SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

COURSE NAME :19IT401 COMPUTER NETWORKS

II YEAR /IV SEMESTER

Unit 2-**LINK LAYER**

Topic 8 :Wireless LANs: IEEE 802.11

Wireless LANs: IEEE 802.11

✓Wireless communication is one of the fastest-growing technologies.
✓The demand for connecting devices without the use of cables is increasing everywhere.
✓Wireless LANs can be found on college campuses, in office buildings, and in many public areas.

Wireless LANs: IEEE 802.11

Architectural Comparison

Compare the architecture of wired and wireless LANs

Medium

- *Air-broadcast*
- *Wire-point to point*

Host

In a wired LAN, a host is always connected to its network at a point with a fixed linklayer address related to its network interface card (NIC). Of course, a host can move from one point in the Internet to another point. In this case, its link-layer address remains the same, but its network-layer address will change.

Isolated LAN

A wired isolated LAN is a set of hosts connected via a link-layer switch (in the recent generation of Ethernet). A wireless isolated LAN, called an *ad hoc network in wireless* LAN terminology

Wireless LANs: IEEE 802.11

❑Connection to other network

✓A wired LAN can be connected to another network or an internetwork such as the Internet using a router. A wireless LAN may be connected to a wired infrastructure network.

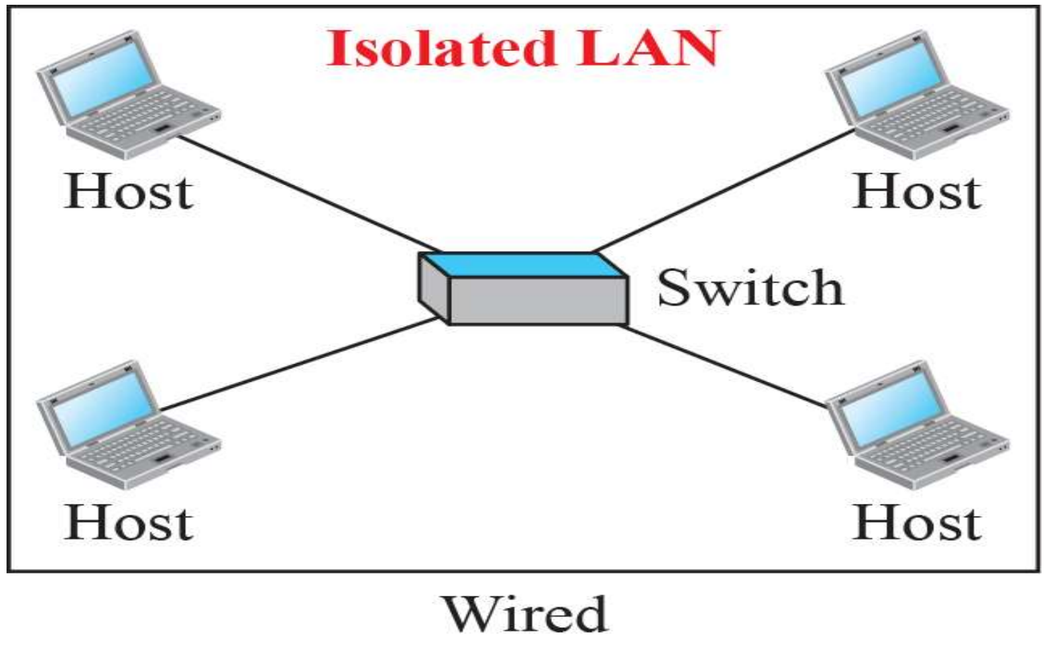
✓Moving between environments

✓the link-layer addresses will change

✓(because of changing NICs), but the network-layer addresses (IP addresses) will remain

✓the same; we are moving from wired links to wireless links.

