

ENSC 427: COMMUNICATION NETWORKS
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FINAL PROJECT PRESENTATIONS

A Better Approach to Mobile Ad hoc Networking

Analysis through Simulation
using NS2

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Group 9

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Introduction:

Wireless Mobile Ad hoc Networking

- Mobile ad hoc networks refer to networks where:
 - nodes may move
 - are connected over a lossy channel
 - do not rely on any centralized support infrastructure
- Networks where link failure is rampant require specialized routing protocols
- Causes of link and node failure:
 - hostile or spectrum scarce environments
 - mobile nodes
- Optimal paths vary greatly as a result of changing network topology - routing protocols must be proactive and dynamic

Introduction:

Applications

- Disaster response networks
 - If infrastructure is destroyed or overburdened, an ad hoc network can quickly be established to facilitate rescue and emergency response
 - Similarly, police, parametric and firefighters all responding to the same call should have information disseminated amongst them.
- Military
 - Soldiers in the battlefield
- Vehicular Networks
 - Communication between cars and road signs.
 - A major topic of research

Introduction

Classes of Mobile Ad hoc Networking

- Table Driven
 - Routing decisions based on:
 - Next hop - examined in this presentation
 - Better Approach to Mesh Ad hoc Networking (BATMAN)
 - Best path - used for comparison
 - Optimized Link State Routing (OLSR)
- Non-Table driven (Source-Initiated On-Demand)
 - Routes are discovered only when data needs to be sent
 - Not examined in this presentation

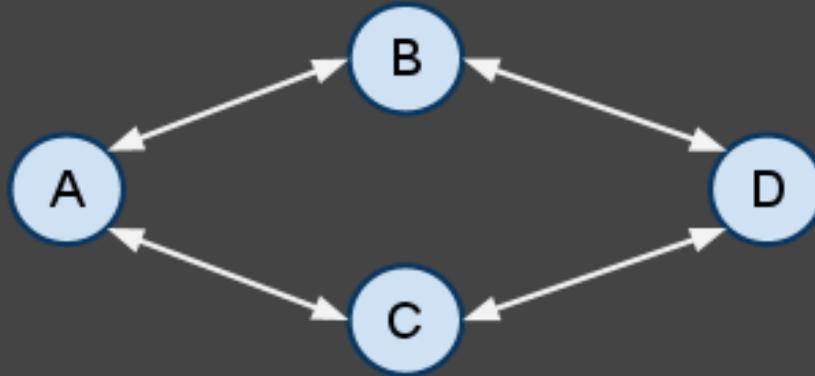
Introduction:

Goals: Validating a Unique Approach

- Traditionally, nodes exchange control packets that contain information about link state (current link utilization, bandwidth, ect).
 - Nodes determine best paths based on control packets.
 - Every node must have near exhaustive information about the entire network
- BATMAN takes a very different approach:
 - The presence or absence of control packets is used to indicate link (and path) quality.
 - By implementing and simulating the protocol in NS2, I hope to validate this innovative approach.

