Wireless Networks
Lecture 13: Wireless LAN
802.11 MAC

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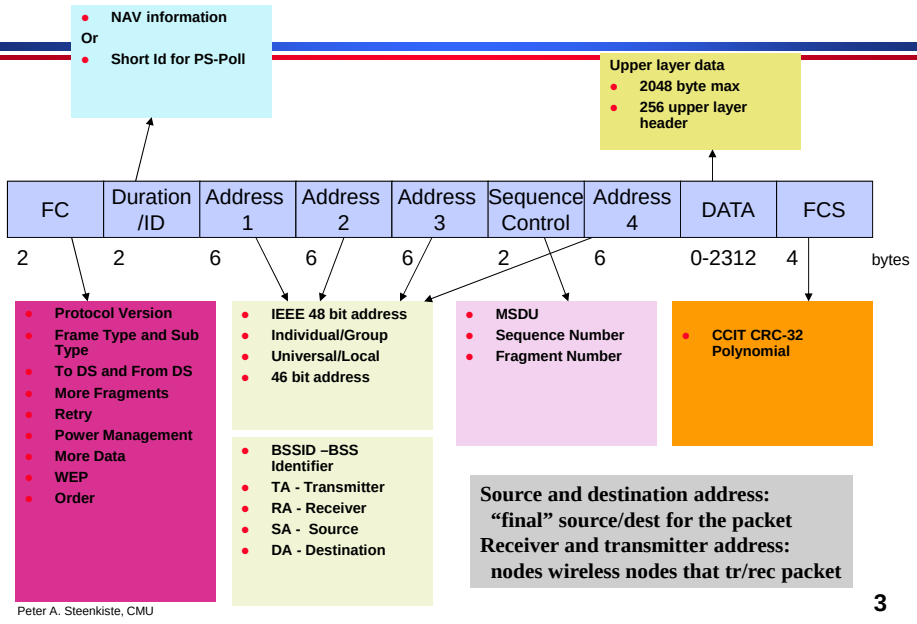
Outline

- 802 protocol overview
- Wireless LANs – 802.11
  - Overview of 802.11
  - 802.11 MAC, frame format, operations
  - 802.11 management
  - 802.11*
  - Deployment example
- Personal Area Networks – 802.15

Frame Format



Packet Types

- **Type/sub-type field is used to indicate the type of the frame**
- **Management:**
  - » **Association/Authentication/Beacon**
- **Control**
  - » **RTS, CTS, CF-end, ACK**
- **Data**
  - » **Data only, or Data + CF-ACK, or Data + CF-Poll or Data + CF-Poll + CF-ACK**

Addressing Fields

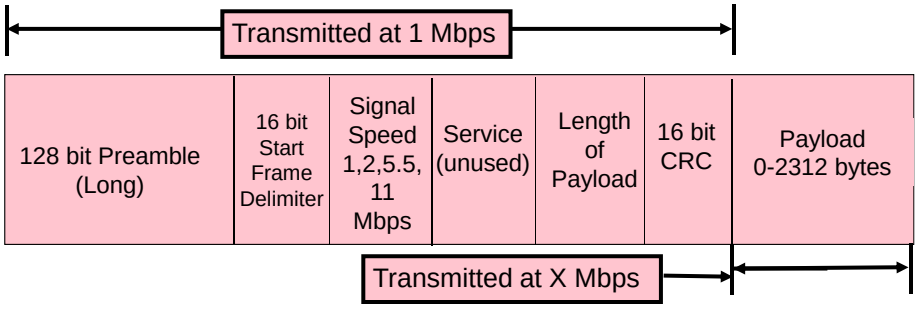
To DS	From DS	Message	Address 1	Address 2	Address 3	Address 4
0	0	station-to-station frames in an IBSS; all mgmt/control frames	DA	SA	BSSID	N/A
0	1	From AP to station	DA	BSSID	SA	N/A
1	0	From station to AP	BSSID	SA	DA	N/A
1	1	From one AP to another in same DS	RA	TA	DA	SA

