Survey of Ad Hoc Network Routing Protocols

Team Adhocracy
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Coming Up

- Project Summary
- Research Papers
  - DSR
  - Champ
  - GPSR
- Simulation Details
- Question/Comments
- References

Project Summary

- Compare three Adhoc routing algorithms
  - DSR
  - Champ
  - GPSR
- Attempt to determine benefits and weaknesses of each algorithm
- Use metrics to determine which one works the best

Paper 1: Dynamic Source Routing

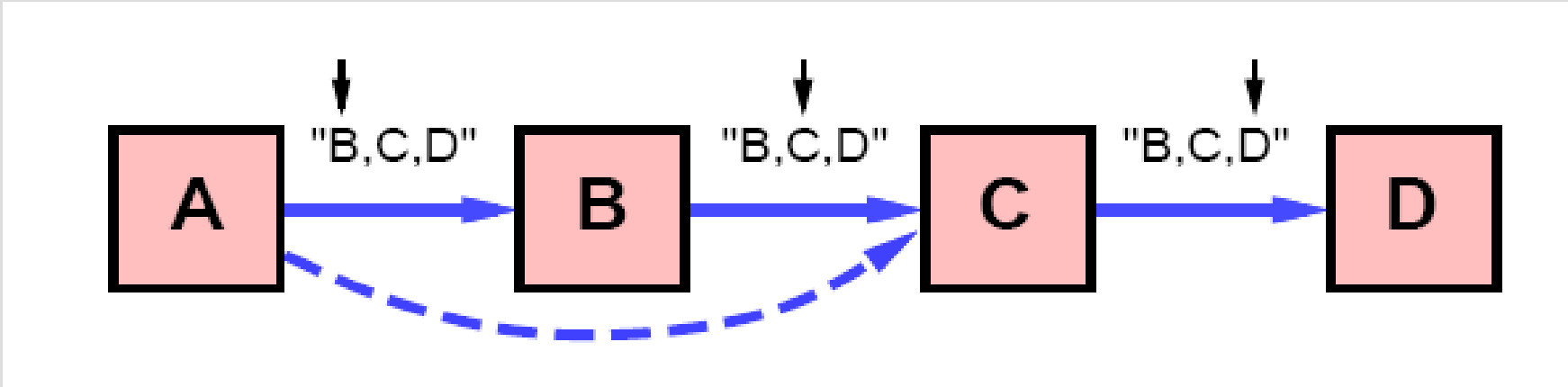
- DSR: The Dynamic Source Routing Protocol for Multi-Hop Wireless Ad Hoc Networks
  - Ad Hoc Networks
  - 2001
- Obtained from:
  http://www.monarch.cs.rice.edu/monarch-papers/dsr-chapter00.ps
- Figures in slides are from the paper

Dynamic Source Routing

- Features
  - Reactive protocol (on-demand)
  - Source routing
  - Supports uni-directional links
    - (optimizations available for bi-directional)
  - Heterogeneous networks
  - Integration with Mobile IP networks
- Non Features
  - Address assignment
  - Multicast

