



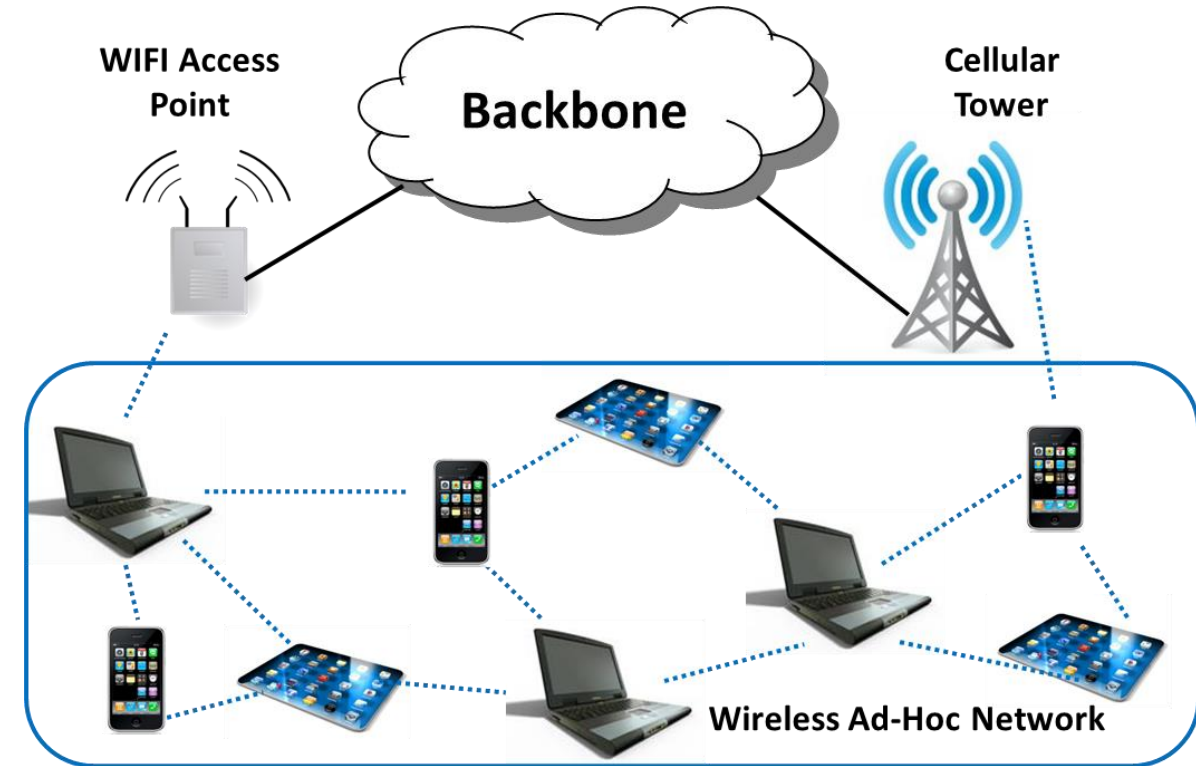
Mobility and MANET

Intelligent Transportation Systems

Rolland Vida

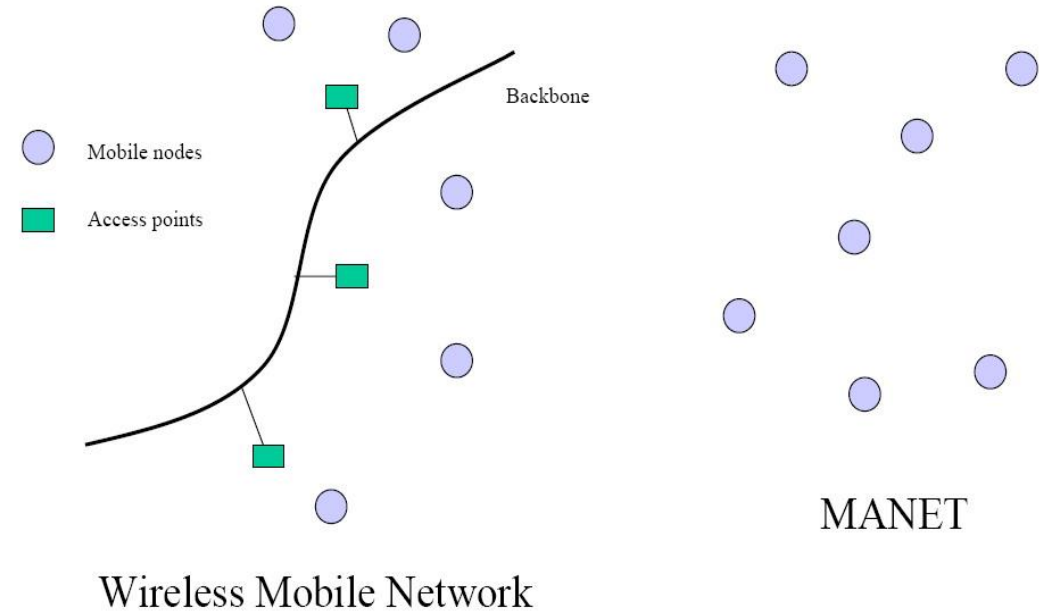
Overview

- MANET – Mobile Ad Hoc Networks
- Meaning of „Ad Hoc”
 - Immediate, provisional, without preparation



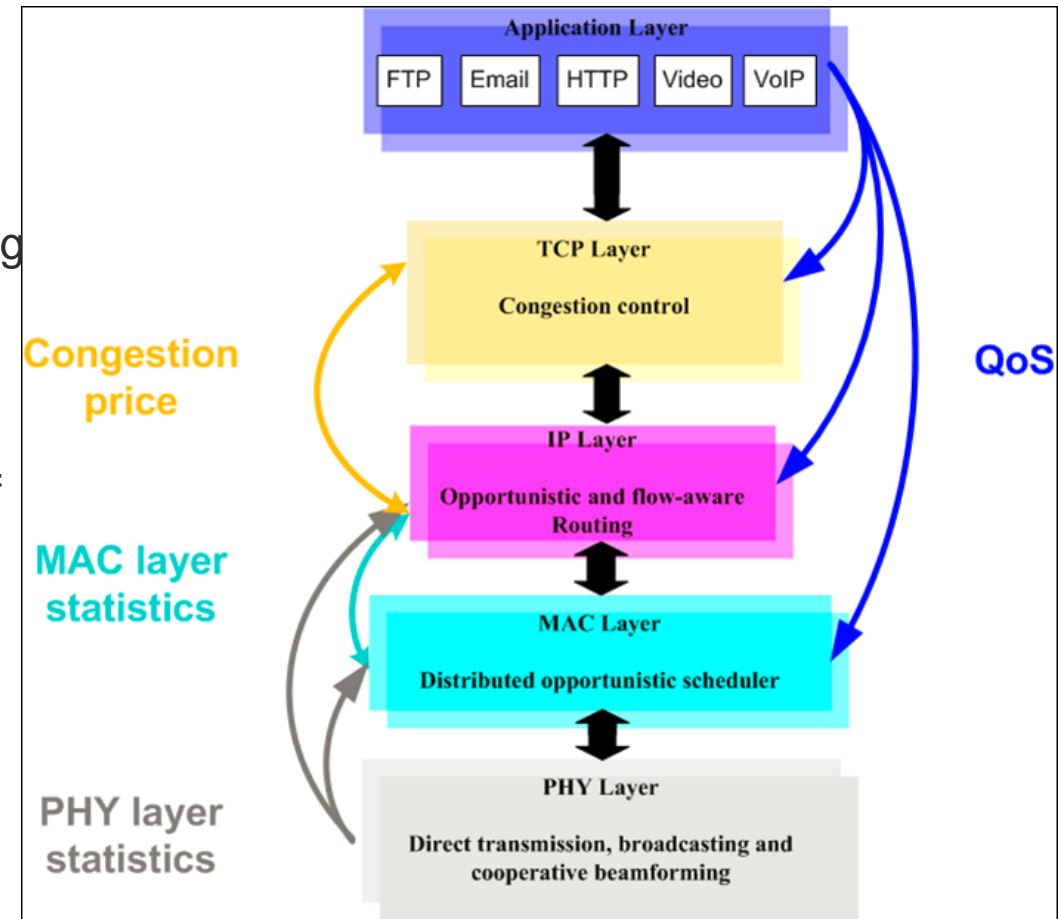
Ad hoc networks

- **No available infrastructure**
 - No internet connections, gateways, access points
 - No dedicated, deployed servers (AAA, DHCP, etc.), or services
- **No addressing based on IP subnets**
 - A problem for „classical” routing protocols
- **No reliable (stable) network devices**
 - Services provided by neighbors, fellow peer nodes
 - The status of my neighbor can change at any time – depleted battery, increased distance, etc.
 - I do not know my neighbors, I do not know if I can trust them
- **Self-organization**
 - Peer-to-peer paradigm (on the networking layer)
- **Multihop**
 - Communication (routing) over several hops (devices)



