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# Design Secure Schemes For Data Transmissions In Opportunistic Routing In Wireless Sensor Network

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**Abstract**

A novel concept in wireless sensor networks called opportunistic routing selects the node that is most nearby the destination node to route data to. It makes advantage of wireless sensor networks' broadcasting features. Sensor networks now operate with more effectiveness, throughput, and dependability thanks to opportunistic routing. Opportunistic routing has been used to implement a variety of energy-saving approaches in wireless sensor networks to extend the network lifetime. In this article, we've outlined the fundamentals of opportunistic routing, as well as the many applications for which it has been deemed advantageous and particular protocols' metrics and shortcomings. These days, opportunistic routing in WSN has drawn a lot of attention from academics. OR has

been shown to be more effective than the conventional routing strategy for wireless networks because it makes use of the broadcasting nature of wireless networks. The WSNs have several challenges, including a lack of established network architecture, battery power limitations for sensor nodes, hazardous environmental conditions to which sensors are susceptible, etc. Due to their short battery life, sensor networks face the crucial problem of resource allocation. Many of these WSN-related difficulties are resolved by OR. Compared to the conventional technique, it provides better usage. The current OR-based protocols have mostly concentrated on decreasing data redundancy, boosting utilisation, etc. for overall performance and effectual outcomes.

*Keywords : Design Secure Scheme in Opportunistic Networks, Routing and Opportunistic Networks, Wireless Sensor Network*

## Introduction

In wireless sensor networks (WSN), a node's lifespan directly affects how long thewireless network lasts. The activity that uses the most energy on a sensor node is packet routing. Finding an energy-efficient routing approach for packet transport becomes crucial as a result. One of the newest routing protocols, the opportunisticrouting (OR) protocol [1, 2], offers dependable and energy-efficient packet delivery inwireless sensornetworks (WSN).

A WSN is a network of sparsely populated small sensor nodes in charge of gathering information from the outside world[3].These sensor nodes monitor environmental variables such as pressure, moisture, temperature, data on temperature, vibration, noise, wind speed, etc., and send it to the network's sink node, which is the final destination for the information [4].

Recent advancements in WSN technology have made it possible for sensor sensor node to collect heart rate data in real-time for sophisticated real-world applications, such as medical diagnostics for heart patients. Real-timecommunication between the source and destination nodes node is necessary for certain real-time applications [5].

**Routing Protocols**

The WSN's downlink techniques were roughly categorised into two groups, namely I traditional routing and (ii) opportunistic routing [2]. Without taking into account some of the crucial elements like throughput, connection quality, dependability, etc., conventional routing, also known as outdated routing approaches, focused on finding the path from the source to the destination with the fewest number of intermediary nodes. Table 1 displays a brief comparison of the routing categories.

| Routing Feature | Opportunistic Routing (OR) | Traditional Routing (TR) |
|---|---|---|
| Transmission type | Broadcast | Unicast |
| Data packets overheard | Yes | No |
| Relay selection | Dynamic | Fixed |
| Number of candidates | Multiple | Relay alone (Single) |

The literature makes it clear that the energy consumption of a sensor node greatly impacts the lifetime and quality of a wireless sensor network, making it imperative to design energy-efficient opportunistic routing algorithms in order to maximize the network's overall lifetime and improve the quality of the sensor network.

A couple of the strategies from the literature described below might help the sensor network survive [6]

- Control of media access that is energy efficient (EE-MAC)
- Replacement of nodes (impossible in unsupervised settings)
- Recharging of energy
- Routing that is energy efficient
- Energy harvesting
- Energybalance
- Organizing the duty cycle

Energy-efficient transportation is the technique most essential to the WSN's survival outof those discussed above. This approach used approximately 66.66 percent of the network's totalenergybecauseitentailedsendingandreceivingsignals[7,8].Therefore,itbecameimportant toconsiderdesigninganopportunisticroutingthatimproved the sensor network's vitality in order to extend the sensor network's totallifespan.