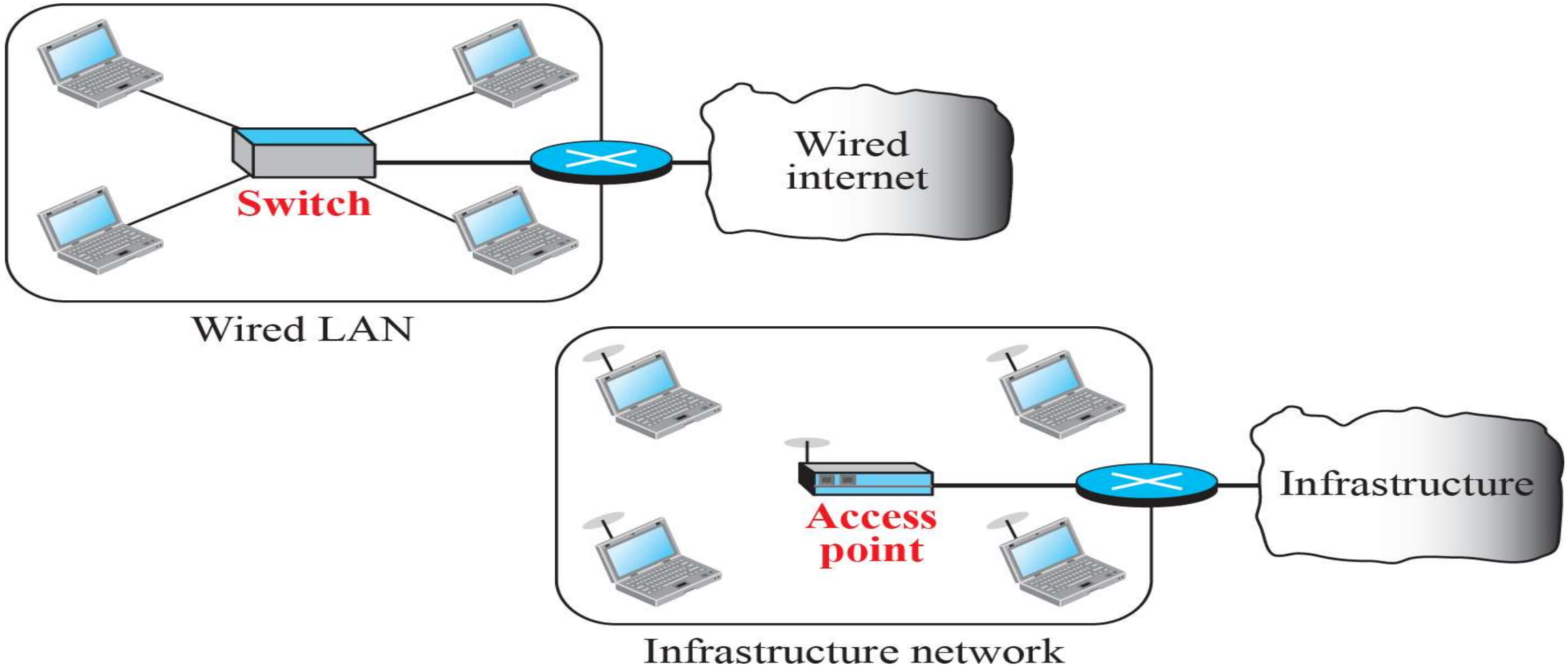
Isolated LANs: wired versus wireless



Wired

Wireless

Connection of a wired LAN and a wireless LAN to other networks



Characteristics

Attenuation

The strength of electromagnetic signals decreases rapidly because the signal disperses in all directions; only a small portion of it reaches the receiver.

Interference

Another issue is that a receiver may receive signals not only from the intended sender, but also from other senders if they are using the same frequency band.

Multipath Propagation

A receiver may receive more than one signal from the same sender because electromagnetic waves can be reflected back from obstacles such as walls, the ground, or objects.

The result is that the receiver receives some signals at different phases (because they travel different paths). This makes the signal less recognizable.

Error

With the above characteristics of a wireless network, we can expect that errors and error detection are more serious issues in a wireless network than in a wired network.

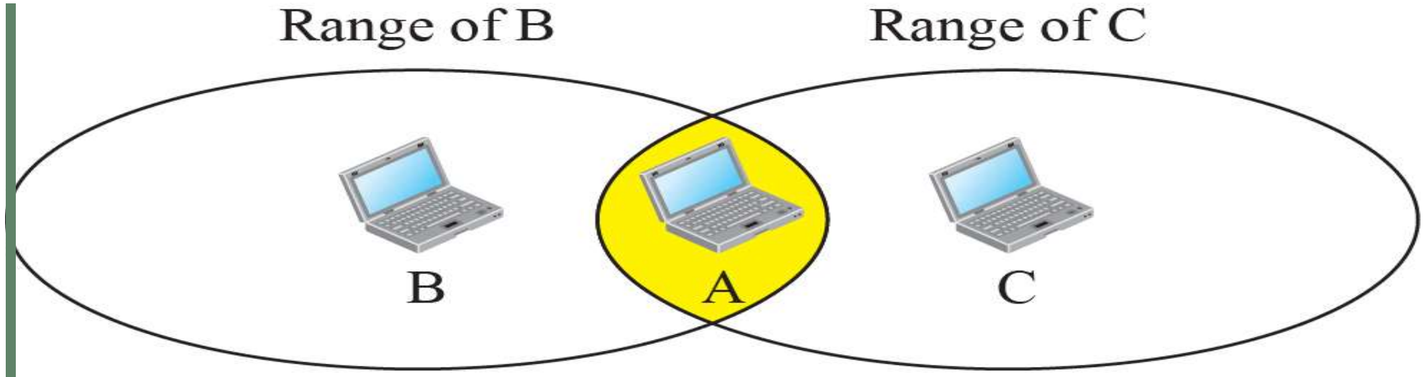
Access control : Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)

