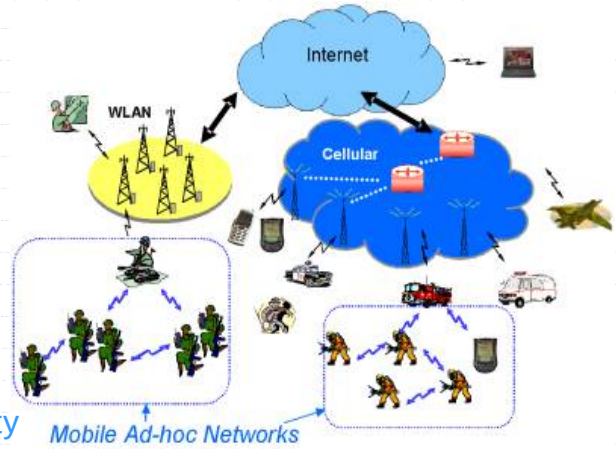
Basics of Mobile Ad hoc Networks

MANET Applications

- MANET– Mobile Ad hoc NETworks

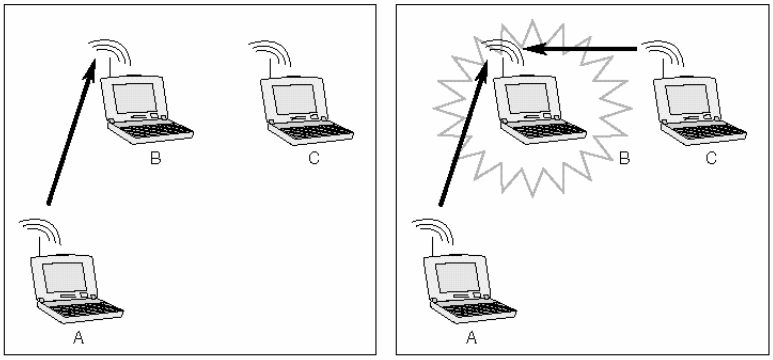


Homogeneity
Multiple-hop
Wireless communication

Mobility
Exhaustible energy
Lack of infrastructure

Medium Access Control Protocols for Ad hoc Networks

Problems in Wireless Channel Access

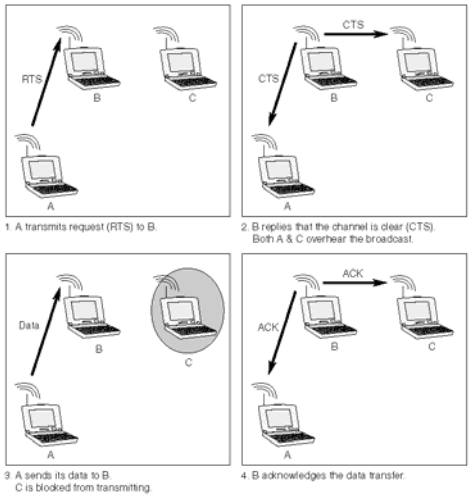


1. A transmits to B. (C does not hear this.)

2. C transmits to B ... Collision!

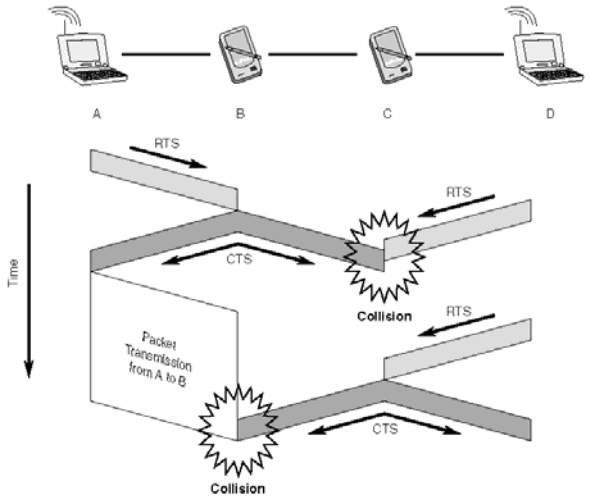
The **hidden terminal** problem – two nods are hidden from each other when both attempt to transmit to the same receiving node (collision occurs at receiver)

