

chapter 3



Local Area Networks – Topologies and Architectures

CHAPTER OBJECTIVES

- Define the term LAN topology, and identify ^①bus, ^②star, ^③ring, and ^④wireless topologies.
- Describe the differences between ^①physical and ^③logical topologies.
- Define the term LAN architecture. *ex) ethernet.*
- Describe the Ethernet LAN architecture and identify common Ethernet standards.
- Describe the Ethernet [★]access method.

CHAPTER OBJECTIVES (cont'd)

PAN-LAN-MAN-WAN

- Describe the wireless LAN architecture.
- Discuss wireless LAN and wireless **PAN** technologies and their histories. Wit
LAN보다 작은 것.
ex) bluetooth
- Identify common standards and access methods for IEEE 802.11 and Bluetooth.
- Discuss technical and business considerations of wireless architectures.
- Identify **FDDI** and **ATM** standards, access methods, and technical and business aspects. 라거에 많이 쓰던

LAN TOPOLOGIES

- A LAN topology is the basic map or layout of a local area network. LAN을 구성하는 지도
- Four common types are ^①bus, ^②star, ^③ring, and ^④wireless.
- ^①Logical and ^②physical topologies must be considered in a LAN design. 데이터가 이동하는 모양 배치된 모양.

목적에 맞는 Layout 선택.

LAN TOPOLOGIES (cont'd)

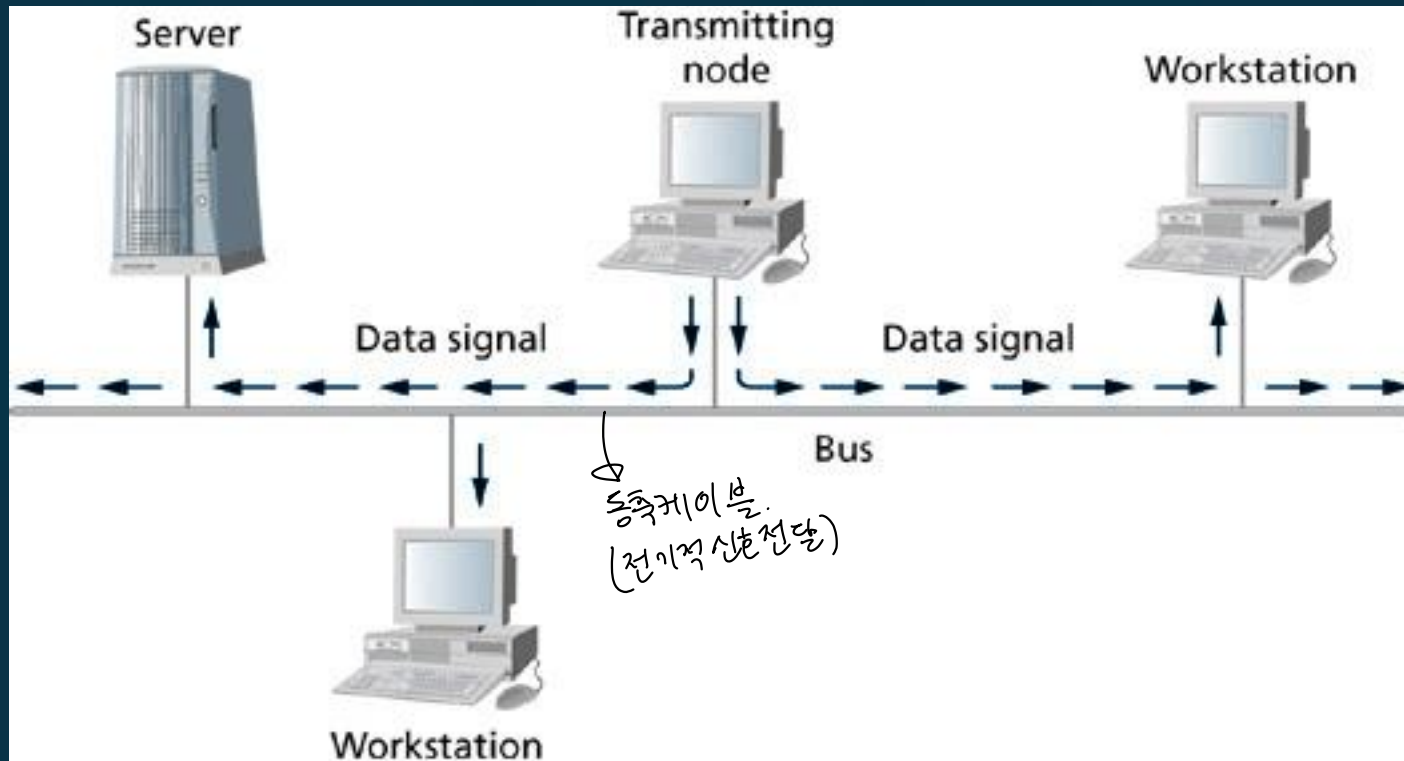
02171.

- **Logical topology** defines the conceptual layout of a LAN, or the way in which data flows across the LAN.
- **Physical topology** defines the actual physical layout of the LAN and the configuration of the cabling, computers, printers, and other devices on the LAN.

