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Welcome to CPSC 441!

Outline

- Introduction to WIFI
- Comparison of different IEEE 802.11 standard
- AP scanning mechanism
- CSMA/CA vs. CSMA/CD
- 802.11 frame: why four address?

Introduction

- **WiFi**: defined as any "wireless local area network (WLAN) products that are based on IEEE 802.11 standards.

- Popular technology that allows an electronic device to exchange data wirelessly (using radio waves) over a computer network.

- IEEE established the 802.11 Group in1990. Specifications for standard ratified in1997.
  - Initial speeds were 1 and 2 Mbps.
  - IEEE modified the standard in 1999 to include802.11 a and b.
  - 802.11g was added in 2003.
 - 802.11b equipment first available, then a,followed by g.

802.11 standard

Why Choose? A vs B vs G
Wireless Technology Comparison Chart

Wireless Standard	802.11b		802.11a		802.11g	
Popularity	✓✓ (4)	Widely adopted. Readily available everywhere.	✓	New technology.	✓✓	New technology with rapid growth expected.
Speed	11 Mbps	Up to 11Mbps (note: cable modem service typically averages no more than 4 to 5Mbps).	54 Mbps	Up to 54Mbps (5X greater than 802.11b).	54 Mbps	Up to 54Mbps (5X greater than 802.11b).
Relative Cost	$	Inexpensive.	$$$	Relatively more expensive.	$$	Relatively inexpensive.
Frequency	2.4 GHz	More crowded 2.4GHz band. Some conflict may occur with other 2.4GHz devices like cordless phones, microwave ovens, etc.	5 GHz	Uncrowded 5GHz band can coexist with 2.4 GHz networks without interference.	2.4 GHz	More crowded 2.4GHz band. Some conflict may occur with other 2.4GHz devices like cordless phones, microwave ovens, etc.
Range	100-150	Good Range. Typically up to 100-150 feet indoors, depending on construction, building materials, room layout.	25-75	Shorter range than 802.11b & 802.11g. Typically 25 to 75 feet indoors.	100-150	Good Range. Typically up to 100-150 feet indoors, depending on construction, building materials, room layout.
Public Access	☕	The number of public "hotspots" is growing rapidly, allowing wireless connectivity in many airports, hotels, college campuses, public areas, and restaurants.	X	None at this time.	☕	Compatible with current 802.11b hotspots (at 11Mbps). Also, it is expected that most 802.11b hotspots will quickly convert to 802.11g.
Compatibility	OK 802.11b	Widest adoption.	OK 802.11a	Incompatible with 802.11b or 802.11g.	OK 802.11b 802.11g	Interoperates with 802.11b networks (at 11Mpbs). Incompatible with 802.11a.

