Infrastructure-less networks

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Convergent Networks and Services (VITMM156)

Overview

Overview

- MANET – Mobile Ad Hoc Networks
- Why MANET?
  - Where are they used?
  - How much need is for their deployment?
  - What about their future?

What does „Ad Hoc” mean?

- On the spot, temporarily, whithout preparation
- Ad hoc commission = a temporary project-team created for a specific –shortterm- task

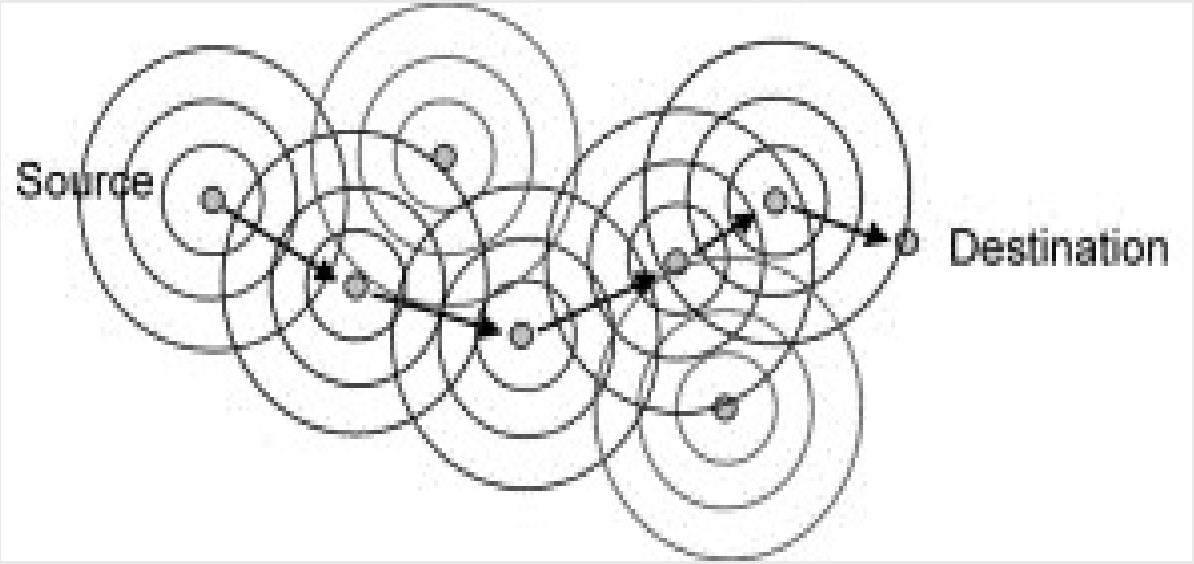
Ad hoc networks

- Infrastructure-less network
  - No internet-connection
- There are no configured servers, services
  - AAA
- No subnets based on IP addresses
  - Problem for “classic” routing protocols
- There are no stable (=reliable) networking devices
  - States, trust, robustness
- Selforganizing
  - Peer-to-peer paradigm on network level (layer 3)
- Multihop
  - Communication (routing) over multiple hops (devices)

Routing

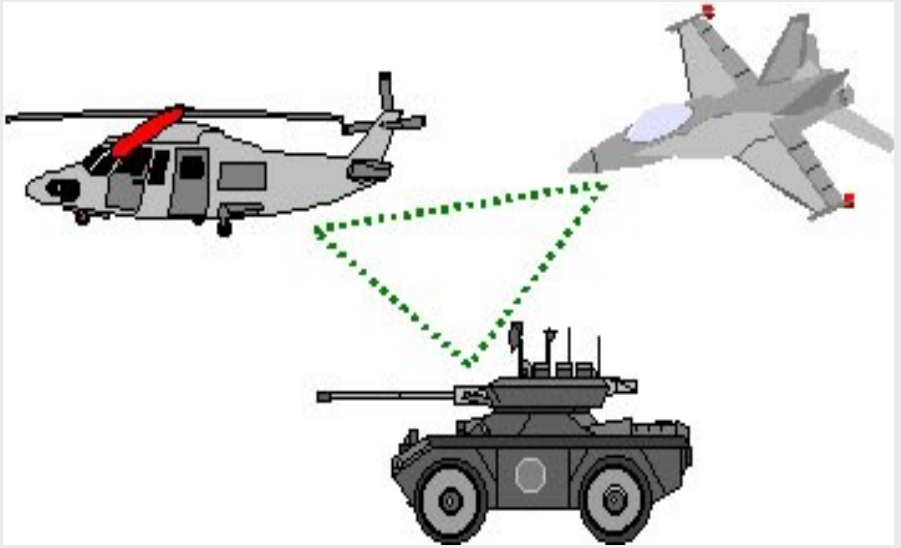
- Point-by-point
  - Hop-by-hop
- Mobile node