LAN TOPOLOGIES – BUS

- A **bus topology** is comprised of a shared network medium to which various network devices are attached, and every connected device hears every data transmission on the network.
- A bus topology that is implemented with coax cable is both a physical bus and a logical bus.

Simple Bus Topology



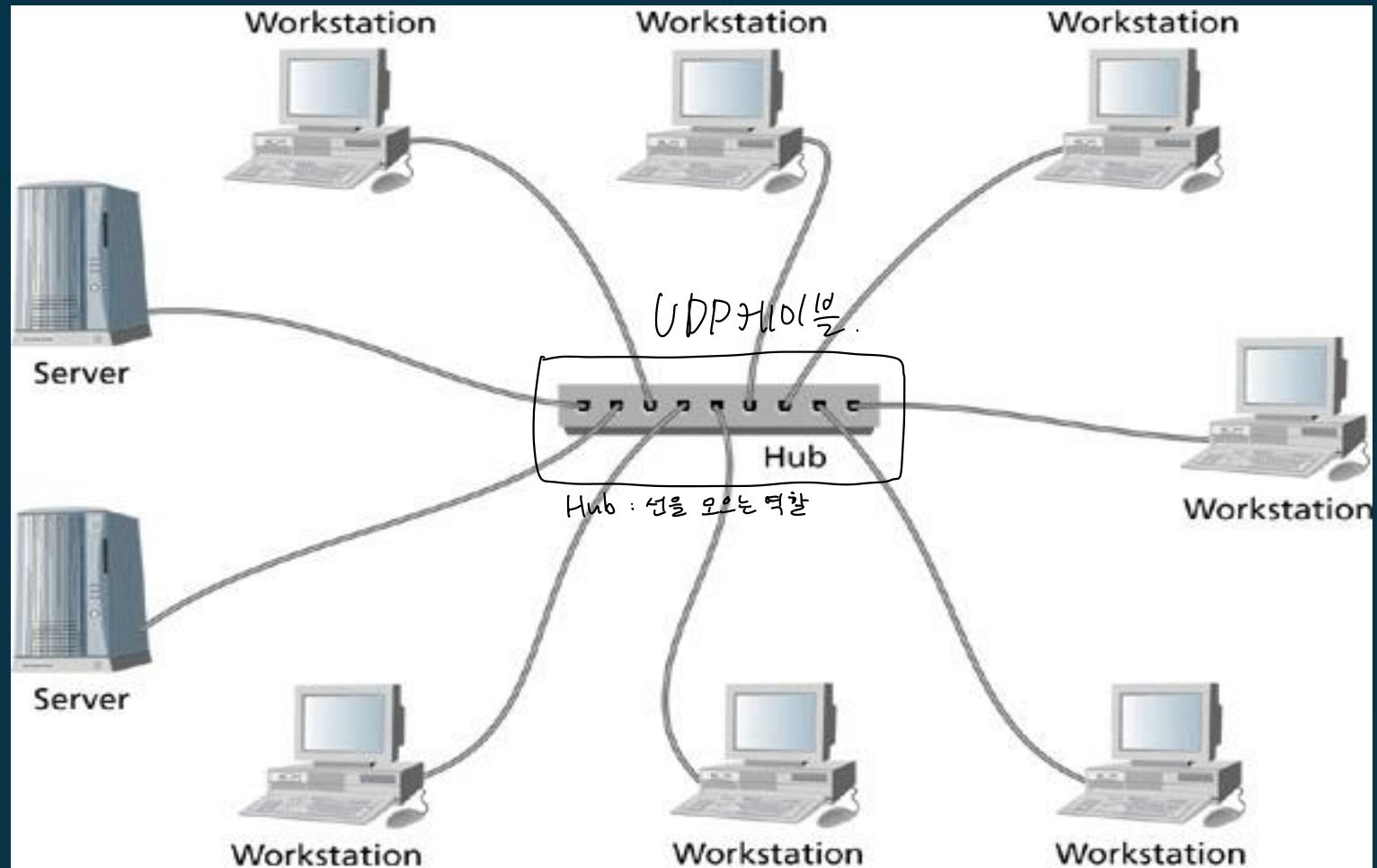
LAN TOPOLOGIES – BUS (cont'd)

- Bus topology advantages/disadvantages:
 - Easy and inexpensive to implement. (Adv.)
 - If a cable segment is disconnected or damaged, the entire network becomes unavailable. (Disadv.)
 - Difficult to troubleshoot because if a cable segment fails, it is not readily apparent which cable segment has failed. (Disadv.)

LAN TOPOLOGIES – STAR

- A **star topology** is comprised of network devices, data transmission media, and a centralized device that provides connectivity among all attached devices.
- Common implementations include UTP cabling connected to a hub or a switch.