Access Control

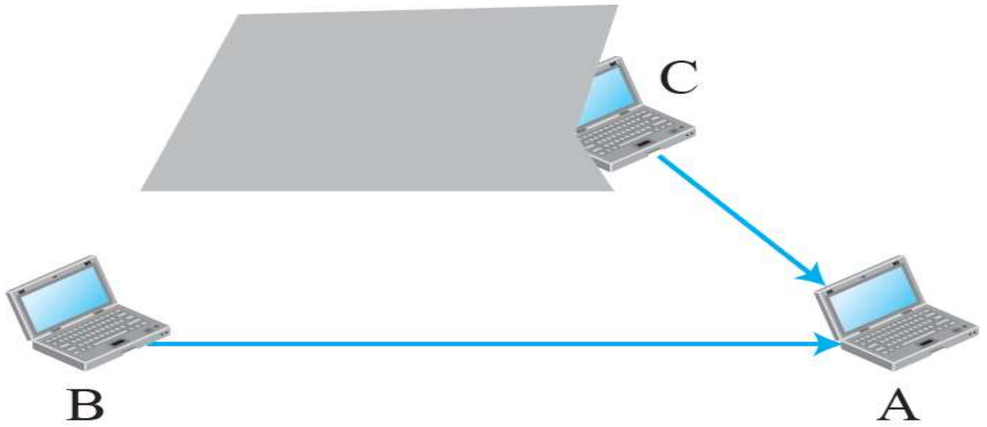
Maybe the most important issue we need to discuss in a wireless LAN is access control—how a wireless host can get access to the shared medium (air). The CSMA/CD algorithm does not work in wireless LANs for three reasons:

1. Wireless hosts do not have enough power to send and receive at the same time.
2. The hidden station problem prevents collision detection
3. The distance between stations can be great.

Hidden station problem



a. Stations B and C are not in each other's range.



b. Stations B and C are hidden

IEEE 802.11 PROJECT

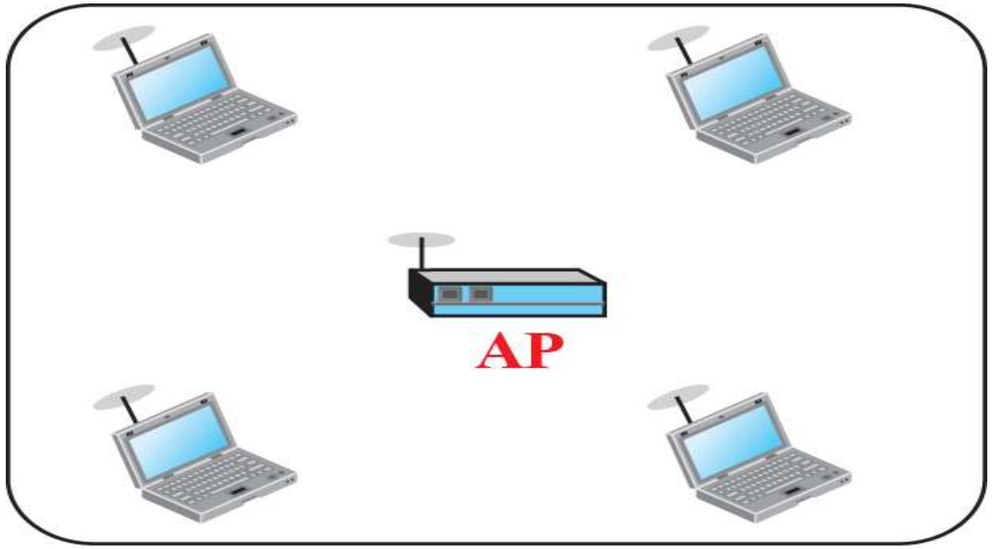
✓IEEE has defined the specifications for a wireless LAN, called IEEE 802.11, which covers the physical and data-link layers.
✓It is sometimes called wireless Ethernet.
✓In some countries, the public uses the term WiFi (short for wireless fidelity) as a synonym for wireless LAN.

