

ENSC 427

Communication **Networks**

Evaluation of Zigbee Remote Sensor Networks

Group 1

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Introduction

- Analyze the performance of Cluster and Star topology with OPNET 16.0
- Compare and contrast the two topologies under different scenarios
 - Network coverage
 - Transmission rate
 - Additional sensors
- Parameters of interest
 - End to end delay (ETED)
 - Throughput
 - Range

Implementation Details

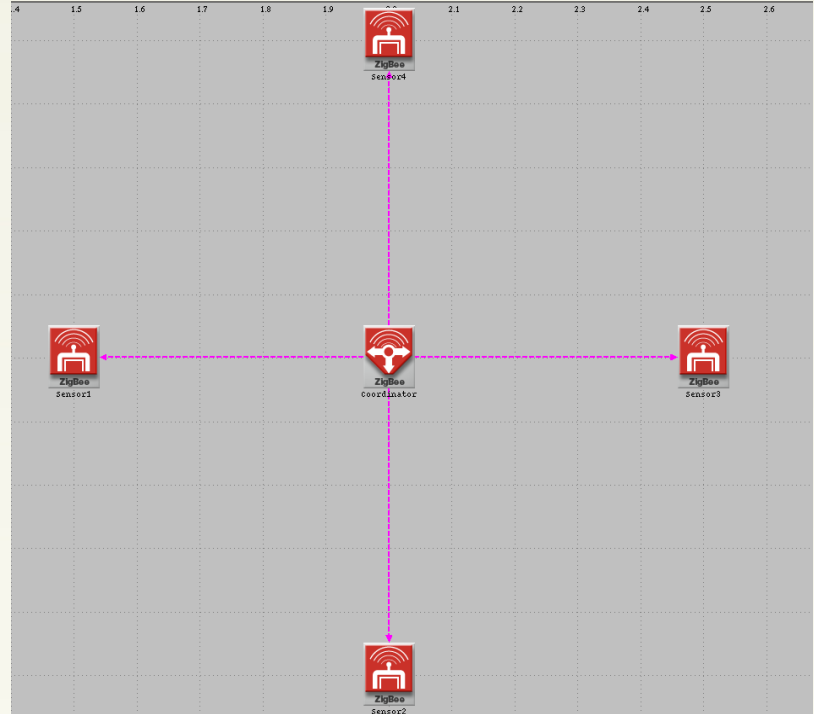
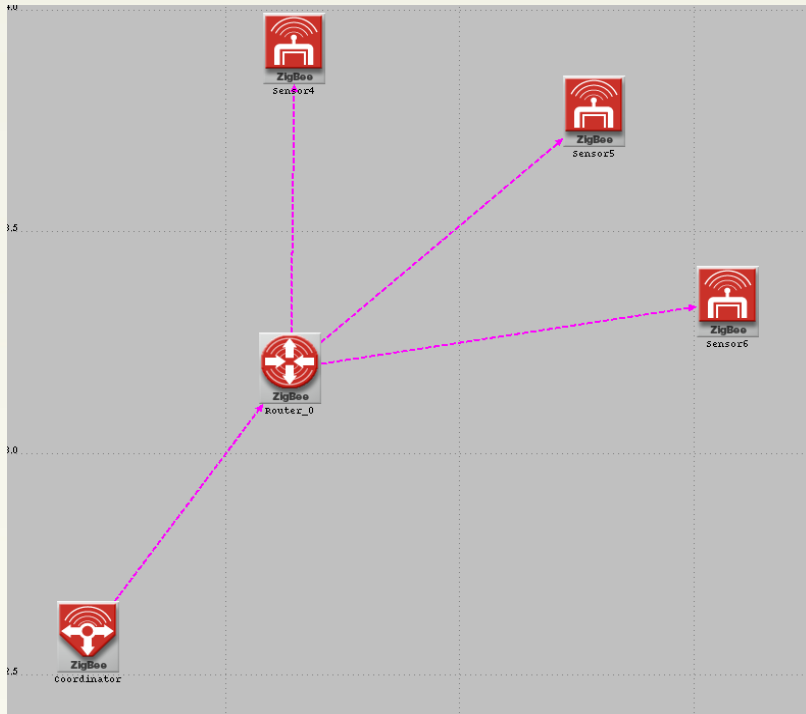
The screenshot displays the OPNET Modeler interface with three configuration windows open: (Sensor4) Attributes, (Router_0) Attributes, and (Coordinator) Attributes. The main workspace shows a ZigBee coordinator icon on a grid.