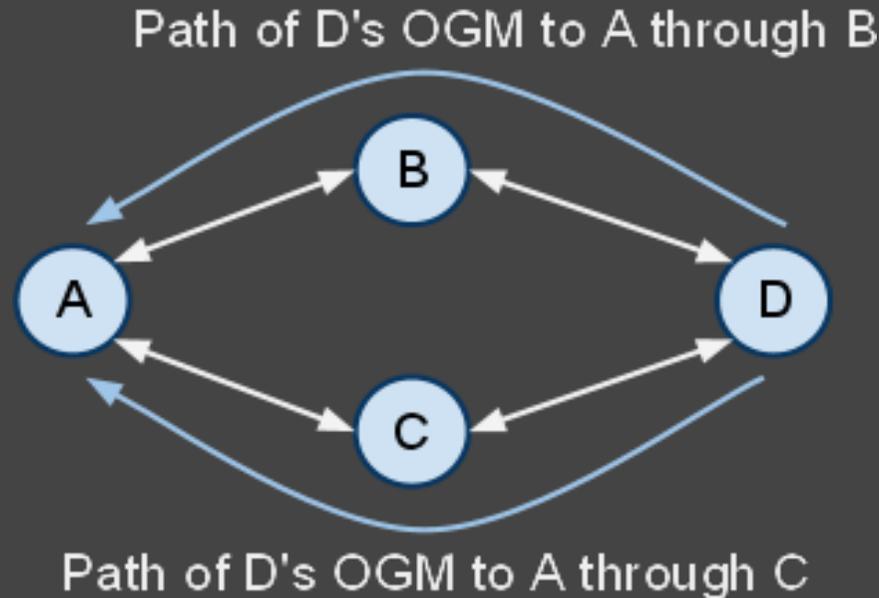
Protocol Details of BATMAN:

Key Features: Neighbors and OGMs



- Each node has a set of direct-link neighbors.
 - In the network above, node A has neighbors B and C. These are the nodes through which A sends and receives all its packets.
- Each node in the network sends an Originator Message (OGM) periodically, in order to inform all other nodes of its presence.
 - OGMs include a sequence number

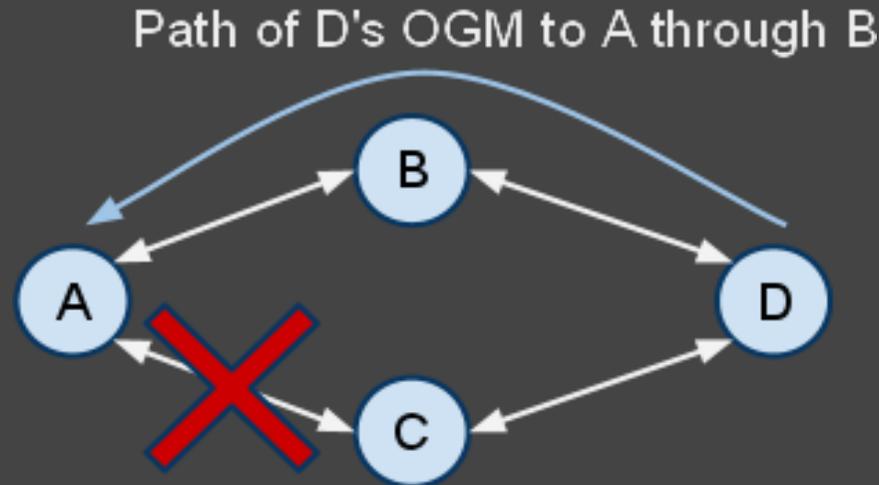
Protocol Details of BATMAN: Key Features: OGMs (continued)



- If all shown links are perfect, Node A will receive node D's OGM through both of its neighbors B and C.
 - If all of D's OGMs arrive through both B and C, then when A needs to send something to D, it can use either B or C as the next hop towards the destination node D.

Protocol Details of BATMAN:

Key Features: OGMs (continued)



- What happens if the link between nodes A and C goes down?
 - Node D's OGM will only arrive to A through node B.
 - Node A therefore considers node B as the best next hop neighbor for all packets destined for node D.
 - Further, Node C's OGMs will also only reach node A through node B. Node B is the best next hop for data destined for Node C.

Protocol Details of BATMAN:

Key Features: Sliding Window

	Out of Range			In Window Range								Out of Range				
Seq. Numbers:	...	5	6	7	8	9	10	11	12	13	14	15	16	17	18	...
Arrived:	...	-	-	-	1	1	1	0	1	0	1	1	-	-	-	...

