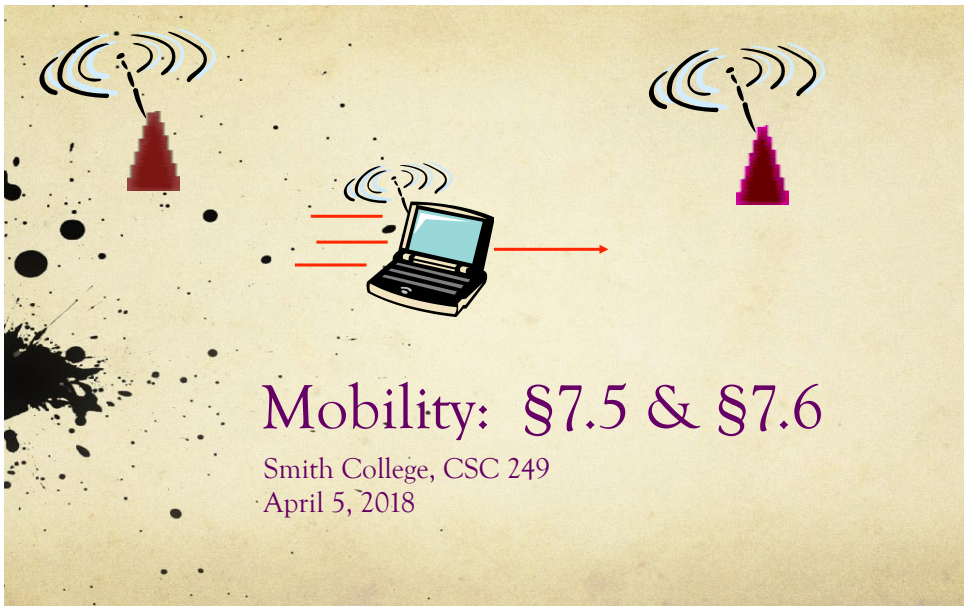


Mobility: §7.5 & §7.6

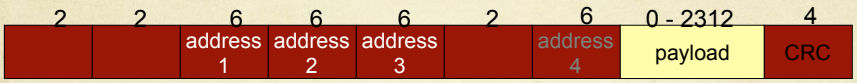
Smith College, CSC 249
April 5, 2018

Overview

- Wireless – addressing and frame structure
- Mobility
  - Within a single subnet
  - Between subnets
- Mobility vocabulary
- Acting out mobility

2

Wireless: 802.11 frame: addressing



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

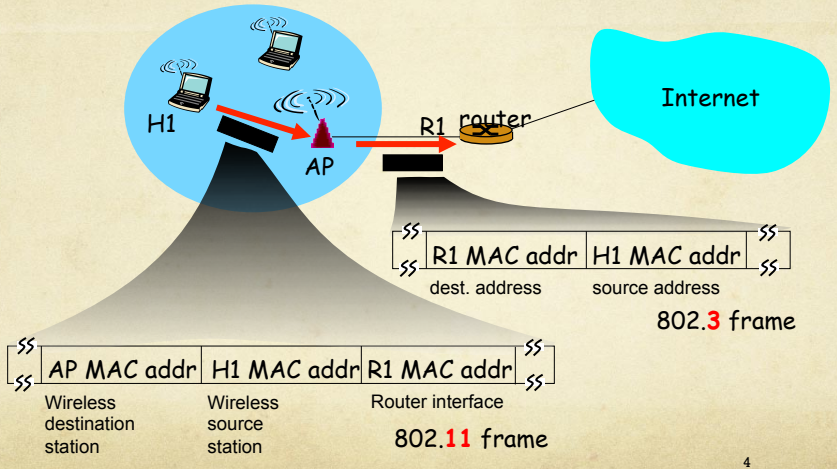
Address 2: MAC address of wireless host or AP transmitting this frame

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

Address 4: used only in ad hoc mode

3

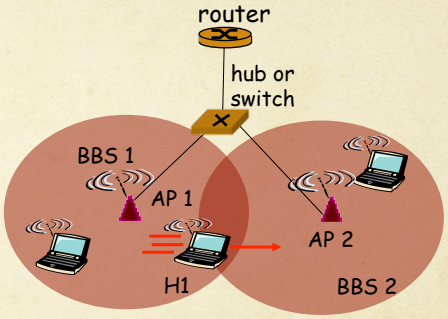
802.11 frame: addressing



4

802.11: mobility within same subnet

- H1 remains in same IP subnet: IP address will remain same
- How does the switch find H1 as it changes association from AP1 to AP2?
  - self-learning: switch will see frame from H1 and "remember" which switch port can be used to reach H1