**Opportunistic Routing (OR)**

Unlike traditional routing, which involves (pre)selecting a node for each transmission, OR allows neighboring nodes to overhear a data packet as it is broadcasted to a list of potential relays. After the data packet has been acknowledged, the relay candidates in the forwarders list will next work together to sort out which one will be the most suitable for forwarding the data packet. Alternatively stated, these three abstract acts make up OR:

- The first step is to prepare the forwarder list by sending a data packet to the candidates for the relay.
- The second step is to select the most suitable relay from the forwarder list of nodes by use of a coordination protocol.
- In next step, after selecting a relay node, transmit the data packet to it.

Network R1, R2, R3, R4, as well as R5 carry packets from source node S to destination node D in this hypothetical situation. S initiates packet transmission. Nodes R1, R2, and R3 may potentially switch roles and become relay nodes.

Additionally, R2's selection as a potential forwarder opens the door for R4 and R5 to transition into relay nodes. If R5 is the forwarder node, the data packets are delivered to destination node D in a similar way [9, 10, 11].

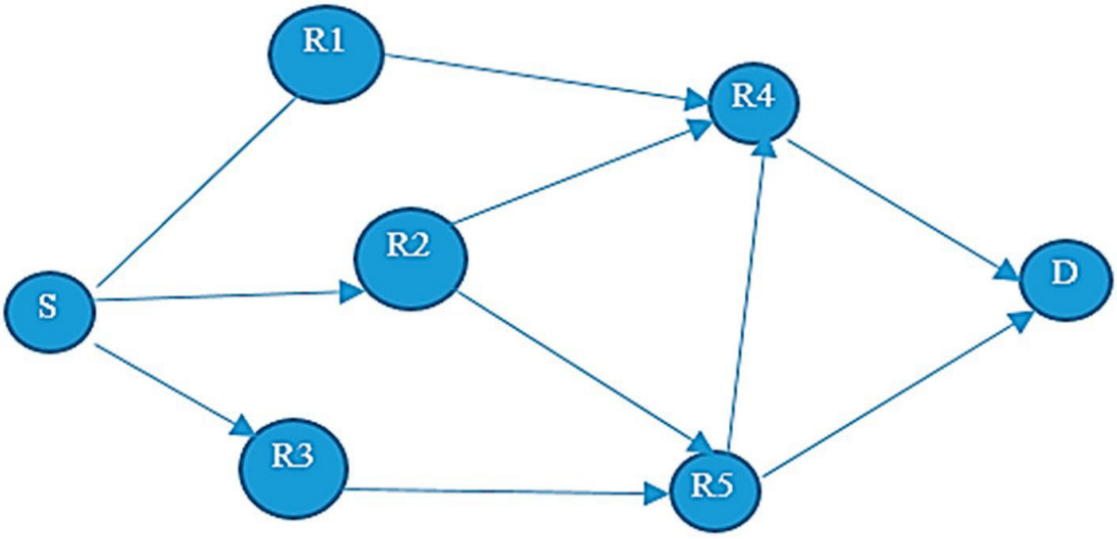


Figure 1 : Opportunistic Routing

The key advantages of opportunistic routing were as follows: The improvement in dependability. Because this protocol transmits the data packet across any available connection rather than just one that has been chosen in advance, the dependability of WSN was greatly improved by employing this routing technique. As a result, this routing strategy offered extra links that may serve as backup links, lowering the likelihood of transmission failure.

The broadcast property of the wireless medium was used in this routing approach to enhance the transmission range. This is because all connections, irrespective of their location or data packet quality, were picked up. As a result, the data transfer was successful in reaching the furthest relay node [11,12].