Architecture

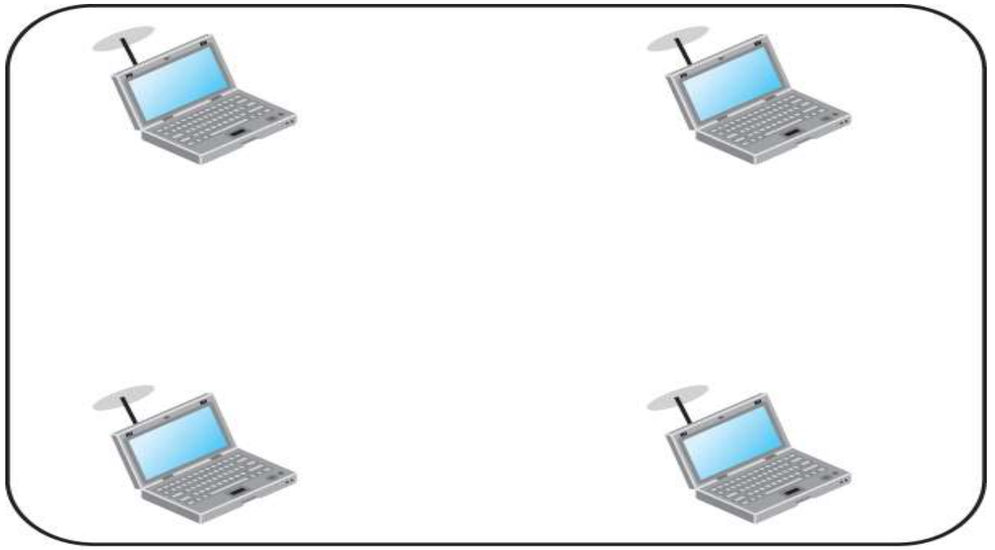
The standard defines two kinds of services:

1. the basic service set (BSS)
2. the extended service set (ESS)

Basic service sets (BSSs)

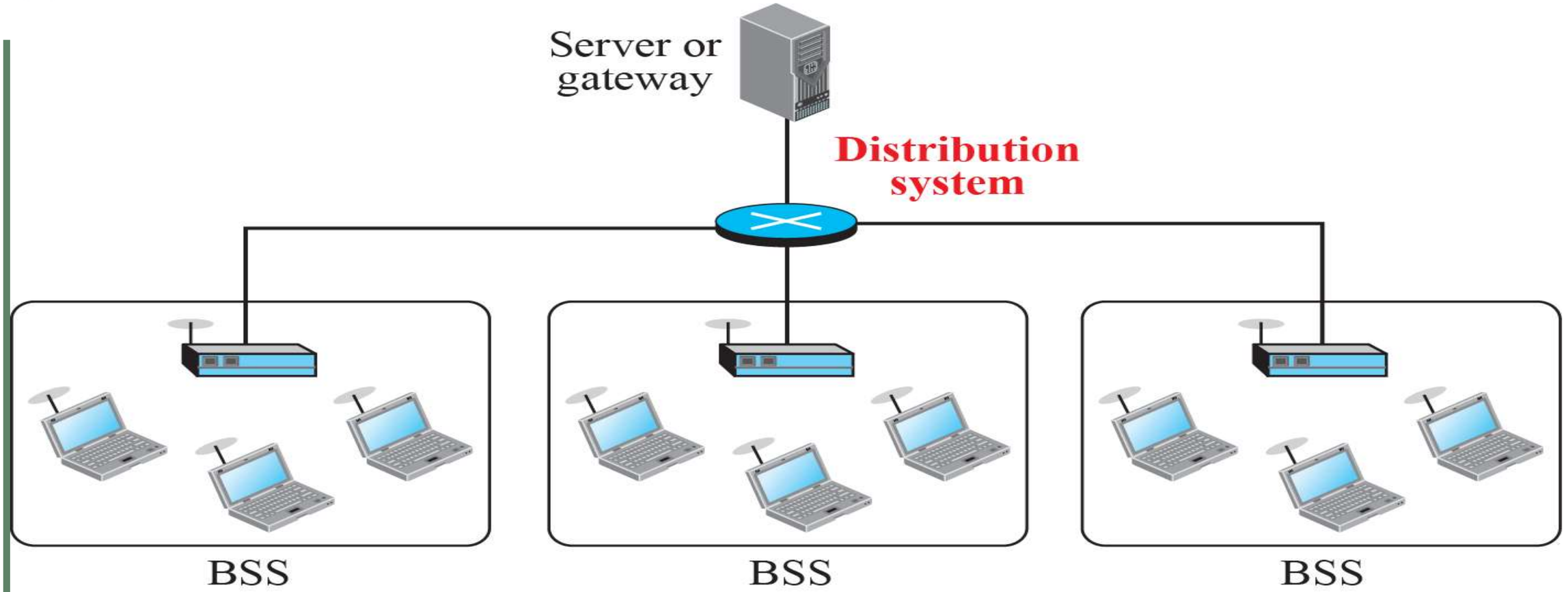


Infrastructure BSS



Ad hoc BSS

Extended service set (ESS)



