

# EVOLVING INTERNET

2020/2021



17/09

# MOBILE IP PROTOCOL (DIRECT/INDIRECT ROUTING)

ISSUES WITH MOBILITY ?

! IP vs ID

WHAT'S MOBILITY?  $\Rightarrow$  When you change GATEWAY or IP

## (1) FIND SOMEONE

- IP is a LOCATOR  $\rightarrow$  used to send packet to you
- ID is a IDENTIFIER  $\rightarrow$  used to find you
- BIG DNS  $\rightarrow$  way of giving an  $(IP, ID)$  tuple to you, the issue is that does not scale, is fixed

## (2) MAINTAIN CONNECTION

- IP == ID
- You cannot maintain a connection while moving, TCP/UDP protocols open an END TO END connection

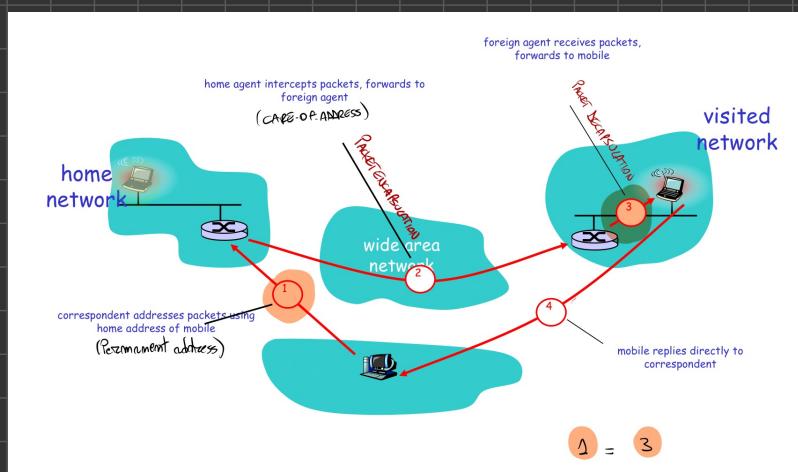
MOBILITY APPROACHES

(1) change routing  $\Rightarrow$  Not scalable (PERMANENT IP for every device)

$\hookrightarrow$  used in JAPAN to handle INFRASTRUCTURE FAILURE for EARTHQUAKE

(2) let end point handle it : DIRECT AND INDIRECT ROUTING

- INDIRECT ROUTING



PRIVACY ADVANTAGE

• The sender, in this way, knows only your HOME ADDRESS

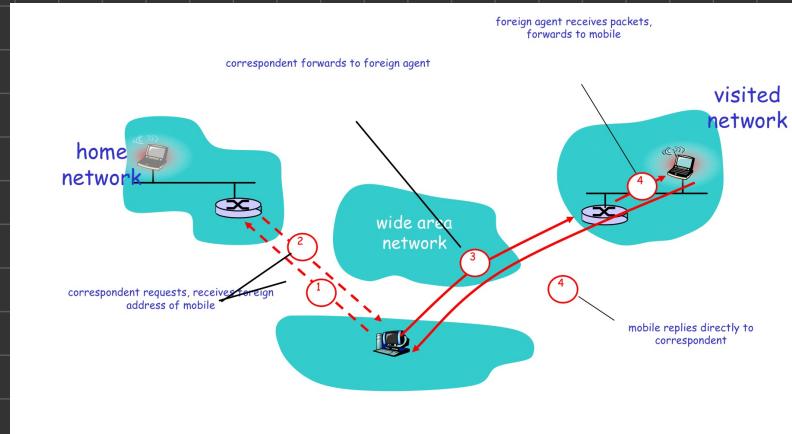
BUT

• WORST CASE : given d the diameter of the network

- in INDIRECT ROUTING is  $4d$  ( $\text{if you are in the same position of the sender}$ )