Problems in Wireless Channel Access



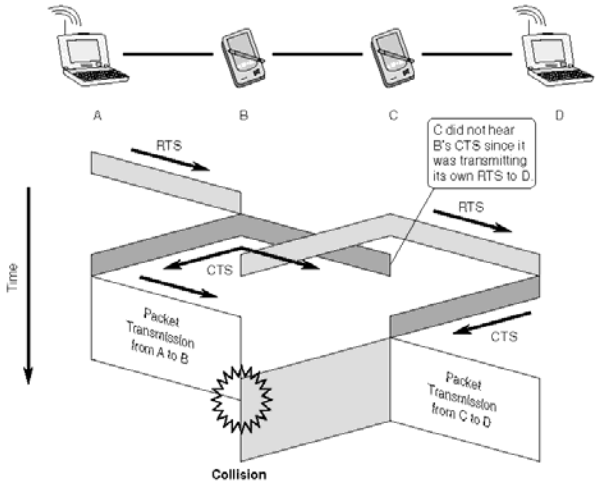
Using **RTS/CTS handshake** to resolve the hidden terminal problems

Problems in Wireless Channel Access



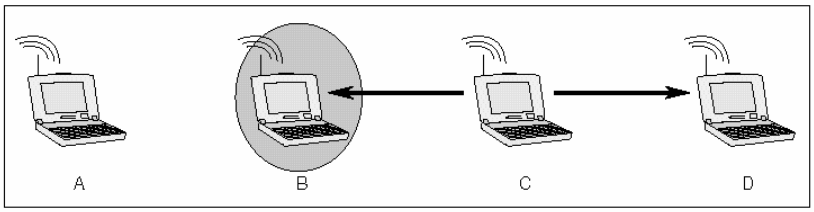
The **incompleteness** of the RTS/CTS protocol – RTS/CTS sent by different nodes may still collide

Problems in Wireless Channel Access



Another RTS/CTS problem scenario – multiple CTS are granted to different neighboring nodes

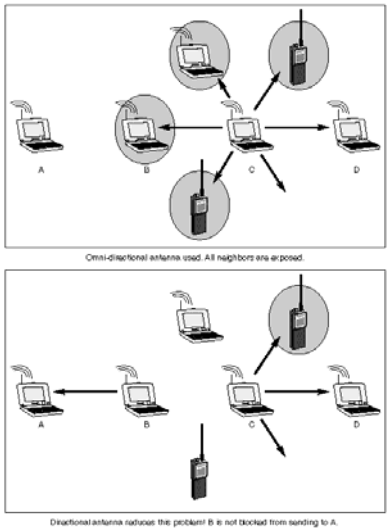
Problems in Wireless Channel Access



- C is transmitting to D.
- B overhears this, and is blocked.
- B wants to transmit to A, but is being blocked by C.
- Wasted bandwidth!

The **exposed terminal** problem – overhearing a transmission from neighboring node can inhibit a node from transmitting to other nodes

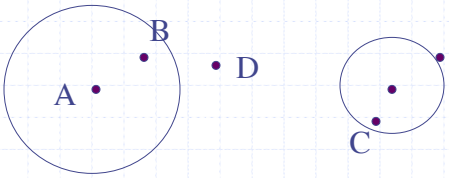
Problems in Wireless Channel Access



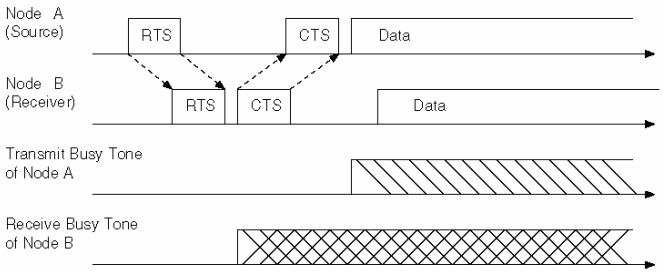
Solutions to exposed terminal problem - **directional antenna** and **separate data/control channels**

