
Mobility, Network Address Translation

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Lecture 14

Some Slides Credit and Copyright:
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Topics for Today

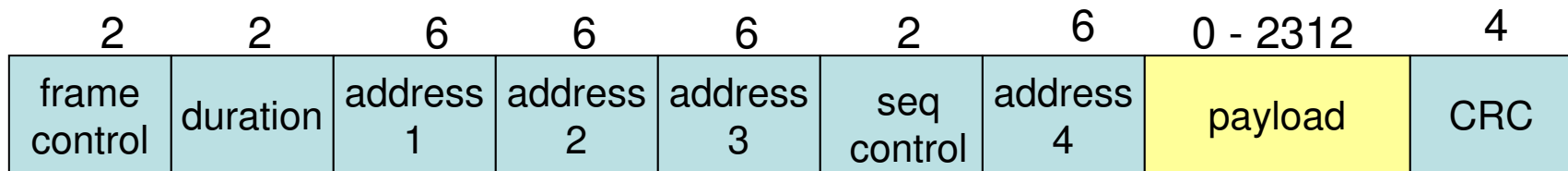
- 802.11 Wireless LANs (Wi-fi)
 - 802.11 Frame Format
 - Mobility in the Same IP Subnet
- 802.15 Personal Area Networks
- 802.16 WiMax
- Network Address Translation (NAT)

Sources:

KR 6.1-6.6

NAT: PD 4.3

802.11 frame: addressing



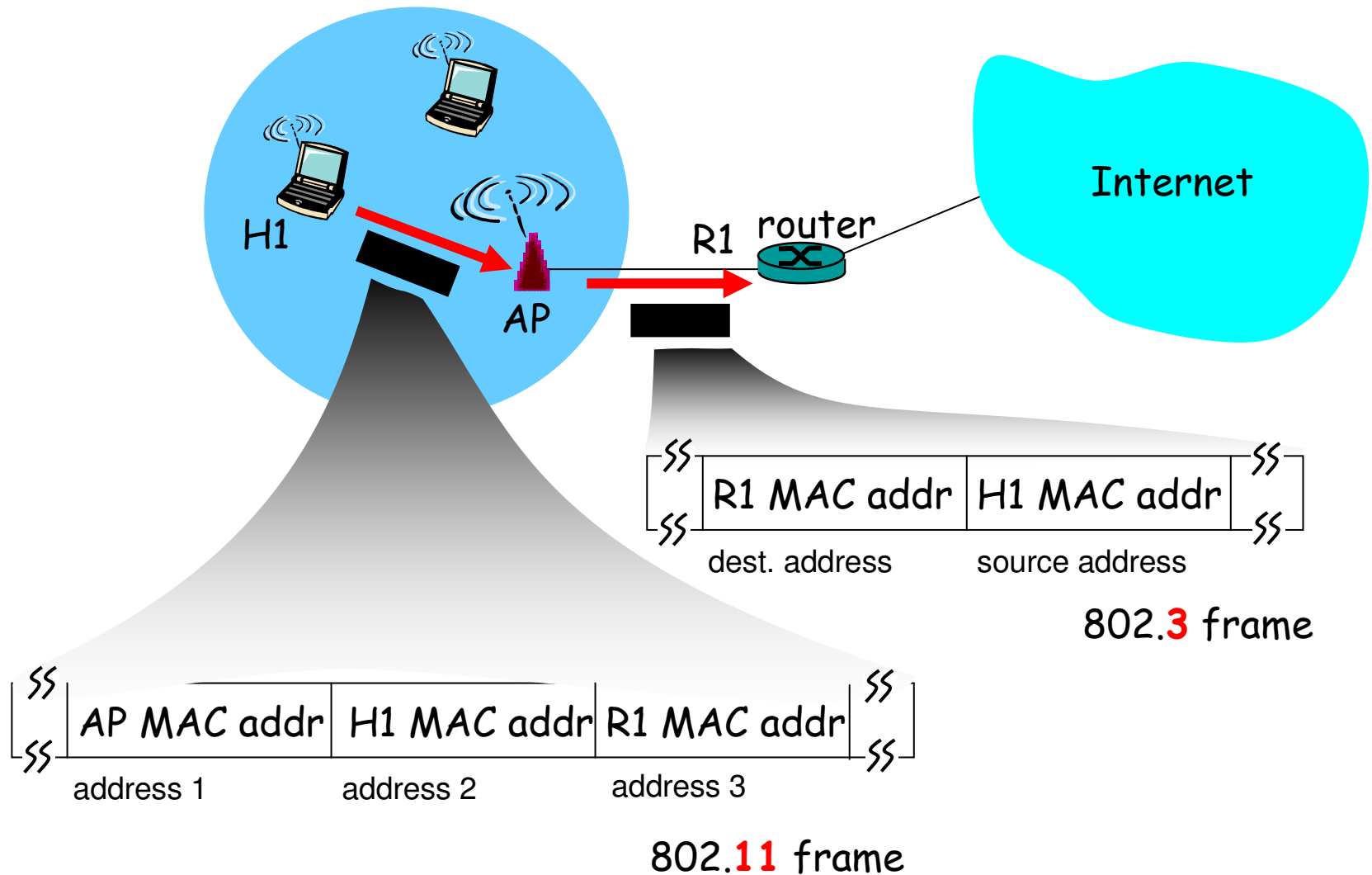
Address 1: MAC address of wireless host or AP to receive this frame