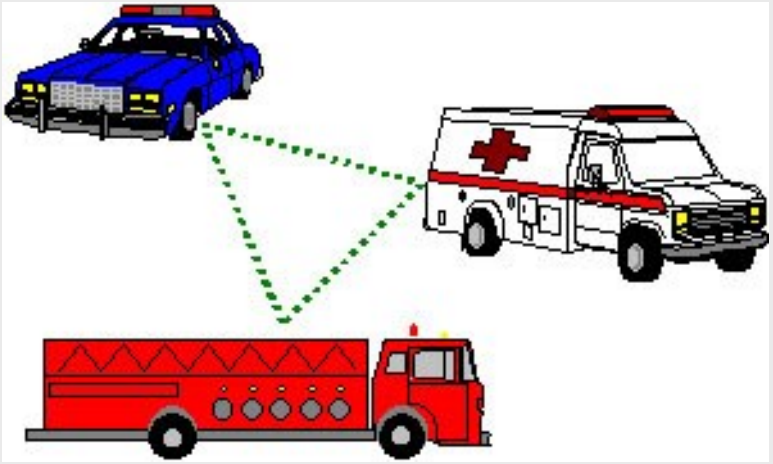
= endpoint + router



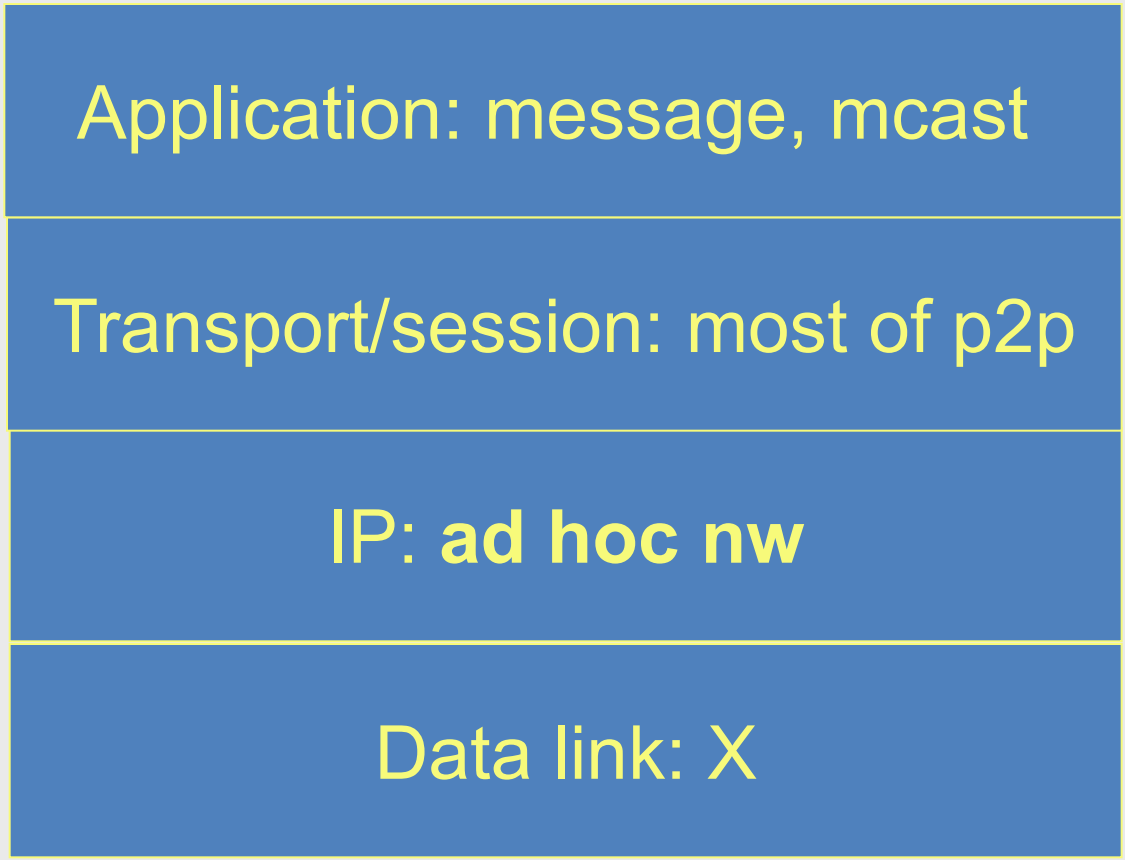
Typical application fields

- Military
- Emergency





Peer-to-peer and the layers



Ad hoc networks and mobility

- Nothing is fixed => moves
  - Natural association

MOBILE AD HOC NETWORK = MANET

- Független, előre nem konfigurálhtó elemek
  - Various (unpredictable) movement patterns
- Grouping based on specific utilization areas

Development of the MANET topics

- Military use
  - Independent, mobile, unpredictable
  - Connection – routing
  - Reliability, AAA
- Research
  - Advances in technology
  - Handheld devices, personal multimedia
  - PAN – Personal Area Network
- Sensors
  - Usually not mobile
  - BAN – Body Area Network, Vehicular, ...
- Global IP-based mobility
  - UMTS, WiMAX, LTE, LAN radio technologies – Wireless LAN

MANET „topics”

MANET research topics

- Cross-layer optimization
  - Common optimization of several layers of the ISO/OSI model
  - Each level has an impact on the mobility

- Upper layers
  - Packet retransmissions, TCP (pckt losses, „uncertain” medium)
  - Security (expandable over each layer)
- **Networking layer**
  - Routing (dynamic topology, prefix-based routing not applicable)
- **Datalink layer**
  - MAC (shared medium access, wireless)
- Physical layer-> „*mobility models*”
  - Power saving
  - Radio technologies

