Ad-Hoc Wireless Networks and Protocols

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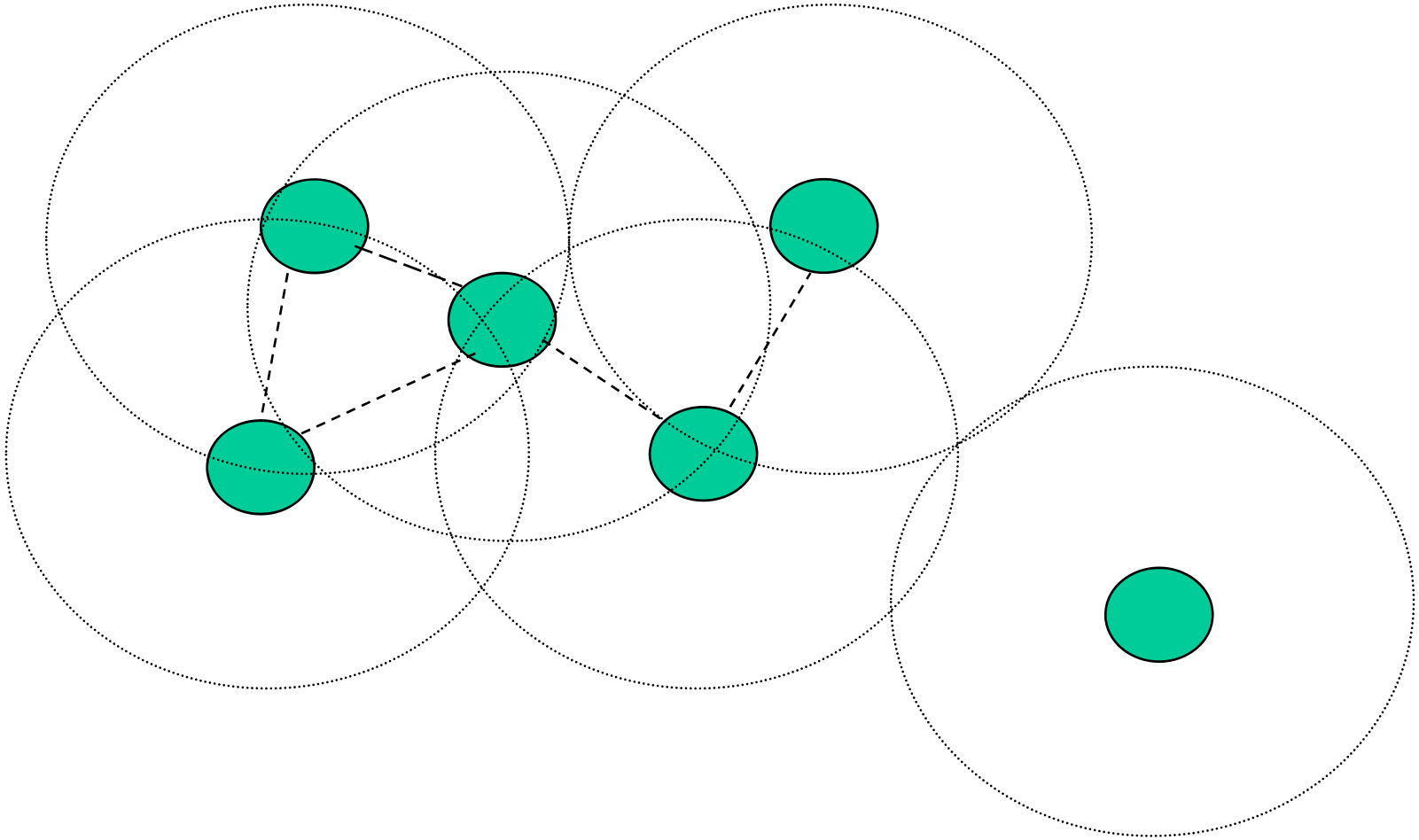
Wireless Ad Hoc Networks