IEEE 802.11 defines two MAC sublayers:

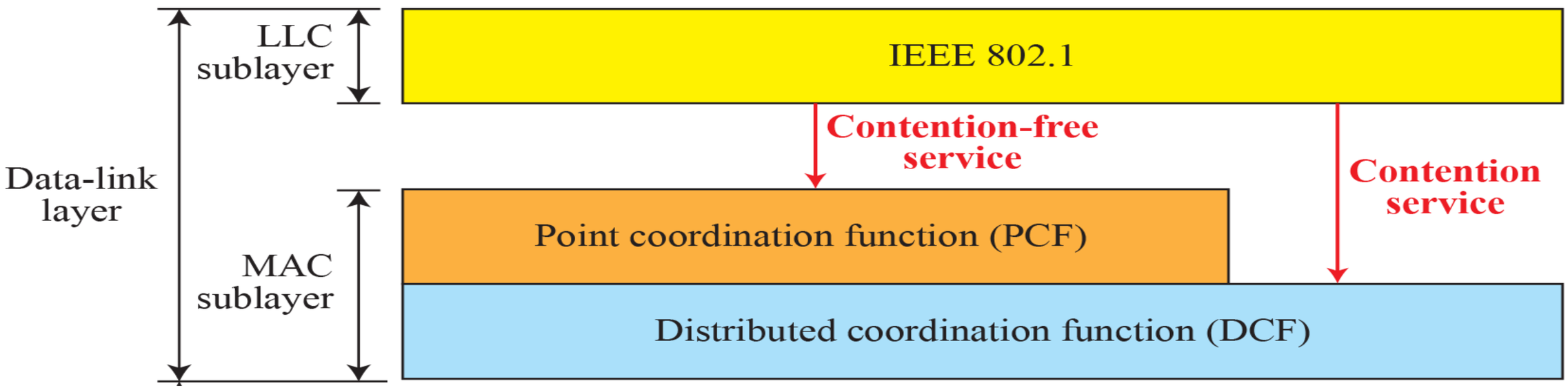
1. the distributed coordination function (DCF)
2. point coordination function (PCF).

✓The DCF of IEEE 802.11 is based on CSMA/CA(Carrier Sense Multiple Access with Collision Avoidance).

✓In DCF, the wireless station senses the state of the medium before transmitting a packet. If the medium is idle for a time interval greater than a distributed inter-frame space (DIFS), then the station transmits a packet. Otherwise the transmission state becomes idle and is monitored by the station.

✓PCF in IEEE 802.11 is based on a polling scheme. This polling scheme should be either a simple round robin method or priority-based scheme.

MAC layers in IEEE 802.11 standard



✓The network allocation vector (NAV) is a virtual carrier sensing mechanism used with wireless network protocols such as IEEE 802.11.

✓The NAV may be thought of as a counter, which counts down to zero at a uniform rate.

✓When the counter is zero, the virtual carrier-sensing indication is that the medium is idle; when nonzero, the indication is busy.

✓The medium shall be determined to be busy when the station (STA) is transmitting.