Star Topology

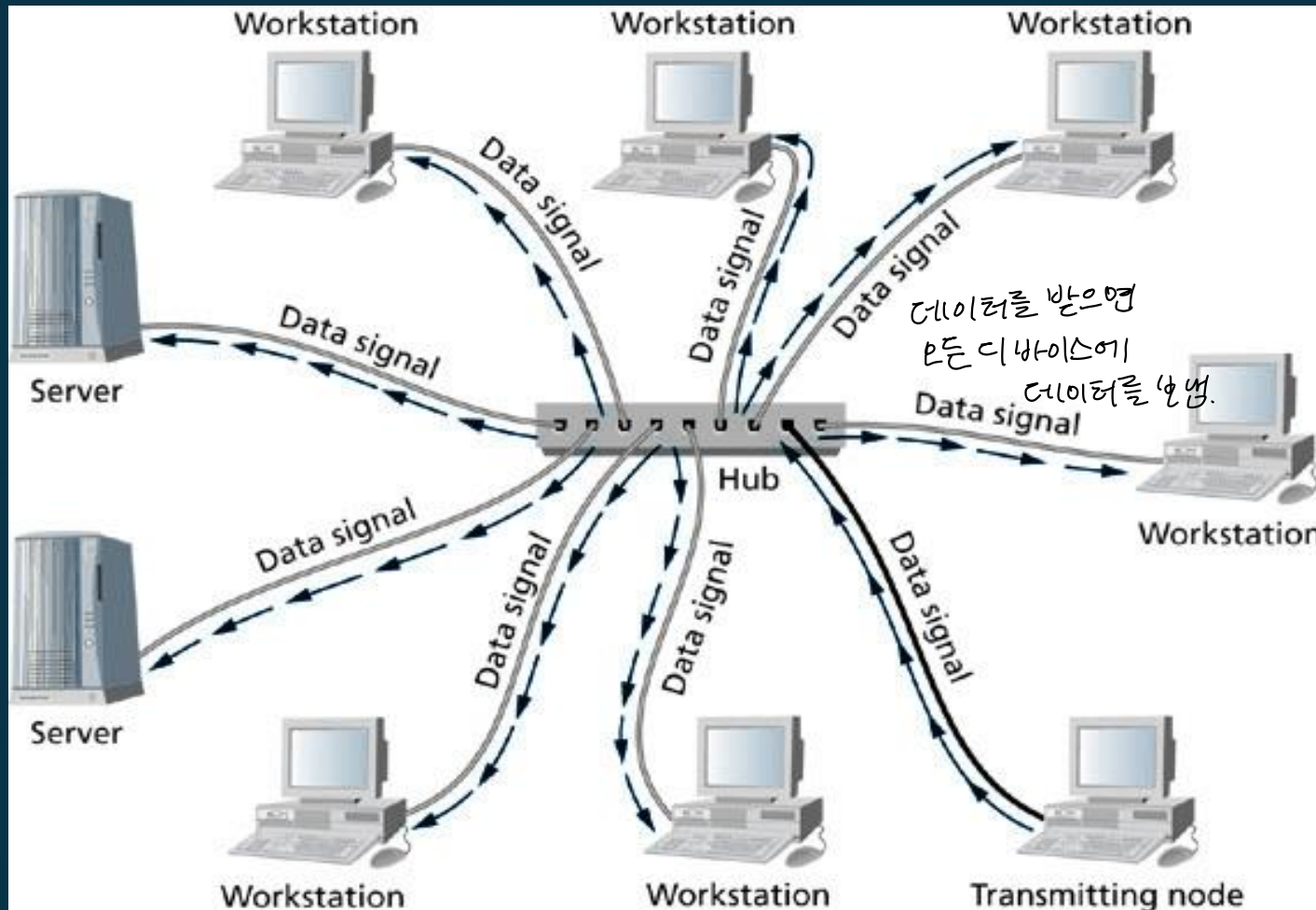


LAN TOPOLOGIES – STAR

(cont'd)

- **Physical star/logical bus**
 - A physical star/logical bus topology uses twisted pair cabling and a hub.
 - All computing devices that are connected to the hub immediately hear the data, which makes the configuration a logical bus.
 - The actual physical layout that links devices to the hub via twisted pair cabling is a physical star.