Address 2: MAC address of wireless host or AP transmitting this frame

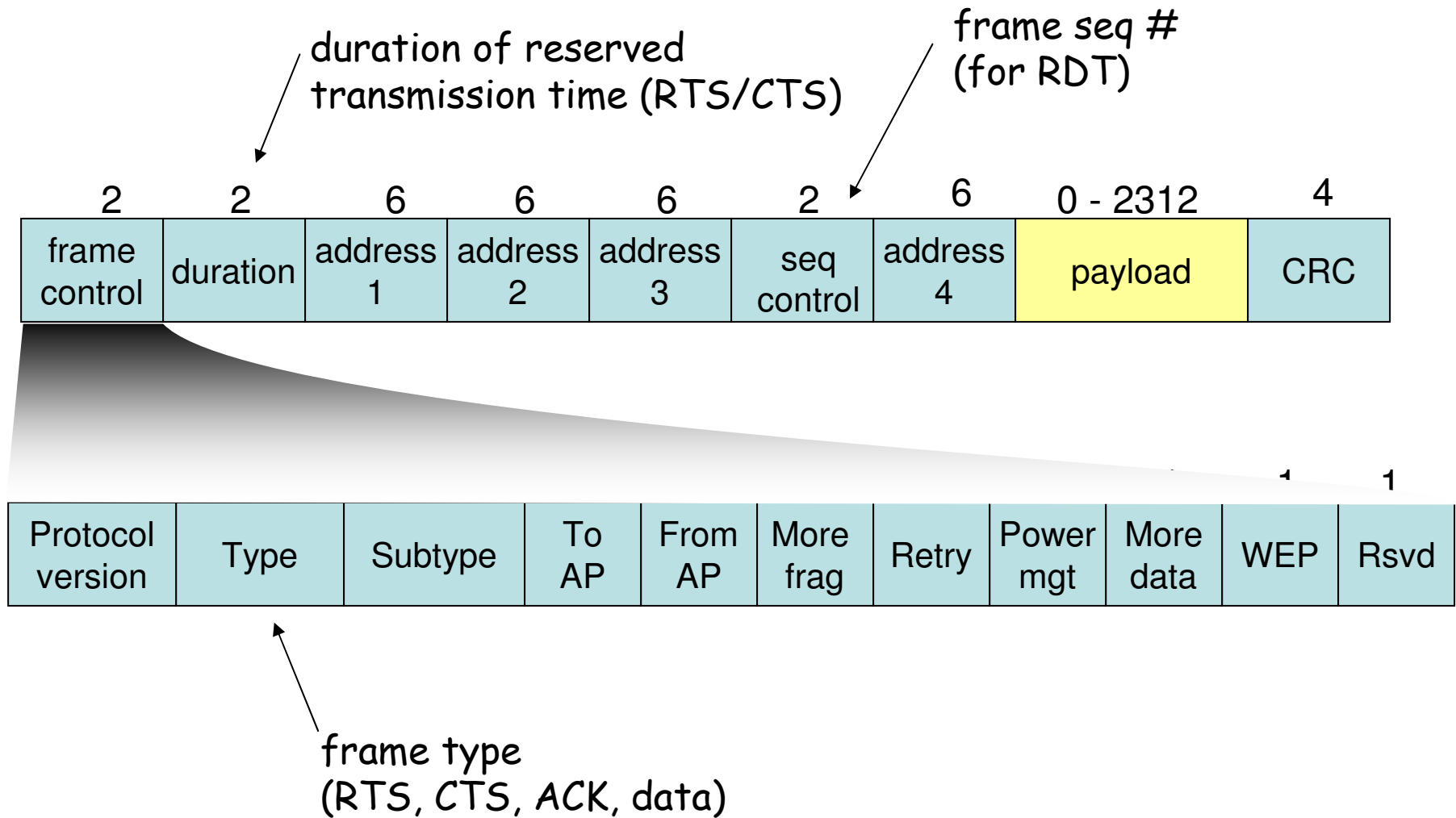
Address 3: MAC address of router interface to which AP is attached

