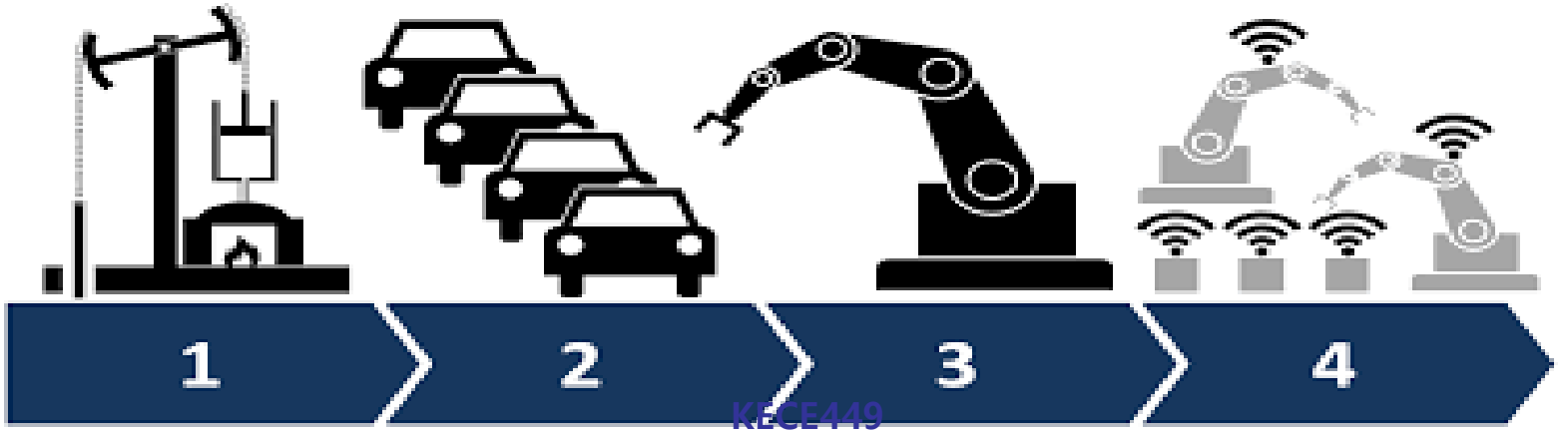

Smart Building



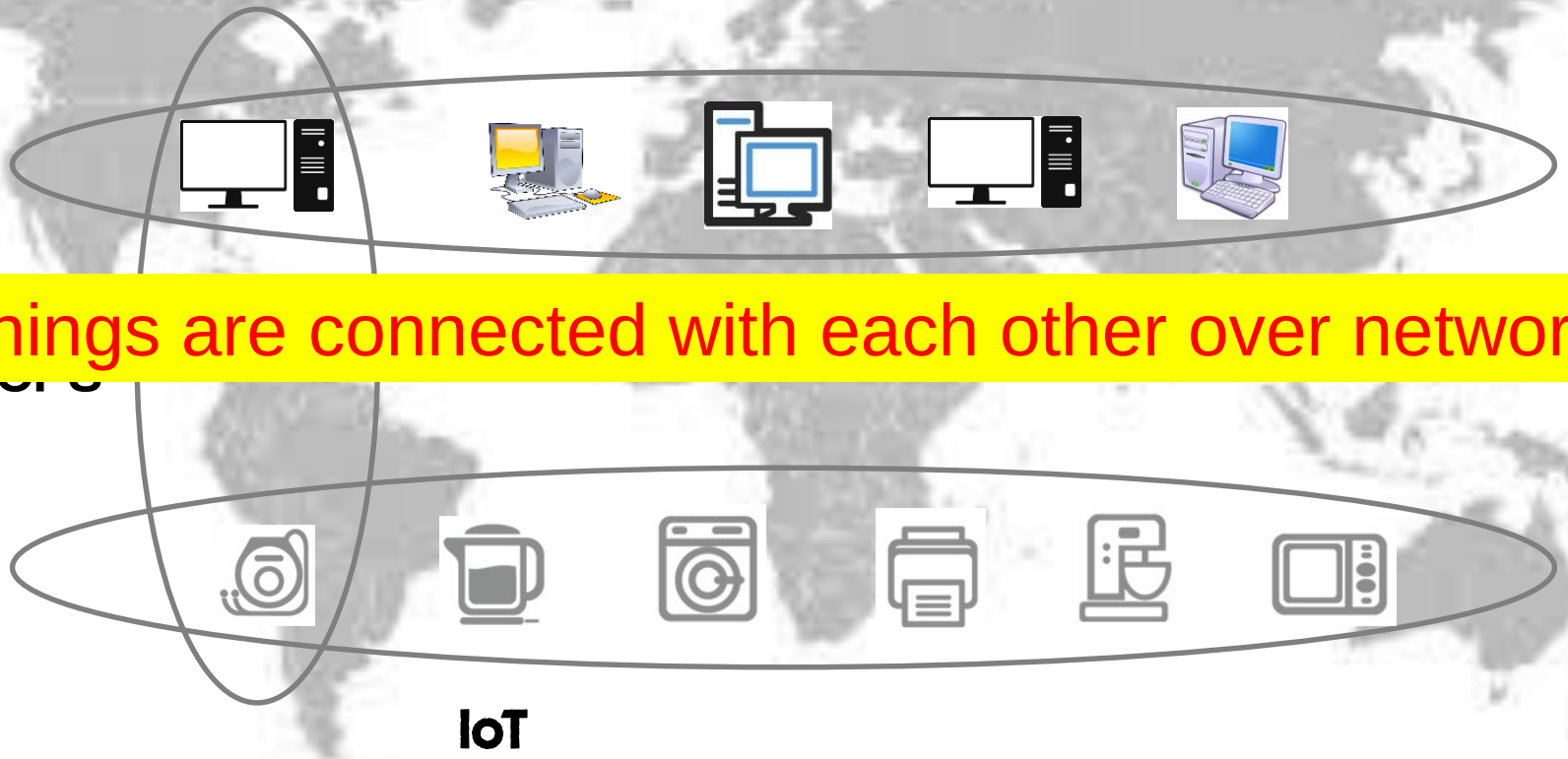


# Another Industrial Revolution

| 제 1차 산업혁명 | 제 2차 산업혁명 | 제 3차 산업혁명 | 제 4차 산업혁명 |
|---|---|---|---|
| 18세기 | 19세기~20세기 초 | 20세기 후반 | 2015년~ |
| 증기기관 기반의 기계화 혁명 | 전기 에너지 기반의 대량생산 혁명 | 컴퓨터와 인터넷 기반의 지식정보 혁명 | IOT/CPS/인공지능 기반의 만물 초 지능 혁명 |
| 증기기관을 활용하여 영국의 섬유공업이 거대산업화 | 공장에 전력이 보급 되어 벨트 컨베이어를 사용한 대량 생산보급 | 인터넷과 스마트 혁명으로 미국주도의 글로벌 IT기업 부상 | 사람,사물,공간을 초 연결 , 초 지능화 하여 산업구조 사회 시스템 혁신 |



# Internet is Omnipresent




All things are connected with each other over networks!!!

# ChatGPT

- **Developed by openAI**
- **Background**
  - **A pretrained language model**
    - **Machine learning model trained on a large dataset of text data**, such as a corpus of written or spoken language, prior to being fine-tuned for a specific task.