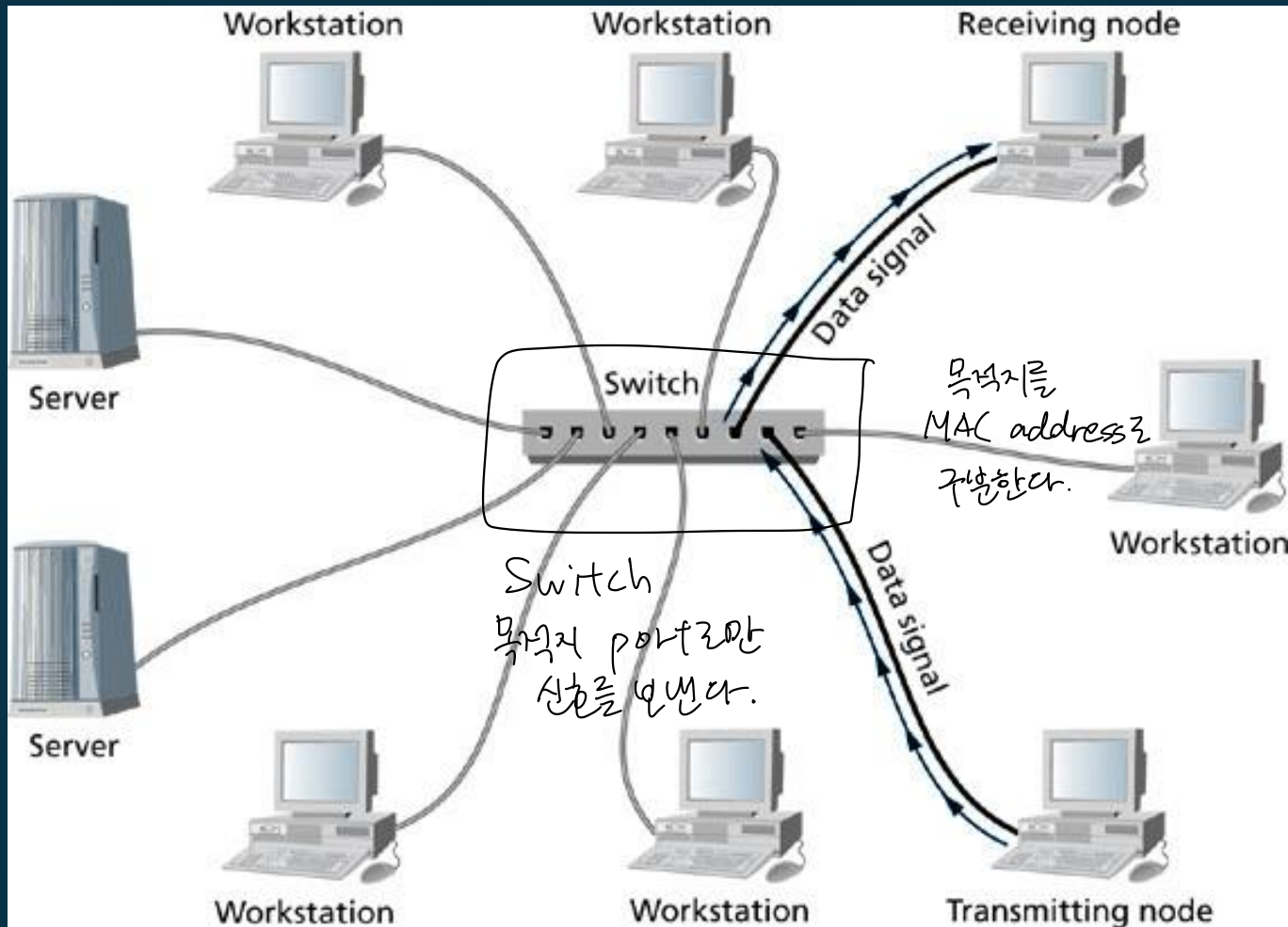
Physical Star/Logical Bus



LAN TOPOLOGIES – STAR (cont'd)

- Physical star/logical star
 - Uses twisted pair cabling and a switch.
 - Has the physical configuration of a star.
 - The flow of data emanates only to the intended recipients, which makes the configuration a logical star as well.

Physical Star/Logical Star



LAN TOPOLOGIES – STAR

(cont'd)

- Physical star advantages/disadvantages:
 - Connectivity to the LAN is through a centralized device. (Adv.)
 - Centralized device is a potential single point of failure. (Disadv.)
 - The loss of one cable segment does not bring down the entire network. (Adv.)

구현쉬움, 중앙 네트워크 down시,

LAN TOPOLOGIES – RING

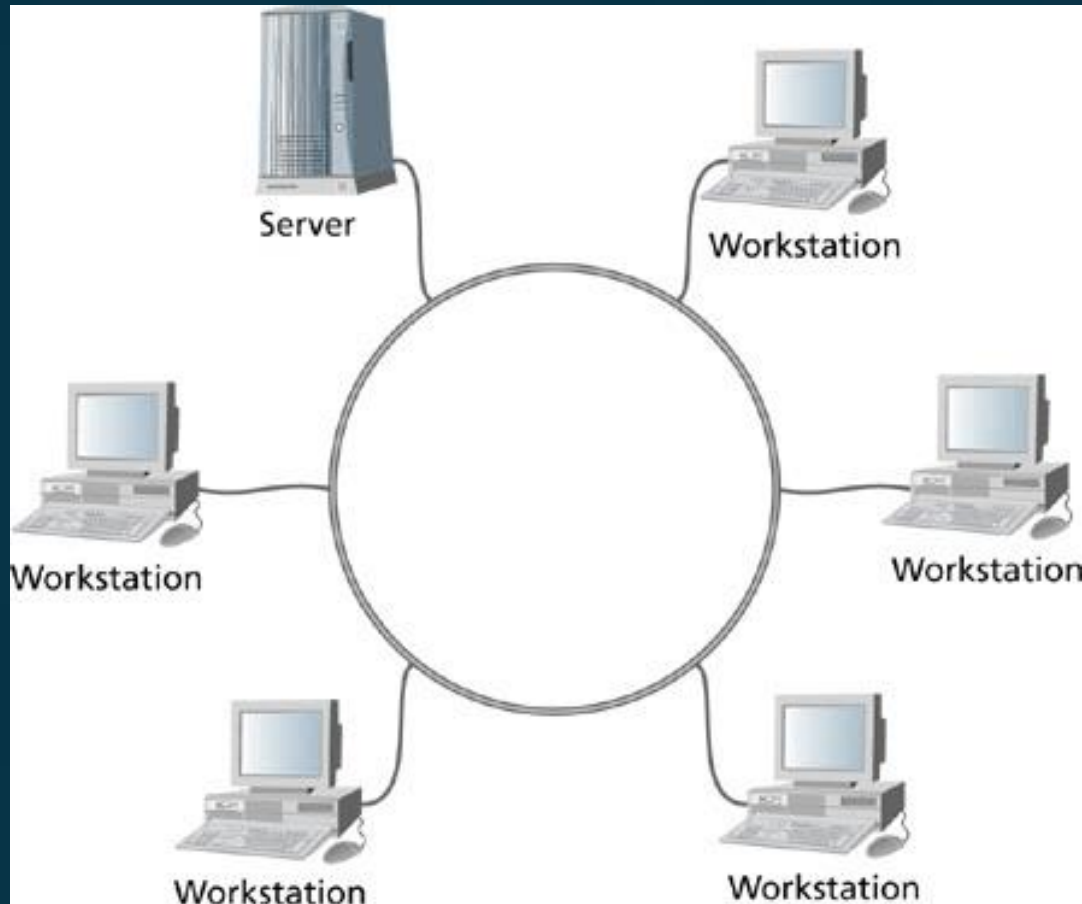
- In a **ring topology**, all network devices are connected in a closed loop, and the data flows from device to device in a unidirectional fashion, around the ring.

