

Exercise 3

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Switch Learning Process

- Observation of traffic
 - When receiving a frame, location of **sender** is learned
 - Record that information as sender/location pair in **switch table**
- Forwarding Table: Mapping MAC addresses to ports
 - If it does not know where to forward to, it **broadcasts** the packet on all ports
 - If it gets an answer on one port, it updates the forwarding table (as when receiving a frame)

MAC address	Interface	TTL
12-34-56-78-9A-BC	1	9:30
AB-CD-EF-12-34-56	3	9:40

Hubs, Switches, Routers...

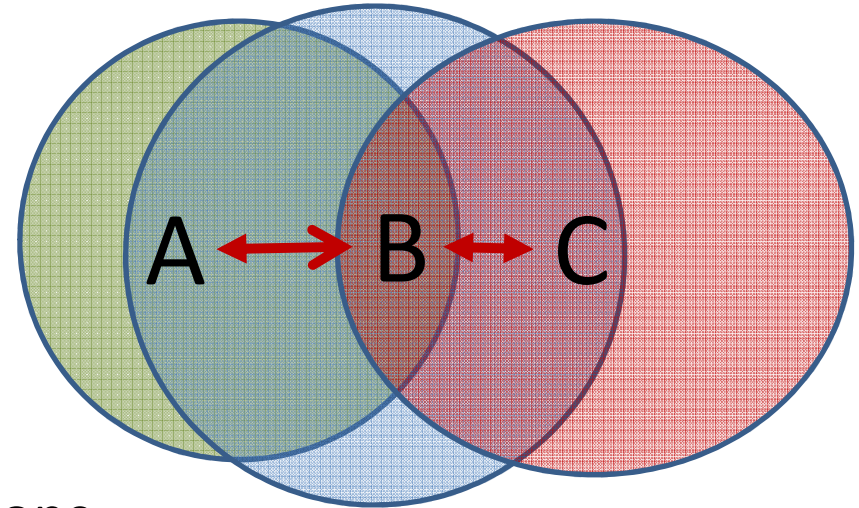
- Hub:
 - Sort of dumb (e.g., no collision analysis)
 - operates as broadcaster
- Switch: Layer 2 device
 - Connects hosts **inside one** broadcasting domain
 - uses CSMA/CD for collision detection
 - **learning process** via switch tables (see slide before)
- Router: Layer 3 device
 - connects **different** broadcast domains (ARP only works within 1 domain)
 - **routing tables**

PPP Requirements

- Concept of Layering:
 - Error **correction/recovery**, flow control, delivery order are all **delegated to the upper layers**
- That means: PPP only responsible for
 - Framing of packets arriving from upper layer
 - **Detection** of data errors
 - Detection of link failure

Hidden Terminal Problem

- Appears in **wireless** networks
 - Two nodes that are not visible to each other (A,C) try to communicate to a node (e.g., an AP) visible to both (B) at the same time -> **interference**



- Need a solution that limits collisions
 - RTS/CTS in CSMA/CA
- Contrary Effect: Exposed Station Problem
 - Imagine B sending to A, C wants to send to D (out of range of B)
 - C waits for A,B finishing their communication (-> unnecessary)

CSMA/CA Collision Avoidance

- Sender:
 - Sense channel
 - If idle for a certain amount of time (802.11: DIFS, $\sim 50 \mu\text{s}$) transmit entire frame
 - If busy, start exponential backoff (see last weeks exercise)
- Receiver:
 - If frame received OK, return ACK after waiting a certain amount of time (802.11: SIFS, $\sim 10 \mu\text{s}$)
 - Hidden terminal problem

CSMA/CA RTS/CTS

- Goal: Avoid collisions of **large** data frames
- **Idea:**
 - Use reservation of channel instead of random access
 - Allow collisions of reservation packets (**small!**)
 - Only reservation packets collide, no data frames!
- Solution: Sender transmits Request-To-Send (RTS) to BS, BS broadcasts Clear-To-Send (CTS) as answer (notifies other nodes in range that channel is busy)

CSMA/CA RTS/CTS

