Final Class Project STAGE-1 Report

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Sensor Network Simulation Testing Plan

1. Project Overview

Wireless Sensor Networks (WSNs) play a crucial role in decentralized communication environments. This project aims to simulate a WSN using OMNeT++ to analyze the efficiency, scalability, and responsiveness of two key routing protocols: Flooding and Ad-hoc On-Demand Distance Vector Routing (AODV). Through a series of simulations, we will assess performance under varying network conditions, focusing on key metrics such as average packet delay and throughput. The results will help determine the effectiveness of each routing protocol in nine different network scenarios involving varying rate of packet generation and node density within a given area.

2. Goals & What We Want to Simulate

Our primary objective is to evaluate how Flooding and AODV perform under nine contrasting combinations of node density levels and traffic load. This includes the following settings:

- Node Density Levels: Low (10 nodes), Medium (25 nodes), High (50 nodes)
- Packet Density: Low (5s interval), Medium (3s interval), High (1s interval)

By evaluating the results of the simulation, we can obtain performance measurements to identify patterns and trends in the network based on these differing factors. This will allow us to gain valuable insights into protocol efficiency under a wide range of scenarios, perhaps discovering which is most effective based on the criteria.

3. Simulation Design & Setup

The simulation will be conducted using OMNeT++ with the INET framework. We've decided that the network will span a 1000m x 1000m area, with sensor nodes deployed at random. Node 0 will serve as the central sink/base station. The key parameters include:

- MAC Protocol: IEEE 802.11
- Node Mobility: Static (RandomPlacement) or Mobile (RandomWaypoint)
- Routing Protocols: Flooding and AODV

This setup ensures that our environment is controlled for the purposes of our WSN simulation.

4. Step-by-Step Plan for Each Routing Method

4.1 Flooding Protocol Setup

Flooding is a basic routing approach where nodes rebroadcast every received packet to all neighbors to ensure that the correct receiver acquires its desired data. It serves as a benchmark for comparison, as it's a very redundant but simple mechanism. Configuration in OMNeT++ is achieved via:

```
C/C++
  **.app[*].networkProtocol = "flood"
```

After this routing protocol is established, we will fluctuate node density and packet generation rate from options like low, mid, and high, to get an understanding of how Flooding is carried out within WSNs especially in comparison to a typical network.

4.2 AODV Routing Setup

AODV is a reactive routing protocol that dynamically establishes routes only when needed. It deploys RREQ (route request) and RREP (route reply) messages to discover and maintain routes. In OMNeT++, it is configured as follows:

```
C/C++
*.host*.typename = "AodvRouter"

*.configurator.addStaticRoutes = false
```

The simulation will track route formation, adaptability, and performance stability under the changing network loads and densities mentioned previously.

5. Data Collection & Analysis Plan

OMNeT++'s statistical tools will be used to extract key performance indicators for each scenario:

- Average Packet Delay (ms)
- Network Throughput (packets/time)
- (Optional) Energy Consumption

We will collect data to process it into tables and visualizations to evaluate protocol strengths and weaknesses across all test conditions. Trends will be identified to determine potential optimal routing strategies.

6. Timeline

A clear timeline is outlined below to ensure the timely completion of each project stage. We first tackle the Flooding protocol to form a sort of control or baseline for when we implement AODV.

Date	Milestone Description
March 16	Submit Stage-1 Progress Report (this plan)
March 17–22	Set up simulation framework, implement Flooding and test the combinations
March 23–30	Debug any leftover issues, collect simulation data, begin implementation and debugging of AODV, test all scenarios again
March 31–Apr 7	Finish implementation and testing of all scenarios for AODV, analyze final simulation data
April 8–15	Compile results into final report
April 16+	Begin extra credit tasks if time permits

This timeline offers enough time in between to accommodate for challenges in configuration, experimentation, and documentation.

7. Optional Extra Credit Implementation (if time permits)

If time permits, we plan to implement the two following extra credit components for a more in-depth analysis of network behavior.

7.1 Network Lifetime Measurement

We will incorporate an energy consumption portion to the model where each node has a finite battery level. We will track the time until the last node depletes its energy, measuring the effective lifetime of the network under each routing protocol. This will give us insights into energy efficiency and the sustainability of each protocol in long-term deployments. In terms of implementation, this would likely first be tested with the AODV routing protocol just because the timeline of our project will have it so that our network is already configured with that particular method in mind. We would run through the nine test trials once more for both AODV and then later for the Flooding protocol.

7.2 GPSR Protocol Implementation

We will attempt to implement Greedy Perimeter Stateless Routing (GPSR), a geographic-based protocol that aims to optimize routing efficiency. If successfully deployed, GPSR will be compared against Flooding and AODV under identical conditions. At this point, we'd ideally have the metric for network lifetime added in first; otherwise, we will simply compare these protocols on the basis of average packet delay and throughput like originally planned.

8. Conclusion

This project will provide a detailed evaluation of routing efficiency for at least two kinds of protocols used in wireless sensor networks. By analyzing the performance of Flooding and AODV, our goal is to determine which protocol is most suitable given certain network conditions. If additional time permits, extending the project with energy consumption analysis and GPSR implementation will further enhance its relevance. The knowledge gained will be valuable for optimizing routing strategies in real-world WSN applications.