Coordinating set of wireless nodes without any central Access Points

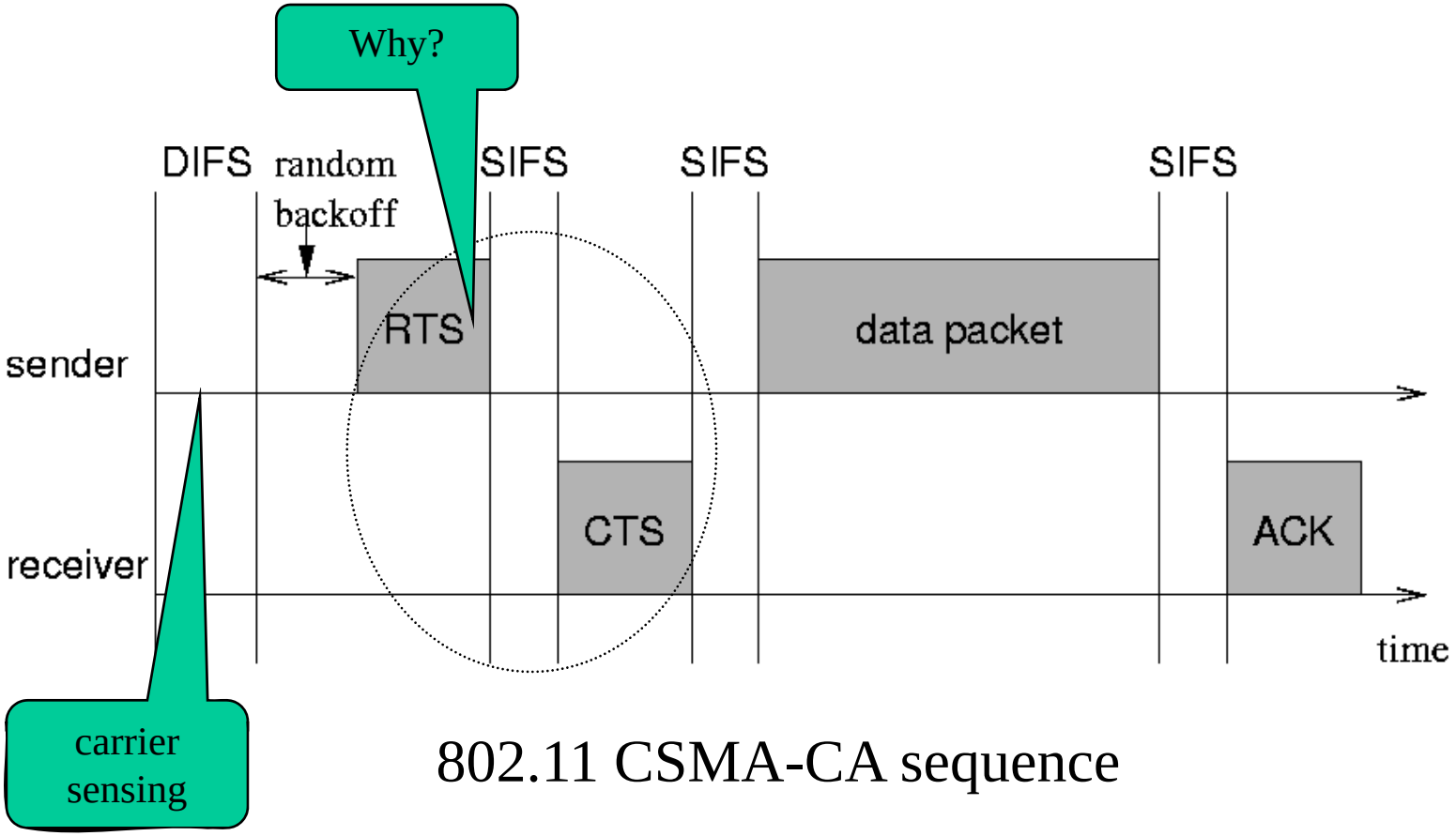


TWO Important Issues

- Wireless Medium Access
- Routing

Wireless MAC

- Random arbitration based (802.11CSMA-CA)
- Priority based (I-EDF): Good for real-time app.