  - **This pre-training allows the model to learn general language understanding**,
    - Then can be fine-tuned for specific natural language processing tasks, such as language translation, text summarization, question answering, and more.
  - Cf. Few-shot learning
    - A machine learning technique where a model is able to learn and generalize to new tasks with very few examples.
    - Few-shot learning models are trained to quickly adapt to new tasks with a small amount of data.

# Effect of ChatGPT

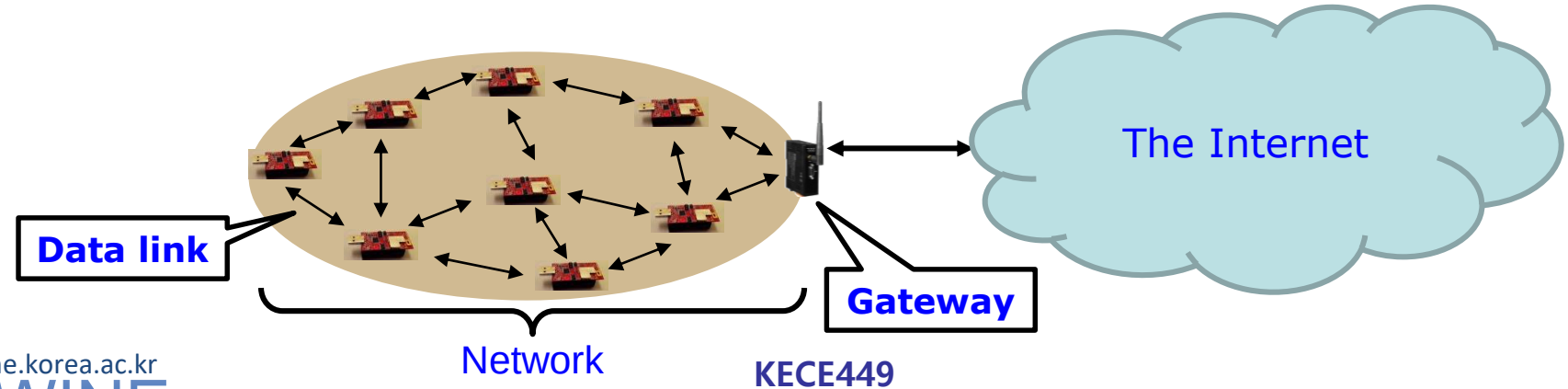
- **Need to speed up data access**
  - GPU, DSP, NPU
  - HBM, PIM, …
- **Need to accommodate a huge amount of data**
  - Data center
  - Virtual machine
  - NVME over fabric
  - Acceleration
- **Need to refine pretrained language model**
- **Need to data access at speed**