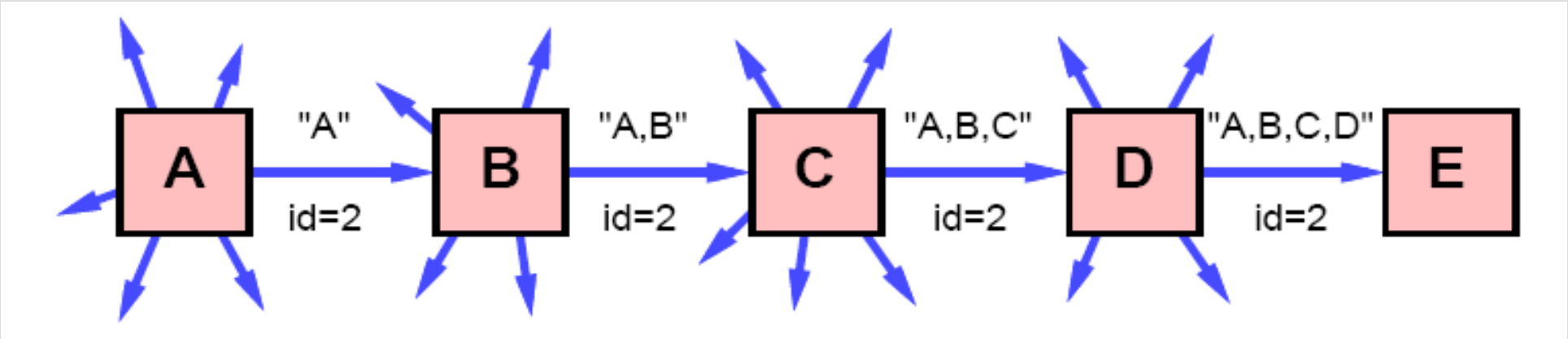
Source Routing Advantages

- Allows the sender to choose paths to destination
- Up-to-date information is not needed in intermediate nodes
- Can allow caching of routes and optimization



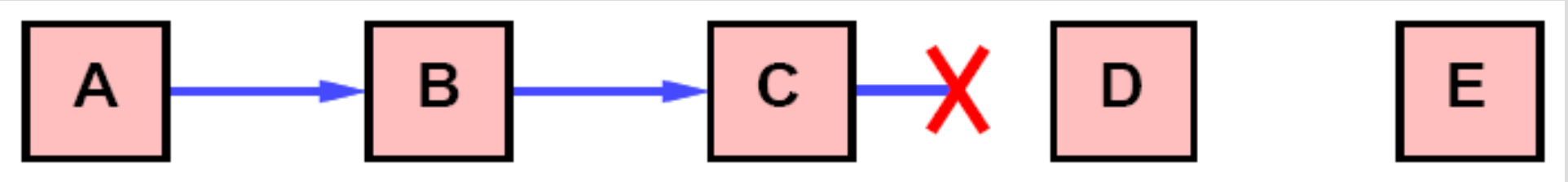
Route Discovery Process

- Source broadcasts, destination replies
- Route reversal is possible with bi-directional links
- Responding from cache is possible
  - Delays needed to prevent collisions
- Max hops equal to 0 for neighbor discovery