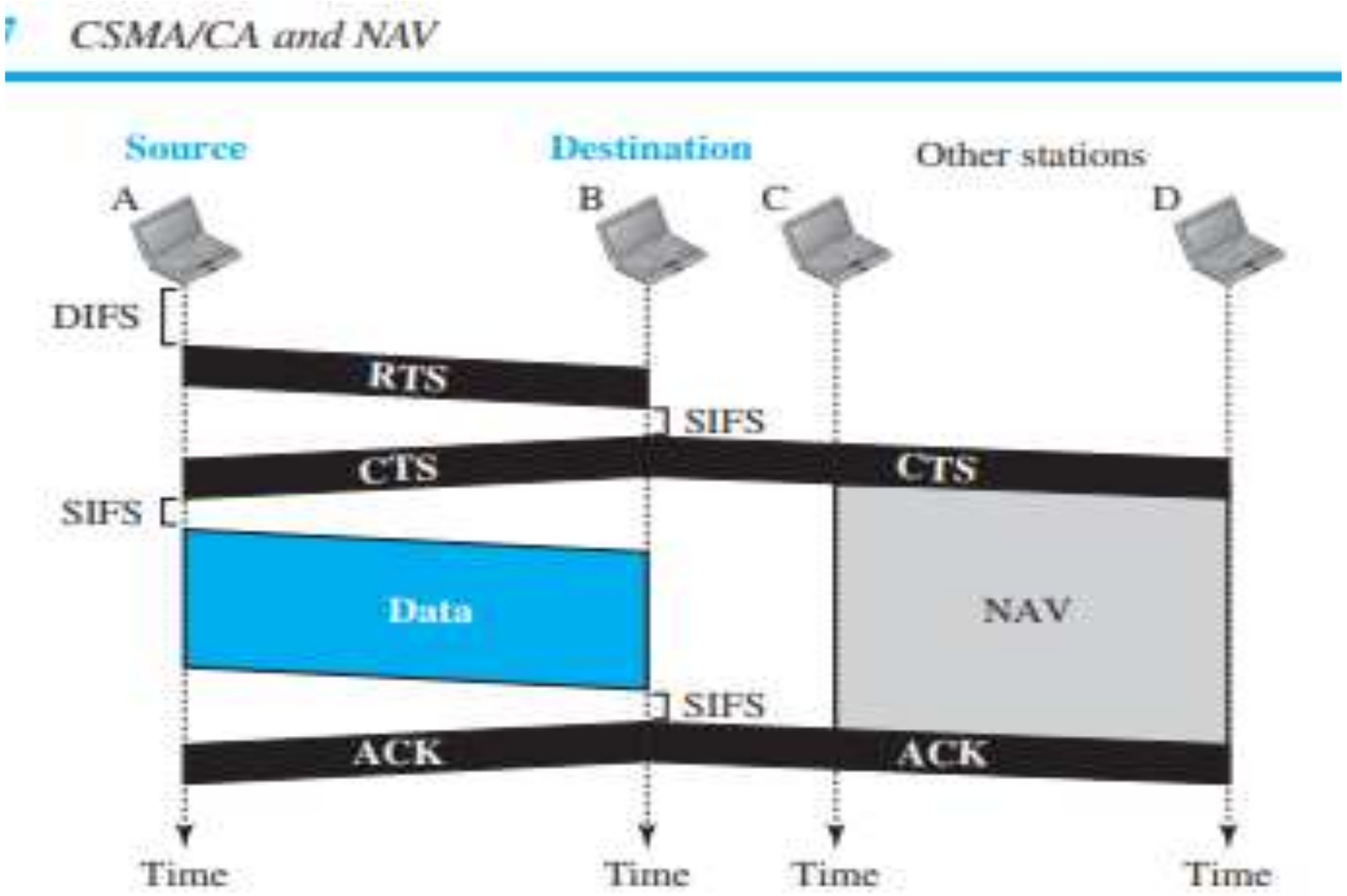
✓In IEEE 802.11, the NAV represents the number of microseconds the sending STA intends to hold the medium busy

✓When the sender sends a Request to Send the receiver waits one SIFS before sending Clear to Send. Then the sender will wait again one SIFS before sending all the data. Again the receiver will wait a SIFS before sending ACK.

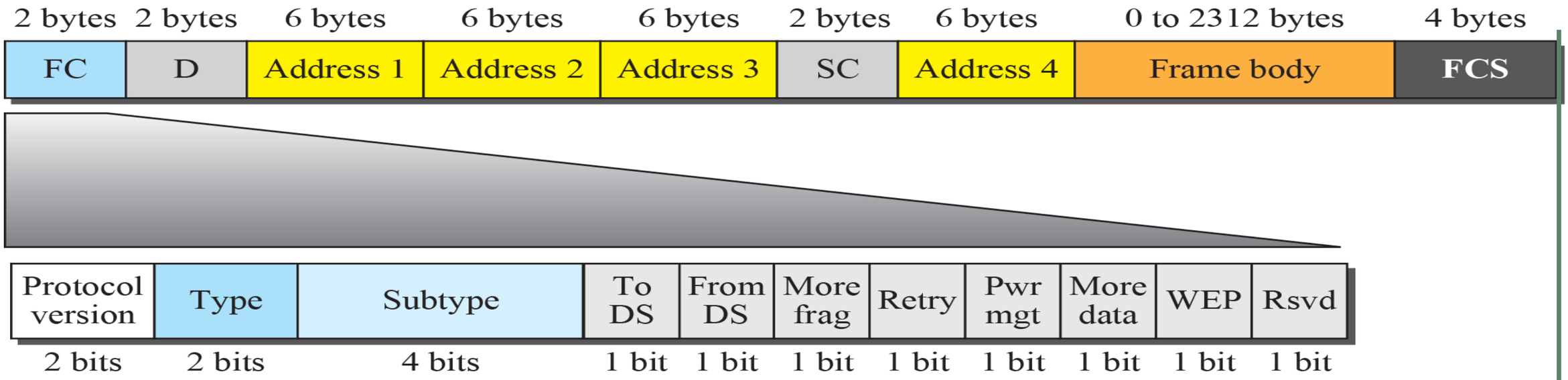
✓So NAV is the duration from the first SIFS to the ending of ACK. During this time the medium is considered busy.