MACA (Multiple Access with Collision Avoidance)

- RTS/CTS handshake without carrier sensing
- Per-packet transmission power control – inhibit a transmitter when a CTS is overheard
  - If node A has been sending data to node B for some time, A would know how much power it needs to reach B
  - If A overhears B's response to an RTS (*i.e.*, a CTS) from another node D, A could lower its power and communicate with C



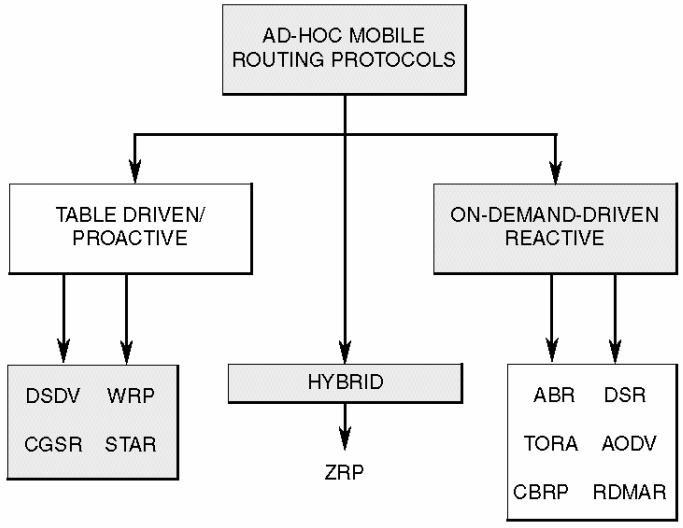
DBTMA – Dual Busy Tone MA



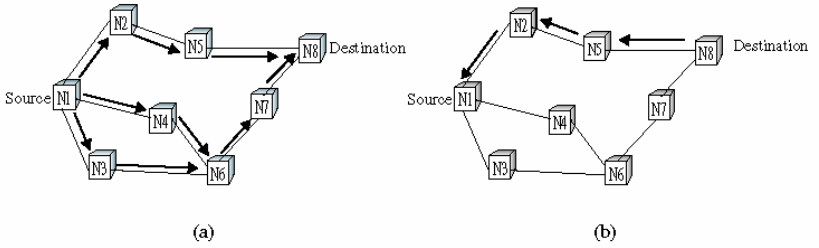
- Two out-of-band busy tones are used to notify neighboring nodes of any on-going transmission
  - BT_t – a node is transmitting on the data channel
  - BT_r – a node is receiving on the data channel
- To transmit, sense BT_r. If no BT_r, send RTS…
- Upon receiving RTS, receiver senses BT_t. If no BT_t, send CTS and raise BT_r…
- ***Continuous*** busy tones are crucial to deal with mobility

Unicast Routing Protocols for Mobile Ad hoc Networks

Categorization of Ad Hoc Routing Protocols

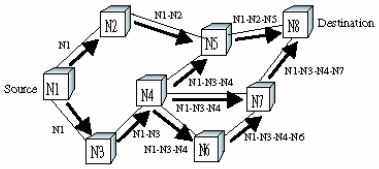


Ad Hoc On-Demand Distance Vector (AODV)

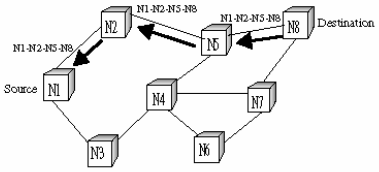


- Use **destination sequence #** to prevent loops and ensure fresh route information
- Establish **reverse pointer (path)** via RREQ
- Establish **forward route entry (path)** via RREP over reverse path
- Assume *symmetric* links