Address 4: used only in ad hoc mode

802.11 frame: addressing



802.11 frame: more

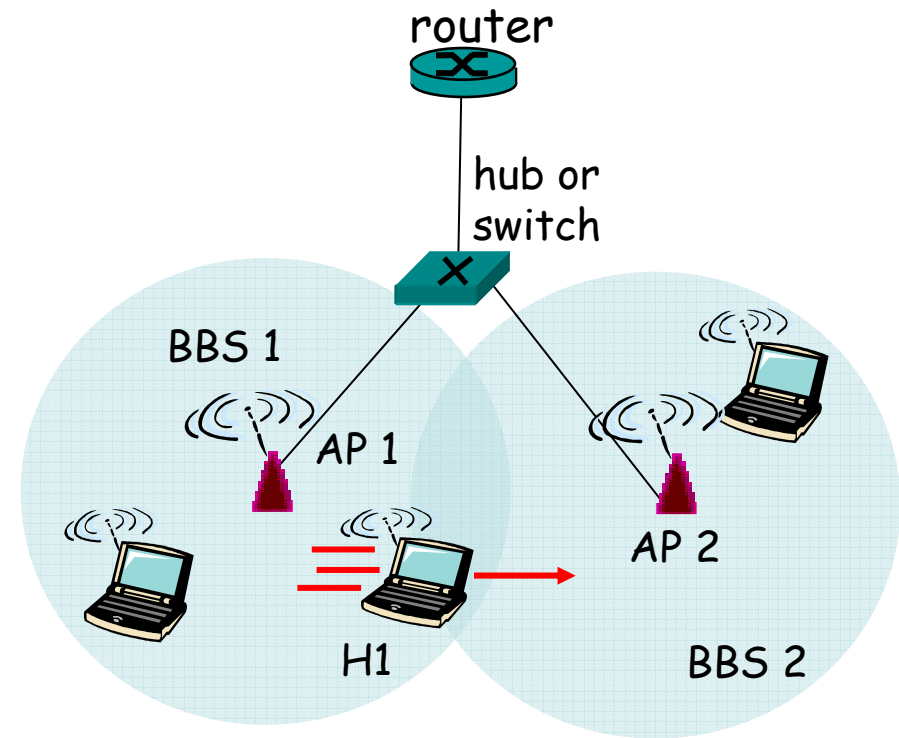


So Far

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 - 802.11 Frame Format
 - Mobility in the Same IP Subnet
- 802.15 Personal Area Networks
- 802.16 WiMax
- Network Address Translation (NAT)
- Cellular Internet Access
 - architecture
 - standards (e.g., GSM)
- **Mobility**
 - Principles: addressing and routing to mobile users
 - **Nobile IP**
 - **Handling mobility in cellular networks**
 - Mobility and higher-layer protocols