802.11 LAN architecture

802.11 Ad Hoc network

http://www.isoc.org/pubs/int/cisco-1-1.html
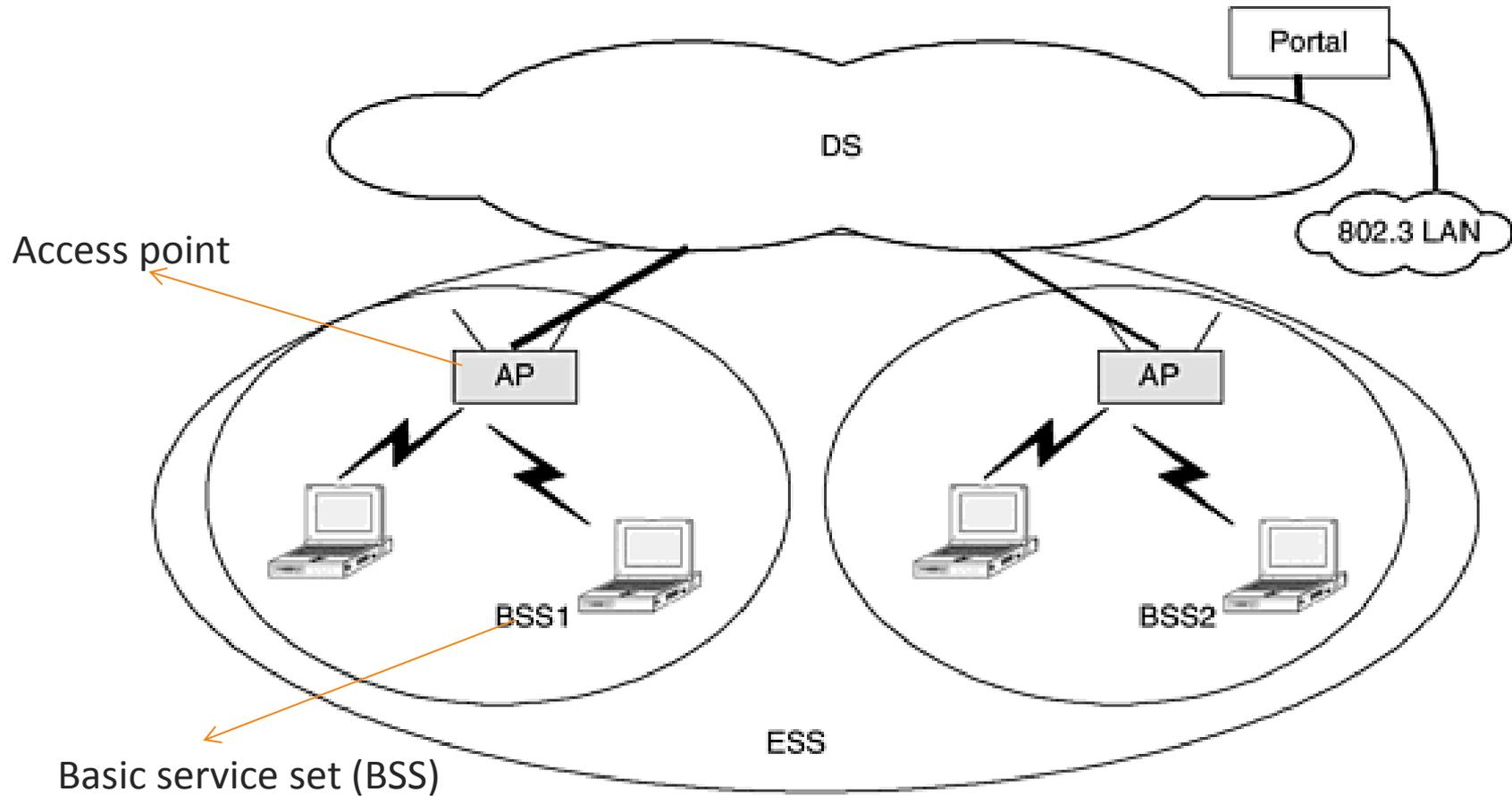