- The previous example was simple.
 - What happens if some but not all OGMs arrive through a link?
 - Solution: Sliding Window
- A sliding window indicates which of the last WINDOW_SIZE (in the example, 8) sequence numbers have been received
 - Uses the sequence numbers received through OGMs

Protocol Details of BATMAN:

Key Features: Sliding Window

	Out of Range			In Window Range									Out of Range			
Seq. Numbers:	...	5	6	7	8	9	10	11	12	13	14	15	16	17	18	...
Arrived:	...	-	-	-	1	1	1	0	1	0	1	1	-	-	-	...

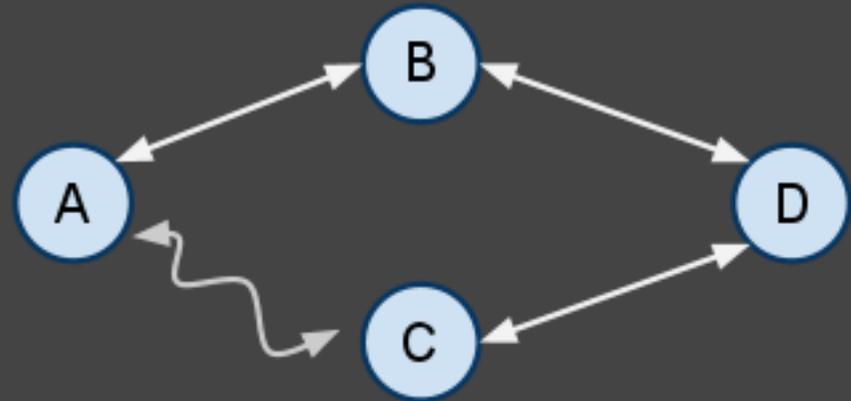


	Out of Range			In Window Range									Out of Range			
Seq. Numbers:	...	7	8	9	10	11	12	13	14	15	16	17	18	19	20	...
Arrived:	...	-	-	-	1	0	1	0	1	1	0	1	-	-	-	...

- When an out of range sequence number is received, in this case seq# 17, the window shifts up.
 - We went for having 6 sequence number in-range to having only 5.