MANET research topics

- Physical layer -> „mobility models”
 - Energy-efficient operation – adjusting radio power, sleep scheduling
 - Mobility-aware radio technologies
- **Data-link layer**
 - MAC (shared medium access, efficiency, decreasing the chance of collisions)
- **Networking layer**
 - Routing (dynamically changing topology, prefix-based routing not working)
- Upper layers
 - Packet retransmissions, TCP (packet loss, unreliable transmission medium)
 - Security (can be extended to any of the layers)
- Cross-layer optimization
 - The parallel optimization of several layers in the ISO/OSI model
 - Each layer might have its own influence over mobility

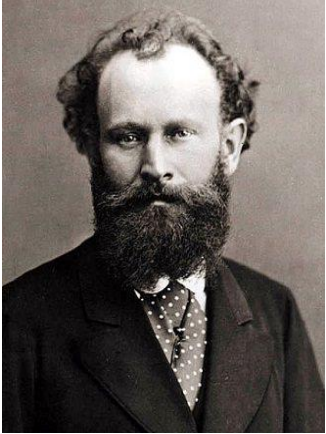


Mobility types

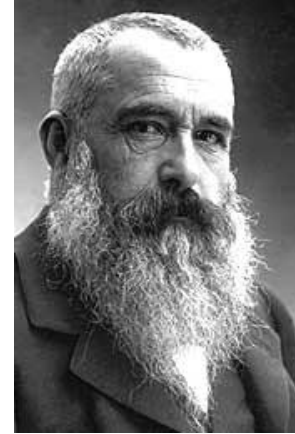
- **Nomadic** mobility (nomadicity)
 - No communication while moving – device turned off
 - When restarting, new IP address, rebuilding the interrupted connections
- **Slow** mobility
 - E.g., people walking around in a building
 - University campus – students walking, biking
- **Fast** mobility
 - Cars, bikes, ...
- Moving networks...

MANET vs. MONET

Edouard MANET



Claude MONET



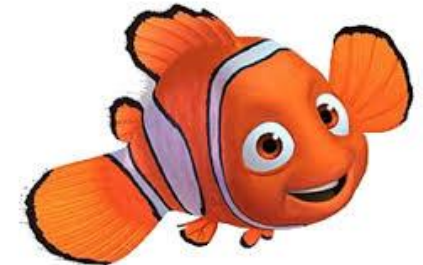
Mobile Ad Hoc Network

Moving Networks

- Networking devices moving together
 - E.g., passengers in a train, metro, bus, airplane
- Alternative name
 - **Networks in Motion – NEMO**

NEMO – Networks in Motion

- Many MNs moving together
 - If they move together, let's handle their mobility together
- MR (mobile router) – default gateway
 - Provides the connection between NEMO-members and the outside world
 - Dedicated device, or one among the others assuming this role (periodic role changes)
 - Usually the biggest battery, the largest bandwidth, etc.
- The MNs have to register at the MR
 - They belong to the subnetwork of the MR
 - “Fixed” nodes in the network (relatively to the MR), their relative position does not change
 - Called also Fixed Local Nodes (FLN) because of that



NEMO efficiency depends on the environment

- (Possible) drawbacks:

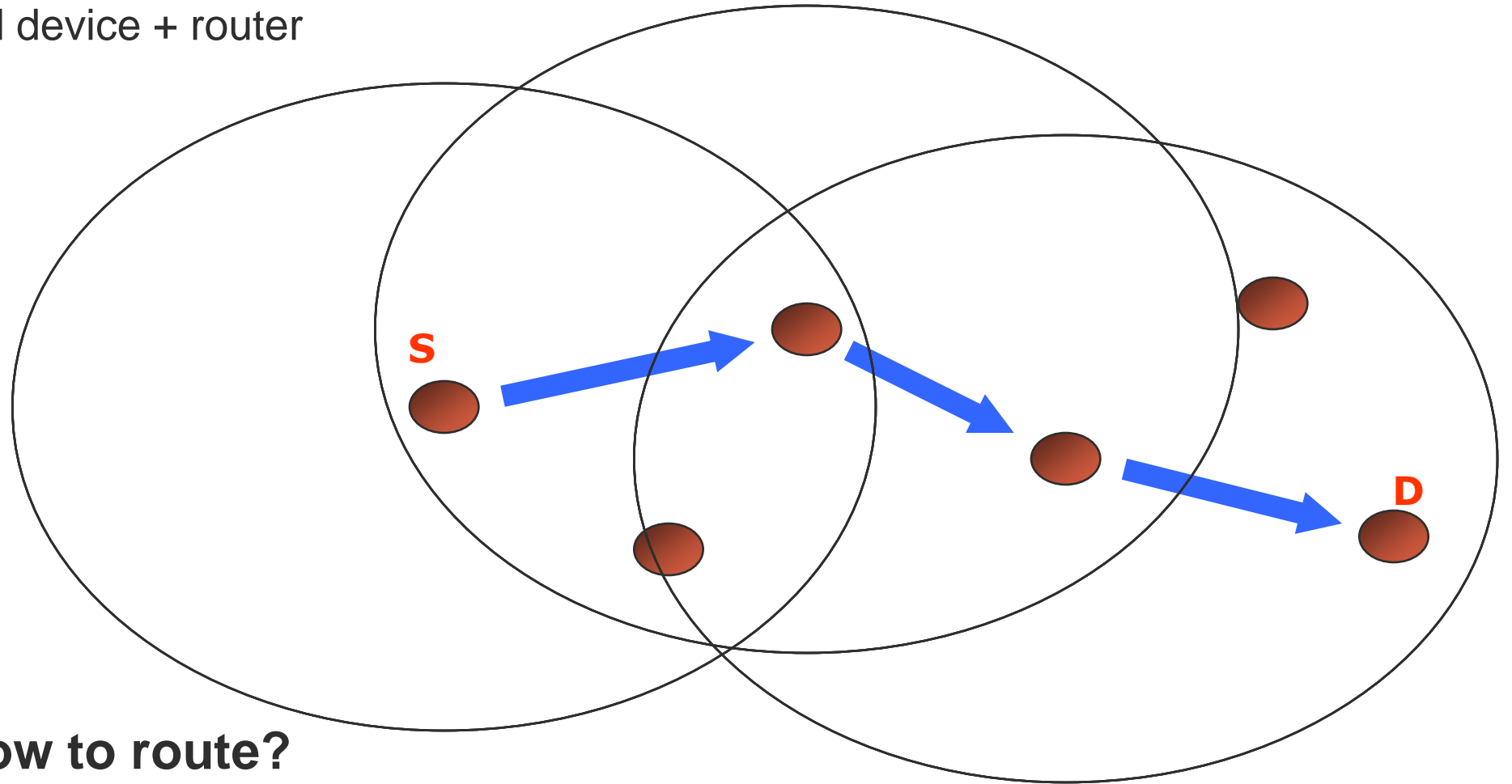
- Case of 100 MNs with 3G/4G mobile internet access in a city
- If the MNs do not join the NEMO
 - - personal mobility management needed for all the 100 MNs
 - + Any one of them receives the bandwidth provided by the given technology
- If all the MNs join the same NEMO
 - The MR link capacity becomes a bottleneck
 - In the worst case, the MNs receive only 1/100 of the bandwidth provided in the previous case

- (Possible) advantage:

- If 100 MNs on an airplane want to connect to the internet
 - The dedicated MR is the only node being able to connect
- Mobility management is optimal
 - Only the mobility of the MR has to be handled