802.11 CSMA-CA sequence

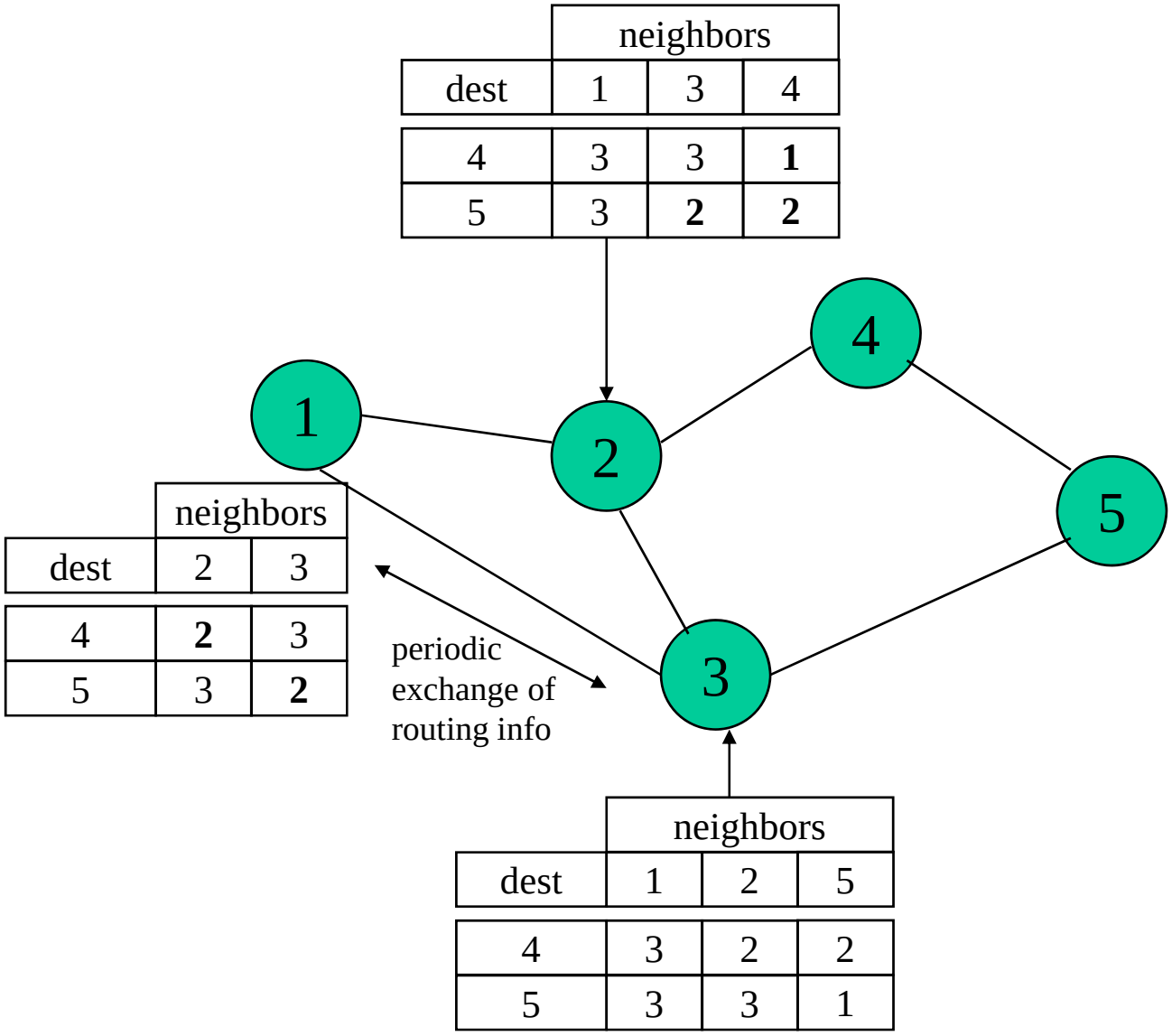
Ad Hoc Routing

- Many protocols: DSDV, DSR, AODV
- Let’s take a close look at DSDV (Destination-Sequenced Distance Vector) as an example

DSDV

- Basically Distance-Vector routing protocol
  - tries to forward packets through the shortest path with smallest hop counts
- Challenge
  - How to manage the routing table?
  - When nodes moves dynamically, will the traditional way to just reporting link-off and link-on work?
  - This may cause inconsistency of the routing information resulting in routing loops
    - The route loops are short-lived in traditional wired networks with low dynamics
    - But, looping may live VERY long in highly dynamic mobile ad hoc wireless networks
- DSDV objective
  - Manage the routing table (e.g., distance vector table) avoiding the looping problem even in highly dynamic networks