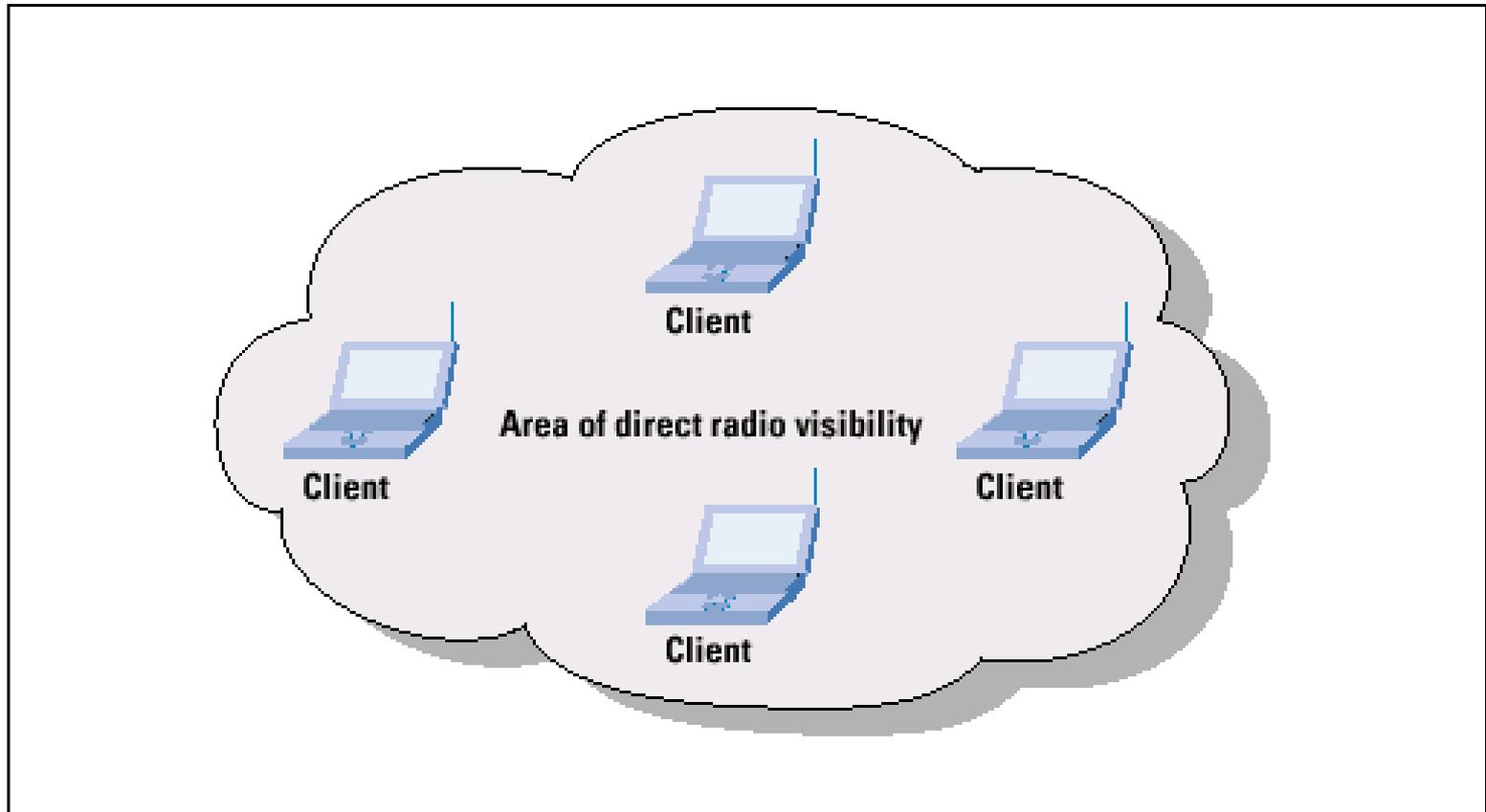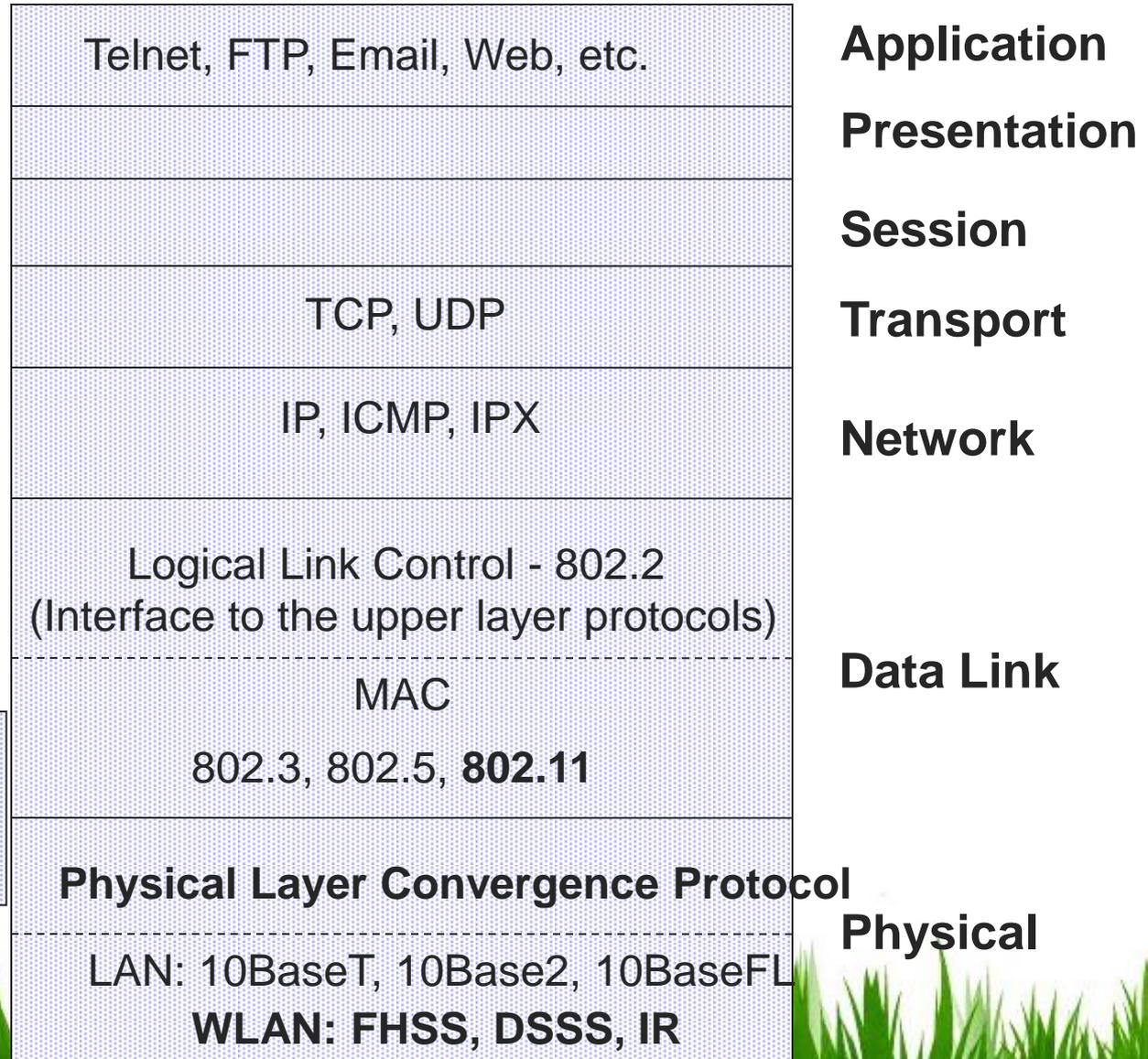
Scan the AP