- in DIRECT ROUTING the longest distance is  $2d$

## - DIRECT ROUTING

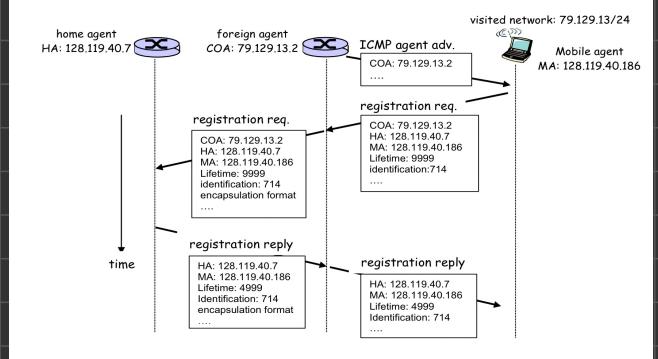


- In ③ there is a legal IP spoofing
- not the privacy of indirect routing

NOTE

## ICMP SIGNALING

IN MOBILE  
(registering  
to a foreign  
network)



## WIRELESS NETWORKING

NOTE

### Scenarios

- INFRASTRUCTURE BASED
- AD HOC



### SINGLE VS MULTI HOP

	Infrastructure-based	Infrastructure-less
Single hop	Base station connected to larger wired network (e.g., WiFi wireless LAN, and cellular telephony networks)	No wired network; one node coordinates the transmissions of the others (e.g., Bluetooth, and ad hoc 802.11)
Multi-hop	Base station exists, but some nodes must relay through other nodes (e.g., wireless sensor networks, and wireless mesh networks)	No base station exists, and some nodes must relay through others (e.g., mobile ad hoc networks, like vehicular ad hoc networks)

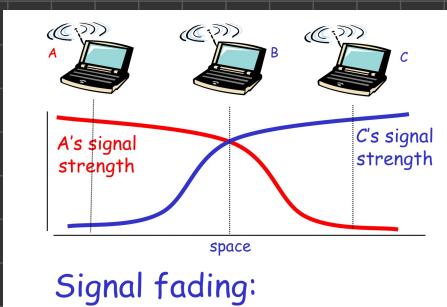
## ISSUES WITH WIRELESS LINKS

- Signal can decrease NATURALLY or by INTERFERENCES
- Multi-path propagation: signal reflects on objects, ground etc...

Does CSMA works for wifi?



Hidden terminal problem



Signal fading:

- CSMA not work because A is aware if C is already communicating with B

- A cannot sense if C is transmitting because of the signal fading

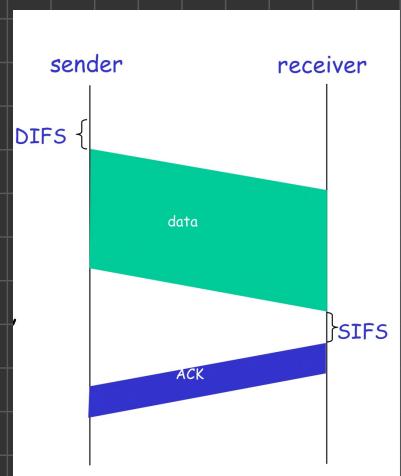
## CSMA/CA

- We can use CSMA/CA, Protocol for COLLISION AVOIDANCE (but not detection)

→ DIFS: wait time to check if there are connection

→ SIFS: same as DIFS but shorter

→ Sender wait for ACK, if it don't receive there is a COLLISION

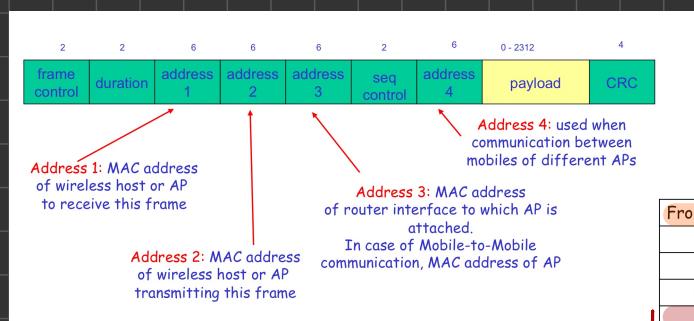


- To avoid loss of big packet we can use 2 small one: REQUEST-TO-SEND (RTS) and a CLEAR-TO-SEND (CTS). CTS is broadcasted from the receiver of the RTS
- If RTS collide the sender should wait some RANDOM TIME before sending a second RTS

