

CS 348: Computer Networks

- WiFi; 14th Aug 2012

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Activity: In-class Assignment

Consider 3 mountains in a straight line, A-B-C. There is a watch-tower on top of each mountain, each having a guard.

- The only mode of communication between the guards is by shouting!
- The distances between A-B-C are such that A-B are within shouting and hearing range of each other. Similarly, B-C are within range. However, A-C are not within range.

Design a protocol to be used in the above scenario, such that A-B-C may communicate meaningfully with each other.

Recap of previous class

Topics covered: ALOHA, CSMA/CD

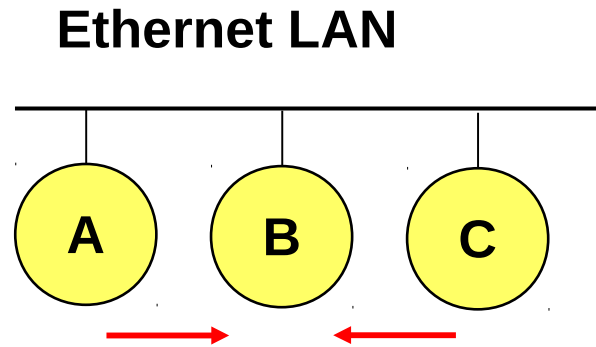
- Choice of MAC depends on:
 - stream vs burst data.
 - spectrum costs.
- ALOHA and slotted ALOHA
- CSMA/CD:
 - 1-persistent, p-persistent, non-persistent.
 - Collision detection (minimum frame size).
 - Collision recovery (binary exponential backoff).

Activity: Think-Pair-Share

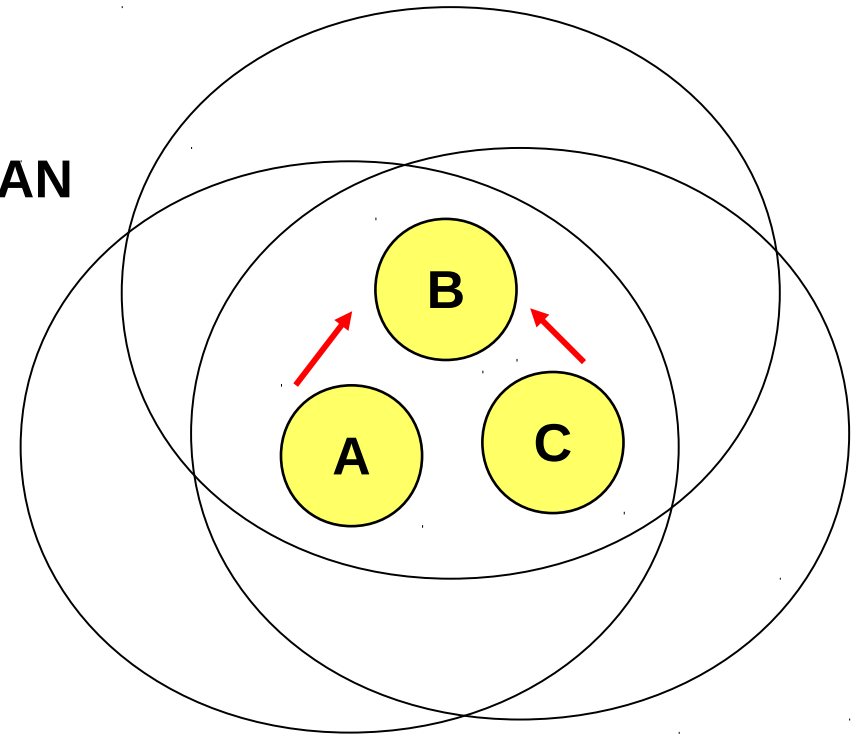
Consider computers connected using wireless links instead of Ethernet cables. WiFi is a popular Ethernet-like protocol for such wireless LANs.

- WiFi also uses CSMA in a manner similar to Ethernet, but instead of Collision Detection (CD), it uses Collision Avoidance (CA).
 - Why do you think this is so?
 - Suggest one mechanism for implementing CA.
- Do Think-Pair-Share.