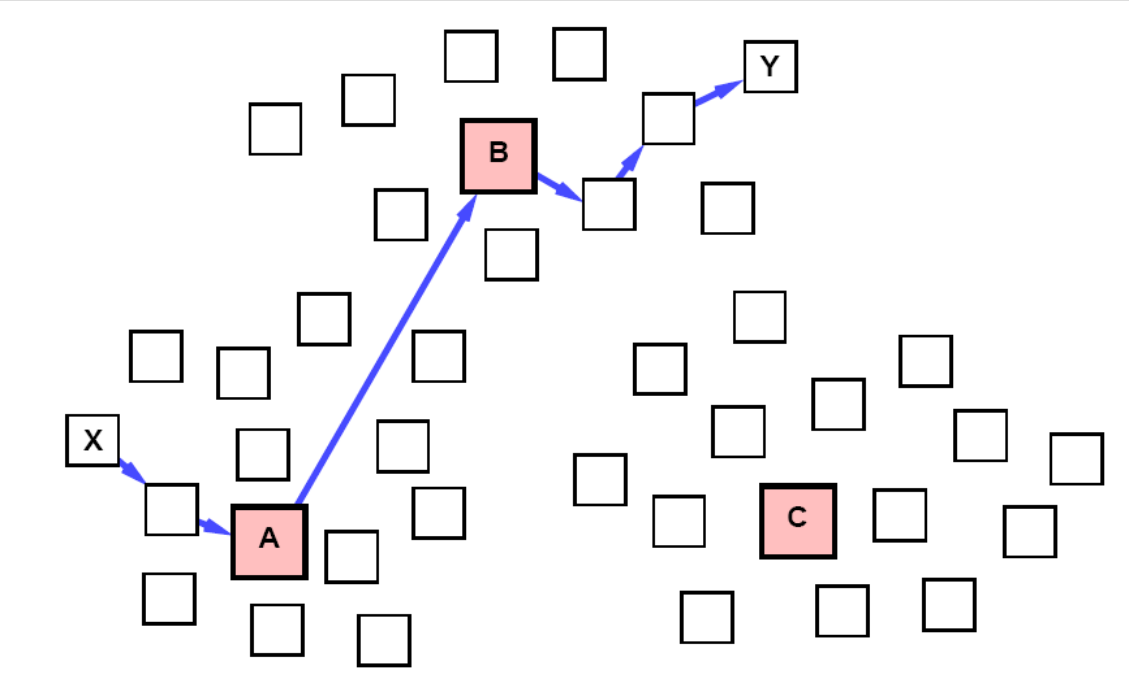
Route Maintenance Process

- Each transmission is confirmed, if confirmation fails, send route error
  - Source node does route discovery, attaching routing error to update caches
- Negative information caching possible
- Route Shortening



Other Features

- Heterogeneous network support
- Mobile IP gateway to Internet



DSR Summary

- Advantages
  - Overhead goes to absolute zero in stationary network
  - Actual implementations exist
  - Unidirectional support
- Disadvantages
  - No multicast support
  - Scaling

Paper 2: CHAMP

- Caching and Multi-Path routing protocol.
- Obtained from:

  ALVIN C. VALERA, WINSTON K.G. SEAH AND S.V. RAO, CHAMP: A Highly Resilient and Energy-Efficient Routing Protocol for Mobile Ad hoc Networks. In Proceedings of the 5th IEEE Conference on Mobile and Wireless Communications Networks (MWCN 2002), Stockholm, Sept 9-11, 2002.

http://texaspecanfest.com/trophy.jpg

Champ Problem

- Improve routing reliability in mobile ad-hoc network.
- While decreasing energy consumption.