✓Short Interframe Space (**SIFS**), is the amount of time in microseconds required for a wireless interface to process a received frame and to respond with a response frame.

CSMA/CA and NAV



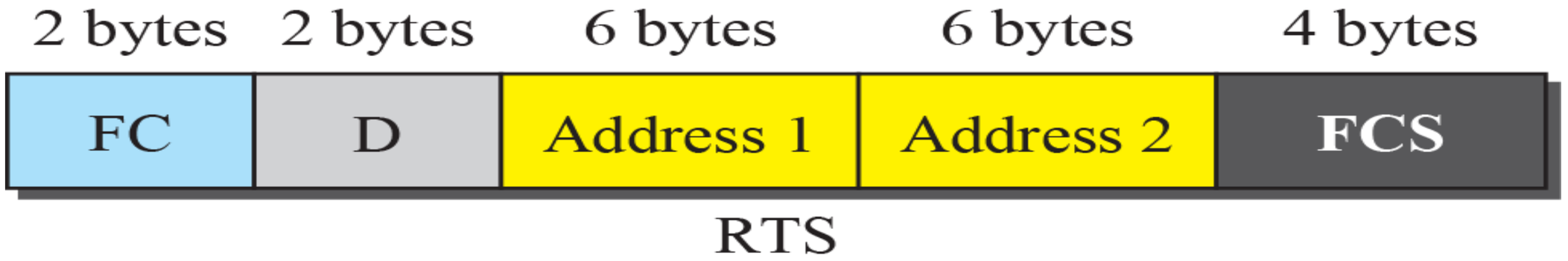
Frame format



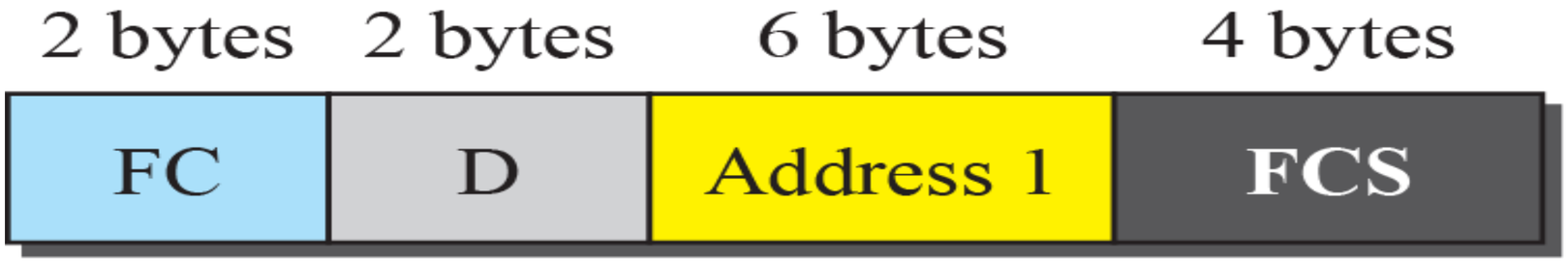
Subfields in FC field

Field	*Explanation*
Version	Current version is 0
Type	Type of information: management (00), control (01), or data (10)
Subtype	Subtype of each type (see Table 6.2)
To DS	Defined later
From DS	Defined later
More flag	When set to 1, means more fragments
Retry	When set to 1, means retransmitted frame
Pwr mgt	When set to 1, means station is in power management mode
More data	When set to 1, means station has more data to send
WEP	Wired equivalent privacy (encryption implemented)
Rsvd	Reserved

Control frames



RTS



CTS or ACK

Values of subfields in control frames

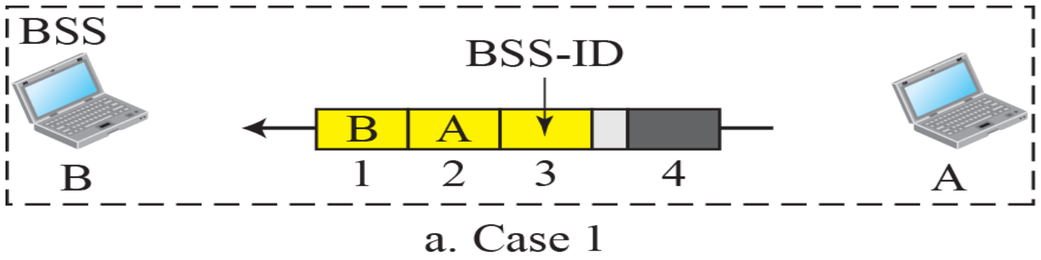
Subtype	*Meaning*
1011	Request to send (RTS)
1100	Clear to send (CTS)
1101	Acknowledgment (ACK)