↓
한 방향으로 돈다.

↓
시작점과
끝점이 같다.

Ring Topology

건물과 건물사이를 이을때 많이쓰인다.



LAN TOPOLOGIES – RING (cont'd)

- Advantages/disadvantages:
 - Without a star configuration, any break in the cable between devices can crash the entire ring. (Disadv.)
 - Dual rings can provide failover protection if the first ring fails or is damaged.

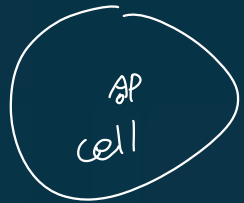
Segment 하나라도 down =>
모든 down.

dual ring { 시계, 반시계

Triple,
quad,

LAN TOPOLOGIES - WIRELESS

- **Wireless topologies** use radio frequencies instead of cables as the transmission medium.
- Wireless topologies use access points instead of hubs for connecting wireless devices to a LAN.
- Geographic areas are divided into cells, and each cell contains an access point.

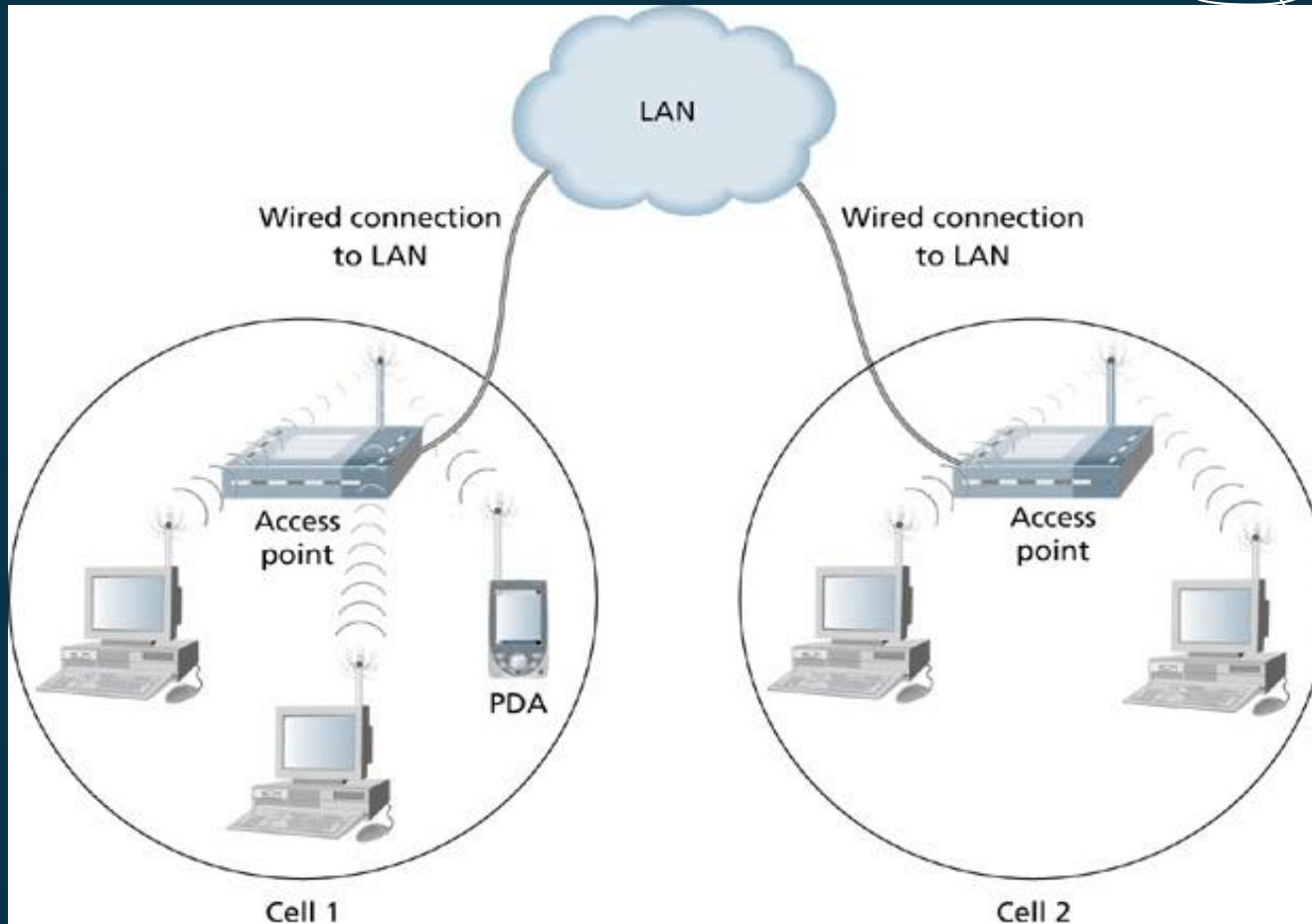


AP (무선공유기)

Wireless Topology

Cell 구성

비콘이 없으면



LAN TOPOLOGIES – WIRELESS

(cont'd)

- The **physical topology** of a wireless LAN can be compared to a **physical star**.
- The logical topology can be compared to a logical bus.
- BUT – wireless devices on a wireless LAN do not always hear each other. This is different from a logical bus topology in which all devices hear every other device on the LAN.

LAN TOPOLOGIES – WIRELESS

(cont'd)

- Advantages/disadvantages to wireless:
 - Wireless LANs are **easy to install**. (Adv.)
 - No cables to install or holes to drill. (Adv.)
 - Network devices **can move** from cell to cell. (Adv.)
 - Network devices ^{Cell 내에서} must be located within a few hundred feet of an access point. (Disadv.)
 - **Security requires more attention**. (Disadv.)

같은 예산으로 구축했을 때, 유선이 속도가 더 빠르다.

LAN ARCHITECTURES

- **LAN architecture** is the way in which data accesses network media and the structure of the data frames that are placed on the media.

어떤 방식으로
이동시키나

LAN ARCHITECTURES - ETHERNET

- Originated in the early 1970s.
- It's based on the data transmission method used by a network known as Alohanet.
- Bob Metcalfe is credited with its invention.
- First Ethernet standard was known as DIX.
- First IEEE Ethernet standard is known as IEEE 802.3 . (alphanet) 덕이큰날 수줍게 인사
- Popular in modern LANs.
- It's reliable, easy to implement, and cost effective.
 손실x, 빠르게