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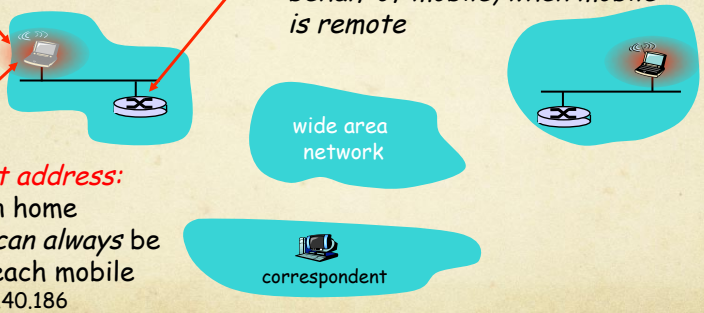
Mobility: Vocabulary

home network: permanent "home" of mobile (e.g., 128.119.40/24)

home agent: *entity that will perform mobility functions on behalf of mobile, when mobile is remote*



Permanent address: address in home network, *can always* be used to reach mobile e.g., 128.119.40.186

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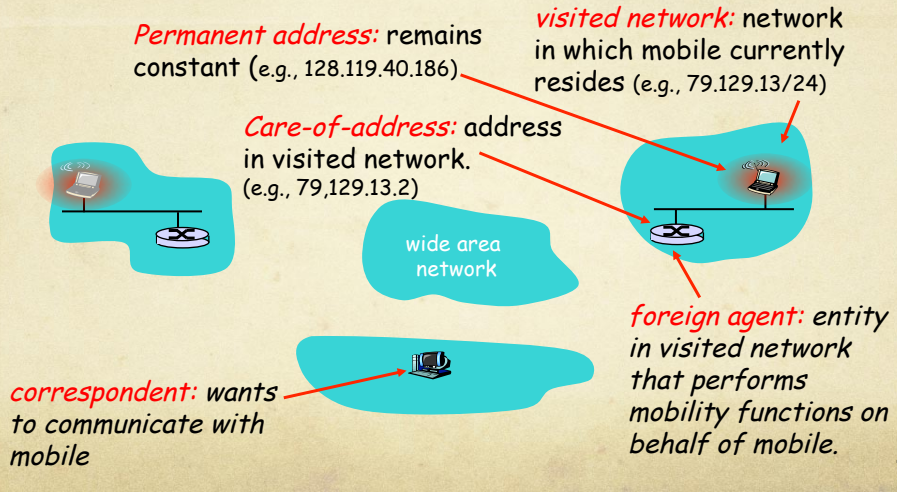
Mobility: more vocabulary



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Mobility: Registration

Protocols needed:

1) Mobile node to foreign agent – mobile node registers with foreign network and deregisters when leaves
2) Foreign agent to home agent registration – foreign agent registers the COA with the home agent → No deregistration of COA, because _?_
3) Home agent datagram encapsulation – datagram within a datagram, addressed to COA ('tunneling')
4) Foreign agent decapsulation – extract original datagram and forward to mobile node

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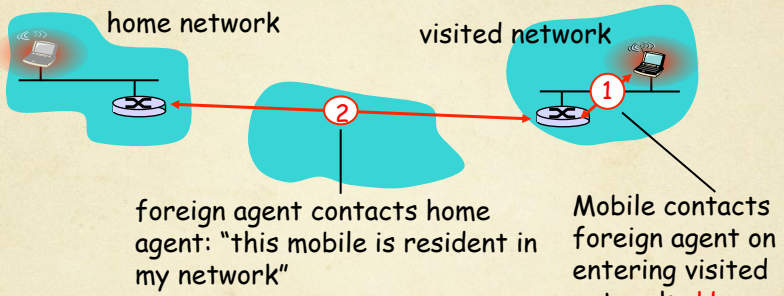
Mobility: Registration



End result:

- Foreign agent knows about mobile
- Home agent knows location of mobile

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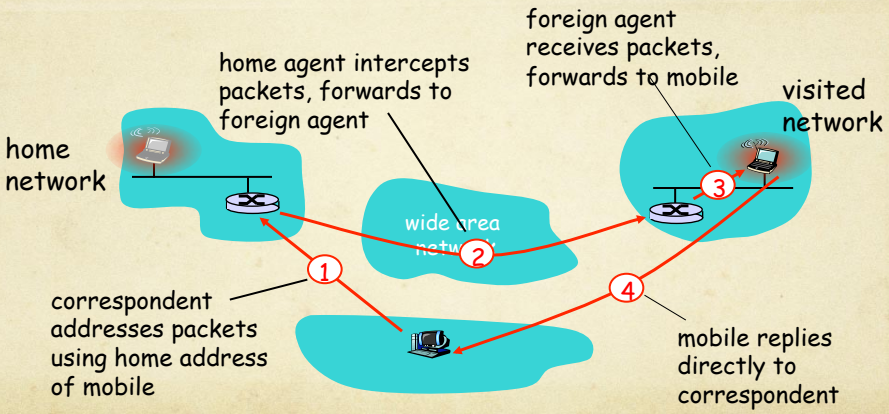
Mobility via Indirect Routing