- **Passive scanning:**
  1. Beacon frames sent from Aps
  2. Associate Request frame sent: host to selected AP
  3. Association Response frame sent: selected AP to host

- **Active scanning:**
  1. Probe Request frames broadcast from host
  2. Probe Response frame sent form APs
  3. Association Request frame sent: host to selected AP
  4. Association Response frame sent: selected AP to host

Protocol Stack View

Telnet, FTP, Email, Web, etc.	**Application**
	Presentation
	Session
TCP, UDP	**Transport**
IP, ICMP, IPX	**Network**
Logical Link Control - 802.2 (Interface to the upper layer protocols)	**Data Link**
MAC 802.3, 802.5, **802.11**	
Physical Layer Convergence Protocol	**Physical**
LAN: 10BaseT, 10Base2, 10BaseFL **WLAN: FHSS, DSSS, IR**	

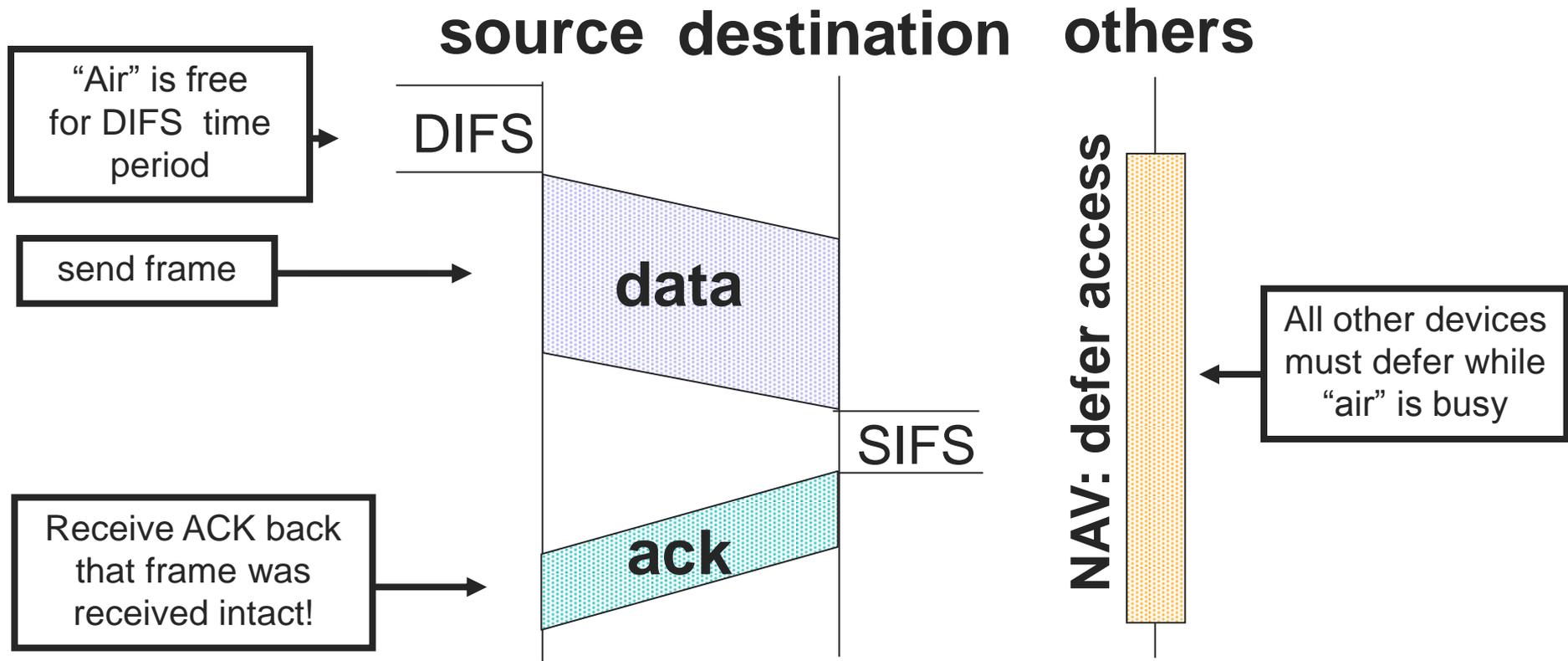**Wireless lives at Layers 1 & 2 only!**

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CSMA/CA

- Short for "Carrier Sense Multiple Access with Collision Avoidance"

- Why "Collision Avoidance", not "Collision Detection"?

1. Hard to build hardware that can detect a collision because of the weak received signal.

2. Hidden terminal problem and fading

CSMA/CA Protocol (cont.)

1. If channel idle, transmit frame after DIFS (Distributed Inter-frame Space)
2. Otherwise, choose random backoff value (exponential backoff)
3. If channel is sensed idle, count down backoff value, otherwise frozen
4. When the counter reach zero, transmits the entire frame and then wait for acknowledgment
5. If acknowledgment not received, go back to step2

CSMA/CA

source   destination   others

"Air" is free for DIFS time period

DIFS

send frame

data

NAV: defer access

All other devices must defer while "air" is busy

SIFS

Receive ACK back that frame was received intact!

ack

* SIFS - Short Inter-Frame Space (approx 28 µs)

• **Every frame is acked - except broadcast and multicast!**

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CSMA/CA VS. CSMA/CD

- 802.11 uses collision-avoidance techniques, instead of using collision detection

- 802.11 uses a link-layer acknowledgment/retransmission scheme, because of the relatively high bit error rates of wireless channels

802.11 frame: why four address fields?

- 1st for source MAC address
- 2nd for destination wireless station MAC address
- 3rd for router interface MAC address
- 4th for ad hoc mode (not discuss here)

Thanks for attending!