- It's a widely accepted industry standard.

ethernet이 주가된 이유 : 비용 !

LAN ARCHITECTURES – ETHERNET (cont'd)

- Ethernet was originally deployed across thicknet (10Base5) and later thinnet (10Base2).
- 10Base-T is 10 Mbps baseband Ethernet over UTP cable.
→ 전송속도 → 전송매체
= UTP cable.
- 100Base-T is 100 Mbps baseband Ethernet over UTP cable.
- Other Ethernet standards fall under the IEEE 802.3 이전 set of standards.

Ethernet의 종류표현.

IEEE 802.3 Ethernet Standards

TABLE 3.2
IEEE 802.3 Ethernet
Standards

Ethernet Standard	Media Type(s) Supported	Description
10BASE5	Thicknet or thick Ethernet	10 Mbps Ethernet over thicknet with a maximum cable segment length of 500 meters
10BASE2	Thinnet or thin Ethernet	10 Mbps Ethernet over thinnet with a maximum cable segment length of 185 meters ^a
10BASE-T	Categories 3-6 UTP	10 Mbps Ethernet over UTP cabling, usually cat5. Uses two of the twisted pairs
100BASE-TX	Categories 3-6 UTP	100 Mbps Ethernet over UTP cabling, usually cat5 or cat5e. Uses two of the twisted pairs
100BASE-FX	Fiber-optic cable	100 Mbps Ethernet over fiber-optic cable
100BASE-T4	Category 3 UTP	Obsolete. Was designed to use all four of the twisted pairs of cat3 UTP cabling
1000BASE-T	Category 5-6 UTP	1 Gbps over cat 5 or greater. Uses all four of the cabling's twisted pairs. Generally implemented on cat5e or greater
10GBase-LX4	SMF or MMF	10 Gbps over SMF or MMF

^aThe 2 in 10Base2 is a representation of 200 meters, which is 185 meters rounded up.

LAN ARCHITECTURES - ETHERNET ACCESS METHOD

※ ethernet이 어떤 방식으로 전송 ? ※

- Ethernet uses CSMA/CD.
- Carrier sense refers to a network device ^{이동 감지 (전기신호감지)} listening for or sensing a neutral electrical signal on the network media. ^{CS}
- Multiple access specifies that all network ^{선착순 (무선순위X)} devices have equal access to the network media. ^{MA}

LAN ARCHITECTURES - ETHERNET ACCESS METHOD (cont'd)

- **Collision detection** ensures that the sending device that detects the collision sends out a signal to all other devices to indicate that a collision has taken place. (D)
- When a collision occurs, network devices wait a random amount of time before attempting to retransmit.

두 디바이스가 각각 랜덤한
시간을 기다렸다가
전송한다.