Difference between Wired and Wireless

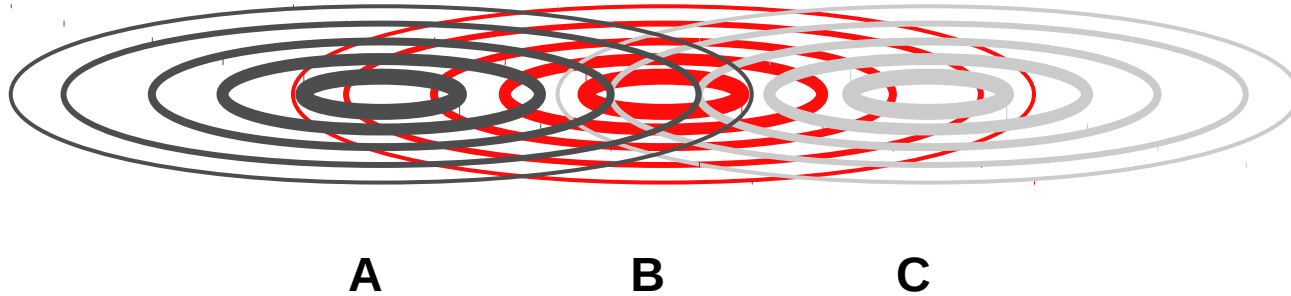


Wireless LAN



- If both A and C sense the channel to be idle at the same time, they send at the same time.
- Collision can be detected **at sender** in Ethernet.

Hidden Terminal Problem



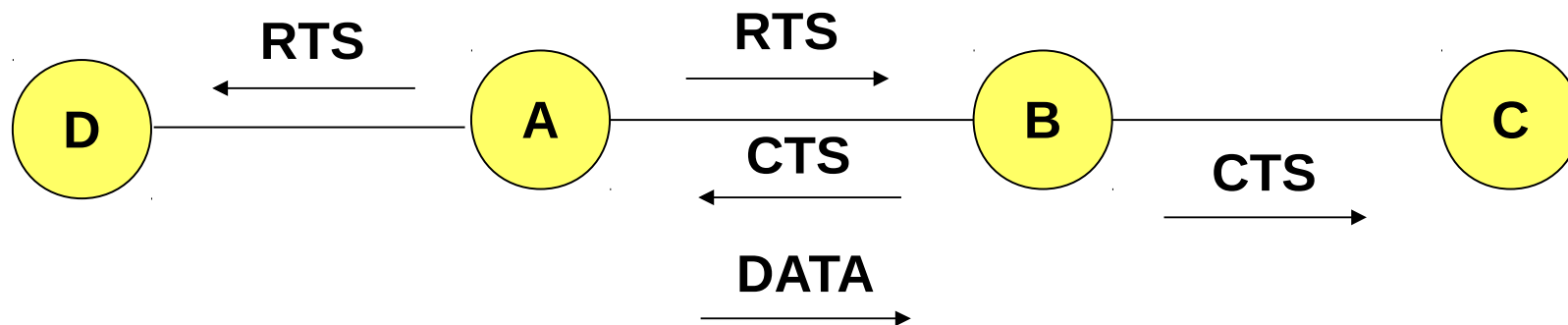
- A sends to B, C cannot receive A.
- C wants to send to B, C senses a “free” medium (CS fails)
- Collision occurs at B.
- A cannot receive the collision (CD fails).
- A and C cannot hear each other.
- A is “hidden” for C.

Wireless PHY

- Medium has neither absolute nor readily observable boundaries outside which stations are unable to receive frames
- Are unprotected from outside signals and are significantly less reliable than wired PHYs
- Have time varying and asymmetric propagation properties
- Lack full connectivity
 - the assumption that every station (STA) can hear every other STA is invalid

