

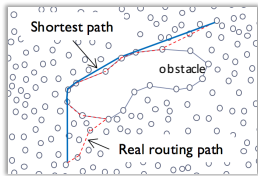
# Obstacles Bypassing Routing Protocol in WSNs

## 無線センサーネットワークにおける障害物を回避するパケット転送手法

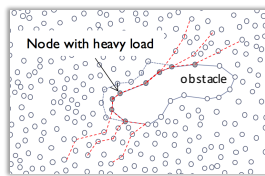
Phi Le Nguyen, Yusheng Ji / National Institute of Informatics – The Graduate University for Advanced Studies, Tokyo, Japan

### Geographic routing

- ❖ Uses only location information; stateless and efficient.
- ❖ Encounter two serious problems, i.e., routing path enlargement and load imbalance, when subject to networks with obstacles.



**Routing path enlargement:** Packets tends to be routed along the boundary of the obstacles.

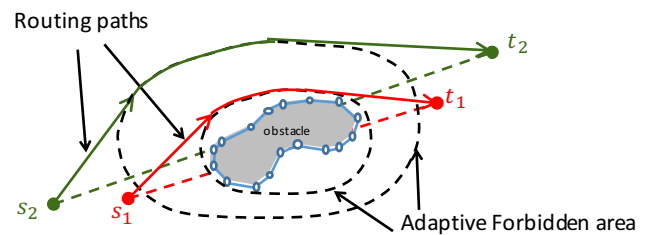


**Load imbalance:** The nodes surrounding the obstacles are imposed a heavy traffic than the other nodes.

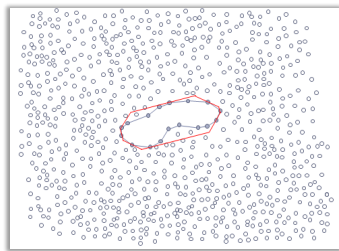
### Adaptive forbidden area approach

- ❖ **Forbidden area:** a region from which the packets are made to stay away.
- ❖ **Adaptive forbidden area:** a forbidden area which varies for each packet.
  - ❖ The diversity of the forbidden area: resolves imbalance problem
  - ❖ The size of the forbidden area: is adjusted to guarantee the constant stretch

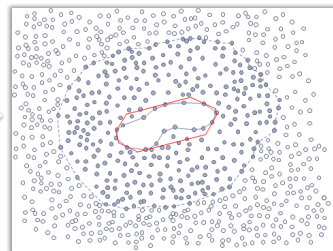
**Stretch:** the ratio between the length (or hop count) of the real routing path and the theoretical shortest routing path



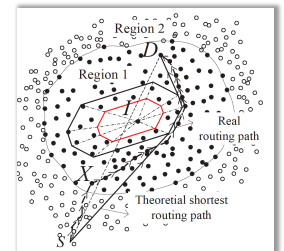
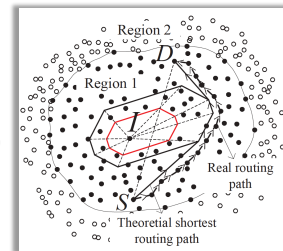
### Our approach



- ❖ Identifies obstacle's boundary, approximates the boundary by a simple polygon, i.e., *core polygon*.



- ❖ Disseminates information of the core polygon to the node surrounding the obstacle.



- ❖ Determines the forbidden area: Image of the core polygon through a homothetic transformation.
  - ❖ The center is random; the scale factor  $\xi > 1$  is computed based on source-destination distance.
- ❖ Packets are forwarded along the shortest path bypassing the forbidden area.

### Performance evaluation

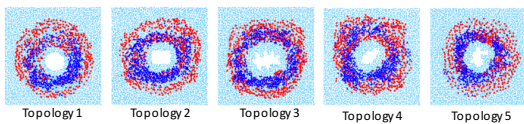


Fig. 1: Simulated topologies.

Table 1: Simulated parameters.

Topology	1	2	3	4	5
Area ( $m^2$ )	1500 x 1500				
Number of nodes	4548	4623	4699	4394	4789
Number of source-destination pairs	466	530	556	567	459

- ❖ **Metrics:** Routing path stretch, balance index, packet overhead.
- ❖ **Benchmarks:** GOAL [1], EHDS [2], GPSR [3]

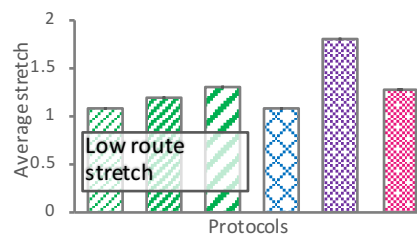


Fig 2. Comparison of routing path stretch.

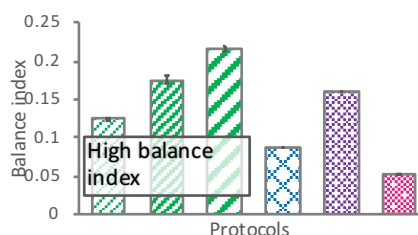


Fig 3. Comparison of balance index.

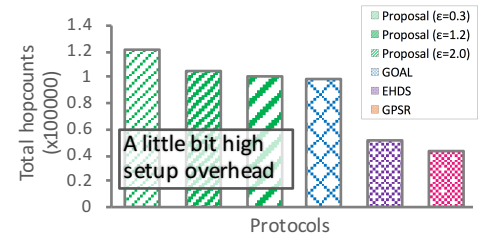


Fig 4. Comparison of setup packet overhead.

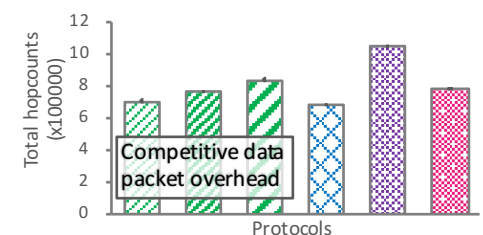


Fig 5. Comparison of data packet overhead.

[1] M.Won, et al., "Goal: A parsimonious geographic routing protocol for large scale sensor networks", Ad Hoc New. 11 (1) (2013) 453-472.  
 [2] F. Yu, et al., "Efficient hole daours scheme for geographic routing in wireless sensor networks", in Proc. of VTC'08, pp.153-157.  
 [3] B. Karp, et al., "Gpsr: Greedy perimeter stateless routing for wireless networks", in Proc. of INFOCOM'04, pp.2458-2468.