LAN ARCHITECTURES - ETHERNET

ACCESS METHOD (cont'd)

- Advantages and disadvantages of CSMA/CD:
 - It's **easy** to configure and has widespread standardization and implementation. (Adv.)
 - Increasing numbers of collisions as more devices are added to the network. (Disadv.)

⇨ 충돌이 많을수록 충돌 가능성 ↑

ETHERNET: TECHNICAL AND BUSINESS CONSIDERATIONS

참고

- Ethernet has distance limitations.
 - For example, 100 Mbps Ethernet has a maximum segment length of 100 meters and a network span of 205 meters.
- Ethernet is an industry standard.
 - Vendors continue to develop new products.
 - ^{경쟁자}Newer versions of Ethernet are backward compatible with older versions.
 - ^{호환성}Plentiful technical support.

LAN ARCHITECTURES – WIRELESS

- Wireless architectures are comprised of IEEE 802.11, Bluetooth, and HomeRF.
- IEEE supports the IEEE 802.11 series of standards and the IEEE 802.15 (Bluetooth) series of standards.

Wireless IEEE 802.11 Data Communications Standards

TABLE 3.4
Wireless IEEE 802.11
Data
Communications
Standards

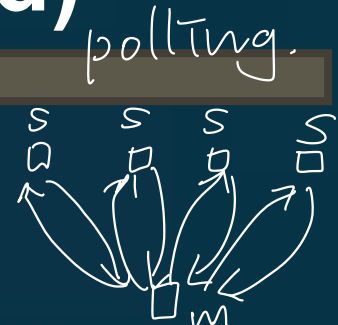
IEEE 802.11 Standard	Description
802.11	The basic standard with transmission rates up to 2 Mbps in the 2.4 GHz frequency range
802.11a	Extension to the basic standard with transmission rates up to 54 Mbps in the 5 GHz frequency range
802.11b	Extension to the basic 802.11 standard with transmission rates up to 11 Mbps in the 2.4 GHz frequency range
802.11e	Provides Quality of Service (QoS) functionality to allow voice, video, and data transmission over wireless
802.11g	Defines data transmission rates up to 54 Mbps in the 2.4 GHz frequency range
802.11h	Allows compatibility with European regulations in the 5 GHz frequency range
802.11i	Defines security protocols for 802.11 WLAN security
IEEE 802.15 (Bluetooth)	
Standard	
802.15.1	The basic standard for wireless personal area networks (WPANs) based on the Bluetooth v1.1 SIG specification, which includes data rate at up to 1 Mbps operating in the 2.4 GHz frequency range and at distances spanning less than 10 meters
802.15.1a	Update to the original standard to include the Bluetooth SIG v1.2 specs
802.15.2	Defines the coexistence of 802.11 WLANs and 802.15 WPANs within the 2.4 GHz frequency range so that the signals do not interfere with each other
802.15.3	Defines high-speed WPANs up to 55 Mbps for distances under 10 meters
802.15.4	Defines WPANs with data transmission rates between 2 Kbps and 200 Kbps in the 2.4 GHz and 915 MHz frequency ranges

LAN ARCHITECTURES – WIRELESS ACCESS METHODS

- **IEEE 802.11** uses a method of collision avoidance known as distributed coordination function (DCF).
- **DCF** reduces the need for a full-duplex channel to communicate collision detection.

LAN ARCHITECTURES – WIRELESS ACCESS METHODS (cont'd)

- **Bluetooth** uses a polling mechanism with controlled access.
- Devices establish themselves as either Master or Slave devices on a Bluetooth **piconet**, and communication between any two devices is controlled by the Master device.
- This method prevents data collisions and ensures efficient use of the communications channel.



polling하는 입장이
공작 비슷하셔!

스카 많을수록 속력↓.

WIRELESS TECHNICAL CONSIDERATIONS

- Frequency overlap between competing standards.
- Access point location should provide optimal coverage for users and not overlap with adjacent access points.

주파수가 겹치지 않게 .

The diagram illustrates a WLAN network with four access points (APs) arranged in a square pattern. Each AP is connected to a LAN via a wired connection. The APs are labeled as follows:

- Top-left: Channel 2
- Top-right: Channel 3
- Bottom-left: Channel 3
- Bottom-right: Channel 2

The diagram shows the overlapping coverage areas of the APs, with the overlapping regions labeled as "Hand-off areas". Handwritten notes in Korean are present:

- Top center: "ch2에서 ch1로 갈 때" (When moving from ch2 to ch1)
- Top left: "정확하게 알려준다." (It tells accurately)

Roaming.

→ Roaring.

데이의 소유 회사가
다르다.

WIRELESS BUSINESS CONSIDERATIONS

- Cost.
- Which wireless architecture to choose.
- Standards are important for longevity and interoperability with existing “wired” technologies.
- Distance and speed requirements to meet business needs.