RA: Receiver Address **TA: Transmitter Address**
DA: Destination Address **SA: Source Address**
BSSID: MAC address of AP in an infrastructure BSS

Long Preamble

Long Preamble = 144 bits

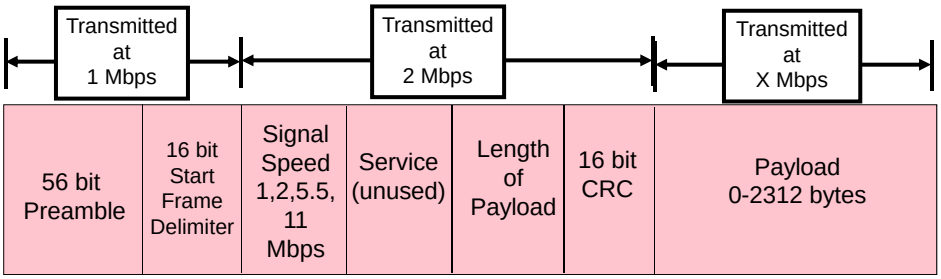
- **Interoperable with older 802.11 devices**
- **Entire Preamble and 48 bit PLCP Header sent at *1 Mbps***



Short Preamble

Short Preamble = 72 bits

- **Preamble transmitted at 1 Mbps**
- **PLCP Header transmitted at 2 Mbps**
- **more efficient than long preamble**



Multi-bit Rate

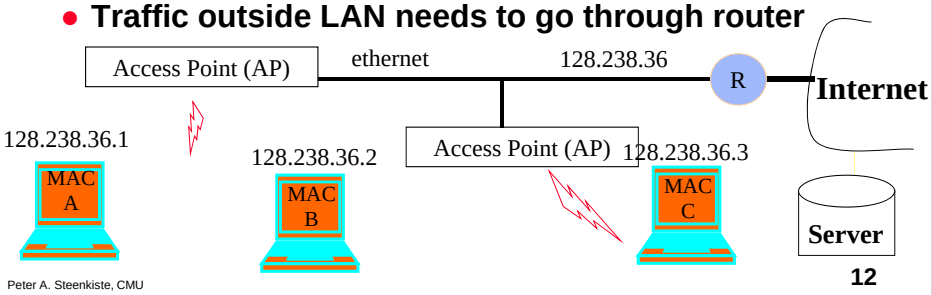
- **802.11 allows for multiple bit rates**
  - » **Allows for adaptation to channel conditions**
  - » **Specific rates dependent on the version**
- **Algorithm for selecting the rate is not defined by the standard – left to vendors**
  - » **Still a research topic!**
  - » **More later in the semester**
- **Packets have multi-rate format**
  - » **Different parts of the packet are sent at different rates**
  - » **Why?**

Data Flow Examples

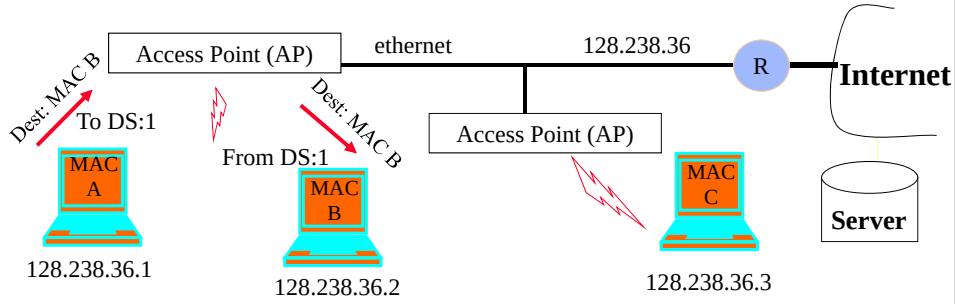
- Case 1: Packet from a station under one AP to another in same AP's coverage area
- Case 2: Packet between stations in an IBSS
- Case 3: Packet from an 802.11 station to a wired server on the Internet
- Case 4: Packet from an Internet server to an 802.11 station