Applications of MANETs

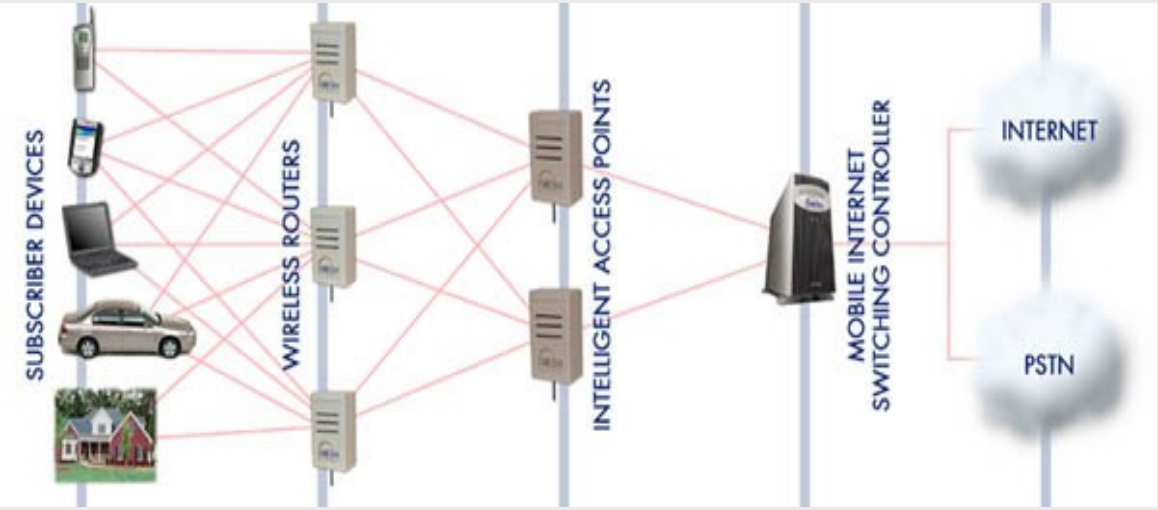
- Pervasive monitoring of farm animals

Paper: http://www.bartosz.wietrzyk.name/files/ICN08-wietrzb.pdf?attredirects=0

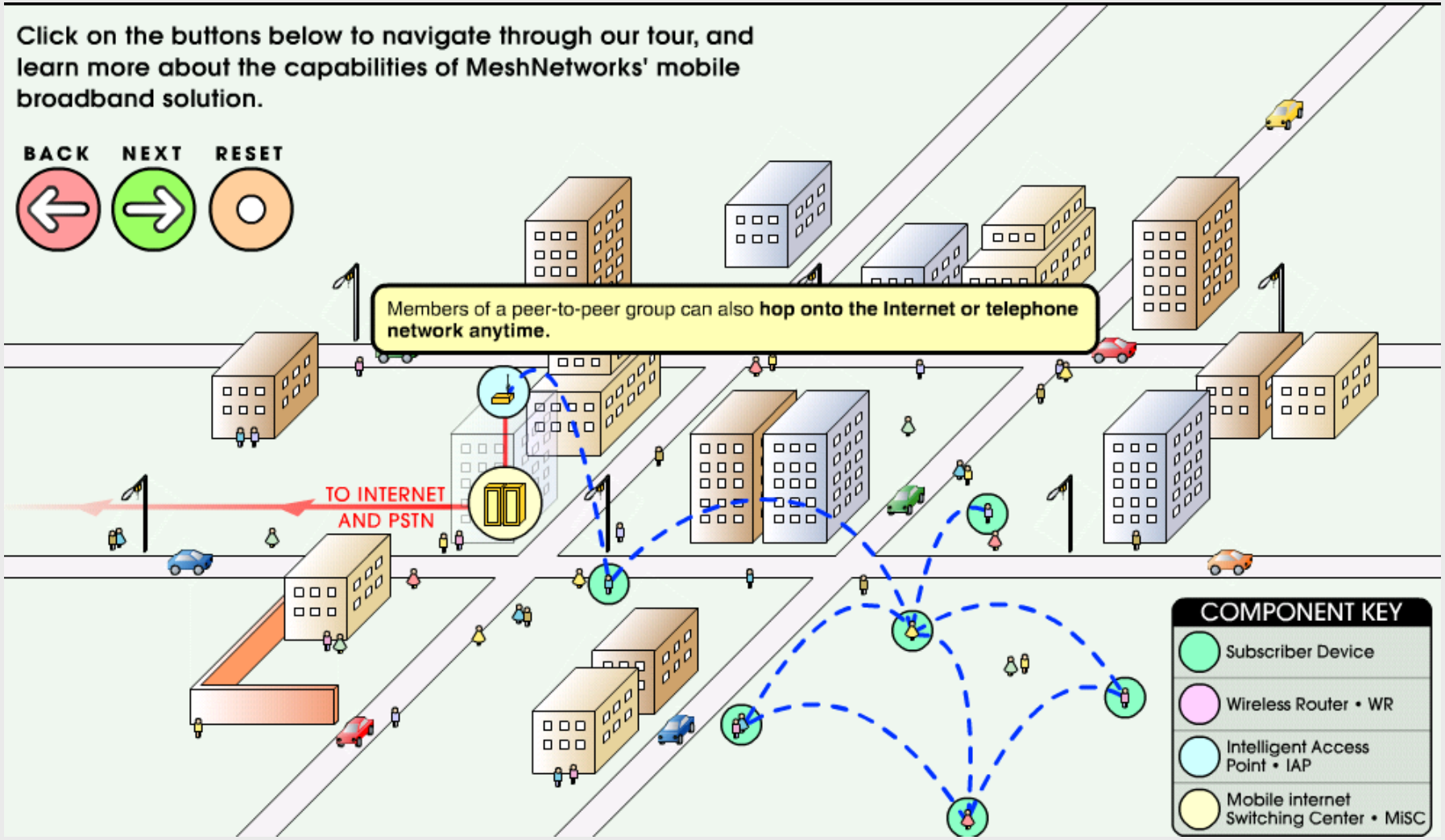
Slides: http://www.bartosz.wietrzyk.name/files/ICN08-wietrzb.ppt?attredirects=0

- Extending the Internet access
  - Business case: community or operator operated
  - Rooftop antenna based
  - Extensions of cellular networks
- Various military applications

Several hardware and architecture vendors/operators



Typical Networking Scenario: redistributing the internet, extending the coverage



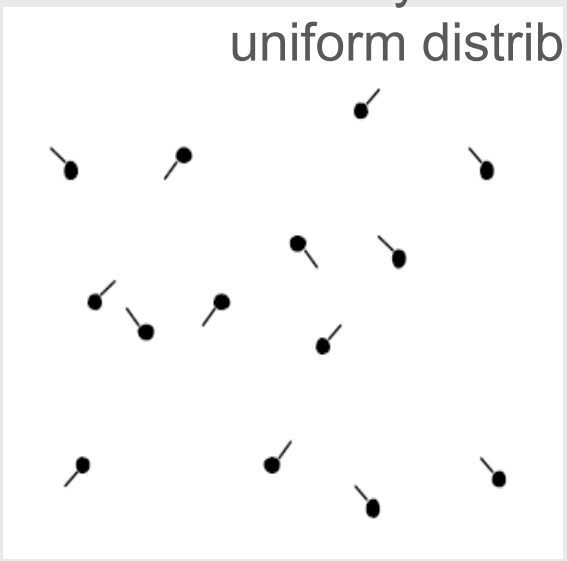
Mobility models

Mobility and MANET

- Different groups, interests, usage scenarios
- Different model, different problems, different solutions
- Relatively few deployments, few feedbacks
- New developments expected

Mobility models

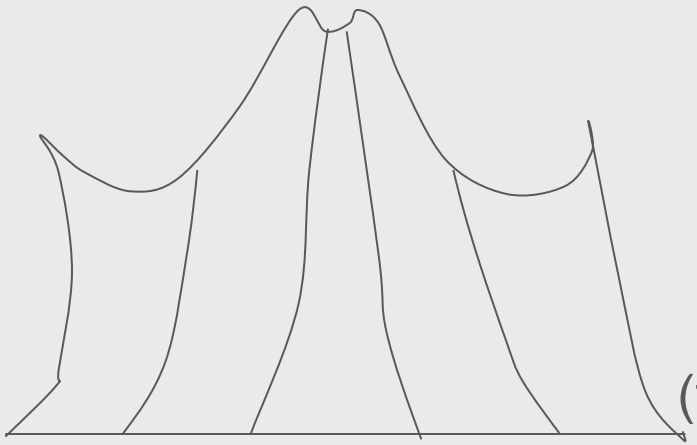
Generic mobility model,
uniform distribution, random movement



In real life scenarios cooperating people move within the same group

Nomadic mobility

- No activity during movement - standby
- New address request, reconnection to previous partners, servers after movement



(this is a tent)

Slow mobility

- People walking in a conference hall
- University campus – walking students, bikers
- Trainstations, large public institutions