http://www.schestowitz.com/IMG/blog/battery_low.jpg

Claims

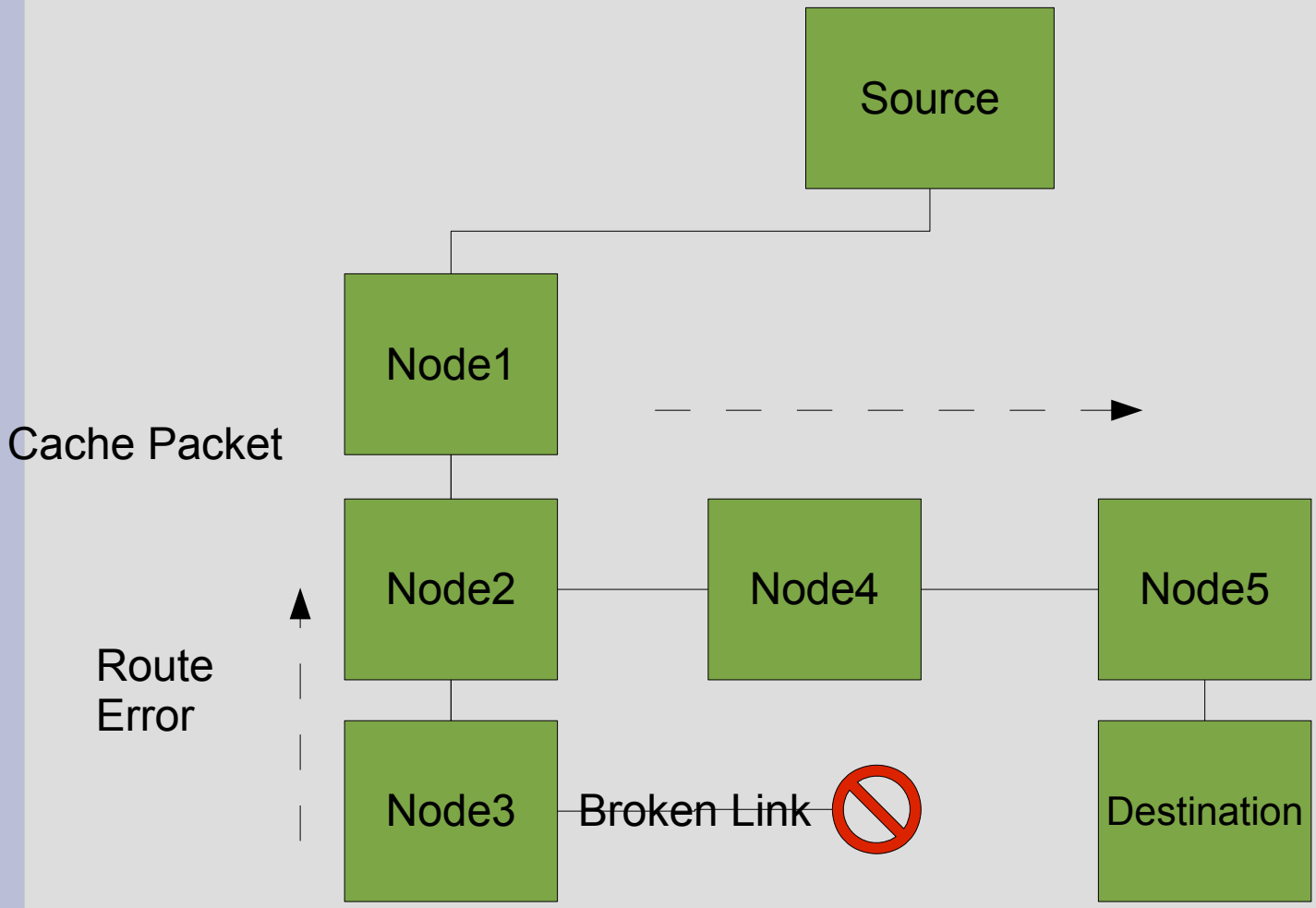
- 5-packet FiFo and 2 paths
  - Significant improvement over DSR and AODV
- High Loads
  - Champ delivers 50%(DSR) to 30%(AODV) more packets
  - While consuming 1/3(DSR) - 1/2(AODV) energy per packet delivered

http://www.coffeewhiz.com/images/DOMINO%20SUGAR%20PACKETS.jpg

Basic Concept

- When route error occurs
  - Tells upstream nodes about it.
  - They have cached copy of packet.
  - If they have another route they send it.
- Multi-path
  - Has more then one path to Destination
  - Chooses one used least for that transmission

Picture


Source
Node1
Cache Packet
Node2
Node4
Node5
Route
Error
Node3
Broken Link
Destination

Protocol Messages

- RREQ(Source,Destination,Sequence Number,previous node,forward count,last known difference,propagation range(hops))

http://www.ahajokes.com/cartoon/directions.jpg

Protocol Messages

- RREP(Source, Destination, sequence number (from request), previous hop, set of nodes that can accept message, hop count from previous node to destination +1, age or route, total route length.

Protocol Messages

- RERR(source, destination,sequence number, previous hop, error generator)

http://www.rivervalleymuseum.org/images/railroad_history2/images/bridge_out.jpg

Data Structures Needed

- Route Cache:
  - contains forwarding information
- Route Request Cache:
  - For storing route requests information
- Send Buffer:
  - Packets awaiting routes
- Data Cache
  - Recently forwarded packets.