802.11: mobility within same subnet

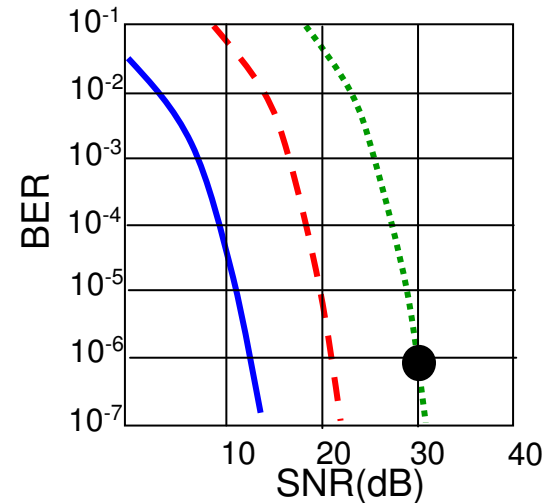
- H1 remains in same IP subnet:
IP address can remain same
- Switch: which AP is associated with H1?
 - self-learning: switch will see frame from H1 and “remember” which switch port can be used to reach H1



802.11: advanced capabilities

Rate Adaptation

- base station, mobile dynamically change transmission rate (physical layer modulation technique) as mobile moves, SNR varies



- QAM256 (8 Mbps)
- - - QAM16 (4 Mbps)
- BPSK (1 Mbps)
- operating point

- SNR decreases, BER increase as node moves away from base station
- When BER becomes too high, switch to lower transmission rate but with lower BER

802.11: advanced capabilities

Power Management

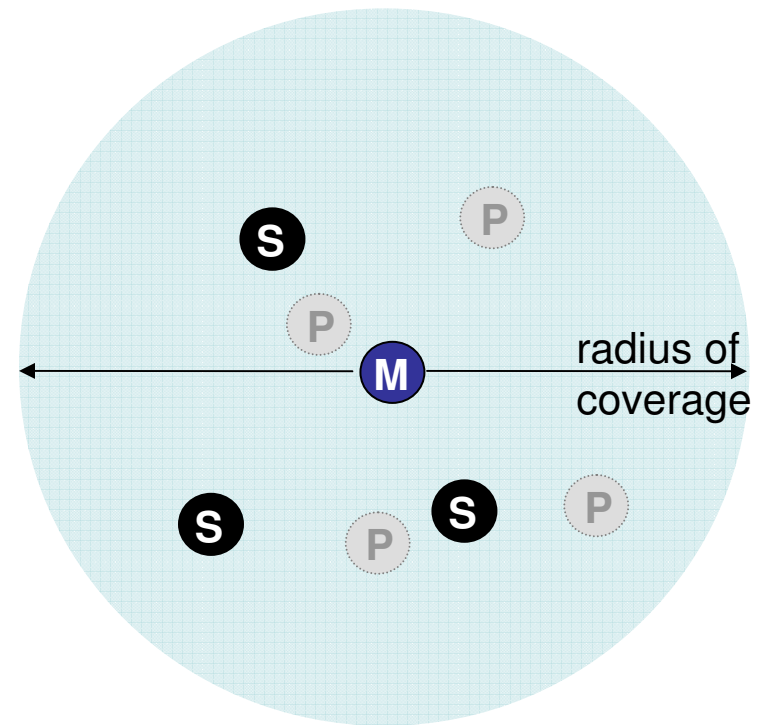
- node-to-AP: “I am going to sleep until next beacon frame”
 - AP knows not to transmit frames to this node
 - node wakes up before next beacon frame
- beacon frame: contains list of mobiles with AP-to-mobile frames waiting to be sent
 - node will stay awake if AP-to-mobile frames to be sent; otherwise sleep again until next beacon frame