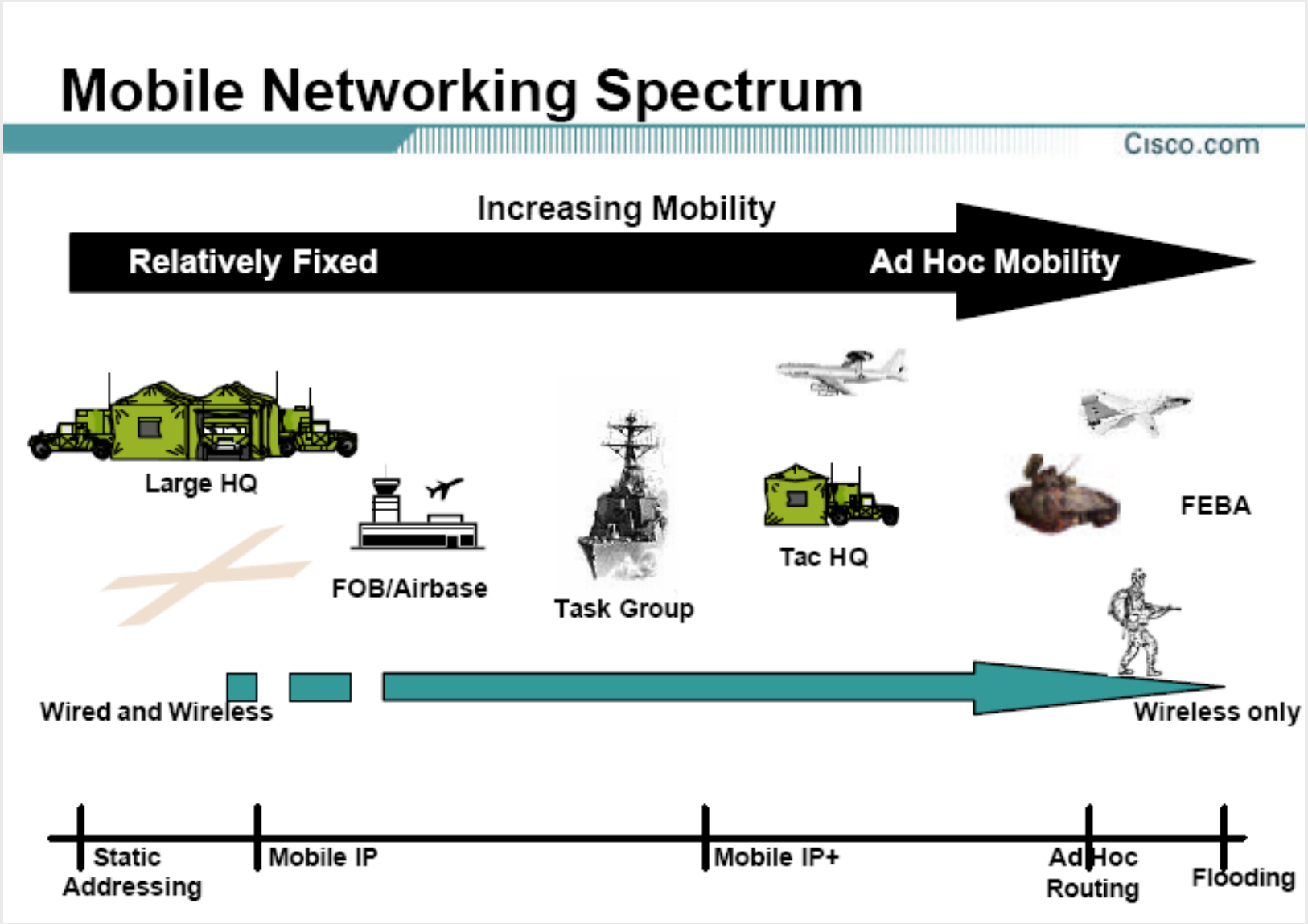
Fast mobility

- Cars, motorcycles, ...

Moving Groups

- Networks moving together
- Networks in Motion – NEMO
- MONET – Moving Networks
- E.g.: people on trains, metro, bus, airplane

Movement types



MANET MAC

Ad Hoc MAC - expectations

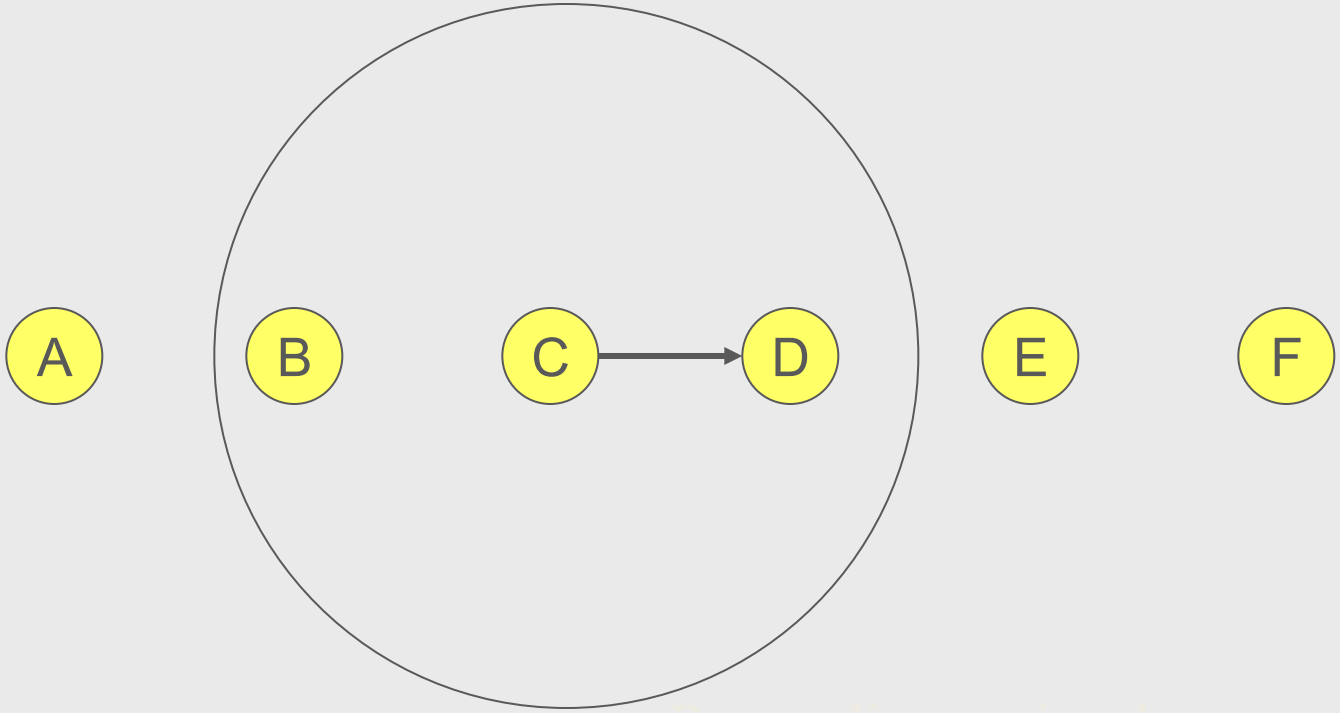
- Delay, jitter
- Efficiency
  - Channel capacity
- Power saving
  - How to handle the stand-by state
- Fairness
  - Medium access
- Quality of Service - QoS
  - Priority handling