Communication in LANs

- Every interface to the network has a IEEE MAC and an IP address associated with it
  - » True for both end-points and routers
- IP address inside a LAN share a prefix
  - » Prefix = first part of the IP address, e.g., 128.238.36
  - » Can be used to determine whether devices are on same LAN
- Traffic outside LAN needs to go through router

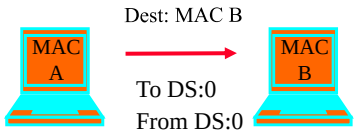


Case 1: Communication Inside BSS



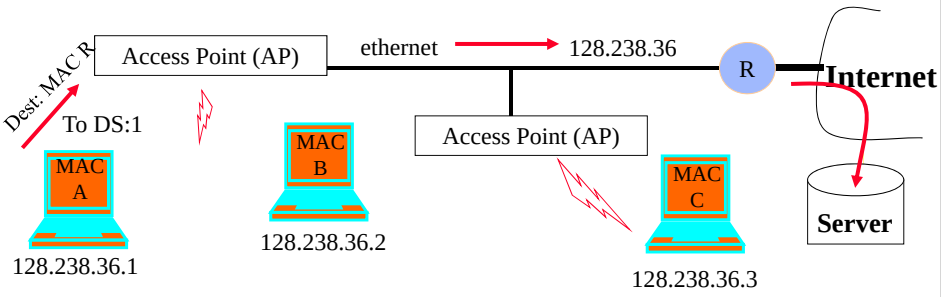
- **AP knows which stations are registered with it so it knows when it can send frame directly to the destination**
- **Frame can be set directly to the destination by AP**

Case 2: Ad Hoc



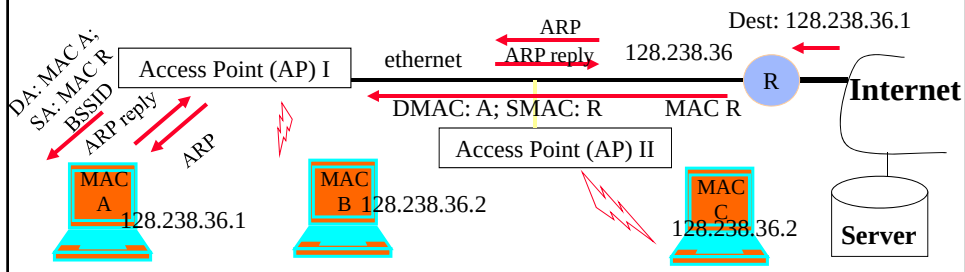
- **Direct transmit only in IBSS (Independent BSS), i.e., without AP**
- **Note: in infrastructure mode (i.e., when AP is present), even if B can hear A, A sends the frame to the AP, and AP relays it to B**

Case 3: To the Internet



- MAC A determines IP address of the server (using DNS)
- From the IP address, it determines that server is in a different subnet
- Hence it sets MAC R as DA;
  - Address 1: BSSID, Address 2: MAC A; Address 3: DA
- AP will look at the DA address and send it on the ethernet
  - AP is an 802.11 to ethernet bridge
- Router R will relay it to server

Case 4: From Internet to Station



- Packet arrives at router R – uses ARP to resolve destination IP address
  - AP knows nothing about IP addresses, so it will simply broadcast ARP on its wireless link
  - DA = all ones – broadcast address on the ARP
- MAC A host replies with its MAC address (ARP reply)
  - AP passes on reply to router
- Router sends data packet, which the AP simply forwards because it knows that MAC A is registered
- Will AP II broadcast the ARP request on the wireless medium? How about the data packet?

Summary

- Wifi packets have 4 MAC addresses
- Needed to support communication inside a LAN, across access points connected by a wired LAN
- WiFi frames have a multi-rate format, i.e., different parts are sent at different rates
  - The header is sent at a lower rate to improve chances it can be decoded by receivers
  - Contains critical information such as virtual carrier sense, and the bit rate used for the data