Distance Vector Routing



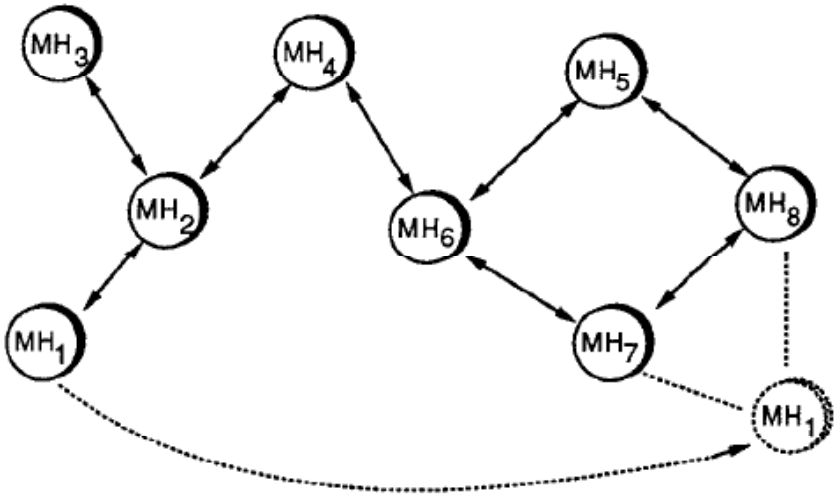
DSDV routing

- Each node broadcast its routing table
  - periodically
  - on-demand as topological changes are detected
- At each broadcast, the following information is carried
  - new sequence number (for the case that this node is the destination)
  - for each destination
    - the destination's address
    - the number of hops required to reach the destination
    - the sequence number of the information received regarding this destination, as originally stamped by that destination
- At routing decision,
  - Routes with more recent sequence numbers are always preferred
  - With this destination-oriented sequence number the global consistency of route can be maintained for each particular destination

Two cases of RouteInfo forwarding

- When a new route is found which was previous unreachable
  - immediately forward this info to all neighbors
- When a new route is found to have a better metric
  - delay the forwarding to a certain extent of time expecting better routing info will arrive soon
  - this can reduce the route info fluctuation

Example DSDV operation



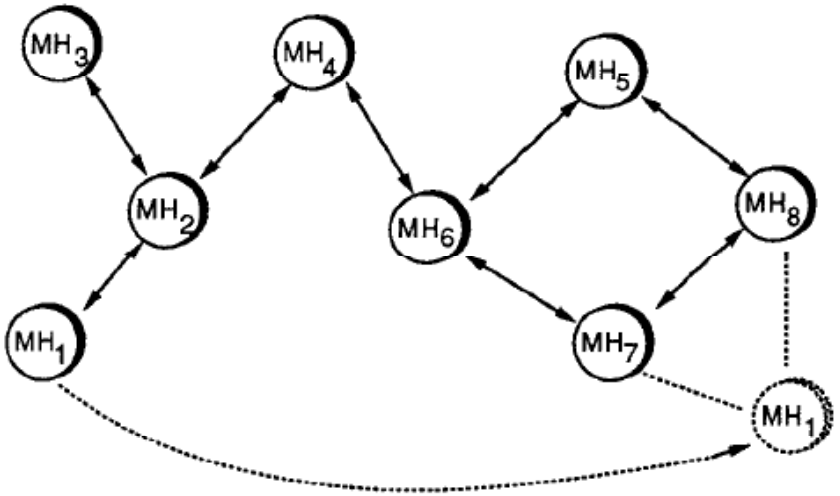
Destination	NextHop	Metric	Sequence number
MH_1	MH_2	2	S406_MH_1
MH_2	MH_2	1	S128_MH_2
MH_3	MH_2	2	S564_MH_3
MH_4	MH_4	0	S710_MH_4
MH_5	MH_6	2	S392_MH_5
MH_6	MH_6	1	S076_MH_6
MH_7	MH_6	2	S128_MH_7
MH_8	MH_6	3	S050_MH_8

MH_4 forwarding table before MH_1's move

Destination	Metric	Sequence number
MH_1	2	S406_MH_1
MH_2	1	S128_MH_2
MH_3	2	S564_MH_3
MH_4	0	S710_MH_4
MH_5	2	S392_MH_5
MH_6	1	S076_MH_6
MH_7	2	S128_MH_7
MH_8	3	S050_MH_8

Advertised route table by MH_4 before MH_1's move

Example DSDV operation



Destination	NextHop	Metric	Sequence number
MH_1	MH_6	3	S516_MH_1
MH_2	MH_2	1	S238_MH_2
MH_3	MH_2	2	S674_MH_3
MH_4	MH_4	0	S820_MH_4
MH_5	MH_6	2	S502_MH_5
MH_6	MH_6	1	S186_MH_6
MH_7	MH_6	2	S238_MH_7
MH_8	MH_6	3	S160_MH_8

MH_4 forwarding table after MH_1's move

No route inconsistency will occur since only the last sequenced info for MH_1 is used at every node

Destina	Metric	Sequence number
MH_4	0	S820_MH_4
MH_1	3	S516_MH_1
MH_2	1	S238_MH_2
MH_3	2	S674_MH_3
MH_5	2	S502_MH_5
MH_6	1	S186_MH_6
MH_7	2	S238_MH_7
MH_8	3	S160_MH_8

Advertised route table by MH_4 after MH_1's move

Reference

- Charles E. Perkins and Pravin Bhagwat, “Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers, ACM SIGCOM 1994

NS2 implementation of DSDV

- Take a look at
  - C++: dsdv.cc, dsdv.h, rtable.cc, rtable.h in ns-2.30/dsdv
  - OTcl: dsdv.tcl in ns-2.30/tcl/mobility