802.11 - WiFi

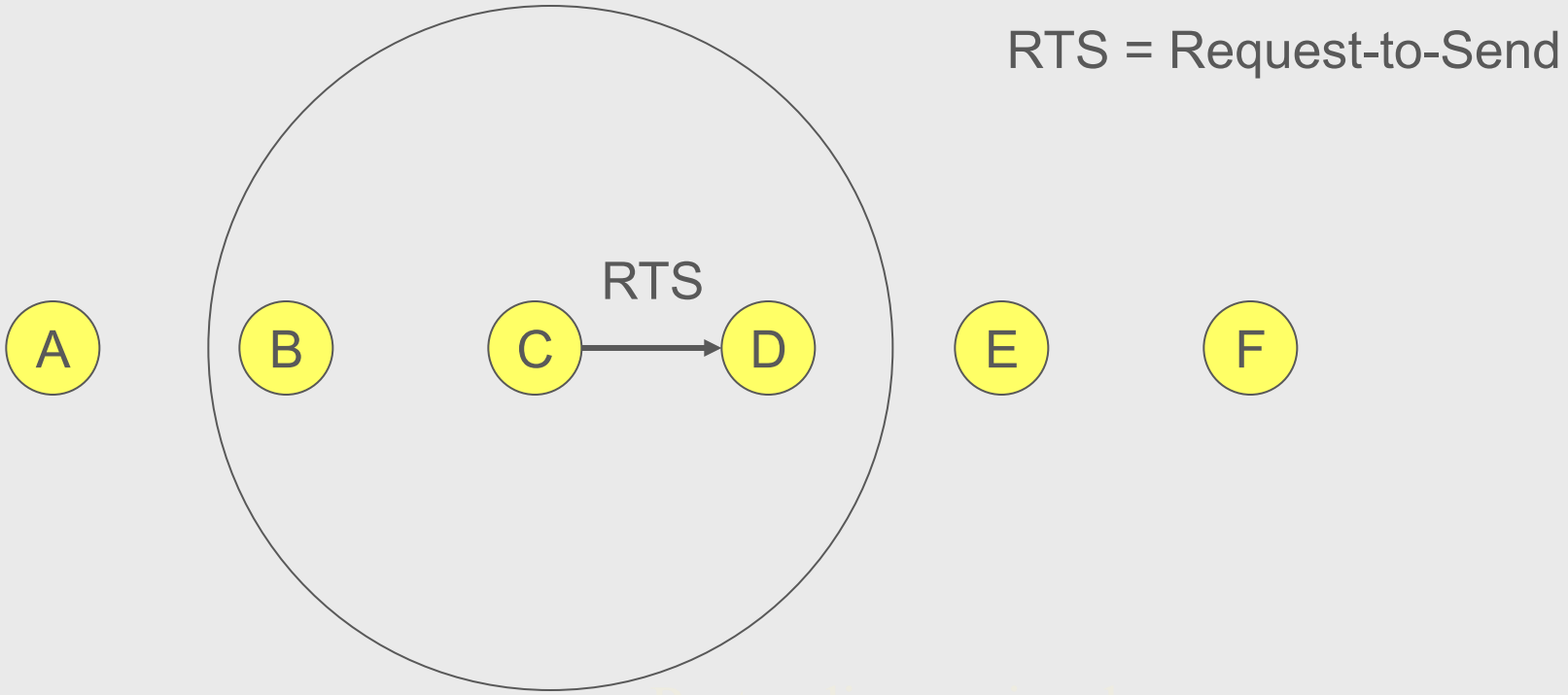
- Most used w'less MAC in LANs
- Straightforward option for MANETS
  - Laptops, PDAs, smartphones

Hidden terminal

- C starts to send data to D
- E is not aware of this communication – it is hidden to it
- E starts sending to D, that node will experience interference