Microscopic view

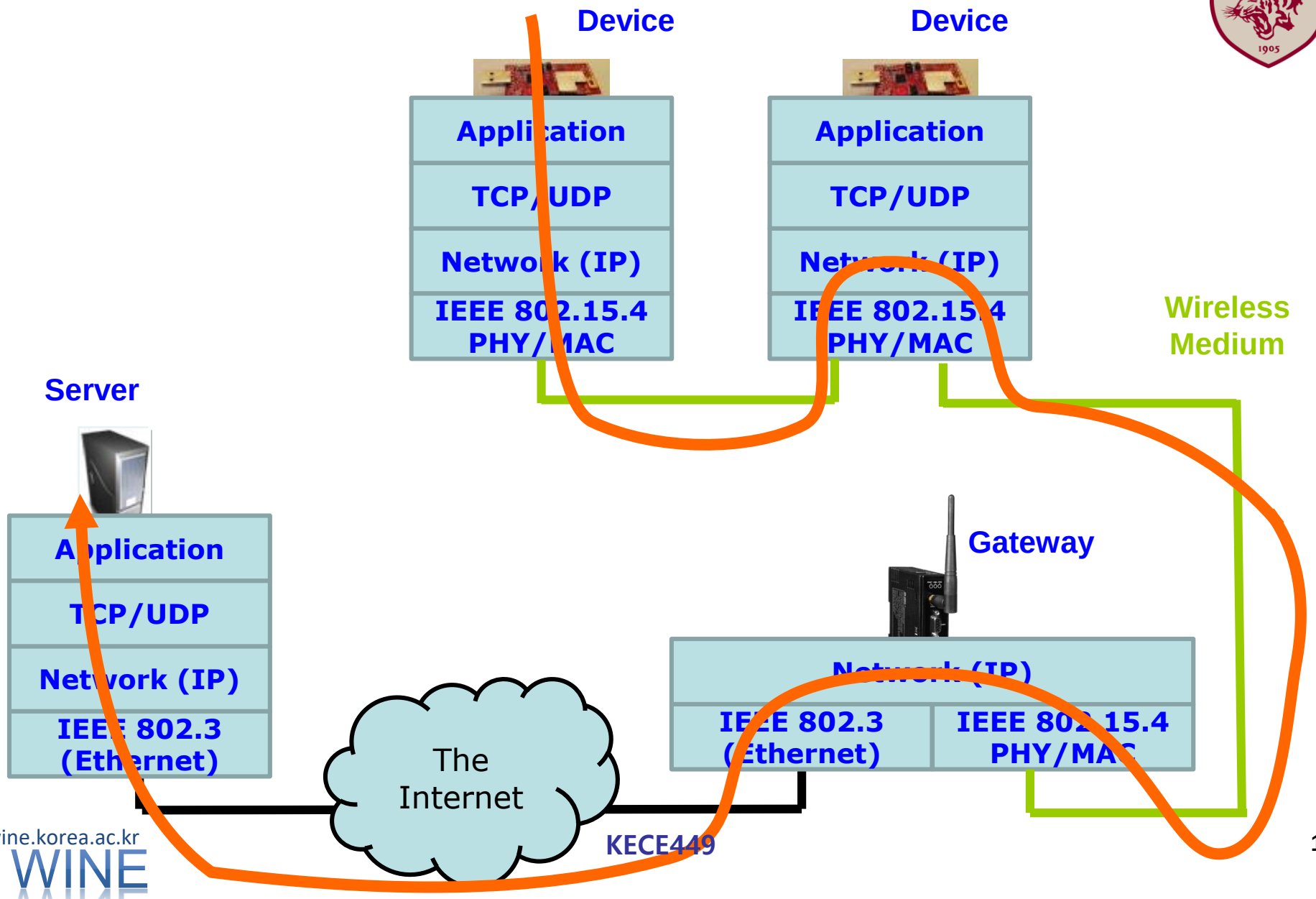
# TRENDS IN NETWORK TECHNOLOGIES

# The Internet

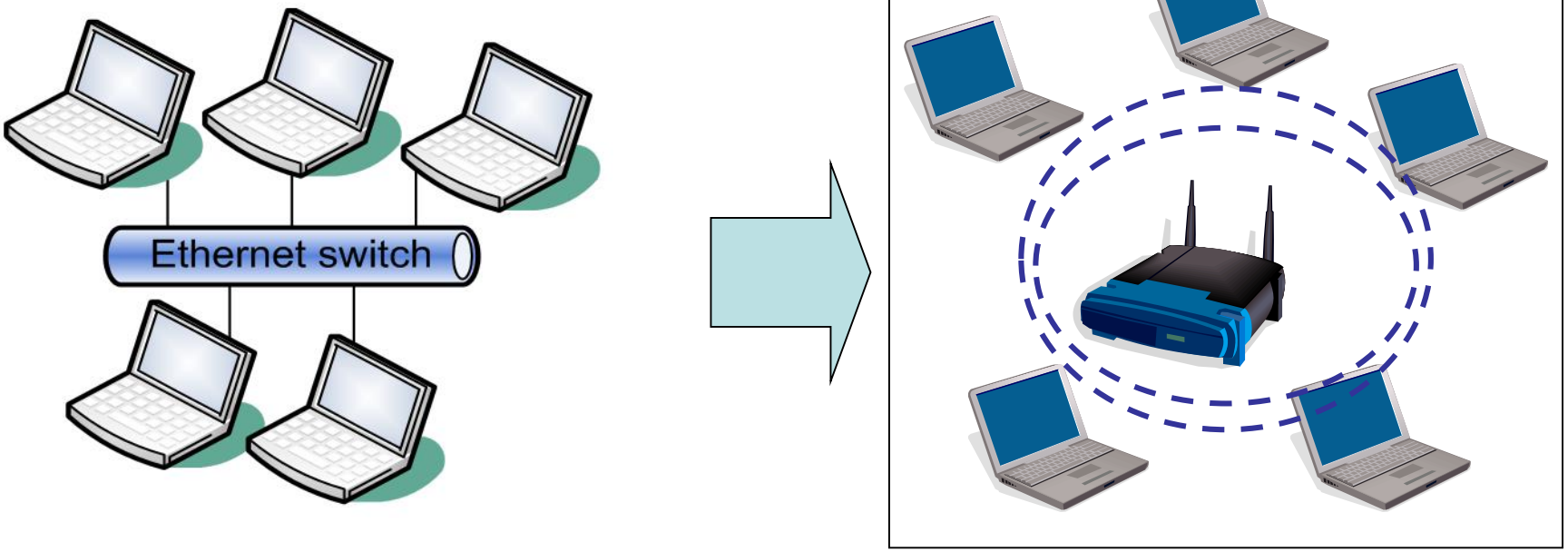
- **The Internet serves as a wide area networking for a local network.**
- **The Internet uses TCP/IP. This implies that things must also support TCP/IP.**
- **Gateway (or sink)**
  - For a practical deployment, a gateway is often needed in a network.
  - It offers relaying packets between the network and the Internet.



# The Internet: Protocol Stack



# The Internet is being changed from Wired to Wireless!!!



# Wireless Technologies are so many!

- **Diverse application requirements**
  - Energy consumption
  - Range
  - Bandwidth
  - Mobility
  - Cost
- **Diverse deployments**
  - Licensed vs. unlicensed
- **Technologies have different**
  - Signal penetration
  - Frequency use
  - Cost
  - Market size