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802.15: personal area network

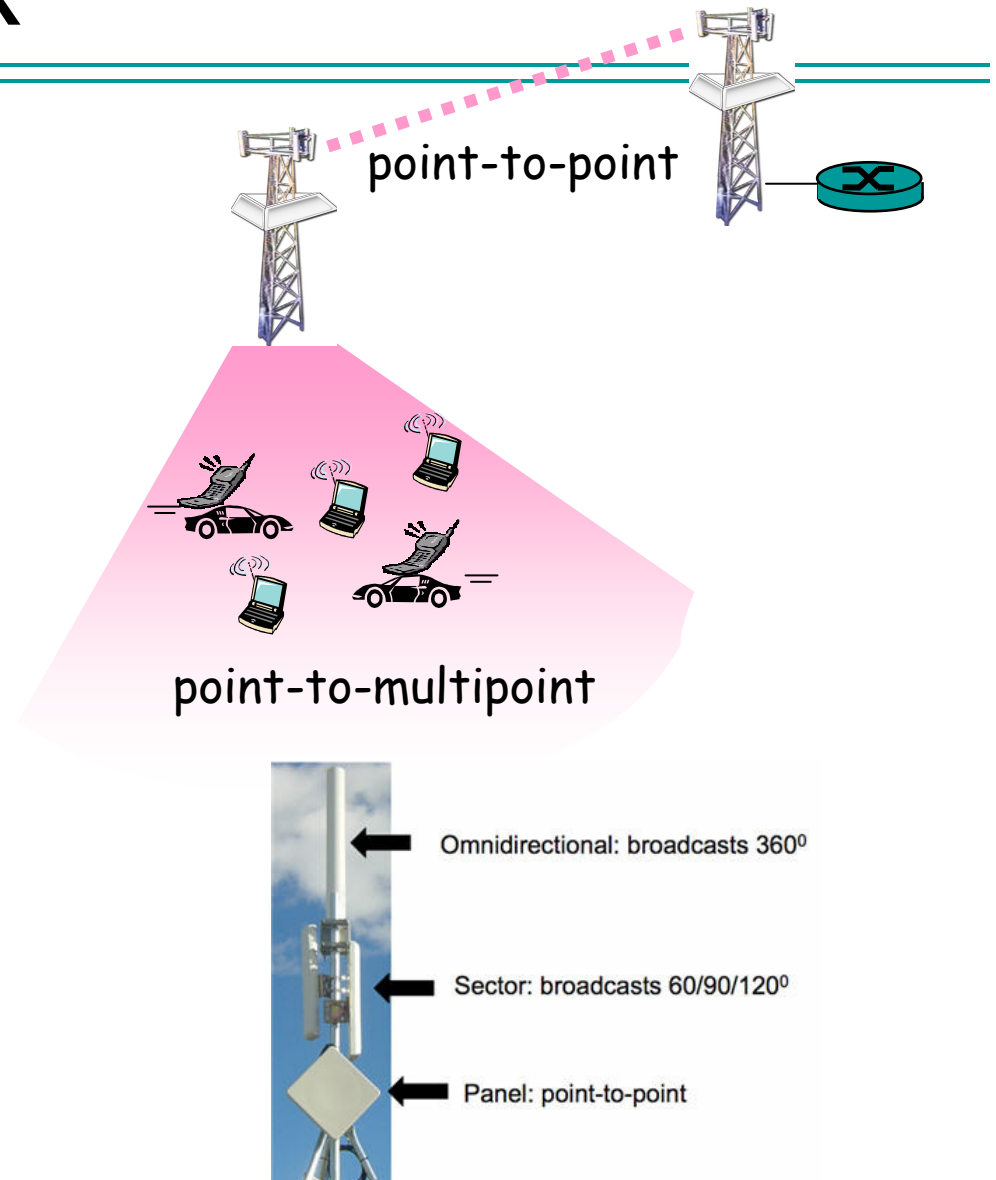
- less than 10 m diameter
- replacement for cables (mouse, keyboard, headphones)
- ad hoc: no infrastructure
- master/slaves:
 - slaves request permission to send (to master)
 - master grants requests
- 802.15: evolved from Bluetooth specification
 - 2.4-2.5 GHz radio band
 - up to 721 kbps