Protocol Details of BATMAN: Key Features

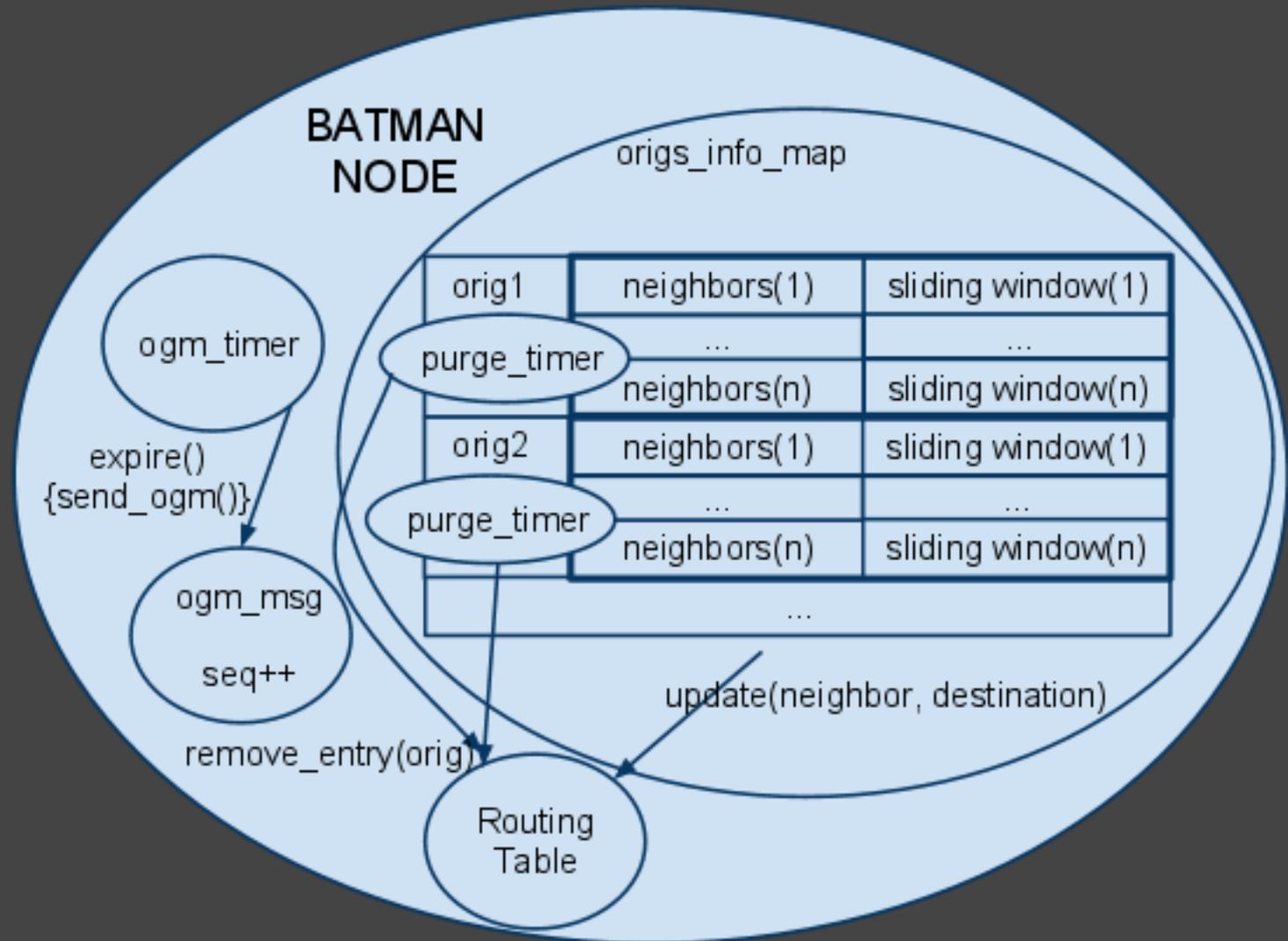
Originators	Neighbour	In Window Range Packet Count
B	B	8
	C	3
C	B	6
	C	2
D	B	7
	C	2



Information stored by node A in order to determine best next hop to each node in the network