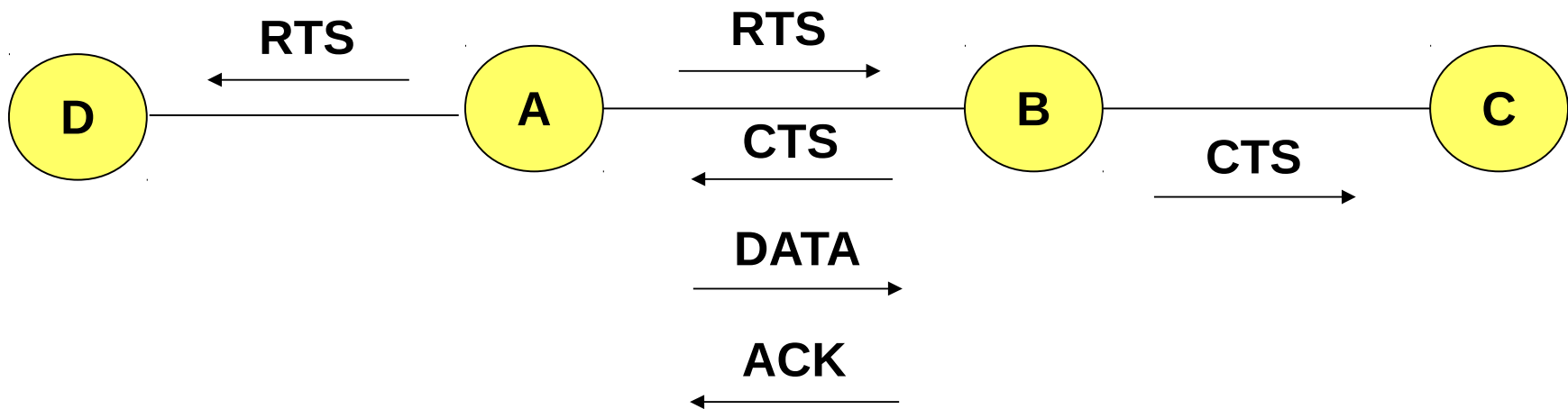
Solution for Hidden Terminals

- A first sends a *Request-to-Send (RTS)* to B
- On receiving *RTS*, B responds *Clear-to-Send (CTS)*
- Hidden node C overhears *CTS* and keeps quiet
 - Transfer duration is included in both *RTS* and *CTS*
- Exposed node overhears a *RTS* but not the *CTS*



