

# The Center for Cyber Defenders

## Expanding Computer Security Knowledge

### Ad Hoc Mobile

Julia Calandro, Missouri University of Science and Technology;  
Wesley Folz, University of Arizona



Project Mentors: Anand Ganti and Uzoma Onunkwo, Org. 9336; Eric Hokanson, Org. 5636

#### Problem Statement:

The most common routing protocols for Mobile Ad Hoc Networks, such as Dynamic Source Routing (DSR) and Ad Hoc On-Demand Distance Vector Routing (AODV), perform poorly in large-scale networks with variable connectivity. The Efficient Spreading with Backtracking Protocol (ESPB) was developed to solve these problems by using a geographic/geometric routing approach, which improves routing performance in densely-populated regions.

#### Objective and Approach:

Assist in testing of a delay-tolerant Routing Protocol for a large-scale Mobile Ad Hoc Network (MANET).

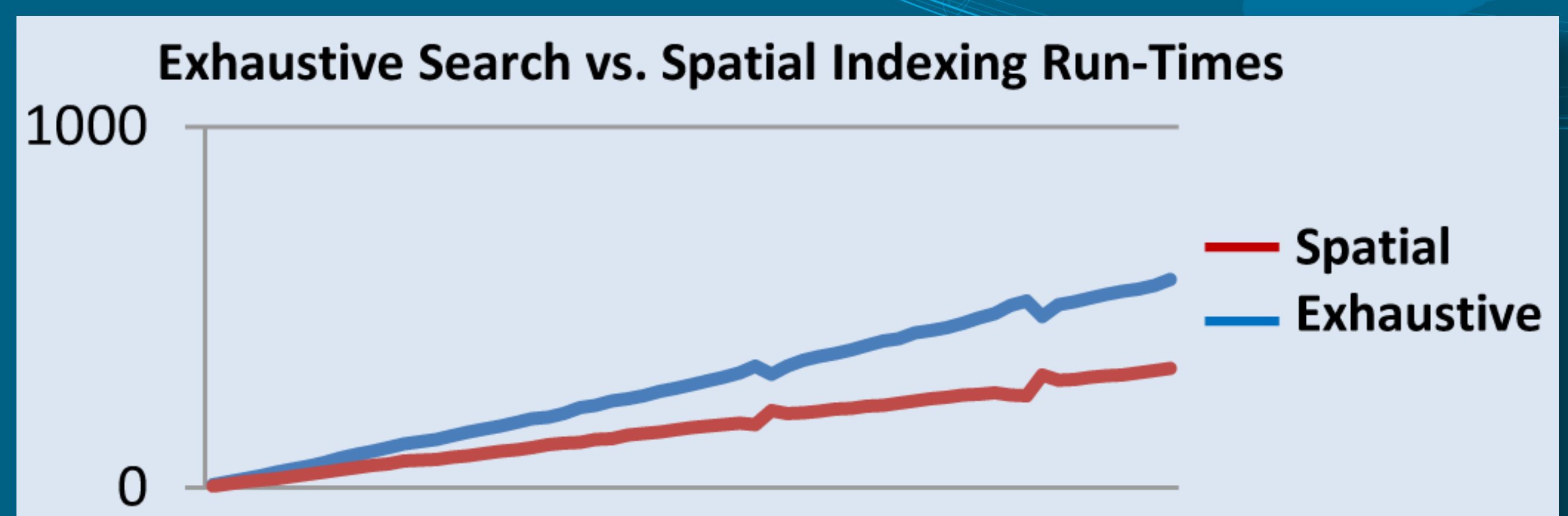
#### Task 1: Spatial Indexing Neighbor Search

- Develop a R-Tree data structure which encompasses a function to determine the neighbors of a specified node
- Compare its performance with that of an Exhaustive Neighbor Search over a wide range of population sizes.

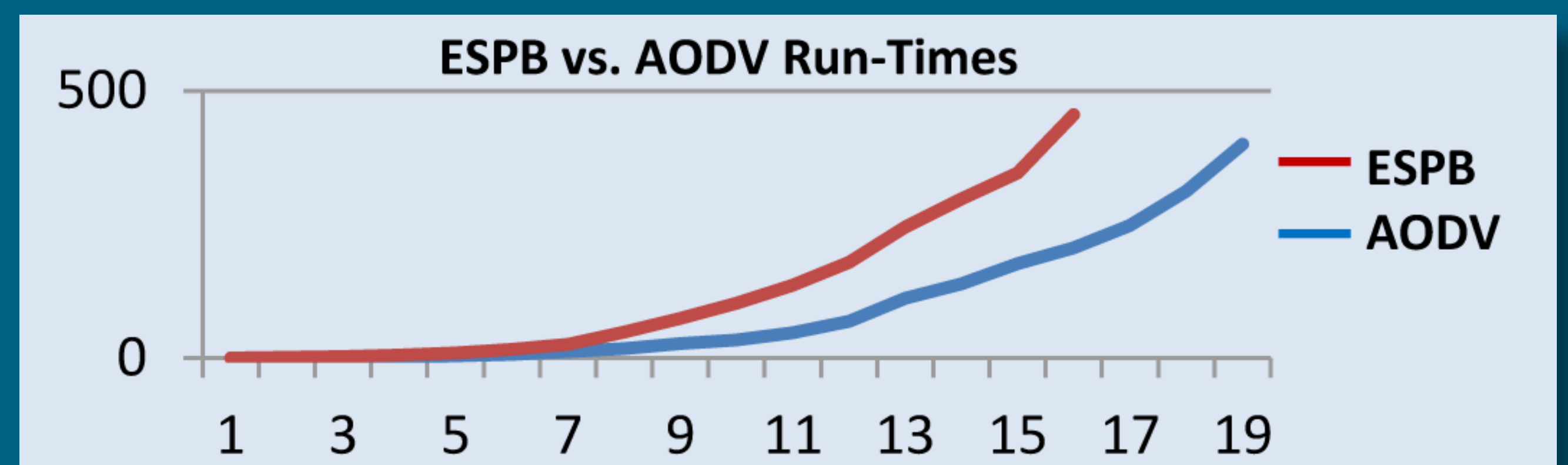
#### Task 2: Simulation Using OPNET Modeler

- For increasing  $N \times N$  grids consisting of stationary nodes, test the ESPB Routing Protocol against the AODV Routing Protocol using the Riverbed OPNET Modeler Discrete Event Simulation Tool
- Ensure that packets are successfully transferred from Source to Destination
- Record the plots of the various traffic, the traffic delay, and the simulation run time.

#### Results:



- Generated results for the AODV protocol up to  $N = 17$ , and for the ESPB protocol up to  $N = 20$
- Found inconsistencies in the required choke point for each  $N \times N$  grid size



$N = 7$  MANET Traffic Received for Destination Node



#### Impact and Benefits:

The R-Tree data structure's efficient method for determining the neighbors to a specified node can be utilized by the ESPB team to improve their algorithm.

The OPNET Modeler simulations:

- Demonstrate the correctness of the ESPB algorithm
- Offer a point of comparison against other Discrete Event Simulation Tools

We can compare our generated plots with those of more-powerful Discrete Event Simulation tools to ensure consistency.