- M Master device
- S Slave device
- P Parked device (inactive)

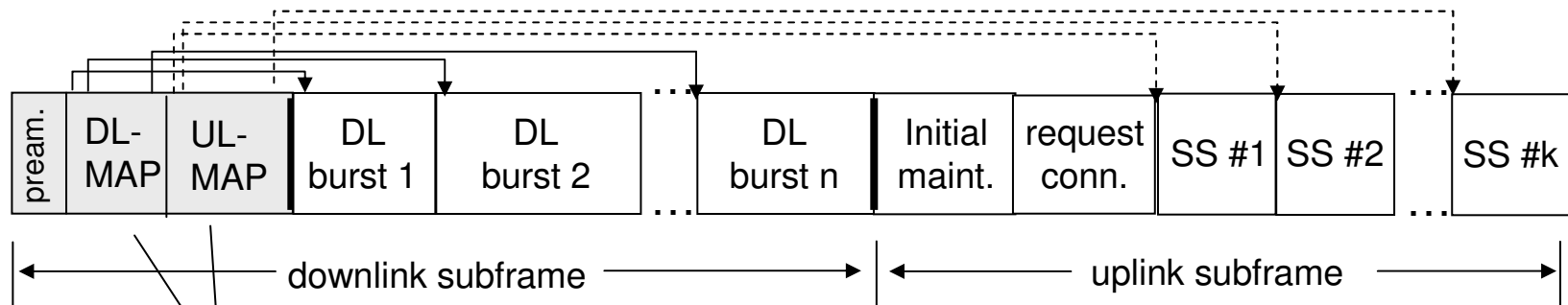
802.16: WiMAX

- like 802.11 & cellular: base station model
 - transmissions to/from base station by hosts with omnidirectional antenna
 - base station-to-base station backhaul with point-to-point antenna
- unlike 802.11:
 - range ~ 6 miles (“city rather than coffee shop”)
 - ~14 Mbps



802.16: WiMAX: downlink, uplink scheduling

- transmission frame
 - down-link subframe: base station to node
 - uplink subframe: node to base station



base station tells nodes who will get to receive (DL map) and who will get to send (UL map), and when

