Ns Simulation of IEEE 802.11

SC546 Project (Fall 2002)

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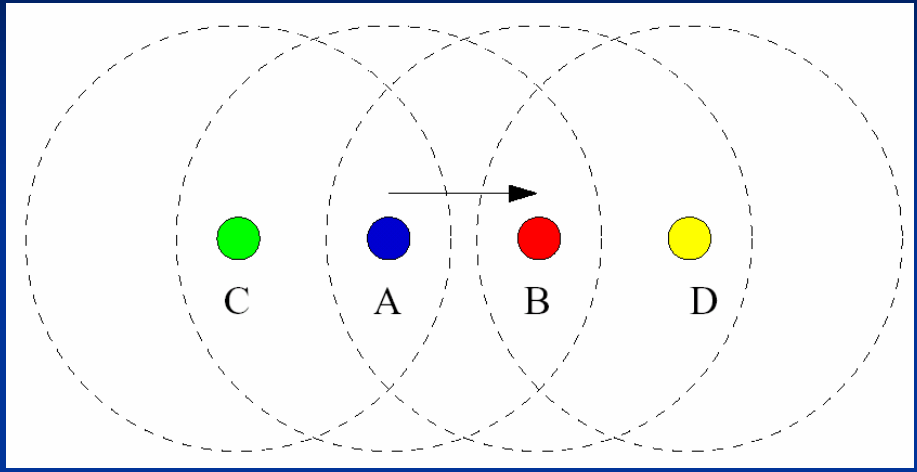
Project descriptions

- Goals
  - Understand the IEEE 802.11
  - Do wireless LAN simulations using Ns
- Focus
  - Ad hoc networking
  - Collision avoidance (RTS/CTS handshake)

Wired vs. Wireless

- Wireless communication
  - No wired links: radio, infrared, laser
  - Ad hoc network
- Problems in Wireless Network (IEEE 802.11)
  - No multi-hop awareness
  - Hidden/ Exposed
  - Unfairness
  - Packet drop is occurred often by errors in transmission layer
- (Compare) Problems in Wired network
  - Major cause of dropped packets: Congestion in Routers