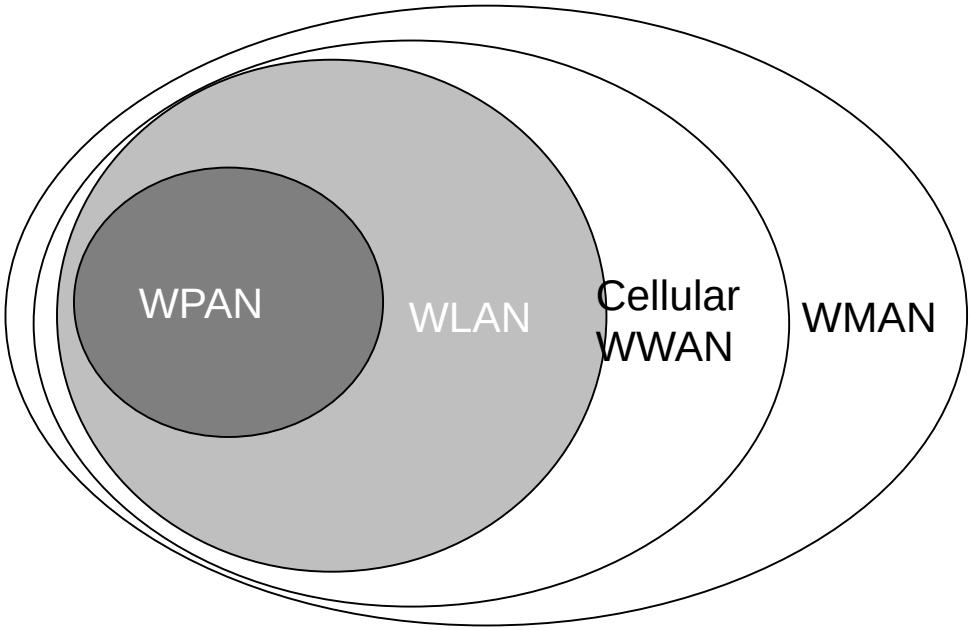
# Wireless is Common

- **Limited set of "special" users → everyone**
  - Broadcasting, emergency services, etc.
  - 10s … 100s of devices per person
- **Device to infrastructure → people to people → device to device**
  - Broadcasting, Internet access
  - Phone calls, social networking, …
  - Sensor networks, health, …
- **Special-purpose applications → wired link replacement → wireless application market**
  - Often single-use devices
  - Make application/protocol work over wireless
  - Wireless only applications for multi-purpose devices

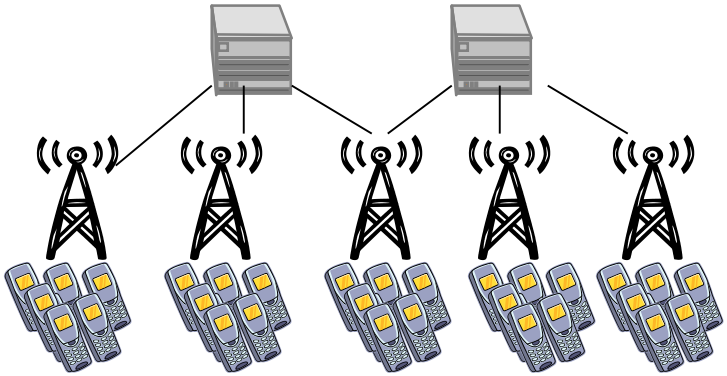
# Wireless Network Classifications

- Personal Area Network (WPAN) Wireless
- Local Area Network (WLAN)
- Metropolitan Area Network (WMAN)
- Cellular/Wireless Wide Area Network (WWAN)