| Attribute | Value |
|--------------------------------|------------------|
| name | Sensor4 |
| ZigBee Parameters | |
| MAC Parameters | |
| ACK Mechanism | (...) |
| Status | Disabled |
| ACK Wait Duration (seconds) | 0.05 |
| Number of Retransmissions | 5 |
| CSMA-CA Parameters | (...) |
| Minimum Backoff Exponent | 3 |
| Maximum Number of Backoffs | 4 |
| Channel Sensing Duration | 0.1 |
| Physical Layer Parameters | |
| Data Rate | Auto Calculate |
| Packet Reception-Power Thre... | -85 |
| Transmission Bands | (...) |
| 2450 MHz Band | Enabled |
| 915 MHz Band | Disabled |
| 868 MHz Band | Disabled |
| Transmit Power | 0.006 |
| Device Type | End Device |
| PAN ID | Auto Assigned |
| Application Traffic | |
| Destination | Coordinator |
| Packet Interarrival Time | constant (0.1) |
| Packet Size | constant (1024) |
| Start Time | uniform (20, 21) |
| Stop Time | Infinity |

| Attribute | Value |
|--------------------------------|------------------|
| name | Router_0 |
| ZigBee Parameters | |
| MAC Parameters | |
| ACK Mechanism | (...) |
| Status | Disabled |
| ACK Wait Duration (seconds) | 0.05 |
| Number of Retransmissions | 5 |
| CSMA-CA Parameters | (...) |
| Minimum Backoff Exponent | 3 |
| Maximum Number of Backoffs | 4 |
| Channel Sensing Duration | 0.1 |
| Physical Layer Parameters | |
| Data Rate | Auto Calculate |
| Packet Reception-Power Thre... | -85 |
| Transmission Bands | (...) |
| 2450 MHz Band | Enabled |
| 915 MHz Band | Disabled |
| 868 MHz Band | Disabled |
| Transmit Power | 0.006 |
| PAN ID | Auto Assigned |
| Application Traffic | |
| Destination | Coordinator |
| Packet Interarrival Time | constant (0.1) |
| Packet Size | constant (1024) |
| Start Time | uniform (20, 21) |
| Stop Time | Infinity |

| Attribute | Value |
|--------------------------------|------------------|
| name | Coordinator |
| ZigBee Parameters | |
| MAC Parameters | |
| ACK Mechanism | (...) |
| Status | Disabled |
| ACK Wait Duration (seconds) | 0.05 |
| Number of Retransmissions | 5 |
| CSMA-CA Parameters | (...) |
| Minimum Backoff Exponent | 3 |
| Maximum Number of Backoffs | 4 |
| Channel Sensing Duration | 0.1 |
| Physical Layer Parameters | |
| Data Rate | Auto Calculate |
| Packet Reception-Power Thre... | -85 |
| Transmission Bands | (...) |
| 2450 MHz Band | Enabled |
| 915 MHz Band | Disabled |
| 868 MHz Band | Disabled |
| Transmit Power | 0.005 |
| Network Parameters | (...) |
| Beacon Order | 6 |
| Superframe Order | 0 |
| Maximum Children | 8 |
| Maximum Routers | 5 |
| Maximum Depth | 5 |
| Beacon Enabled Network | Disabled |
| Mesh Routing | Disabled |
| Route Discovery Timeout | 10 |
| PAN ID | Auto Assigned |
| Application Traffic | |
| Destination | No Traffic |
| Packet Interarrival Time | constant (1.0) |
| Packet Size | constant (1024) |
| Start Time | uniform (20, 21) |
| Stop Time | Infinity |

Implementation Details



Implementation Details

The screenshot displays a simulation environment with several windows. The top window, titled "Edit Trajectory Information", shows a table with trajectory data for two points. Below the table are unit selection dropdowns for ground speed, distance, and altitude, along with "Insert", "Delete", "Redefine...", "OK", and "Cancel" buttons. The middle window shows a 2D plot with two ZigBee nodes: "ZigBee coordinator" and "ZigBee mobile_node_0". The bottom-left window, "ZigBee 802_15_4 MAC Throughput (bits/sec)", shows a line graph where throughput is constant at approximately 11,500 bits/sec until 11:58:00, then drops to zero. The bottom-right window, "ZigBee Application End-to-end Delay (seconds)", shows a line graph with fluctuating delay values between 0.0060 and 0.0063 seconds. The taskbar at the bottom includes "SFU Connect: Inbox - Mozilla Firefox", "[Terminal]", "OPNET Modeler 16.0 -- Educational ...", and "Project: Zigbee Project Scenario: sc...".