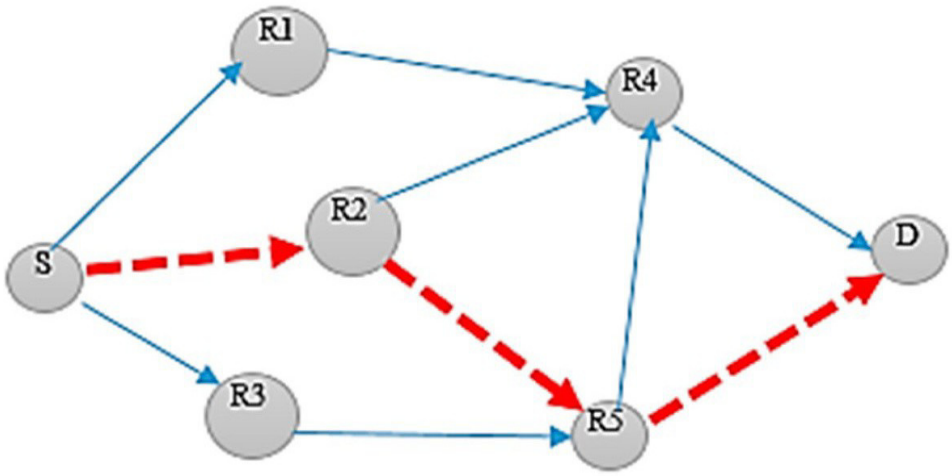


Figure 2 : Routing with Intelligent Opportunistic Routing

Assume for the sake of argument that the WSN consists of N nodes, with N1, N2,..., NK neighbors and X1, X2,..., Xn attributes assigned to each of these neighbors. Under these conditions, the number of neighbours (k) for various nodes at a specific instance mayvary.A furtherassumption wasthatthewirelesssensornetworkwouldcoveraspace.

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To find the probability that node A would contact one of its neighbors, i.e., N1, N2,..., NK, this method used the Naive Bayes classifier. P(N1, N2,..., NK|A) is the probability. P(N1, N2,..., NK|A) is the probability of each node, and the one with the greatest value was selected. As shown for each node individually, the probability P of selecting a particular relay nodes from the provided set A might be computed [13, 14].

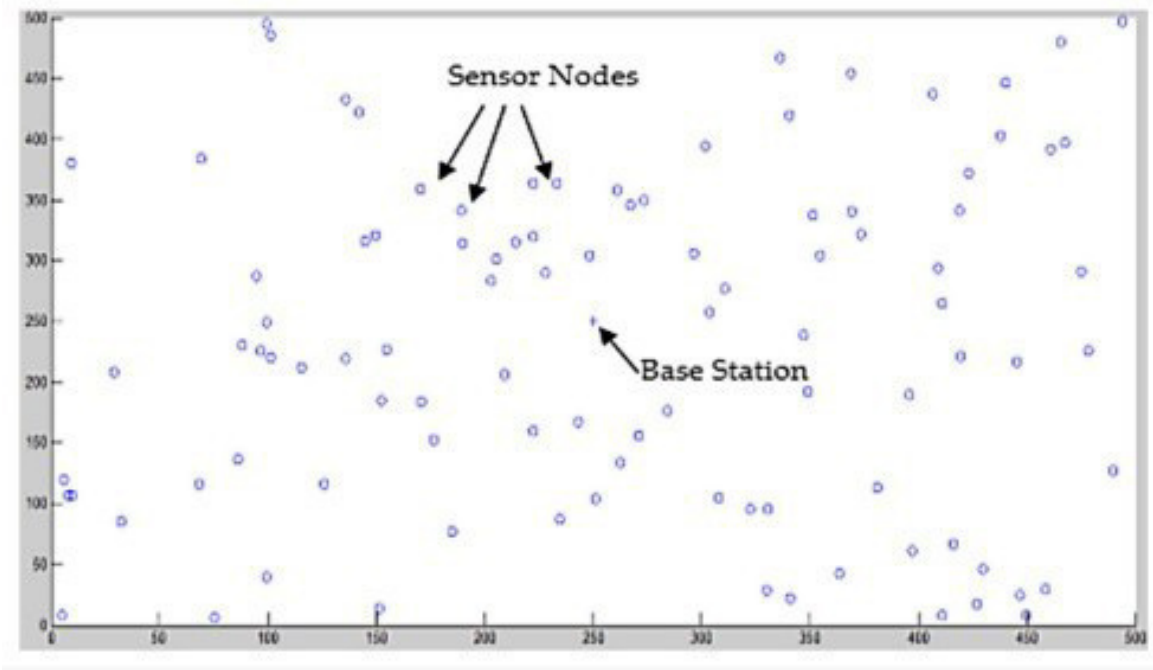


Figure 3 : Implementation Pattern and Scenario

**Energy Efficiency**

The suggested algorithm's primary goal was energy efficiency. It might be estimated asthetotalamountofenergyusedbythenetworktocarryoutdifferentnetworkfunctions.