Note

# FRAME

## ADDRESSING

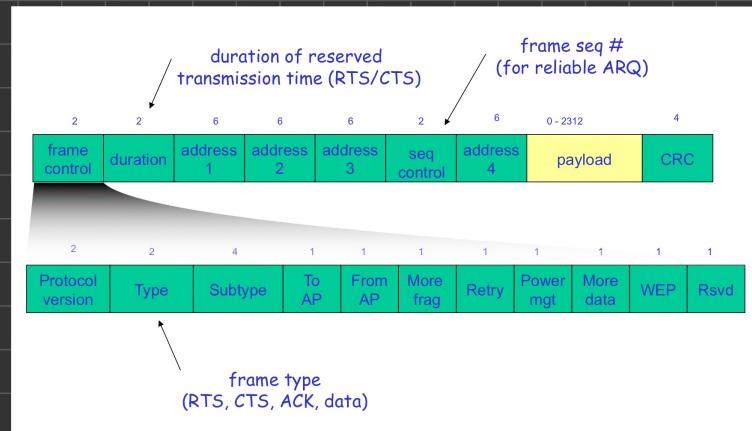


How to put addresses

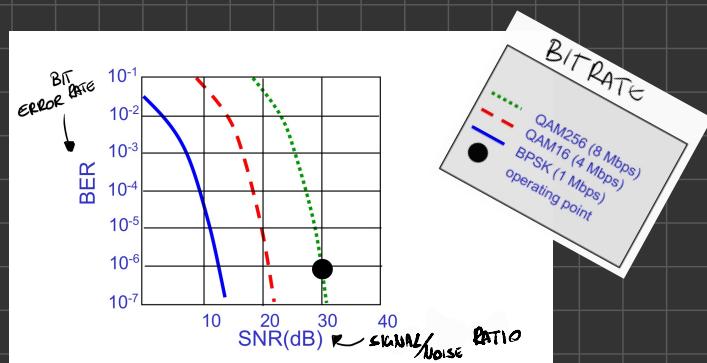
From AP	To AP	Add 1	Add 2	Add 3	Add 4
0	0	Dst M	Src M	AP	0
1	0	Dst M	AP	Src R	0
0	1	AP	Src M	Dst R	0
1	1	Dst AP	Src AP	Dst M	Src M

→ NO ROWER, just communication by two ACC. POINT.

## OTHER FIELDS



- If we decrease bit rate, the BER decreases, because it's like speaking slowly in noisy room



## FAIRNESS PROBLEM

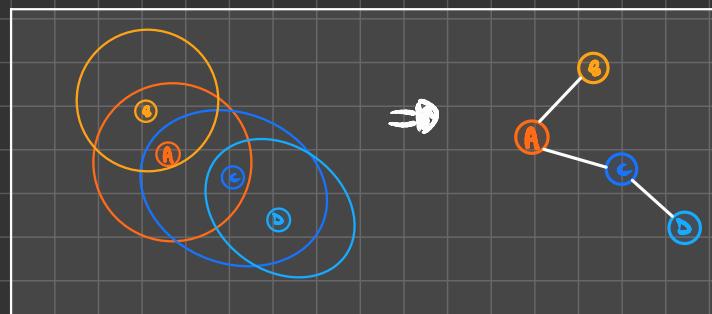
- You have 2 stations transmit at 11 Mbps and 1 Mbps
- one occupy the channel  $\frac{1}{12}$  and the other  $\frac{11}{12}$ , so the channel occupation is divided in a way that they transmit at the same throughput, the second sends more packet per s