| | X Pos (km) | Y Pos (km) | Distance (km) | Altitude (m) | Traverse Time | Ground Speed | Wait Time | Accum Time | Pitch (degrees) | Yaw (degrees) | Roll (degrees) |
|---|------------|------------|---------------|--------------|---------------|--------------|-----------|------------|-----------------|---------------|----------------|
| 1 | 2.100893 | 2.001005 | n/a | 0.000000 | n/a | n/a | 00.00s | 00.00s | Autocomputed | Autocomputed | Unspecified |
| 2 | 3.001657 | 1.998088 | 0.900769 | 0.000000 | 30m00.00s | 1.119424 | 00.00s | 30m00.00s | Autocomputed | Autocomputed | Unspecified |

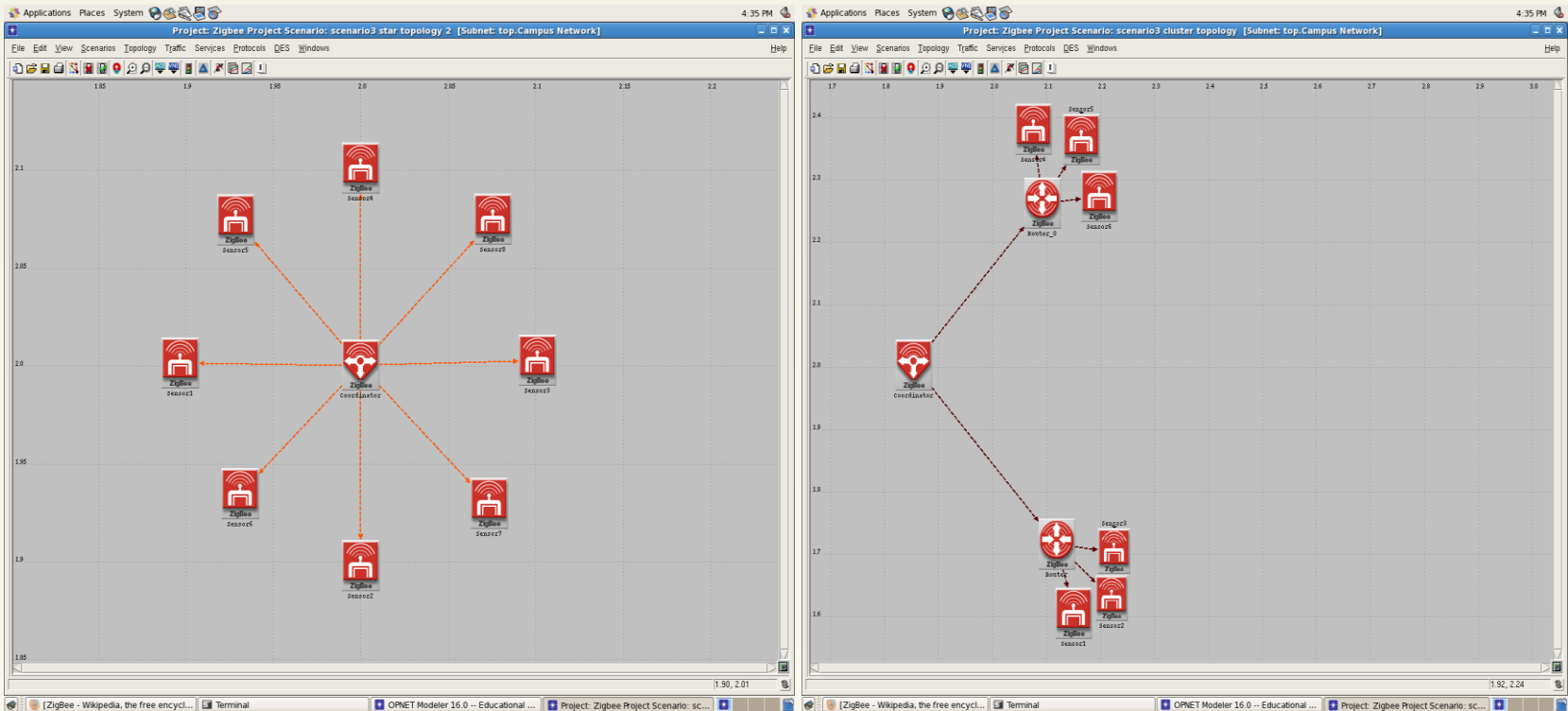
Ground speed in: mi/hr
Distance in: kilometers
Altitude in: meters

ZigBee coordinator ZigBee mobile_node_0

ZigBee 802_15_4 MAC Throughput (bits/sec)

ZigBee Application End-to-end Delay (seconds)

Implementation Details



Conclusion

- ETED is smooth proportional to increase packet size/transmission rate (as expected)
- Star topology more prone to Packet Loss (PL)
- Throughput is higher in cluster topology
- PL proportional to transmission rate

THANK YOU