MANET routing

- Point-to-point
- Mobile node = end device + router

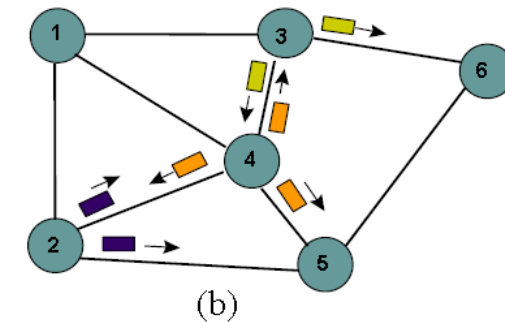
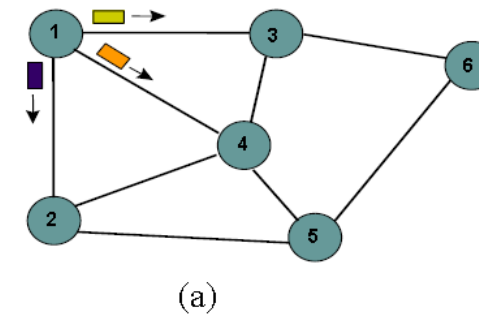
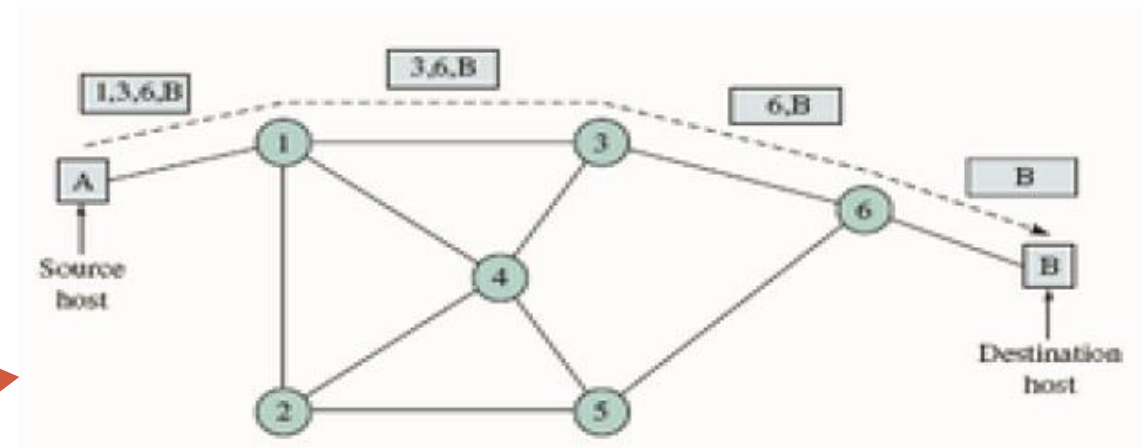


- **Who knows how to route?**

Where to send the packet?

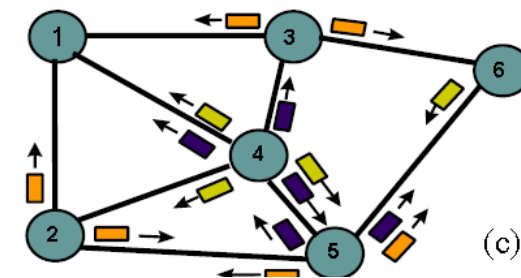
- **Sometimes only the source knows**

- All the route is stored in the header
 - Packet is routed based on the header
- **Source routing**, as the entire route is decided by the source
 - **E.g., Dynamic Source Routing (DSR)**
- Header can grow large
 - Fragmentation, low efficiency
 - Especially if long routes and not much data



- **Sometimes nobody knows**

- **Flooding** solutions
 - Everyone rebroadcasts the received packet
 - Hopefully it will reach the destination
- High burden on the wireless network, where resources are limited



About routing in general

- Many routing protocols were developed
 - Some specific to MANETs
 - Some others adapted from the wired networks
- There is no one-size-fits-all protocol, which performs well in all circumstances

- Desired features for a MANET routing protocol
 - Distributed operation
 - Loop-free
 - Operation on demand
 - Security
 - Support for „sleeping” cycles
 - Support for one-directional links

Topology-based routing

- **Proactive routing**

- The routing table is continuously maintained
 - No matter if there is traffic or not
- Relatively stable networks
- DSDV – based on the Bellman-Ford algorithm

- **On demand, reactive routing**

- Builds a route only if needed, if a packet has to be sent to the destination
- The routes are temporary, are dismantled if not used
- AODV

- **Hybrid protocols**

- Combining the previous two