Dynamic Source Routing (DSR)



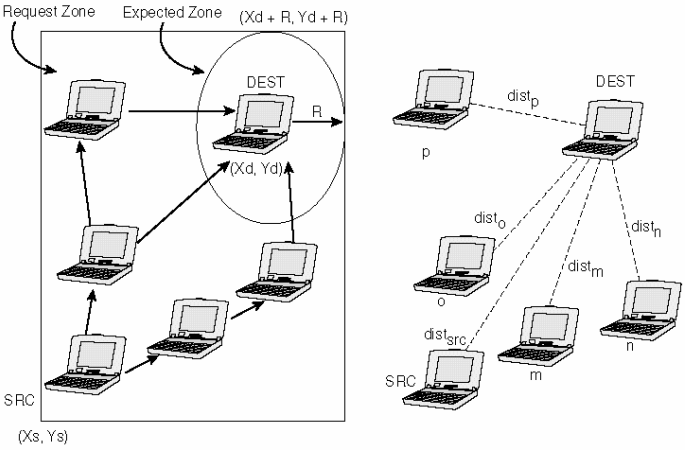
(a) Building of the route record during route discovery



(b) Propagation of the route reply with the route record

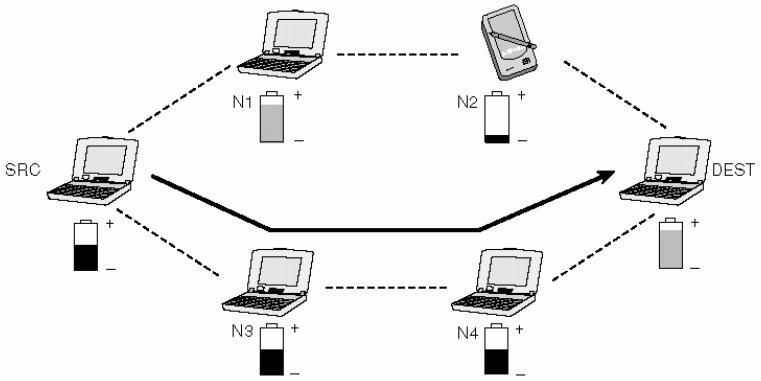
Each data packet sent by the source has to contain complete source route information

Location-Aided Routing (LAR)



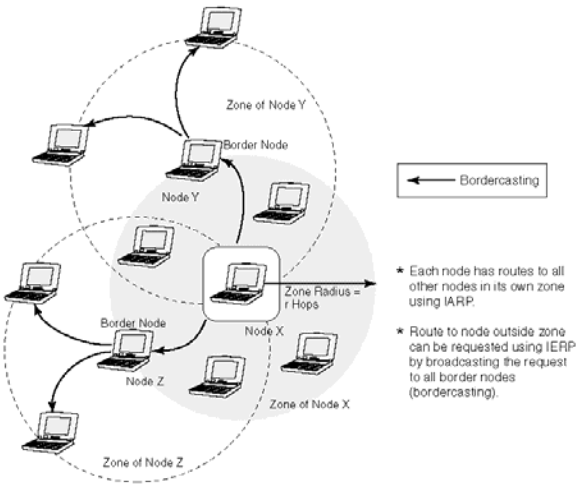
- Assume the location and speed of the destination node are known
- Concepts of **request zone** and **expected zone** and consideration of route physical distance
- Specify the request zone in RREQ to contain propagation

Power-Aware Routing (PAR)



Remaining battery life is used as the primary routing metric – select routes that have a longer overall battery life

Zone Routing Protocol (ZRP)



- Hybrid approach – proactive (intra-zone) and on-demand (inter-zone)
- Border nodes (via bordercast) perform on-demand route discovery