Bypass Routing: An On-Demand Local Recovery Protocol for Ad Hoc Networks

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Outline

• Introduction
• Related Works
• Proposed Schemes
• Simulations
• Conclusion
Introduction (1/2)

• On-demand routing protocols for ad hoc networks reduce the cost of routing in high mobility environments.

• However, route discovery in on-demand routing is typically performed via network-wide flooding, which consumes a substantial amount of bandwidth.
In this paper, we present bypass routing, a local recovery protocol that aims to reduce the frequency of route request floods triggered by broken routes.
Related Works

• Dynamic Source Routing (DSR)

<table>
<thead>
<tr>
<th>Dest</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>→e→D</td>
</tr>
<tr>
<td>D</td>
<td>→c→D</td>
</tr>
</tbody>
</table>

Route Cache
Related Works

• Dynamic Source Routing (DSR)
Proposed Scheme

• Bypass Routing
  – MAC cache
  – Route cache
  – Error recovery
    • route salvaging
    • bypass recovery

• Source Routing with Local Recovery (SLR).
  – Use DSR underlying protocol, but implements route selection and error recovery based on bypass routing.
Proposed Scheme

- **MAC cache**
  - Maintain the most recent neighborhood state.

<table>
<thead>
<tr>
<th>Condition</th>
<th>MAC cache status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heard any activity of neighbor</td>
<td>Active</td>
</tr>
<tr>
<td>After “refresh interval” time</td>
<td>no communication</td>
</tr>
<tr>
<td>After “delete interval” time</td>
<td>(deleted)</td>
</tr>
</tbody>
</table>
Proposed Scheme

- Error recovery
  - route salvaging

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<td>D</td>
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</tr>
<tr>
<td>D</td>
<td>→c→D</td>
</tr>
<tr>
<td>D</td>
<td>→f→D</td>
</tr>
</tbody>
</table>

Route Cache(b)

Neighbor | Connectivity
---------|----------------
 c        | no communication
 f        | Active
Proposed Scheme

• Error recovery
  – Bypass recovery

Node c’s connectivity with D is Active.
Node f’s connectivity with D is no communication.
So only node c reply the query message.
Simulations

• Simulator : ns-2 network simulator
  CMU wireless extension
• Mobility Model: random waypoint
• Mobility: 0-20 m/sec
## Simulations

### TABLE I
PARAMETERS USED IN SLR SIMULATION

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail-record: Table size (number of entries)</td>
<td>34</td>
</tr>
<tr>
<td>Fail-record: Timeout (s)</td>
<td>1.0</td>
</tr>
<tr>
<td>Fail-buffer: Packet timeout (s)</td>
<td>0.02</td>
</tr>
<tr>
<td>MAC Cache: Refresh interval (s)</td>
<td>0.05</td>
</tr>
<tr>
<td>MAC Cache: Delete interval (s)</td>
<td>3.0</td>
</tr>
</tbody>
</table>

### TABLE II
AVERAGE HOP COUNT WITH DIFFERENT TRAFFIC LOAD

<table>
<thead>
<tr>
<th>Network</th>
<th>SLR (cache)</th>
<th>DSR (cache)</th>
<th>SLR (nocache)</th>
<th>DSR (nocache)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500x500</td>
<td>3.427</td>
<td>3.144</td>
<td>3.324</td>
<td>3.160</td>
</tr>
<tr>
<td>2000x1500</td>
<td>5.484</td>
<td>4.861</td>
<td>5.590</td>
<td>5.383</td>
</tr>
</tbody>
</table>
Simulations

A. Impact of traffic load

Fig. 4. Routing overhead vs. traffic load in terms of packets, 20 CBR connections, 60 nodes, 1500mx500m region, speed 0-20m/s
Simulations

Fig. 5. Route Requests vs. traffic load, 20 CBR connections, 60 nodes, 1500mx500m region, speed 0-20m/s
Fig. 7. Goodput vs. traffic load in terms of packets, 20 CBR connections, 60 nodes, 1500mx500m region, speed 0-20m/s
Simulations

Fig. 8. Delay vs. traffic load, 20 CBR connections, 60 nodes, 1500mx500m region, speed 0-20m/s
Simulations

• B. Impact of network size

Fig. 9. Routing Overhead in terms of packets vs. traffic load, 40 CBR connections, 150 nodes, 2000mx1500m region, speed 0-20m/s
Fig. 10. Route Requests vs. traffic load, 40 CBR connections, 150 nodes, 2000mx1500m region, speed 0-20m/s
Simulations

Fig. 11. Delivery Ratio vs. traffic load, 40 CBR connections, 150 nodes, 2000mx1500m region, speed 0-20m/s
Simulations

• *C. Impact of Mobility*

Fig. 12. Routing overhead (packet) vs. mobility, 20 CBR connections, 60 nodes, 1500mx500m region, speed 0-20m/s
Simulations

Fig. 13. Route requests vs. mobility, 20 CBR connections, 60 nodes, 1500mx500m region, speed 0-20m/s
Simulations

Fig. 14. Delivery Ratio vs. mobility, 20 CBR connections, 60 nodes, 1500mx500m region, speed 0-20m/s
Simulations

Fig. 15. Goodput (packet) vs. mobility, 20 CBR connections, 60 nodes, 1500mx500m region, speed 0-20m/s
Simulations

Fig. 16. Average number of hops vs. mobility, 20 CBR connections, 60 nodes, 1500mx500m region, speed 0-20m/s
Conclusion

- In this paper, they propose bypass routing, which reduces the need to perform route discovery for broken routes via bypass recovery and a novel cache invalidation mechanism.

- In future work, they plan to investigate the benefits of bypass routing with other on-demand protocols.

- Maybe they also can study how bypass routing using at power-saving ad hoc network.