The simulation in MATLAB operated based on simulation rounds. The focus of the simulation was on sending packets from one location to another. At the start of the experiment in MATLAB, transmission is initiated by a randomly selected source [15].

This node starts implementing the proposed protocol and produces a list of forwarders. The successful or unsuccessful transmission of packet from a single network resource is replicated in a simulation round.

Different source and relay nodes are chosen for every round.Untilat least one node runs out of energy, this process keeps on[16].

| Neighbours of A1 |
| --- |
| $N_A^1$ |
| $N_A^2$ |
| ..... |
| $N_A^K$ |
| |
| **Neighbours of A2** |
| $N_A^1$ |
| $N_A^2$ |
| ..... |
| $N_A^K$ |
| |
| |
| **Neighbours of $A_n$** |
| $N_A^1$ |
| $N_A^2$ |
| ..... |
| $N_A^K$ |

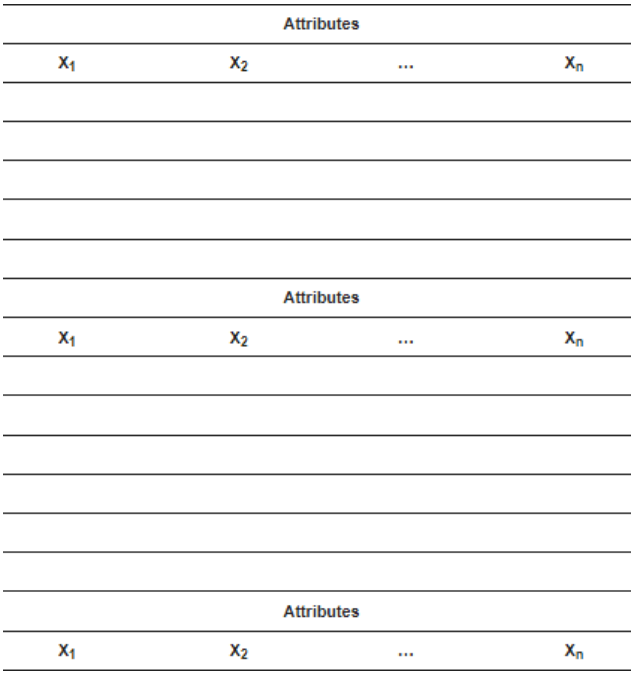


Figure 4 : Node Attributes

In order to determine the PRR of each node, this process was repeated several times, but never more than the threshold, and the neighbour list was created using this method. The forwarder set was derived using the neighbour list and the PRR value. The first phase's output was a requirement for the second phase to function. The collection of all nodes with

the potential to forward the data packets was the forwarder set produced by Algorithm 1. All of the nodes in the set could not be chosen for transmission, though, as doing so would result in packet duplication throughout the network.

**Latency**

The amount of delay between transmitting a packet and receiving it at the base station is known as latency. The packets' end-to-end delay in getting to their destination is also known as that [17, 18].

Table 1 : Performance Outcomes

| Simulation Attempt | Nodes | Packets Loss: Classical | Packets Loss: Proposed |
|---|---|---|---|
| 1 | 10 | 23 | 2 |
| 2 | 20 | 34 | 1 |
| 3 | 30 | 21 | 2 |
| 4 | 40 | 16 | 3 |

Every time a wireless sensor network is active, data must flow from the nodes at the source to the nodes at the sink. It is possible for certain randomly placed nodes to establish a direct connection with the base station. Data packets supplied by certain nodes

must first travel across a series of relay nodes before reaching the base station; this technique is known as multi-hop transmission. Consequently, there can be a wide range of values for the network latency [19].