26/09/21

# MANET (MOBILE AD HOC NETWORK)

## DYNAMIC TOPOLOGY

- Every node can be a ROUTER!
- We can draw a graph by checking neighbours in the communication range of every node, it has more links than a traditional network
- a MANET should check neighbours continuously (the topology changes fast)



## Assumption

## TCP / IP

- We will assume the END-TO-END principle in the order of milliseconds, so a path should be stable for some milliseconds
- Only END HOST will need TCP, every node in between is used just for IP routing.
- A Node has only one INTERFACE (only one IP address), a normal router can have multiple interface

## ROUTING

- We can choose :
  - SOURCE ROUTING : Path is computed at the sender; so routing tables are not needed
  - Hop-By-Hop Routing : Routing decision are made in intermediate nodes  
↑  
BEST OPT.

## MANET PROTOCOLS

### REACTIVE Protocols

- Network compute the path only if I ask it. there is overhead when you ask for a route

### PROACTIVE Protocols

- Node are continuously computing routes, when you ask for it, it will be ready. it uses routing tables

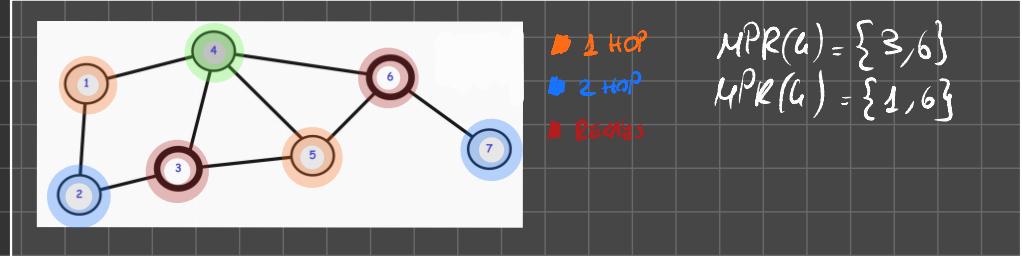
### OLSR protocol (OPTIMIZED LINK STATE ROUTING)

- PROACTIVE and Hop-by-Hop Protocol
- Nodes get infos only from Neighbourhood
- Uses MULPOINT RELAYS nodes to send infos (Reducing Flooding)

### MPR(i)

How do we choose relays?

→ Every mode  $i$  select a set  $MPR(i) \subseteq N(i)$  in such a way that every 2-hop neighbor of  $i$  is covered by its 1-hop relays

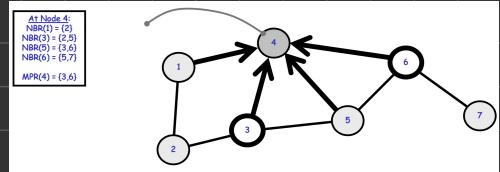


$MR(i)$

- A MULTI-POINT SELECTOR set  $MS(i)$  for a mode  $i$  is the set of nodes that has chosen  $i$  in their  $MPR$  set