Paper 3: GPSR

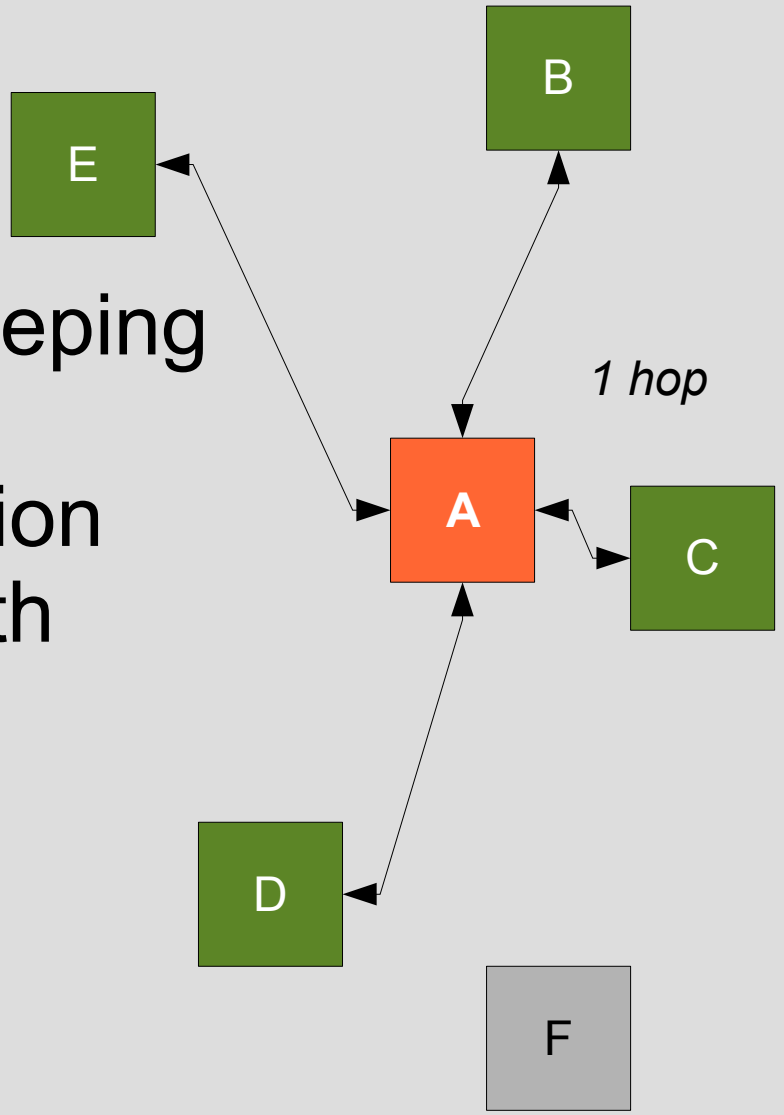
- GPSR: Greedy Perimeter Stateless Routing for Wireless Networks
  - Mobile Computing and Networking
  - 2000
- Obtained from: http://doi.acm.org/10.1145/345910.345953

Greedy Perimeter Stateless Routing

- Features
  - Geographical Data
  - Stateless, less protocol message overhead
  - Simple packet forwarding
  - Small packet header