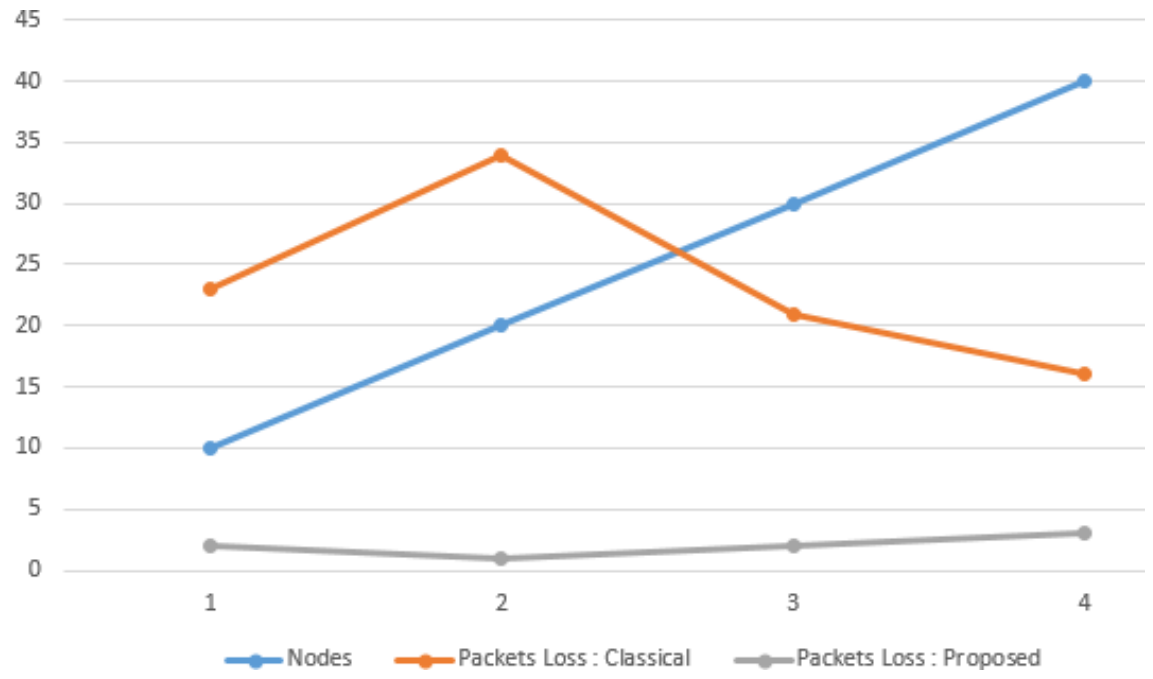


Figure 5 : Performance Outcomes and Plot

A novel concept in wireless sensor networks called opportunistic routing selects the node that is most nearby the destination node to route data to. It makes advantage of wireless sensor networks' broadcasting features. Sensor networks now operate with more effectiveness, throughput, and dependability thanks to opportunistic routing. Opportunistic routing has been used to implement a variety of energy-saving approaches in wireless sensor networks to extend the network lifetime. In this article, we've outlined the fundamentals of opportunistic routing, as well as the many applications for which it has been deemed advantageous and particular protocols' metrics and shortcomings.

**Conclusion**

Recently, many people are interested in opportunistic routing because they believe it will improve the performance of wireless ad hoc as well as sensor networks. Cooperation with intermediary nodes in packet forwarding may be localized and reliable using opportunistic routing. Opportunistic routing greatly improves network speed as well as transmission reliability by utilizing the broadcast feature of the wireless medium.In this essay, we first explain the fundamental concept of opportunistic routing and then group recent research projects according to various standards. The segments demonstrate how various protocols operate and go through their benefits and downsides and discuss possible problems and future approaches for wireless ad hocandsensornetwork opportunistic routing.

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