LAN ARCHITECTURES – FDDI

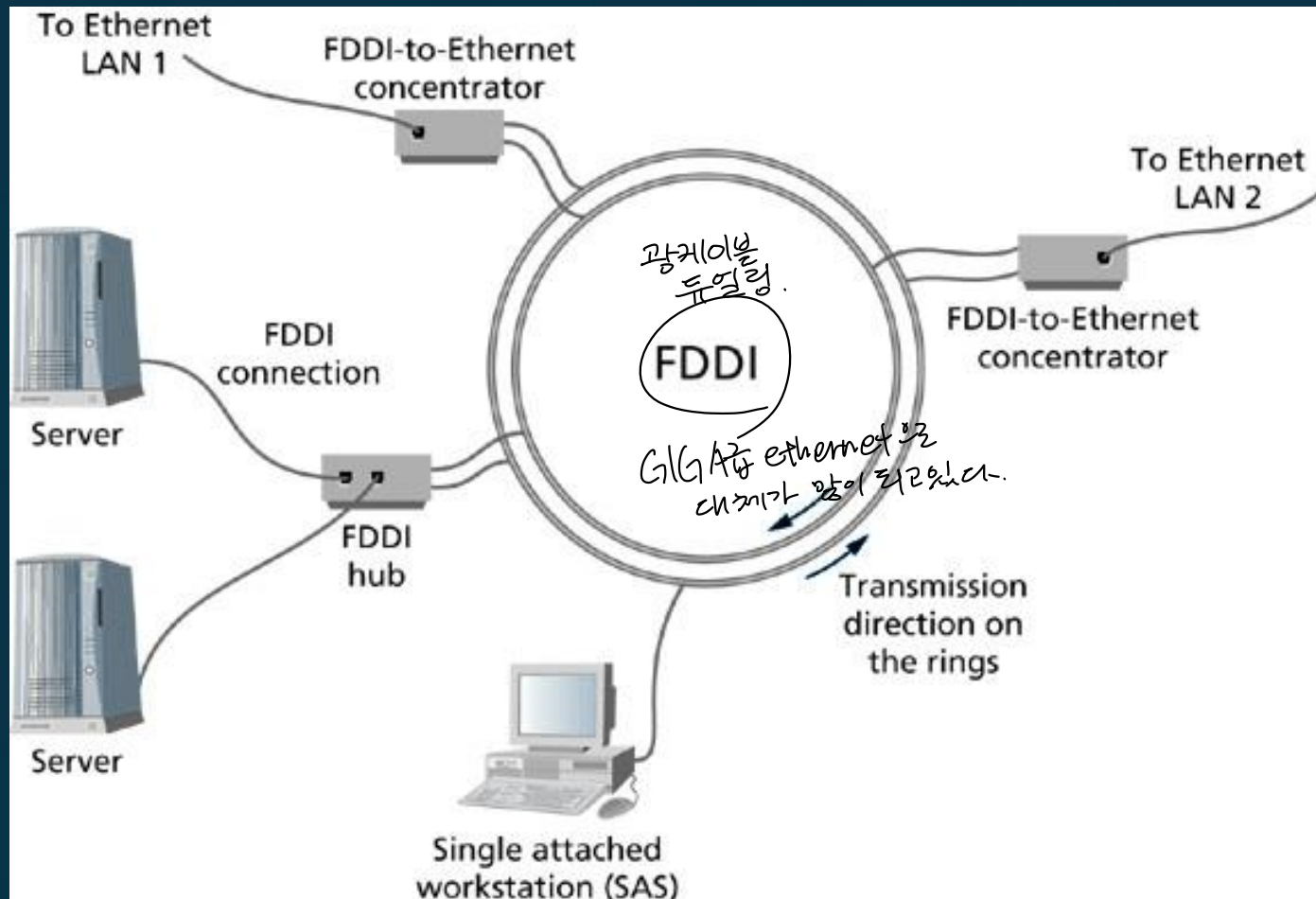
ethernet // FDDI, ATM.

- FDDI – Fiber Distributed Data Interface
광섬유이브.
- It's an older data transmission technology.
- It's roots date back to the early 1980s.
- It's still supported in various network environments.
- At one time it was a common choice for high-speed connectivity between remote LANs in a campus environment.

속도 ↑ 전송매체 upgrade
전송기술 upgrade

ethernet : 전송기술 upgrade, (가성비)
나중에 매체 upgrade.

FDDI Dual-ring Configuration and Network Interconnectivity



LAN ARCHITECTURES – FDDI (cont'd)

- FDDI can be maintained in existing installations, but as higher data rates are required, it is generally replaced by Gigabit (or faster) Ethernet.

LAN ARCHITECTURES – ATM

비동기 전송 모드

- ATM is a technology that dates back to the late 1960s at Bell Labs.
- ATM provides high-speed and low-latency data transfer on networks that require reliable and timely delivery of data, voice, and video transmissions. 전화시각 도입하고있었다. 연구는 했으나 정품안함. 그래서 정부가 Baby Bell로 지칭했음.
- Is generally reserved for network backbones, wide area networks, and carrier service networks. ATM = mother Bell

Asynchronous Transfer Mode.



LAN ARCHITECTURES – ATM

(cont'd)

- Business Considerations for ATM:
 - Not widely used in LANs due to cost and efficient competitors such as Ethernet.
 - Can be used for backbone connectivity in LAN settings, but Gigabit (and faster forms of) Ethernet are efficient competitors here as well.
 - ATM is used extensively in carrier service networks for the transmission of data, voice, and video.

G/GA ethernet 이즈 대치일 ~