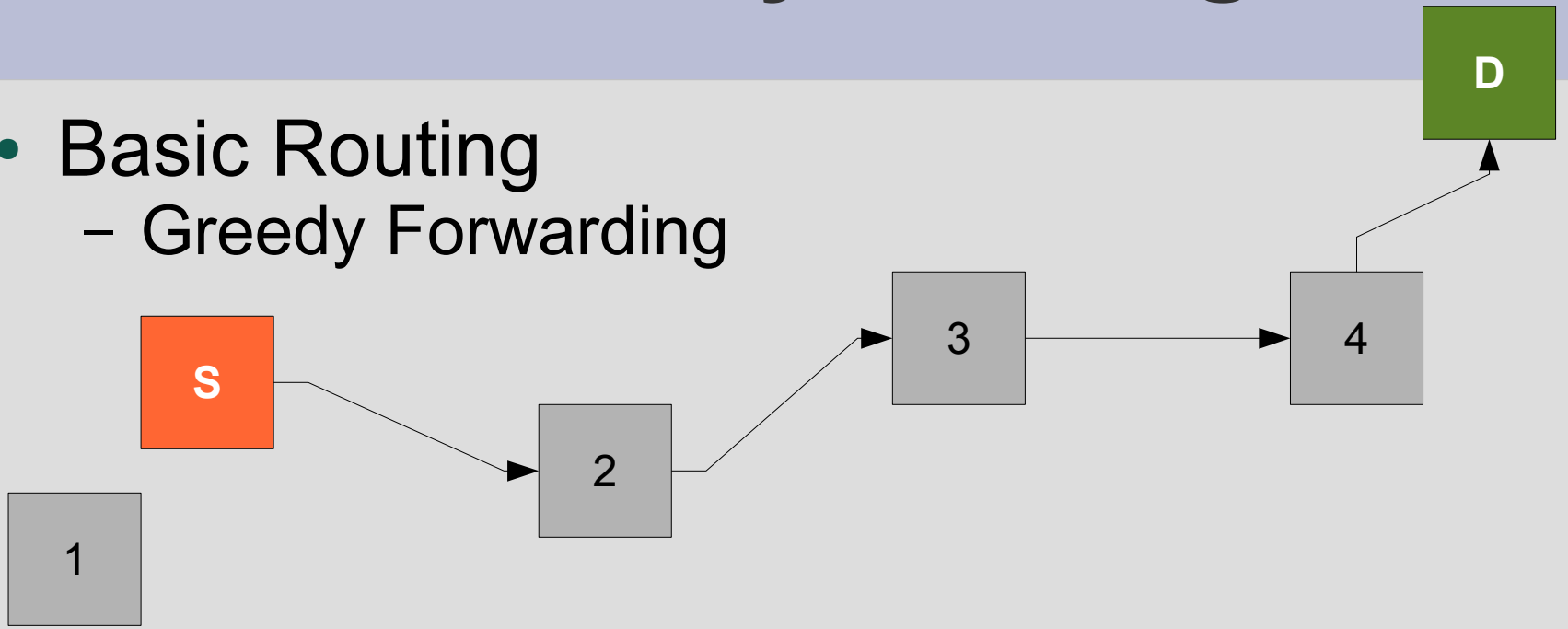
Geographical

- Simple Beacon message
  - Contains unique identifier
  - Originators location
- Beacon Interval is key to keeping neighbors up to date
- To reduce power consumption beacon data is also sent with standard packets