Addressing Mechanism

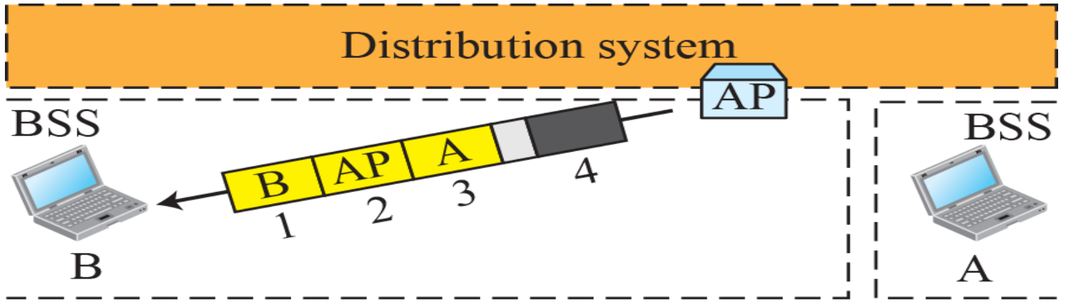
The IEEE 802.11 addressing mechanism specifies four cases, defined by the value of the two flags in the FC field, To DS and From DS.
Each flag can be either 0 or 1, resulting in four different situations.
The interpretation of the four addresses (address 1 to address 4) in the MAC frame depends on the value of these flags, as shown in Table.

To DS	*From DS*	*Address 1*	*Address 2*	*Address 3*	*Address 4*
0	0	Destination	Source	BSS ID	N/A
0	1	Destination	Sending AP	Source	N/A
1	0	Receiving AP	Source	Destination	N/A
1	1	Receiving AP	Sending AP	Destination	Source

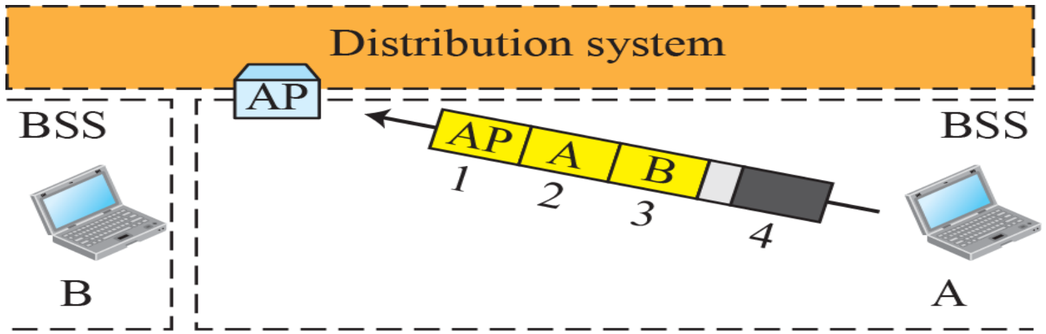
Addressing mechanisms



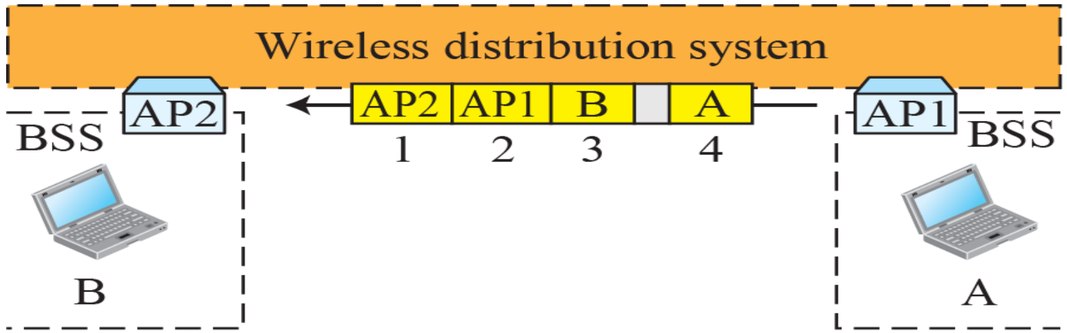
a. Case 1



b. Case 2



c. Case 3



d. Case 4

Assessment

a) What is wireless LAN?
b) What is CSMA/CA?
c) What is IEEE 802.11?
d) Compare Wired and wireless LAN

Reference

TEXT BOOKS

Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.

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