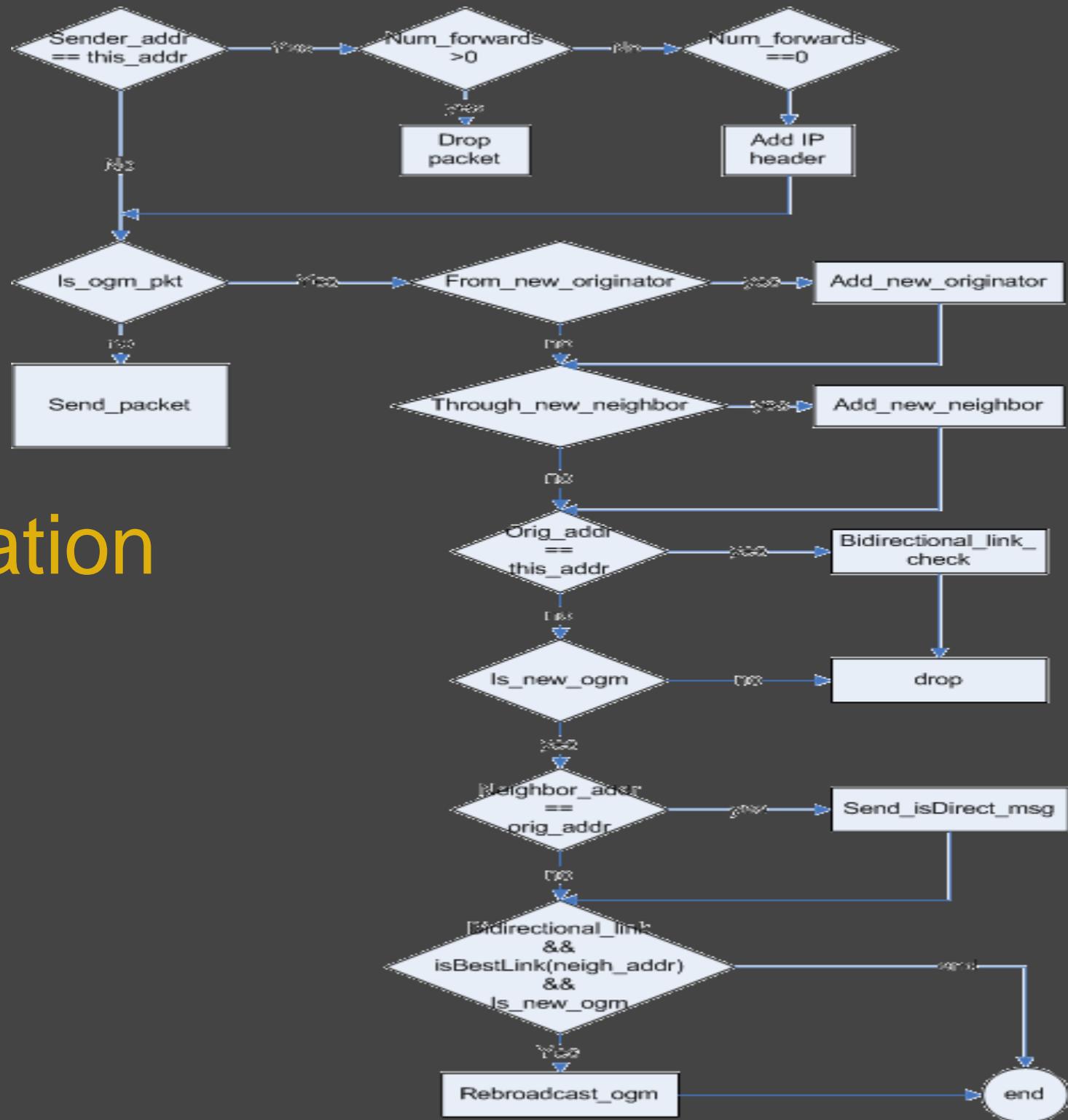
- All nodes have a sliding window for each originator (other node) in the network for each neighbor.
- Link between A and C is suspect

Protocol Details of BATMAN: Implementation Details



Protocol Details of BATMAN:

Implementation Details

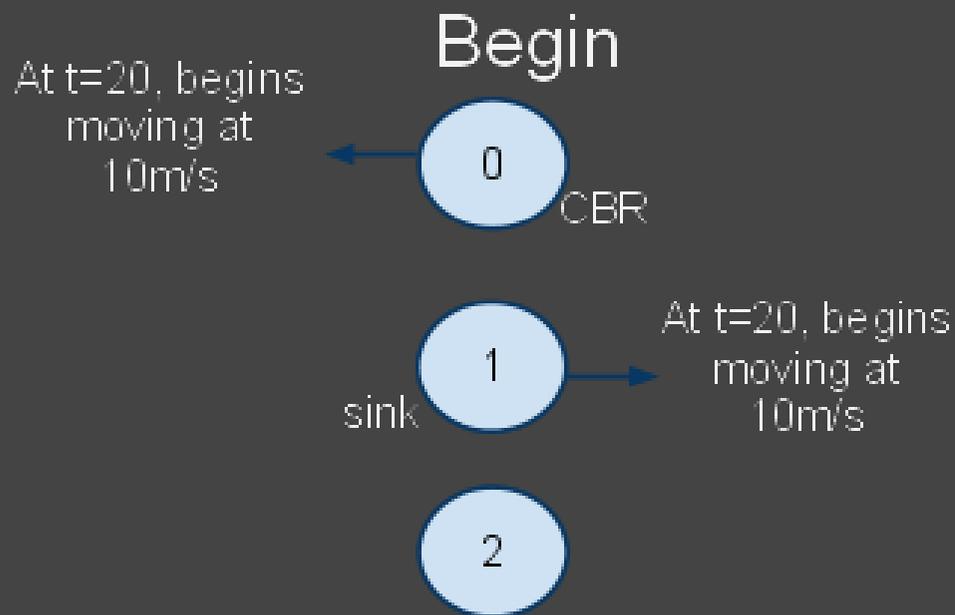


Comparison

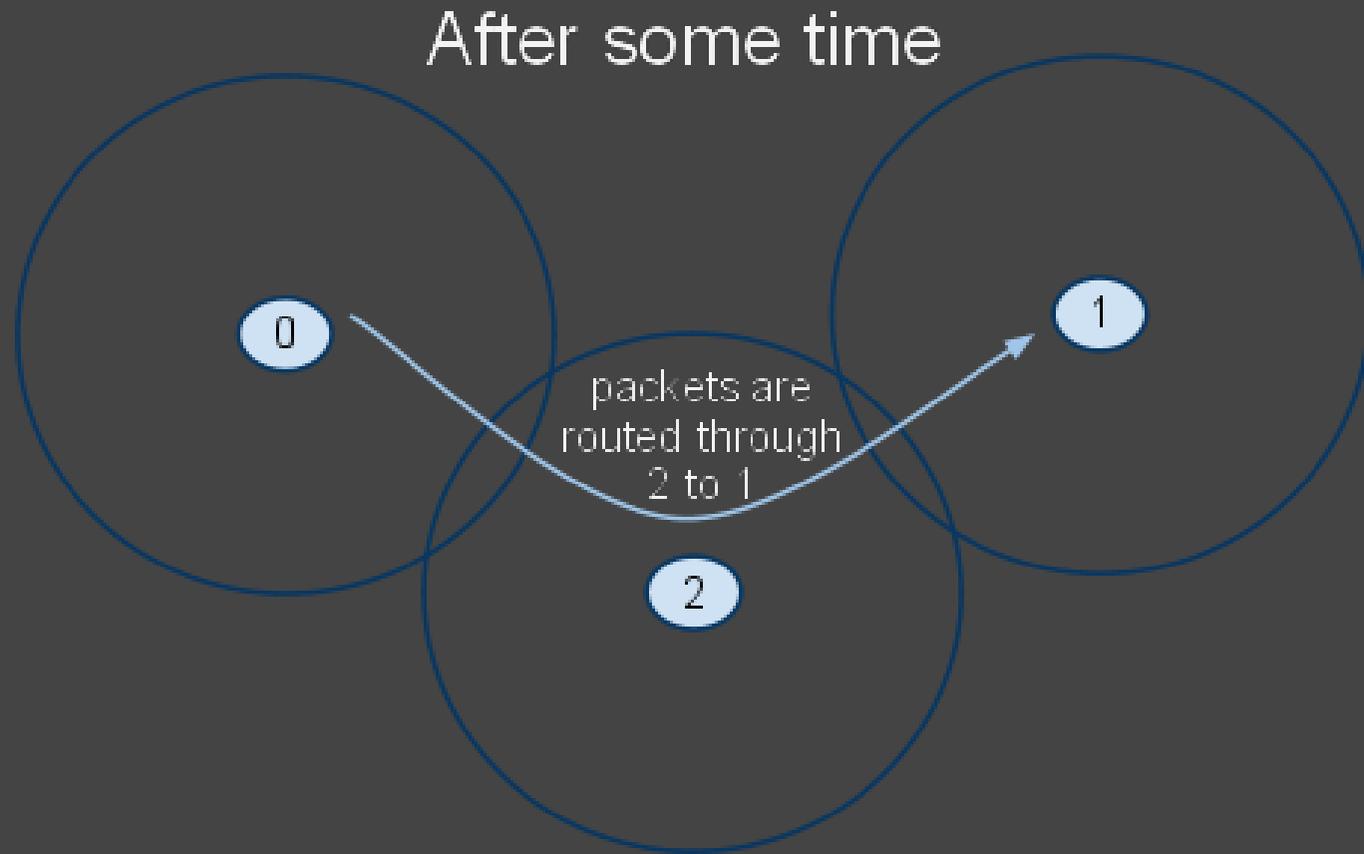
- OLSR and similar protocols explicitly include link-state information in the control packets.
 - This information is used to determine best paths in the network
 - Loss of control packets means nodes aren't making informed routing decisions
- BATMAN receives information about link (and path) quality through the presence or absence of control packets.
 - Collective intelligence - retransmission of an OGM implies it arrived successfully through a best-link neighbour
 - No node needs to have exhaustive knowledge of network