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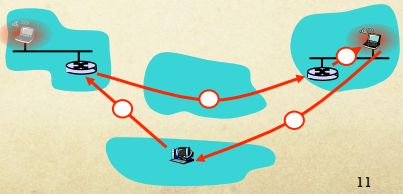
Indirect Routing: comments

- Mobile node has two addresses:
  - permanent address: used by correspondent (hence mobile location is *transparent* to correspondent)
  - care-of-address: used by home agent to forward datagrams to mobile
- (foreign agent functions may be done by mobile itself)



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Mobile IP

- Built upon Indirect Routing:
  - home agents, foreign agents, foreign-agent registration, care-of-addresses, encapsulation (packet-within-a-packet)
- Three components in the standard:
  1. agent discovery (using ICMP)
  2. registration with home agent (handshaking)
  3. indirect routing of datagrams

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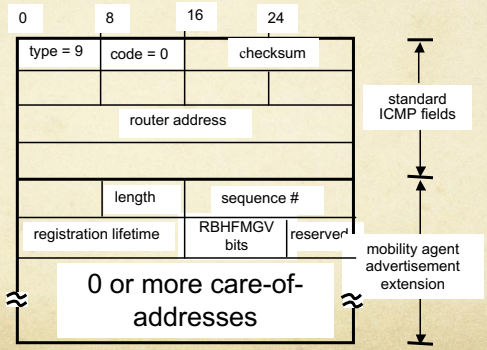
Mobile IP agent discovery, ICMP

- Agent advertisement: foreign/home agents advertise service by broadcasting ICMP messages (typefield = 9)



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ICMP: internet control message protocol

- Used by hosts & routers to communicate network-level information
  - error reporting: unreachable host, network, port, protocol
  - echo request/reply (used by ping)
- Network-layer "above" IP:
  - ICMP messages are carried in IP datagrams
- ICMP message: type, code plus first 8 bytes of IP datagram causing error

Type	Code	description
0	0	echo reply (ping)
3	0	dest. network unreachable
3	1	dest host unreachable
3	2	dest protocol unreachable
3	3	dest port unreachable
3	6	dest network unknown
3	7	dest host unknown
4	0	source quench (congestion control - not used)
8	0	echo request (ping)
9	**0**	**router advertisement**
10	**0**	**router discovery**
11	0	TTL expired
12	0	bad IP header

Act out Mobile IP

Need: home agent, foreign agent and mobile node

(i) Move to new network

(ii) Register

(iii) Receive and send messages

(iv) Move to new network and register

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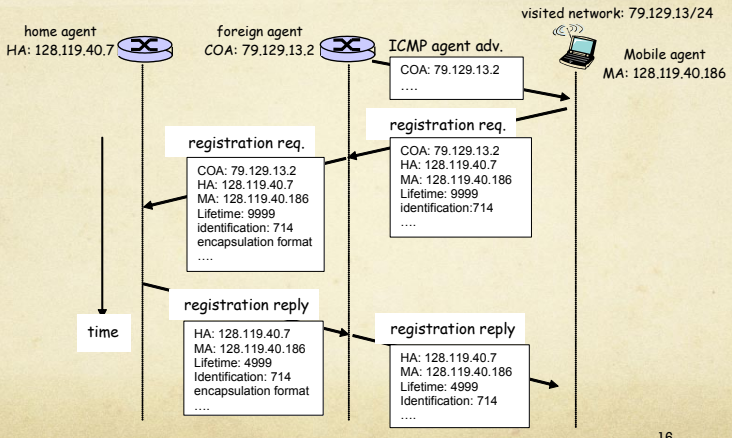
Mobile IP: Registration Example