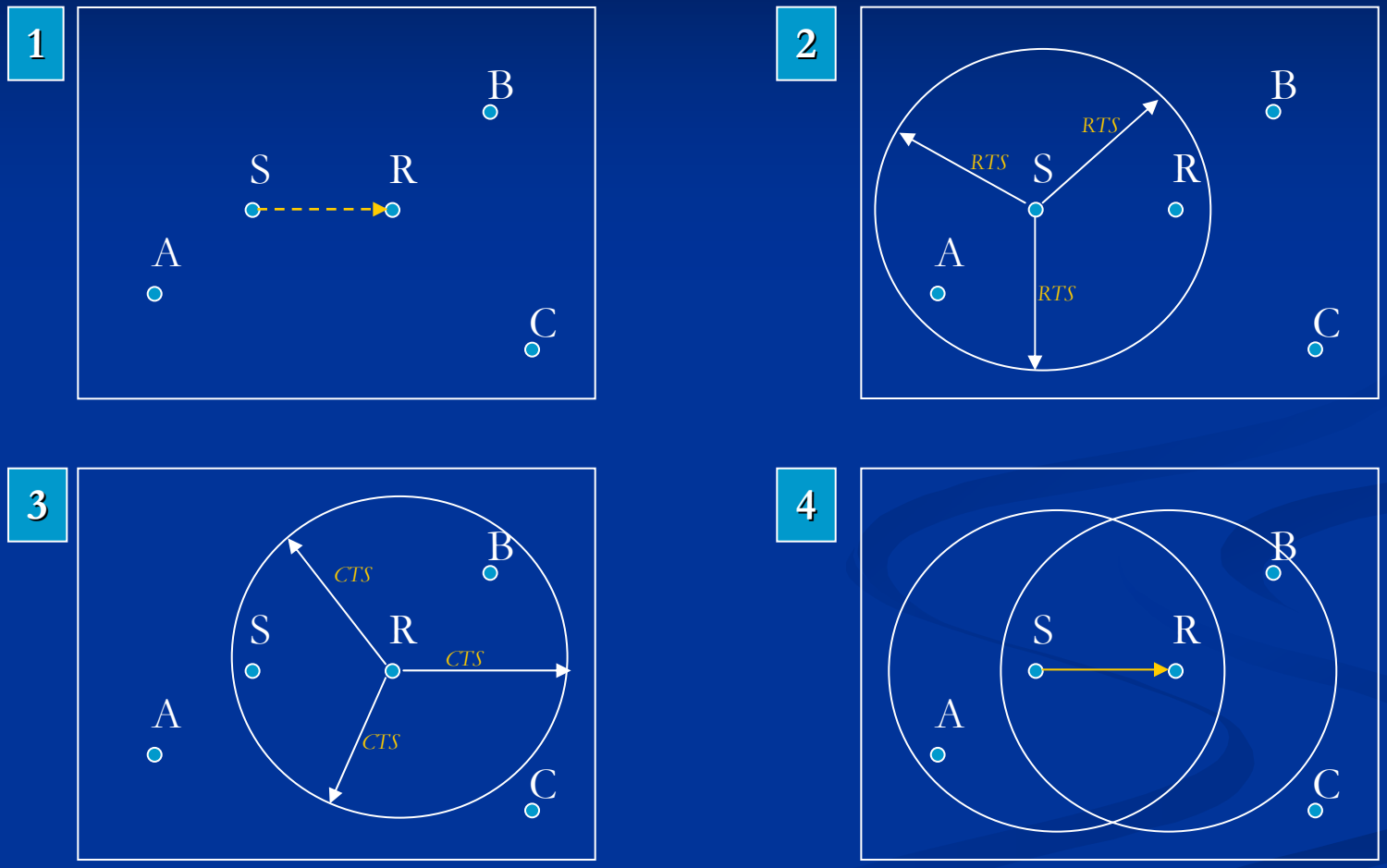
Hidden/ Exposed node



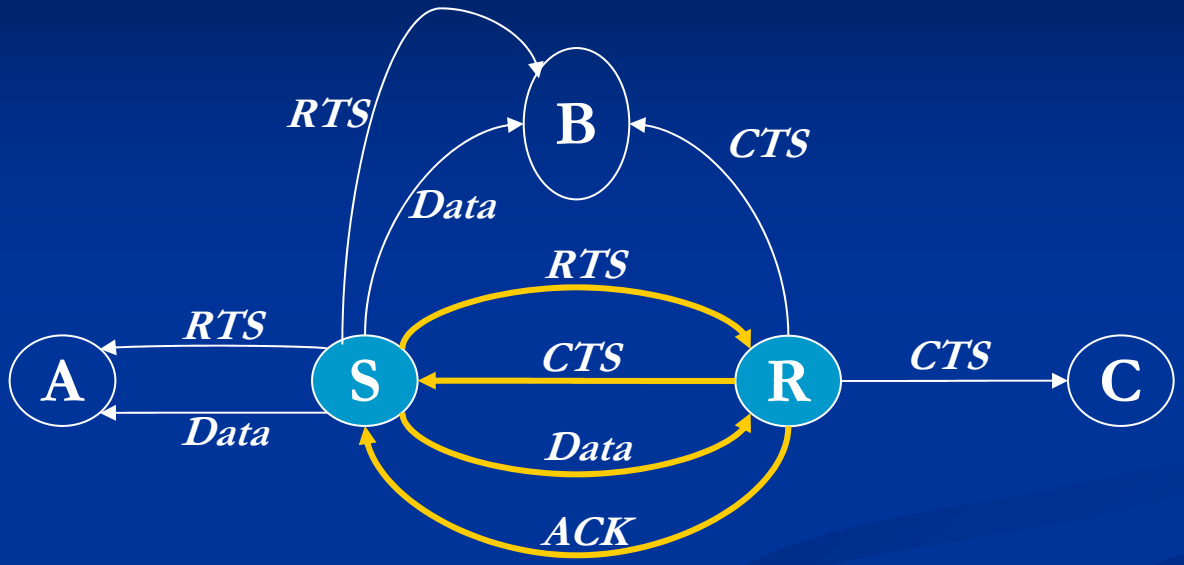
From "The deaf node problem in Ad hoc wireless LANs" by S. Ray, D. Starobinski, and J.B.Carrunthers

- Data transmission from A to B
- Hidden node =D (possibly Deaf node)
  - Cause packet collision
- Exposed node=C
  - Prohibited from transmitting

802.11 Operations (#1)



802.11 Operation (#2)



- Receive RTS: Defer until CTS should have been sent
- Receive CTS: Defer until Data should have been sent
- If you don't receive CTS or ACK, back off and try it all over again

(from http://www-ece.rice.edu/lashu/reneclass/lectures/elec437lecture2.pdf)

Ns (Network Simulator)