IEEE 802.11



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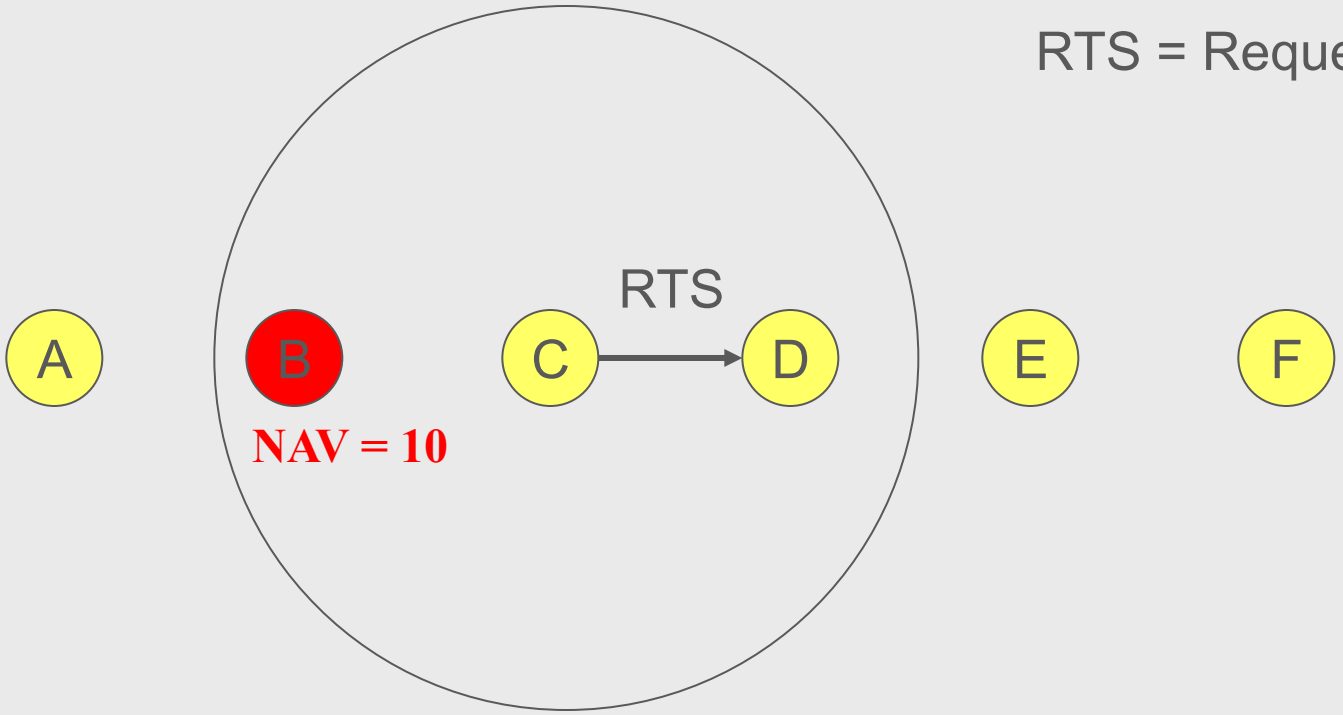
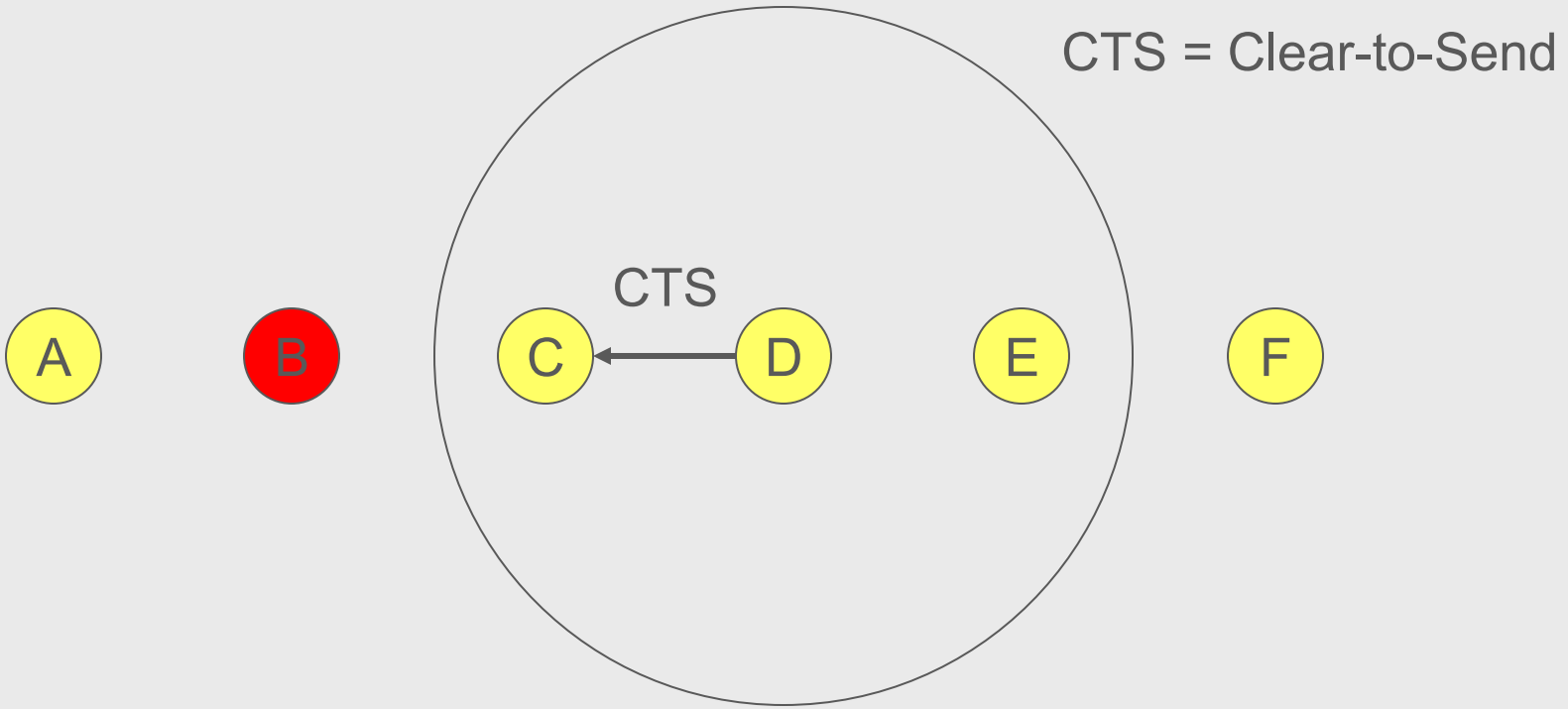