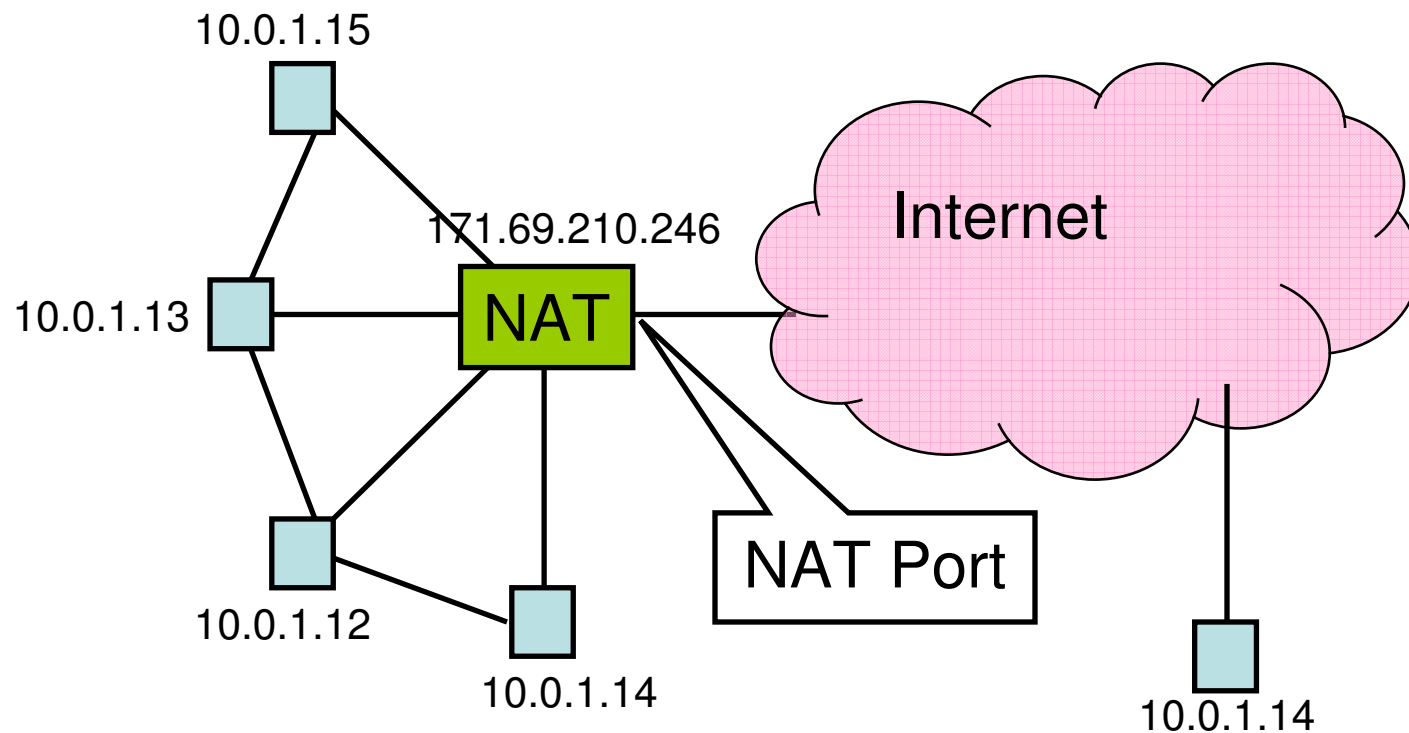
- WiMAX standard provide mechanism for scheduling, but not scheduling algorithm