Simulation

- Initially, nodes 0 and 1 transmit directly

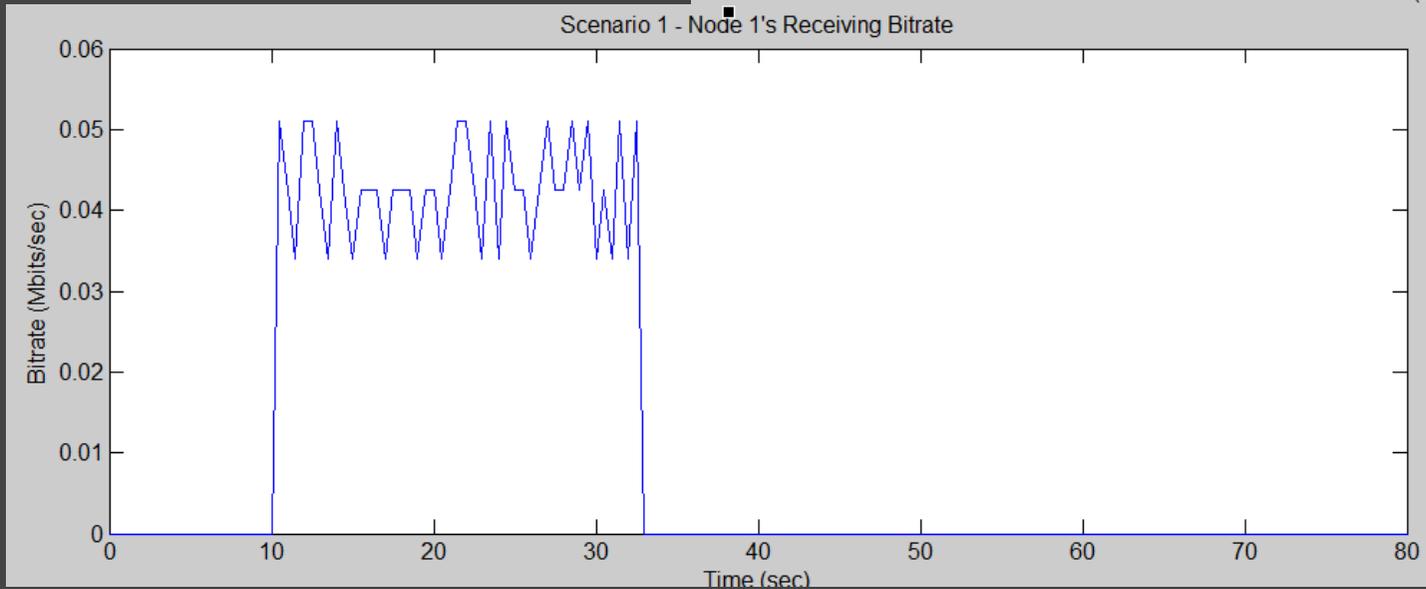
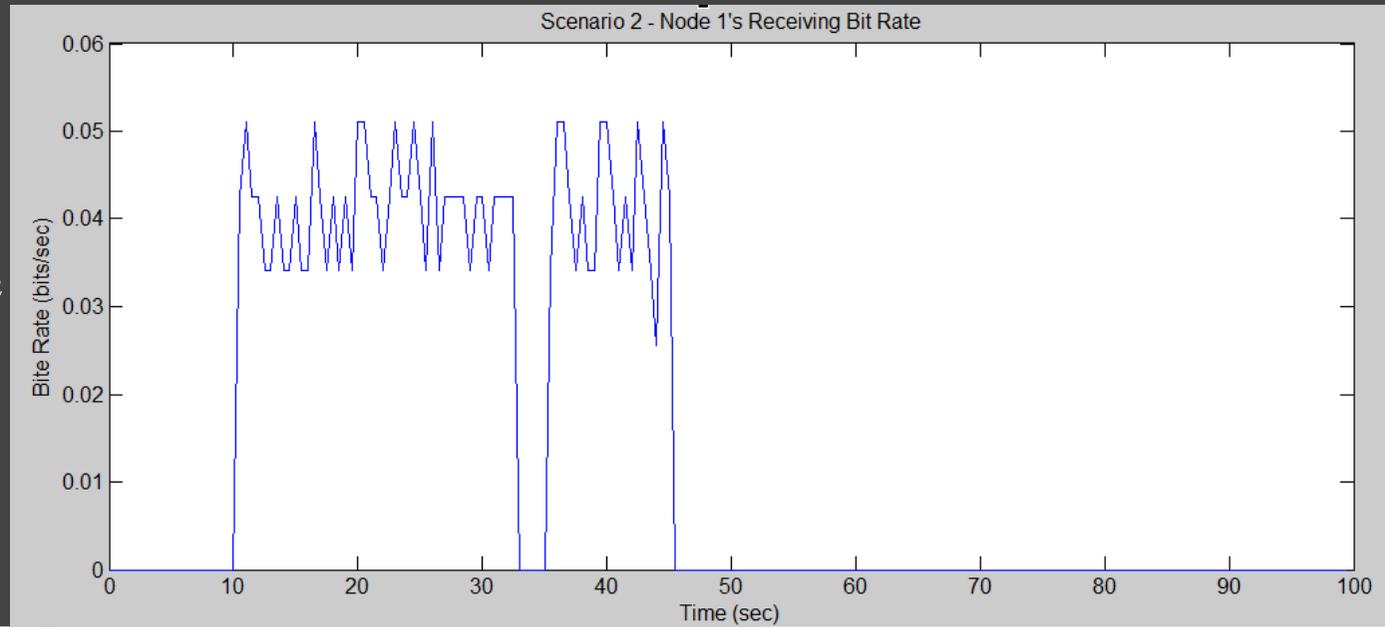


- after some time, it becomes necessary to transmit through node 2



Simulation

Performing the simulation with node 2 results in the plot on the right



Without node 2, results are those shown plotted on the left

Results are very expected: without node 2 to assist communication between nodes 0 and 1 as they drift apart, transmission cuts 12.5 seconds sooner (time spent using node 2 to route)

Discussion

- Results validate BATMAN as an ad hoc routing protocol
- Intention was to compare BATMAN and OLSR
 - the "better" in BATMAN referred to OLSR
 - An implementation of OLSR in NS2 is available, but for ns2.27.
- Familiarity with NS2's inner workings was necessary in order to implement a routing protocol
 - Lots of debugging
 - Routing data needs to be explicitly tracked
- Illustrative scenarios are hard to devise
 - Possibly a whole new project

Future Work

- Vary simulation parameters:
 - topology
 - mobility
 - traffic types
 - amount of loss
- Simulate OLSR in similar scenarios
 - Compare simulation results
- Implement portions of BATMAN protocol that allow interface with other networks

References

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Questions?