- Body Area network
- Ad hoc networks
- Sensor networks
- Vehicular networks

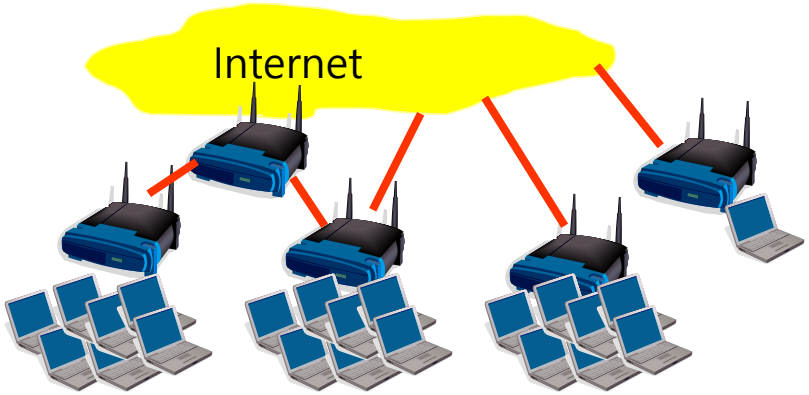


# Wireless Network Architectures



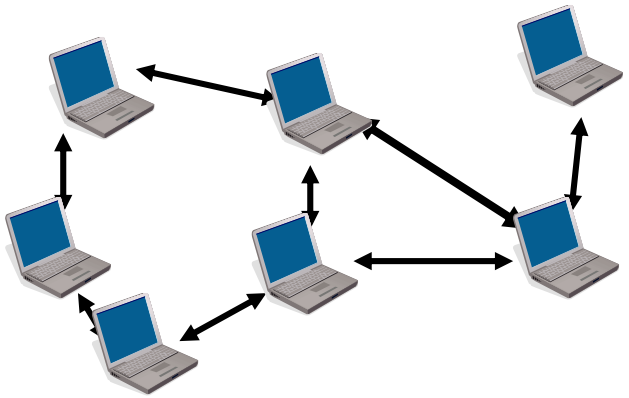
Cellular Networks

👍 QoS, mobility 👎 expensive



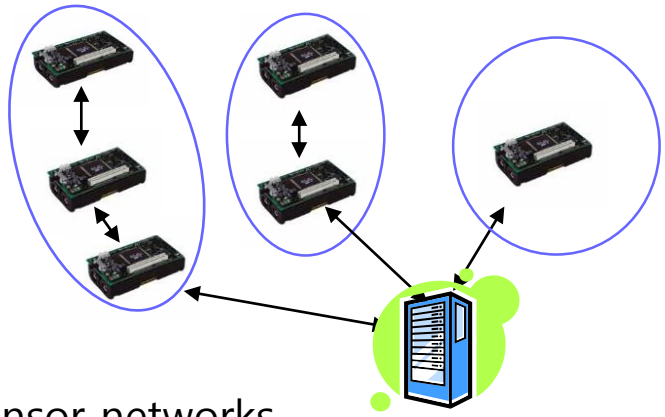

WLAN

👍 Simple, cheap 👎 Mobility,management



Ad hoc networks

👍 no infrastructure cost 👎 no guarantee



Sensor networks

👍 Energy limited, low processing power

# Internet of Things (IoT)

- **Extending the current Internet and providing connection, communication, and inter-networking between devices and physical objects, or "Things," is a growing trend.**
  - That is often referred to as the ***Internet of Things***.

- **"The technologies and solutions that enable integration of real world data and services into the current information networking technologies are often described under the umbrella term of the Internet of Things (IoT)"**

# IoT: Things

- **We can turn almost every object into a "thing".**
- **A "thing" still looks much like an embedded system currently.**
- **A "thing" generally consists of four main parts:**
  - **Sensors & actuators**
  - **Microcontroller**
  - **Networking unit**
  - **Power supply**
- **A "thing" has the following properties:**
  - It's **usually powered by battery**.
    - This implies limited source of energy.
  - It's generally **small in size and low in cost**.
    - This limits their computing capability.
  - It doesn't usually perform complicated tasks.
- **Power consumption is the main design issue.**

# IoT: Communications

- **A "thing" always feature communications for "team working"**
- **The Role of Communications**
  - Providing a data link between two nodes
- **Communication type:**
  - Wireline (e.g. copper wires, optical fibers)
  - Wireless (e.g. RF, IR). RF-based communication is the most popular choice (and also our focus)
- **Popular RF-based communication solutions:**
  - IEEE 802.15.4
  - IEEE 802.11 (or Wifi)
  - Bluetooth
  - Near Field Communication (NFC), e.g. RFID

# IoT: Networks

- **The Roles of Networks**
  - Managing nodes (discovery, join, leave, etc).
  - Relaying data packets from the source to the destination node in the network.
- **Networks are a distributed system.**
  - All nodes need to perform networking related tasks.
- **RF-based Network in IoT is usually a Wireless Multi-hop Network. Some examples:**
  - Wireless Sensor Networks (WSNs)
  - Mobile Wireless Ad hoc Networks (MANETs)
  - Wireless Mesh Networks (WMNs)
  - Vehicular Ad Hoc Networks (VANETs)
  - and others...
- **Main concern: Reliability & Performance**

