Ad Hoc Networks

CSC 512 – Networks: Architectures and Protocols

Instructor: Dr. Frye

frye@kutztown.edu

Computer Science & Information Technology Department, Kutztown University

Mesh Networks

- Network constructed of many individual links

- Mesh networking – route data in a mesh network

- True mesh network / fully connected network

- Wireless mesh network

- Meshing

# Layering in Mesh Networks

- Mesh-under

- (IP) route-over

Ad hoc Networks

- **Infrastructure-less**
- **Routing more complex**
- **Node**
  - ☐ Host
  - ☐ Router

MAC Protocol Issues

- Bandwidth efficiency
- Quality of Service (QoS) support
- Synchronization
- Hidden and Exposed Terminal problems
- Error-prone shared broadcast channel
- Distributed nature
- Mobility of nodes

R1

S2

S1

R2 ◀- - - - - S3

└──► Transmission range of Node S1   └──► Transmission range of Node S2
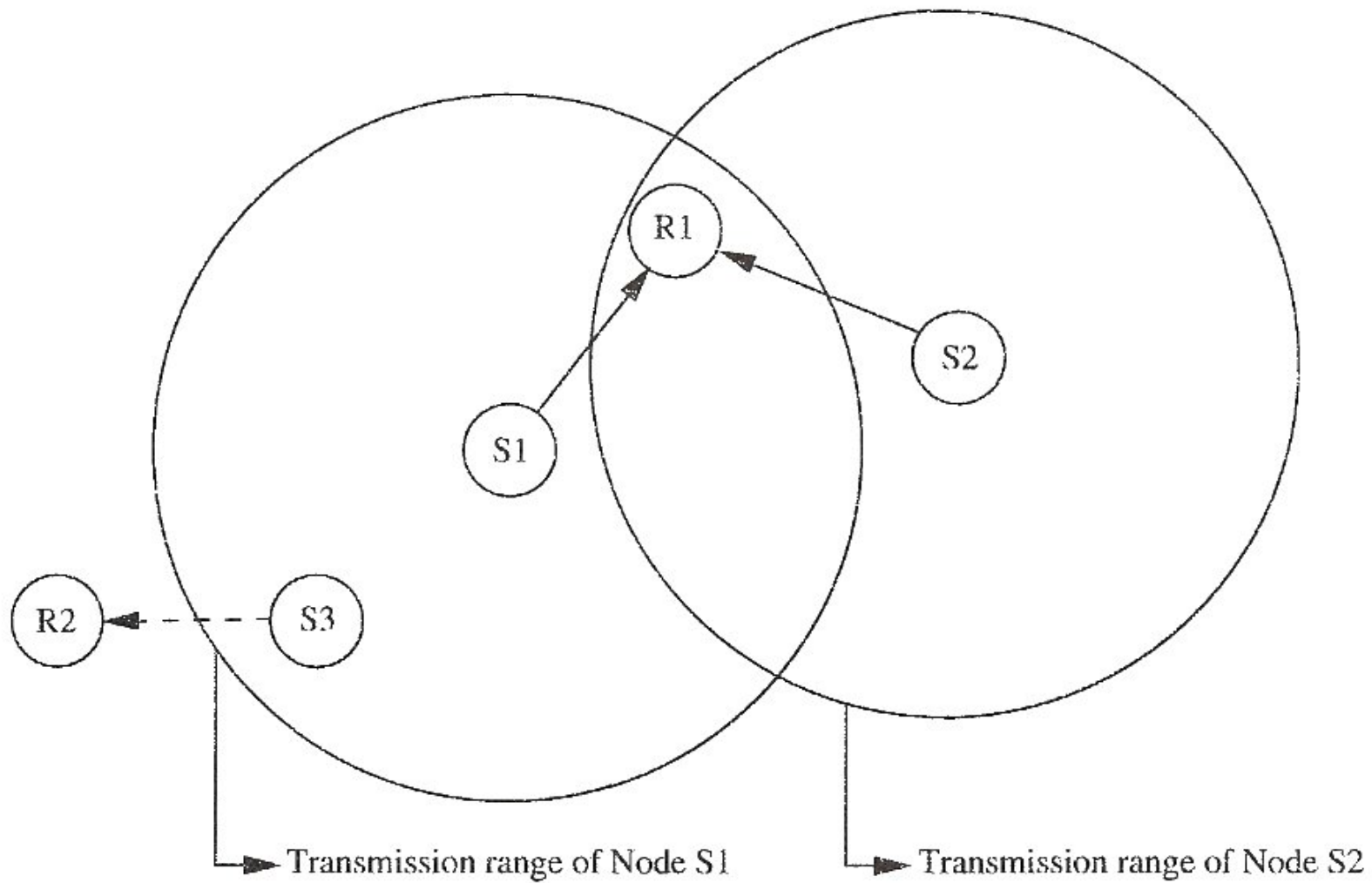
──────► Packet transmission

- - - - ► Transmission that is not permitted

MAC Protocol Design Goals

- Distributed operation
- Provide QoS for real-time traffic
- Keep access delay low
- Utilize available bandwidth efficiently
- Ensure fair allocation of bandwidth to nodes
- Minimize control overhead

- Minimize effects of hidden and exposed terminal problems
- Scalable to large networks
- Include power control mechanisms
- Include mechanisms for adaptive data rate control
- Provide time synchronization among nodes

MAC Protocols Classification

- Contention-based protocols

- Contention-based protocols with reservation mechanisms

- Contention-based protocols with scheduling mechanisms

- Other

Ad Hoc Routing Protocol Challenges

- Mobility of nodes

- Bandwidth constraint

- Error-prone shared broadcast radio channel

- Hidden and Exposed Terminal problems

- Resource constraints

Routing Protocol Characteristics

- Fully distributed

- Adaptive to frequent topology changes caused by node mobility

- Route computation and maintenance must involve a minimum number of nodes.

- Localized (no global information)

- Loop free and free from stale routes
- Minimize number of packet collisions
- Provide reliable transmissions
- Optimally use scarce resources
- Every node should try to store information regarding the stable local topology only
- Should provide a certain level of QoS as demanded by the applications, and should also offer support for time-sensitive traffic

Routing Protocol Classification

- Routing information update mechanism
  - ☐ Proactive or table-driven protocols
  - ☐ Reactive or on-demand routing protocols
  - ☐ Hybrid routing protocols
- Use of temporal information for routing
  - ☐ Routing protocols using past temporal info
  - ☐ Routing protocols using future temporal info

- **Routing topology**
  - ☐ Flat topology routing protocols
  - ☐ Hierarchical topology protocols
- **Utilization of specific resources**
  - ☐ Power-aware routing
  - ☐ Geographical information assisted routing

Energy Management

- Limited energy reserve
- Difficulties in replacing batteries
- Lack of central coordination
- Selection of optimal transmission power

Energy Management Protocols Classification

- Battery Management Schemes

- Transmission Power Management Schemes

- System Power Management Schemes
  - Device Power Management
  - Processor Power Management Schemes