NAV = how much will remain silent the node

IEEE 802.11



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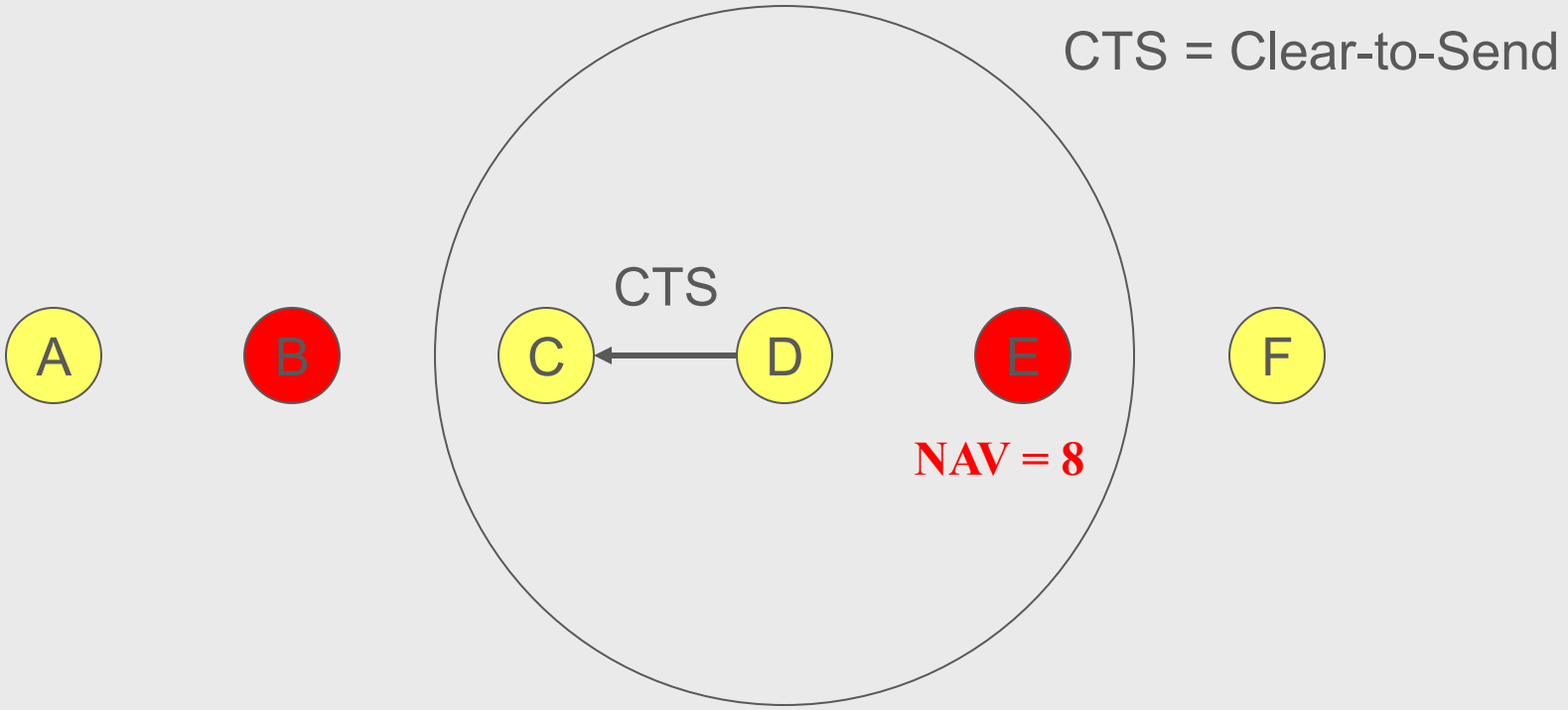
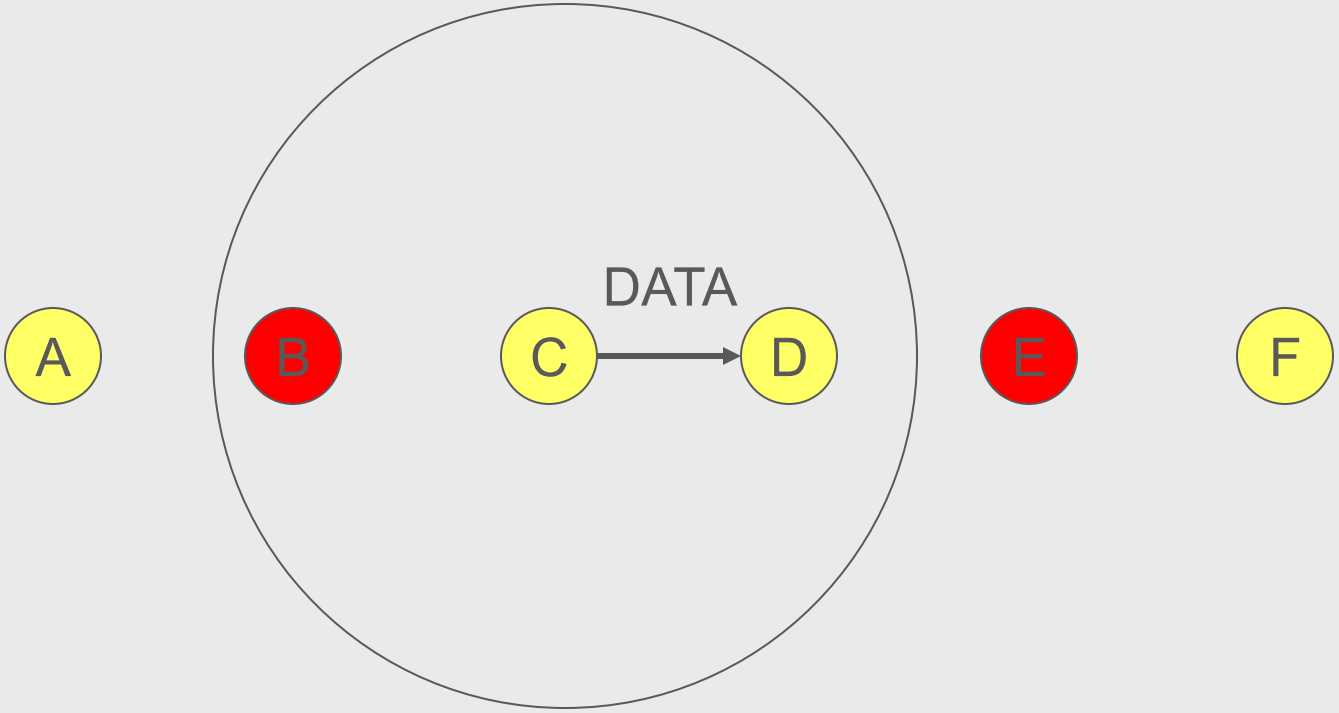


IEEE 802.11

- Data - packets sent just after a CTS
- Ack - acknowledment upon successful reception



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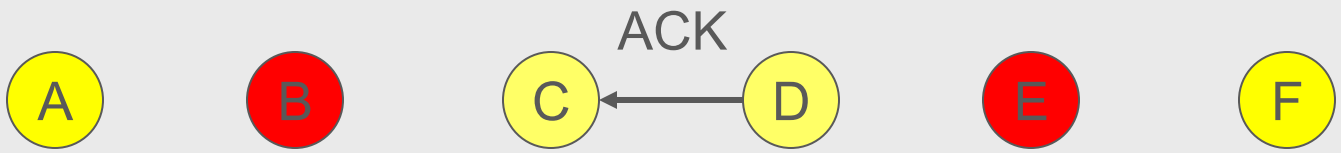