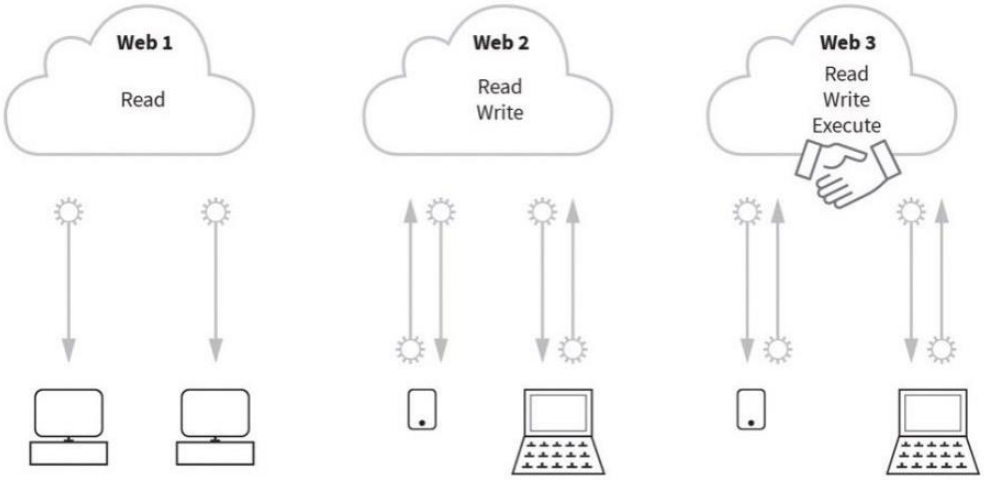
# INTERNET IS EVOLVING

# Internet Is Evolving

- **Extensions**
  - More nodes, more connections, IPv6, 6LowPan,…
  - Any TIME, Any PLACE, **Any THING**
  - USN, M2M, IoT
    - Billions of interconnected devices,
    - Everybody connected.
- **Expansions**
  - Broadband
  - Multimedia
  - **Smart grid, Financing, Blockchain, NFT, Metaverse**
- **Enhancements**
  - **Smart** networks: DL, ML, RL, …
  - **Data-centric** and content-oriented networking
  - **Context-aware** (autonomous) systems

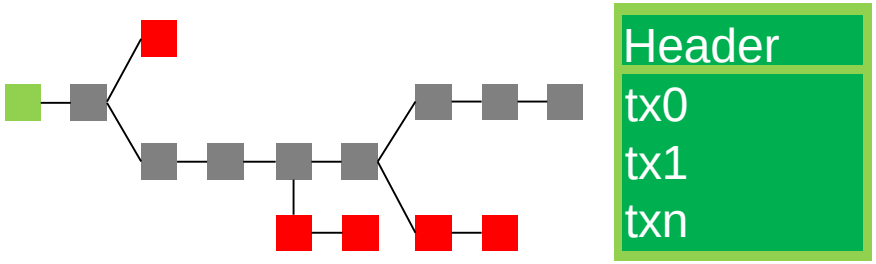
# What Evolution?

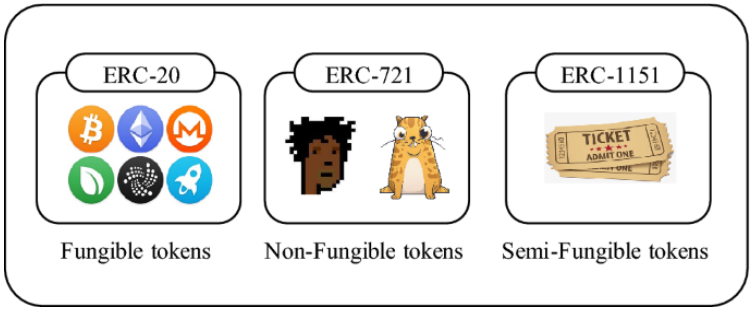
- **Overlay Network: contents distribution**
- **Web3**
  - New World Wide Web based on blockchain technology
  - Incorporates decentralization and token-based economics
  - Computation offloading

