

802.11 Management Protocols

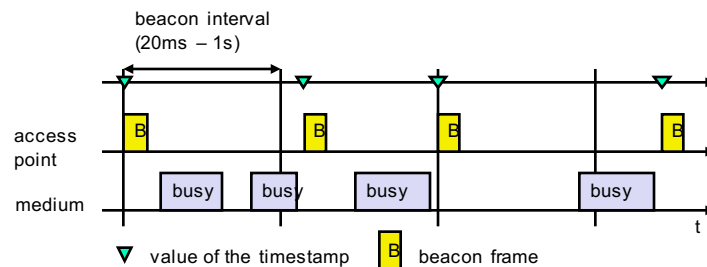
802.11 Management Protocols

- **Roaming/Association**
 - Need to associate to an AP for infrastructure networks
- **Authentication/Security**
- **Time Synchronization**
 - Need to synchronize the slots. Also needed for power management, physical layer frequency hopping, etc.
- **Power Management**
 - Mobile devices are battery operated.
 - Need to reduce battery drain. Network interfaces may consume a significant amount of energy.

Roaming (Infrastructure Mode)

- Scanning
 - scan the environment, i.e., listen into the medium for beacon signals or send probes into the medium and wait for probe responses.
- Association Request
 - Client node sends a request to one or several AP(s)
- Association Response
 - success: AP has answered, client node can now participate
 - failure: continue scanning
- Handoff: Changing association from one AP to other.
 - When to do? Stay with the AP until link fails? Scan periodically to see whether better option available? Scan is not free.
 - Fast handoff protocols.

Time Synchronization (Infrastructure Mode)



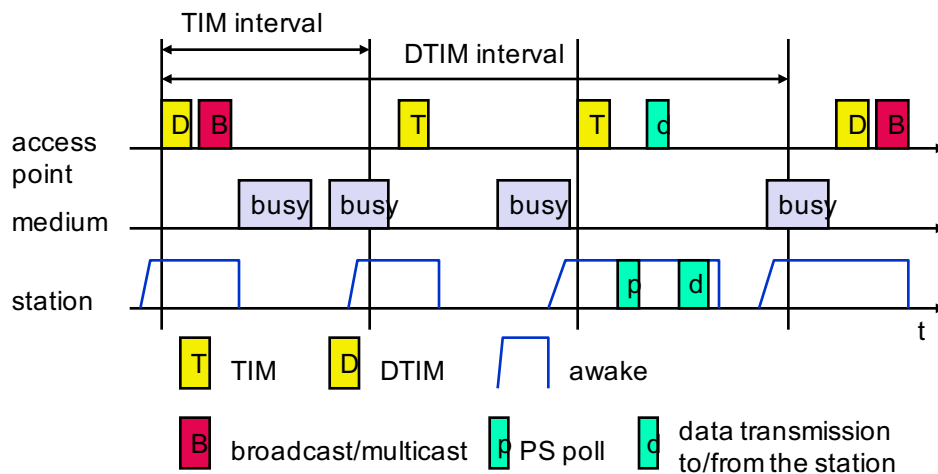
- Called **Time Synchronization Function or TSF** in the standard.
- AP transmits beacon periodically (usually few times a sec) following usual MAC protocol. Beacon has a timestamp. Client nodes adjust their clocks upon hearing such beacon.
- Note beacon interval may not be perfectly periodic as the medium could become busy.
- Time synchronization is somewhat more complex in ad hoc networks.

[Acknowledgement: Jochen Schiller]

Power Management

- General rule: Energy expenditure for various interface activities: transmit > receive > idle listening > sleep or off. Sleep or off states are inactive mode.
- The best way to save power is to switch off (or sleep) interface when not transmitting or receiving. Easy for transmit side. Hard for receive side as packet receive times are unpredictable.
- 802.11 power-save mode solution:
 - Sleep, but periodically wake up to check whether there are packets to receive.
 - Need a protocol to drive this.

Power Management (Infrastructure Mode)



[Acknowledgement: Jochen Schiller]

Power Management (Infrastructure Mode)

- AP buffers all downlink packets.
- AP inserts TIM (traffic indication map) and delivery traffic indication map (DTIM) in the beacons for waiting unicast and broadcast packets, respectively.
- All clients in power save mode must wake up at the expiry of TIM and DTIM intervals (preset) to listen to the beacon with these maps.
- If no TIM for this node or no DTIM, the node can go to sleep.
- If TIM present for this node, the node stays awake to receive the unicast frames.
 - Uses a PS poll (power save poll) for handshake.
- If DTIM is present, all nodes stay awake to receive the broadcast frames.