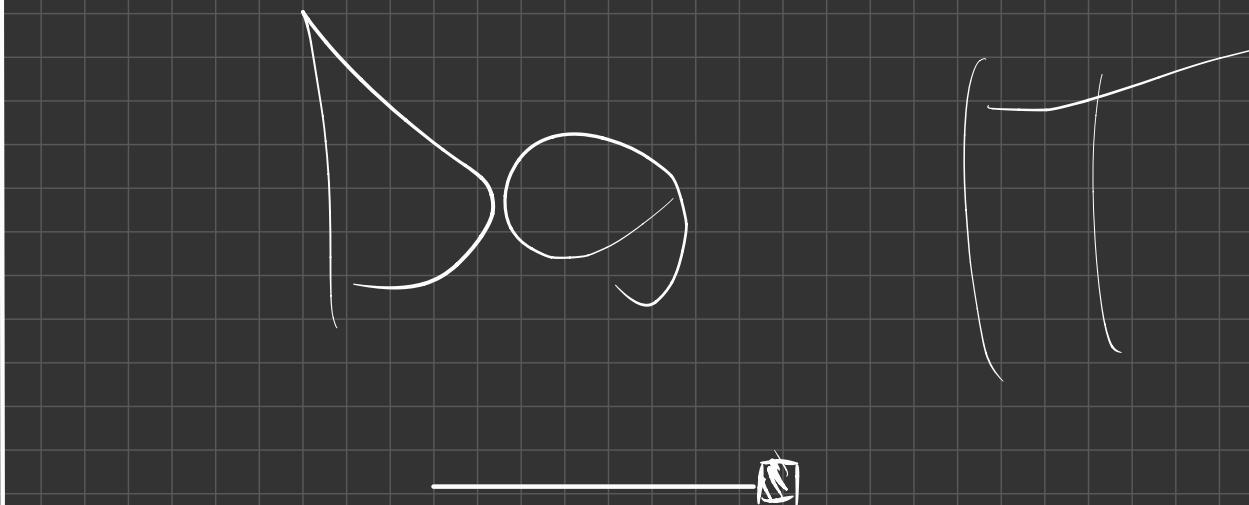
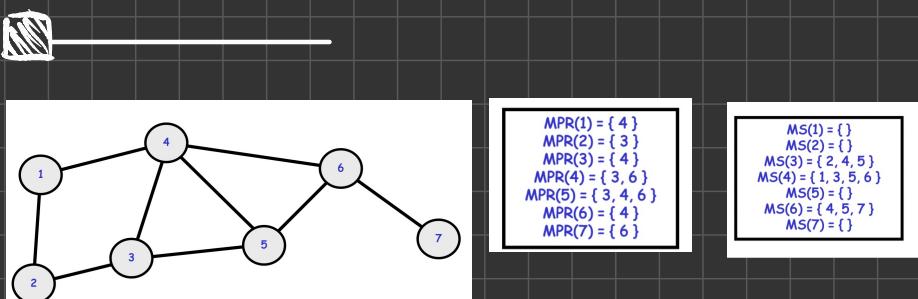
**HELLO** MSG

- Hello messages are sent periodically to 1-hop neighbors, in order to determine MPRs, by checking 2-hop neighbors thanks to the neighbor list in the HELLO msgs



**TC** MSG

- used to send topology infos from MPRs to their MS; only MPR modes propagate TC msgs



# AODV protocol (Ad Hoc on demand distance vector)

- ACTIVE (on demand) and Hop-By-Hop so DYNAMIC TABLES are stored on intermediate nodes of active path
- Every node stores { NODE SEQ. NUMB. , BROADCAST ID }
- Source request a route by BC to N(SOURCE) on RREQ packet

→ Source AND DEST seq. numbers are used to check the version of the path (How much fresh it is?)

→ (SRC-ADD, BC-ID) is the key of the RREQ msg.

↳ BC-ID is incremented for each RREQ packet sent.

type	flags	resvd	hopcnt
broadcast_id			
dest_addr			
dest_sequence_#			
source_addr			
source_sequence_#			

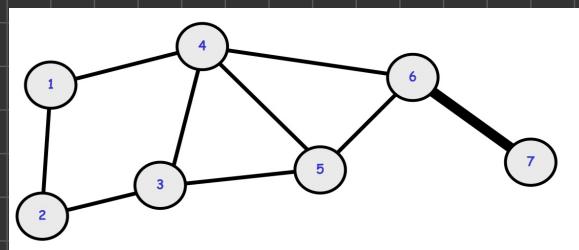
## RREP MSG

- sent if RREQ reaches a node who knows the destination
- Hop-count is needed to choose between multiple RREP packets

type	flags	rsvd	prsz	hopcnt
dest_addr				
dest_sequence_#				
source_addr				
lifetime				

## RERR MSG

- If a node on (s,t)-path detect an error (ex. node crashed), a RERR is sent to s with Hop-Cnt =  $\infty$



- Node 1 needs to send a data packet to Node 7
- Assume Node 6 knows a current route to Node 7
- Assume that no other route information exists in the network (related to Node 7)