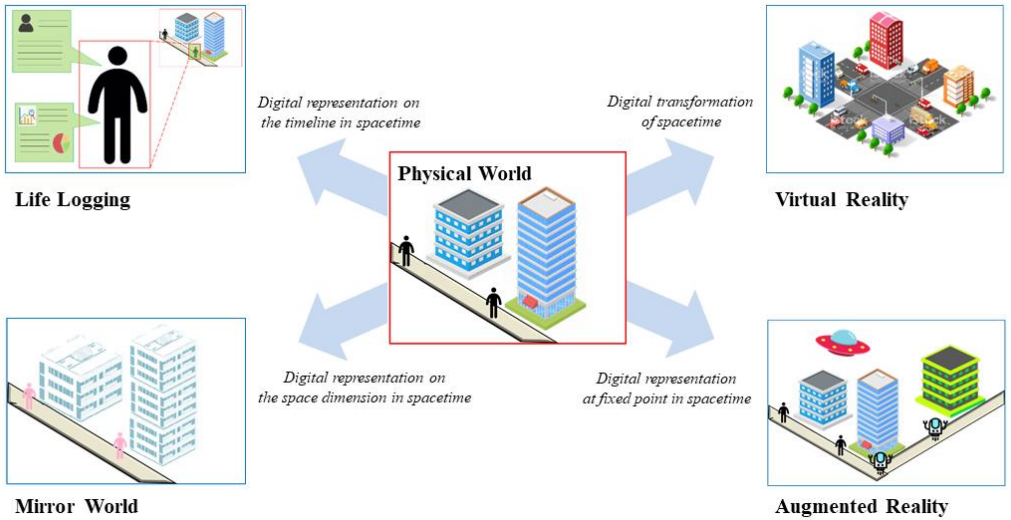


# What Evolution?

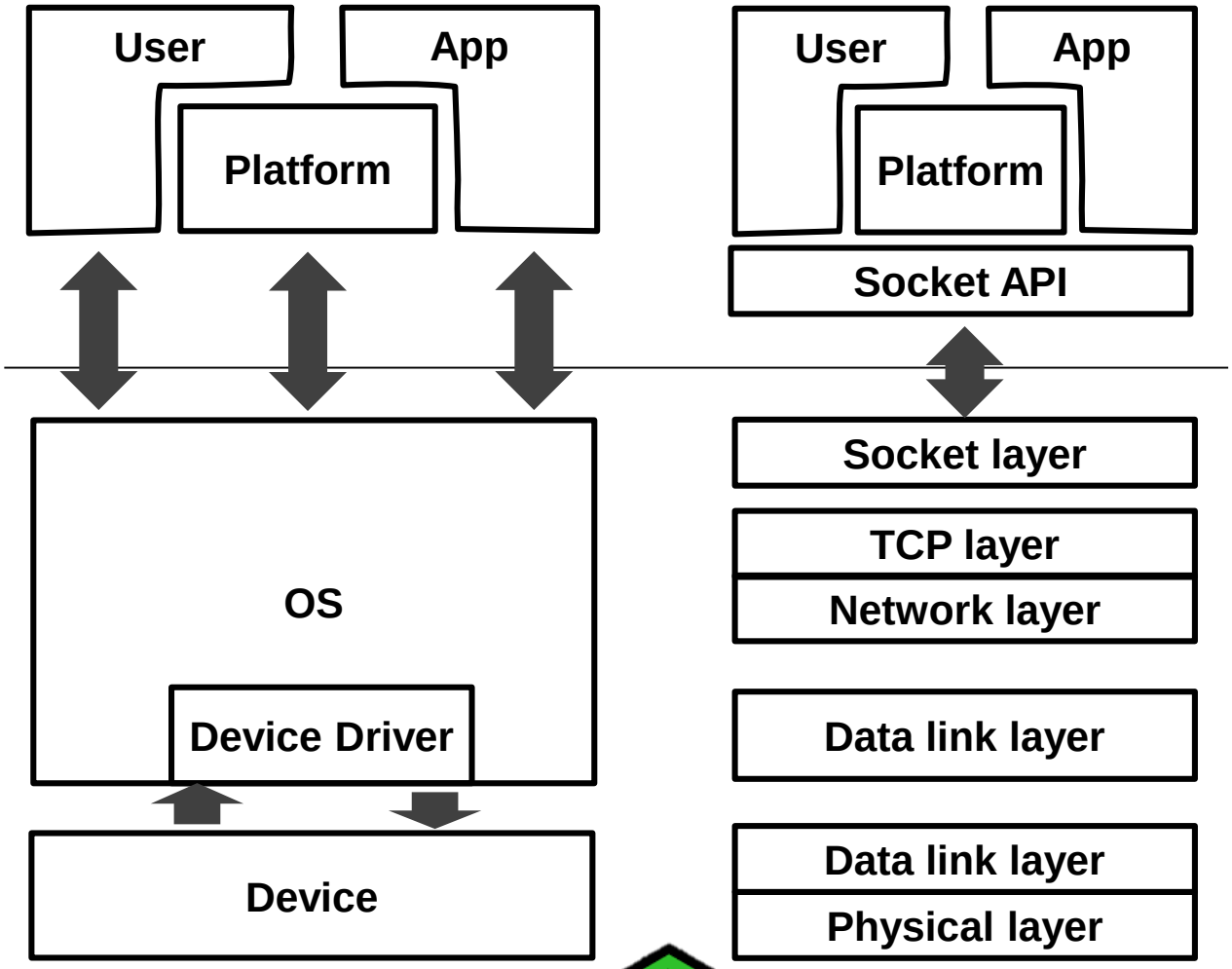
- **Blockchain**
  - Bitcoin
  - Ethereum
  - Alter coins
- **Non-Fungible Token**
  - Is a non-interchangeable unit of data stored on a blockchain, a form of digital ledger.
- **Metaverse**



# How to participate in the evolution




Javascript, JSON, mark-up lang

C++, python, java, solidity

C, rust, Assembly

C, Assembly