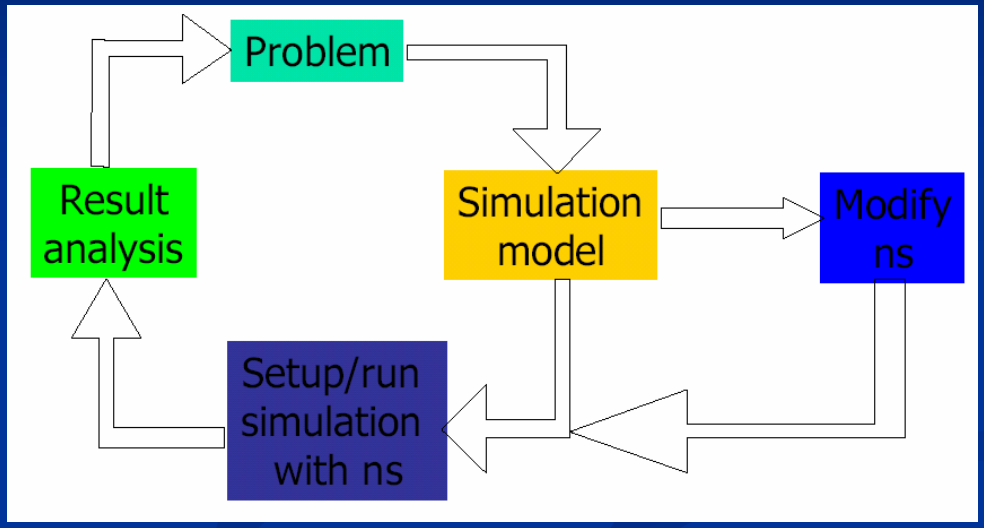
- A discrete event simulator targeted at networking research
- The collaboration of USC/ISI, LBL, UCB, and Xerox PARC
- Two main components: Ns, Nam
- Validation is needed

Ns

- Support wired/wireless models
  - Traffic models and applications
    - Web, FTP, telnet, constant-bit rate, stochastic
  - Transport protocols
    - Unicast: TCP(Reno, Vegas, etc.), UDP
    - Multicast: SRM
  - Routing and queueing
    - Wired routing, ad hoc routing and directed diffusion
    - Queueing protocols: RED, drop-tail, etc.
  - Physical media
    - Wired (point-to-point, LANs), wireless (multiple propagation models), satellite
- Tracing, visualization using Nam

Ns

- Ns Programming
  - Create the event scheduler
  - Turn tracing
  - Create network
  - Setup routing
  - Insert errors
  - Create transport connection
  - Create traffic
  - Transmit application-level data



Using Ns
(from http://www.isi.edu/nsnam/ns/ns-tutorial/)

Environments/Configurations

```
set val(chan)      Channel/WirelessChannel  ;# channel type
set val(prop)      Propagation/TwoRayGround ;# radio-propagation model
set val(ant)       Antenna/OmniAntenna      ;# Antenna type
set val(ll)        LL                       ;# Link layer type
set val(ifq)       Queue/DropTail/PriQueue  ;# Interface queue type
set val(ifqlen)    50                       ;# max packet in ifq
set val(netif)     Phy/WirelessPhy          ;# network interface type
set val(mac)       Mac/802_11               ;# MAC type
set val(nn)        4                        ;# number of mobilenodes
set val(rp)        AODV                     ;# routing protocol
set val(x)         800
set val(y)         800
```

Simulation #1

- Scenario
  - Two fixed nodes
  - moving within 600m x 600m flat topology
  - DSR ad hoc routing
  - TCP and CBR traffic
  - *Receiver move in and out of range*
- Results
  - Time vs. packets arrived

Simulation #2

- Scenario
  - Two fixed pairs (4 nodes)
  - moving within 800m x 800m flat topology
  - AODV ad hoc routing
  - TCP and CBR traffic
  - *2 nodes in each pair communicate each other* (hidden node)
- Results
  - Time vs. packets arrived

Simulation #3

- Scenario
  - Six fixed nodes
  - Change Routing algorithm
  - 4 Ad hoc routing: DSR/ DSDV/ AODV/ TORA
  - *The left-most node sends data to the right-most node*
- Results
  - Time vs. packets arrived

Further studies

- Check the effectiveness of RTS/CTS handshake
- Consider a lot of nodes in a small space
- More experiments using other traffic model (e.g. burst)
- Source-level (C++) modification for deeper understanding

Useful links

- Monarch project
  - http://www.monarch.cs.rice.edu
  - (more links will be added on the web)

That's all

- Thanks.