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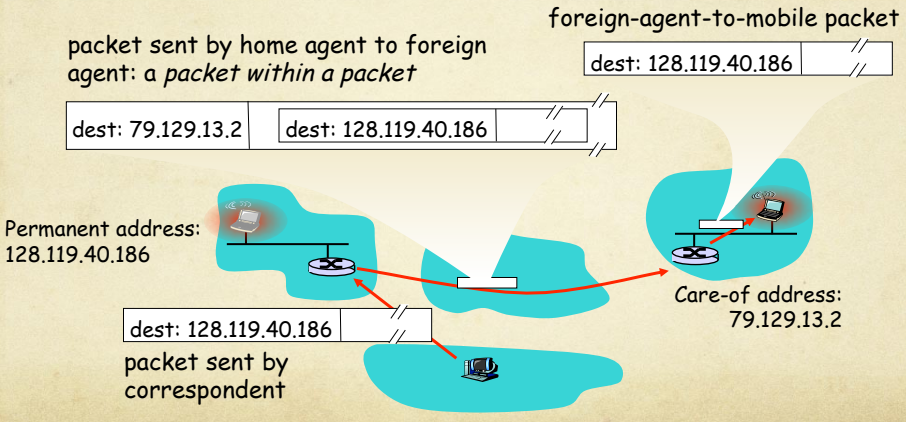
Mobile IP: Indirect Routing



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Mobile IP Question

- Consider two mobile nodes in a foreign network having a foreign agent. Is it possible for the two mobile nodes to use the same care-of-address in mobile IP? Explain
- Yes – COA can simply be the foreign agent (foreign router)

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Indirect Routing: Moving Between Networks

- Suppose mobile user moves to another network
  - Registers with new foreign agent
  - New foreign agent registers with home agent
  - Home agent update care-of-address for mobile
  - Packets continue to be forwarded to mobile (but with new care-of-address)
- Mobility, changing foreign networks transparent: *on going connections can be maintained*

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Wireless, Mobility: Impact on Higher Layer Protocols

- Logically, impact *should* be minimal …
  - Best effort service model remains unchanged
  - TCP and UDP can (and do) run over wireless, mobile
- … but performance-wise:
  - Packet loss/delay may increase
  - TCP interprets loss as congestion, will decrease congestion window un-necessarily
  - Delay impairments for real-time traffic
  - Limited bandwidth of wireless links

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Chapter 7 Summary

Wireless

- Wireless links:
  - Link characteristics
  - Error prone – why?
- Network characteristics
- IEEE 802.11 ("Wi-Fi")
  - CSMA/CA – know collision avoidance rationale and implementation

Mobility

- Indirect routing
  - Elements (actors)
  - Procedure
- Mobile IP
- Impact on higher-layer protocols

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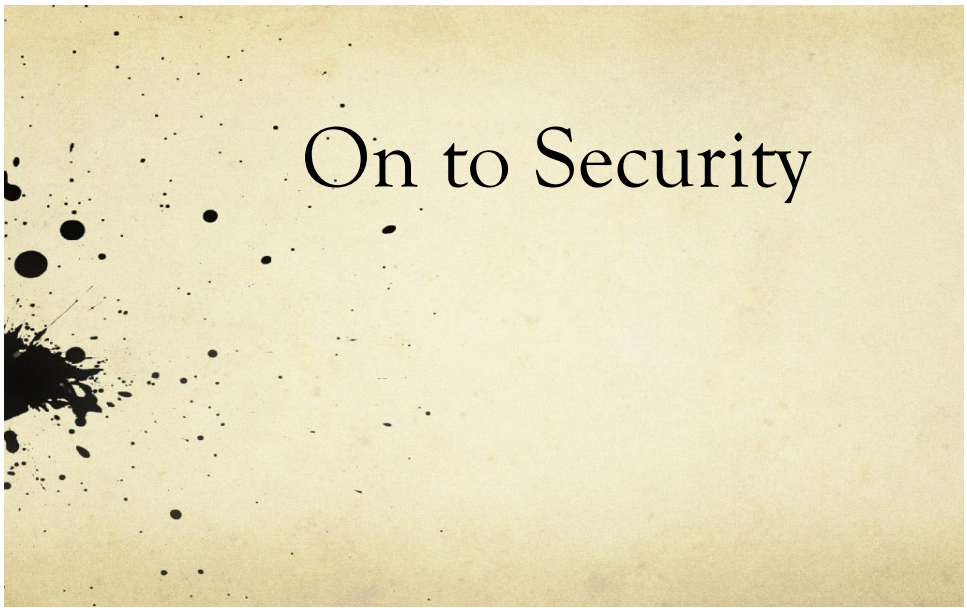

Network Security

- The principles of network security:
  - Access & availability
  - Cryptography, beyond "confidentiality"
  - Message integrity
  - Authentication
  - Securing each layer

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What is network security?