Reliability: ACKs

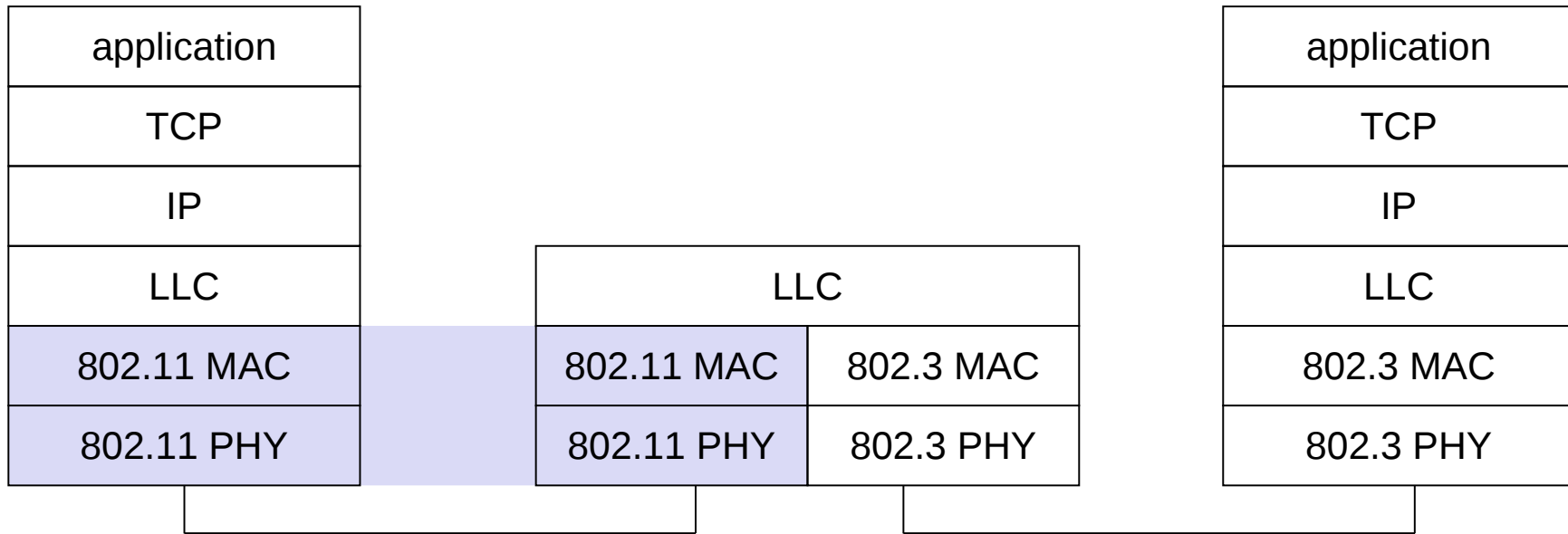
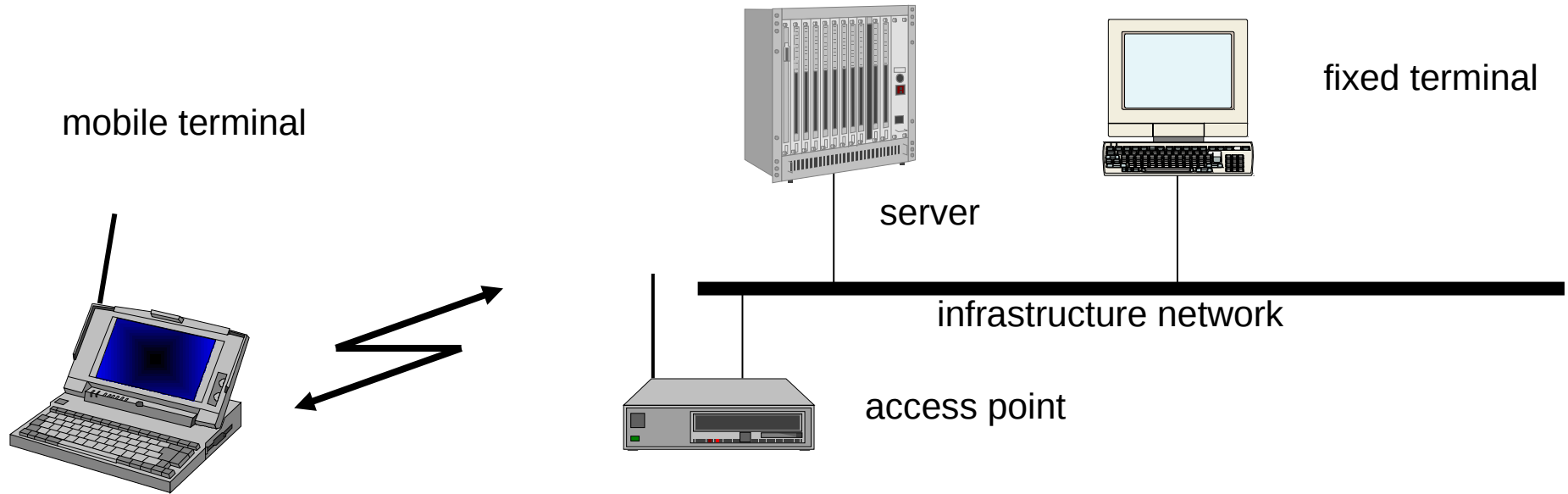
- When B receives DATA from A, B sends an **ACK**
- If A fails to receive an **ACK**, A retransmits the DATA
- Both C and D remain quiet until **ACK** (to prevent collision of **ACK**)
- Expected duration of transmission+ACK is included in **RTS/CTS** packets



IEEE 802.11 (popular as WiFi)

- Standards covers the MAC sublayer and PHY layers
- Three different physical layers in the 2.4 GHz band
 - FHSS (Frequency Hopping Spread Spectrum)
 - DSSS (Direct Sequence Spread Spectrum)
 - IR (Infra Red)
- OFDM (Orthogonal Frequency Division Multiplexing) based PHY layer in the 5 GHz band

802.11- in the TCP/IP stack



Animations

- http://oscar.iitb.ac.in/onsiteDocumentsDirectory/csma_ca/csma_ca/index.html
- http://media.pearsoncmg.com/aw/aw_kurose_network_2/applets/csma-ca/withhidden.html
- And others – Google “CSMA/CA applet”.