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Network Address Translation

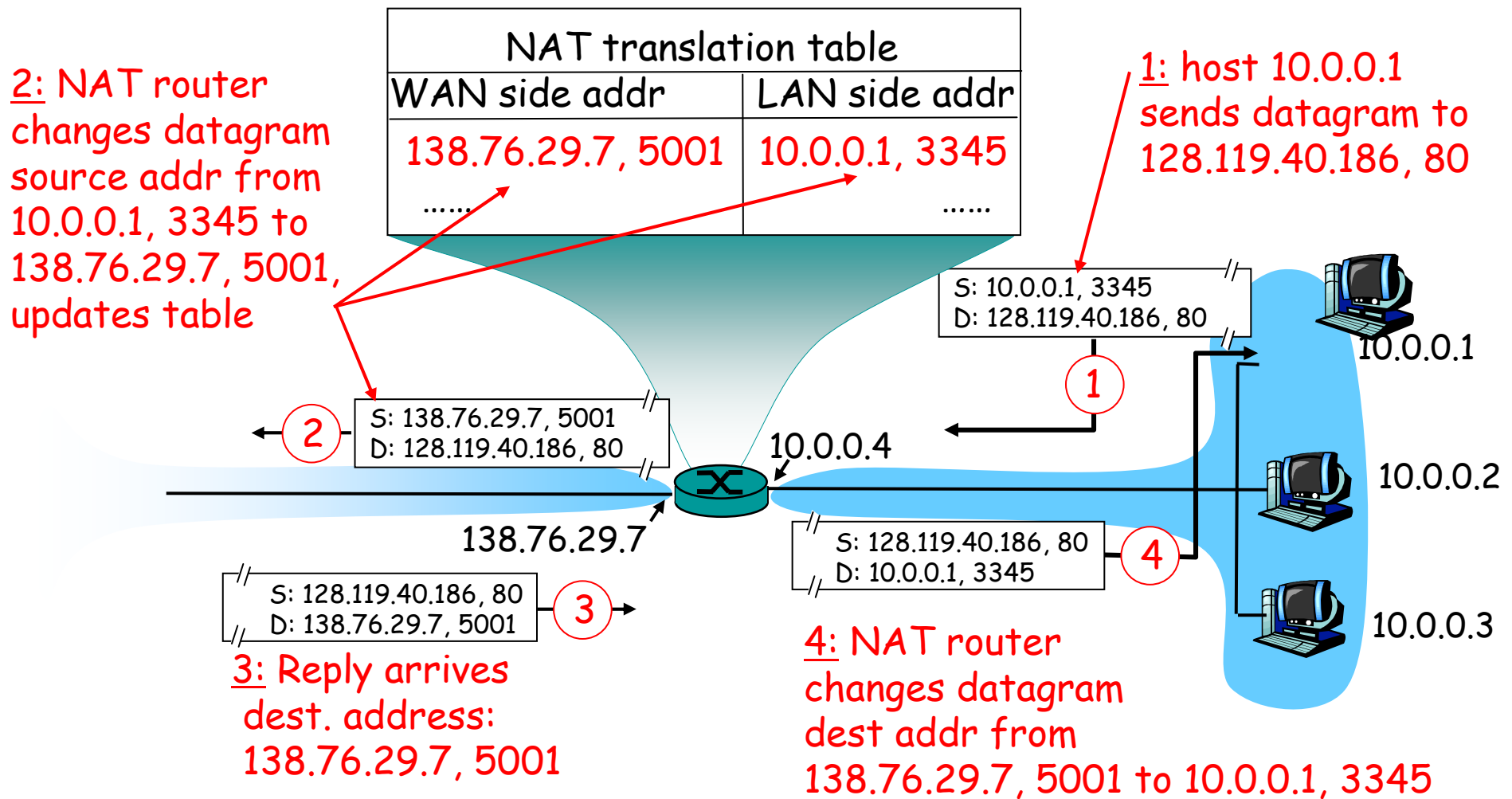
- Idea: Break the invariant that IP addresses are globally unique



NAT Behavior

- NAT maintains a table of the form:
 <client IP> <client port> <NAT ID>
- Outgoing packets (on non-NAT port):
 - Look for client IP address, client port in the mapping table
 - If found, replace client port with previously allocated NAT ID (same size as PORT #)
 - If not found, allocate a new unique NAT ID and replace source port with NAT ID
 - Replace source address with NAT address

NAT: Network Address Translation



NAT Behavior

- Incoming Packets (on NAT port)
 - Look up destination port number as NAT ID in port mapping table
 - If found, replace destination address and port with client entries from the mapping table
 - If not found, the packet is not for us and should be rejected
- Table entries expire after 2-3 minutes to allow them to be garbage collected
- "Private" IP addresses:
 - 192.168.x.x
 - 172.16.x.x
 - 172.31.x.x
 - 10.x.x.x

Benefits of NAT

- Only allows connections to the outside that are established from *inside*.
 - Hosts from outside can only contact internal hosts that appear in the mapping table, and they're only added when they establish the connection
 - Some NATs support firewall-like configurability
- Can simplify network administration
 - Divide network into smaller chunks
 - Consolidate configuration data
- Traffic logging
- Load balancing
- Robust failover

Drawbacks of NAT

- Rewriting IP addresses isn't so easy:
 - Must also look for IP addresses in other locations and rewrite them (may have to be protocol-aware)
 - Potentially changes sequence number information
 - Must validate/recalculate checksums
- Hinder throughput
- May not work with all protocols
 - Clients may have to be aware that NAT translation is going on
- Slow the adoption of IPv6?
- Limited filtering of packets / change packet semantics
 - For example, NATs may not work well with encryption schemes that include IP address information

Conclusion

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Components of cellular network architecture