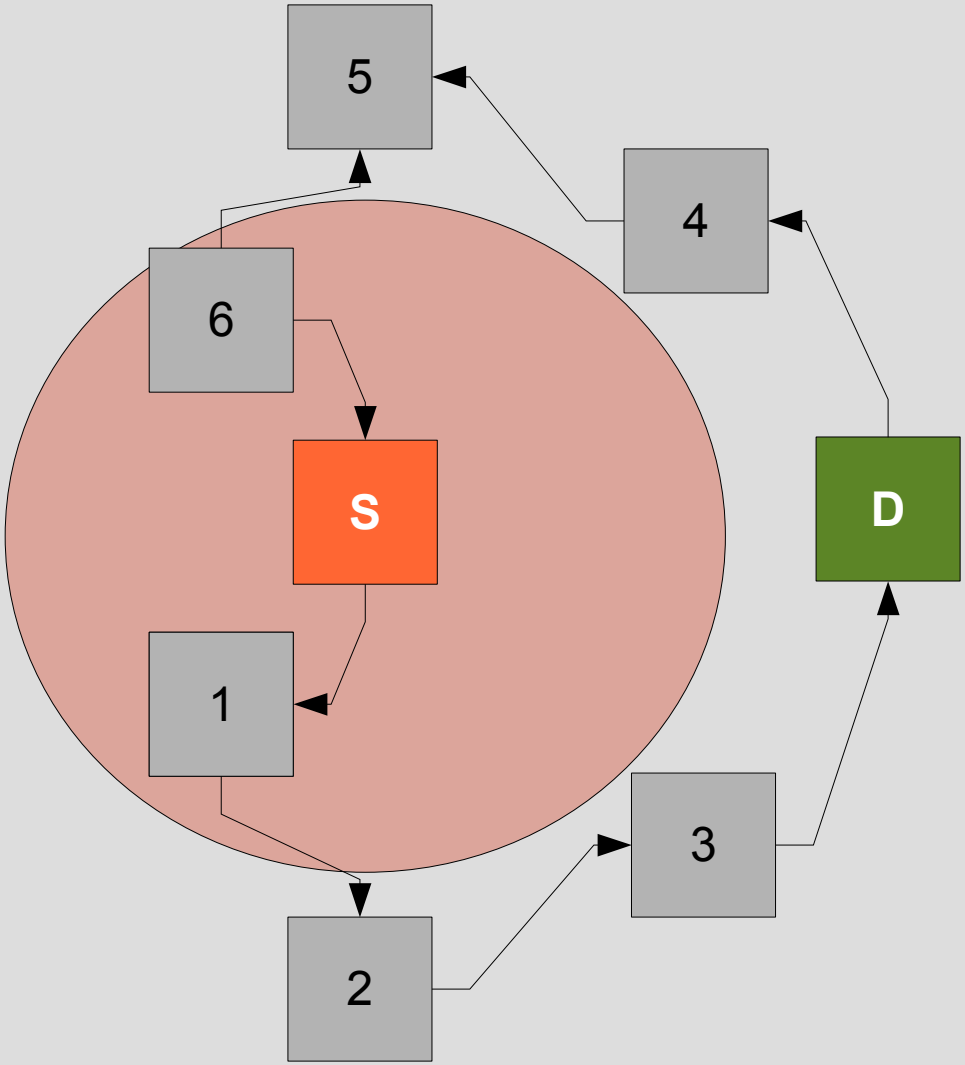
Greedy Routing

- Basic Routing
  - Greedy Forwarding



- Calculates distance to destination, forwards packets to closest

Perimeter Routing



- Handles special cases when Greedy routing fails
- RHR
- Attempts to work around “voids”
- If finds no path around void, possible disconnect in network, packet dropped

GPSR Summary

- Advantages
  - Simple routing
  - Small packet headers (5 parameters)
  - Stateless
  - Non-source
- Disadvantages
  - Beaconing/Stateless (energy)
  - Non-source

Simulation Details

- Simulation Properties
  - Nodes can move
  - Bidirectional Links
  - Static node transmission ranges
  - Nodes know who they are sending to
- Simulation Tests
  - Static Network
  - Random Moving Network
  - Real life simulations (node moving through field)
  - Vary total nodes, field size and sending time

More Simulation Details

- Metrics for Analysis
  - Protocol Messages
  - Packets Delivered/Dropped Packets
  - Protocol/Packet Bytes through each node
  - Number of Hops
  - Collisions
  - Packet Distance
  - Packet Time
  - Power Usage (simple)

Comments/Questions

References

- Johnson, David B., Maltz, David A., Broch, Josh. 2001. DSR: The Dynamic Source Routing Protocol for Multi-Hop Wireless Ad Hoc Networks. in Ad Hoc Networking, edited by Charles E. Perkins, Chapter 5, pp. 139-172, Addison-Wesley, 2001. Obtained from http://www.monarch.cs.rice.edu/monarch-papers/dsr-chapter00.ps
- ALVIN C. VALERA, WINSTON K.G. SEAH AND S.V. RAO, CHAMP: A Highly Resilient and Energy-Efficient Routing Protocol for Mobile Ad hoc Networks. In Proceedings of the 5th IEEE Conference on Mobile and Wireless Communications Networks (MWCN 2002), Stockholm, Sept 9-11, 2002.
- Karp, B. and Kung, H. T. 2000. GPSR: greedy perimeter stateless routing for wireless networks. In Proceedings of the 6th Annual international Conference on Mobile Computing and Networking (Boston, Massachusetts, United States, August 06 - 11, 2000). MobiCom '00. ACM Press, New York, NY, 243-254. DOI= http://doi.acm.org/10.1145/345910.345953