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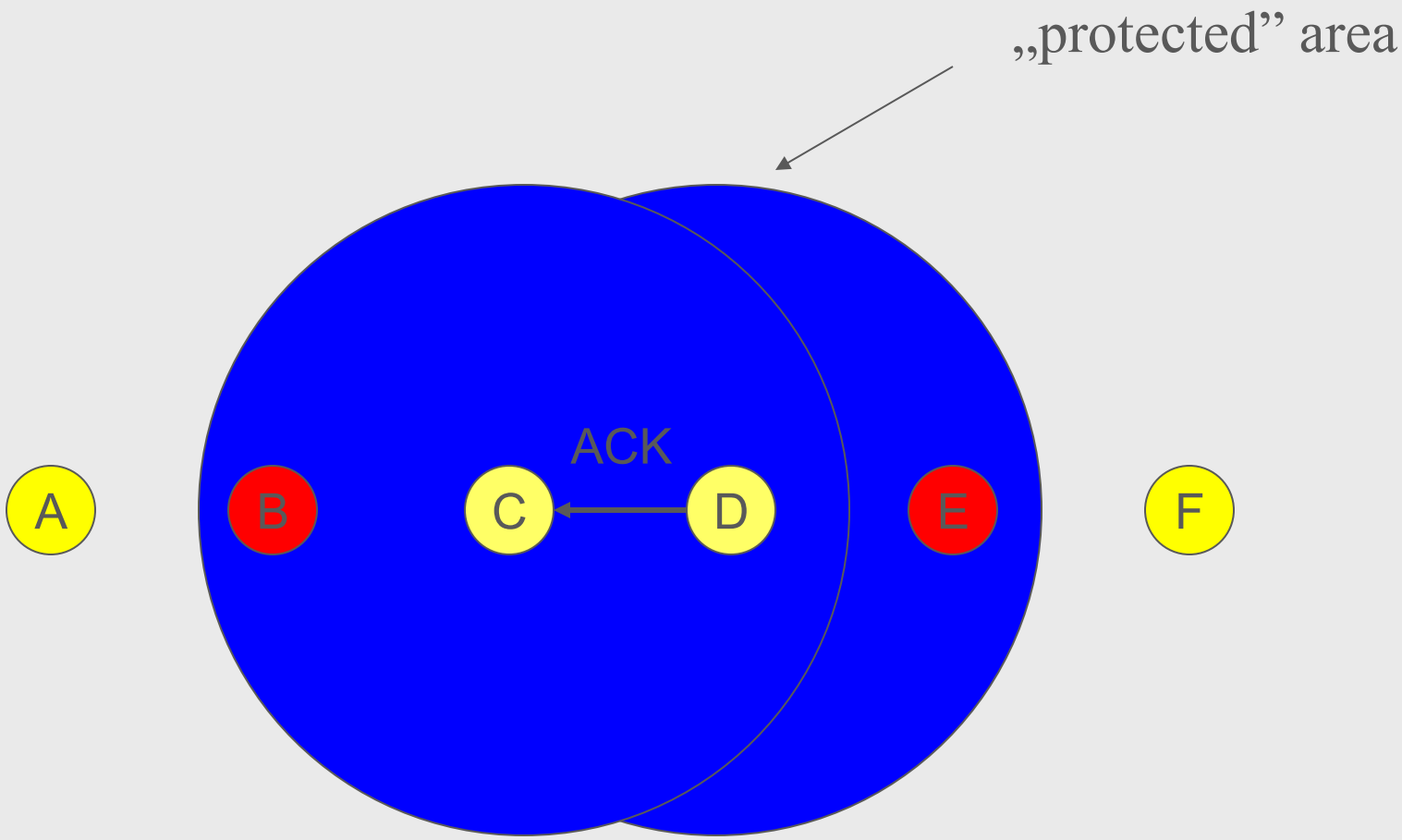
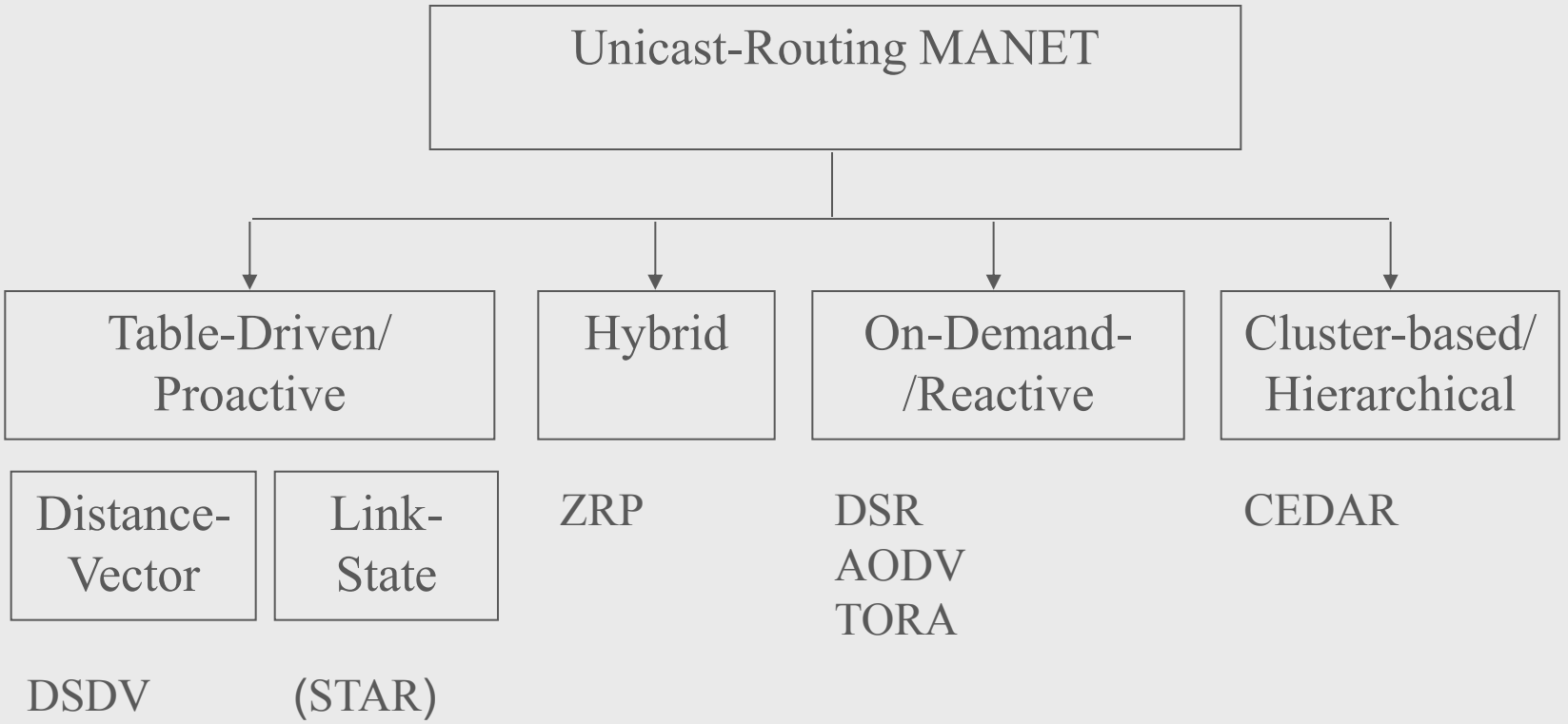


MANET (routing) categories

MANET (routing) protocols



MANET: Mobile Ad hoc Network

(IETF working group)

MANET routing

- Two widely referenced MANETs
  - DSDV – reactive, based on Bellman-Ford
  - AODV – on demand, reactive