Access and Availability:

Confidentiality:

Data Integrity:

Authentication:

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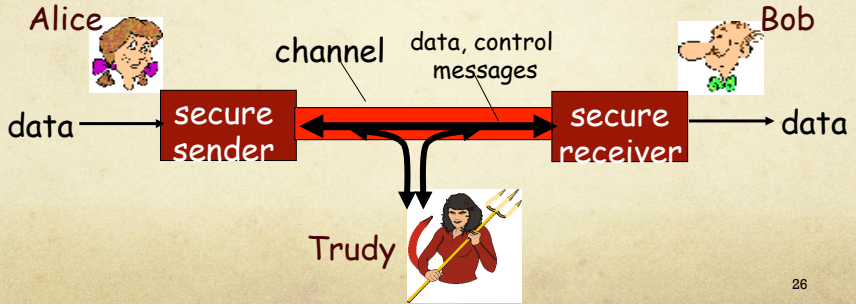
Friends and enemies: Alice, Bob, Trudy

- well-known in network security world
- Bob and Alice want to communicate "securely"
- Trudy (intruder) may intercept, delete, add and/or alter messages
- Who/what might Alice and Bob be?



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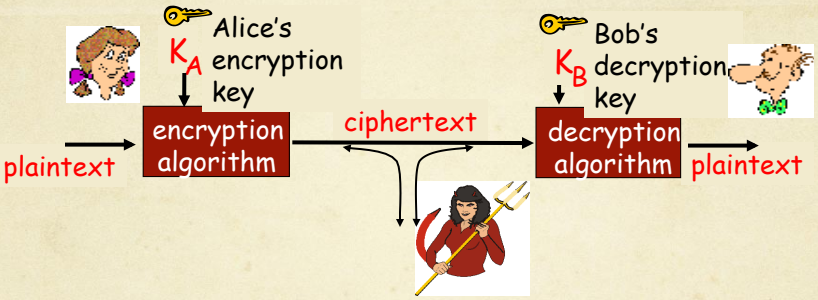
Cryptographic Keys



Symmetric key cryptography: sender & receiver keys are *identical* and *secret* (but known by 2 parties)

Public-key cryptography: the encryption key is *public*, the decryption key *secret*, and know only by one party

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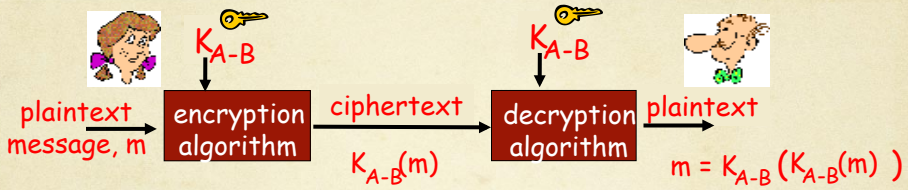
Symmetric Key Cryptography



Symmetric key cryptography: Bob and Alice share/know the same (symmetric) key: K

- e.g., key is knowing substitution pattern in mono-alphabetic substitution cipher

- Q: how do Bob and Alice agree on key value?

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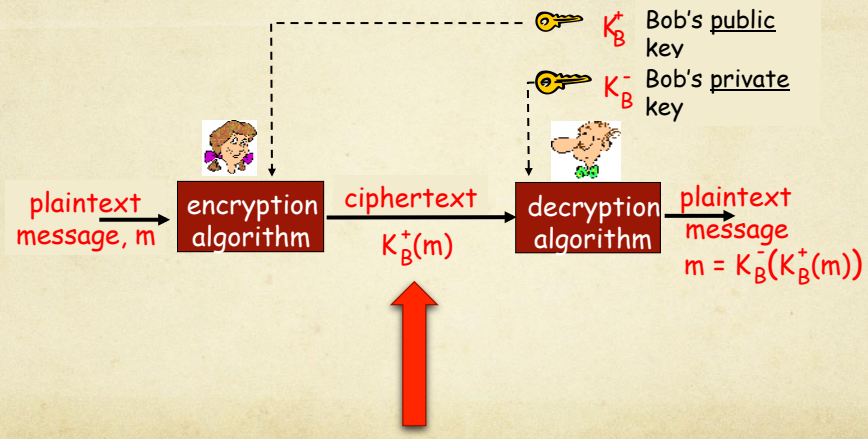
Public Key Cryptography



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RSA Important Property

The following property defines this method:

$$\underbrace{K_B^-(K_B^+(m))}_{\text{use public key first, followed by private key}} = m = \underbrace{K_B^+(K_B^-(m))}_{\text{use private key first, followed by public key}}$$

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