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**Research Article**

# Potentiality Timeserving Reliable Routing (PTRR) Algorithm in Multi Hop Wireless Sensor Networks

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**Abstract:** This study aims to increase the reliability in the multi hop wireless sensor networks with low radio interference and avoid packet collision. In the proposed scheme, each node has the choice of selecting next forwarder node. The next forwarder node is selected based on the link strength, residual energy and the distance to the target. The source node sends the data packet to the best forwarder node. Immediately, the forwarder node sends the acknowledgement along with the number of packets received back to the node from which it receives the data. The sender node ensures the delivery of the transmitted packets by comparing the value of number of packets sent with the value received with the acknowledgement. If they are equal means it will send the authentication ID to the forwarder node. If it is not equal means it will choose another node with highest link strength. After that, the forwarder node chooses the next forwarder and repeat the process until the data reaches the destination. The performance of the proposed scheme is evaluated by using NS2 Simulator.

**Keywords:** Packet collision, radio interference, reliability, Wireless Sensor Network (WSN)

## INTRODUCTION

Wireless Sensor Networks (WSN) is composed of small sensor nodes and they are having the wireless connection with each other. The base station has the control over the sensor nodes. The sensor nodes are sensing its environment to get the specific parameter according to its configuration. The sensor nodes are built with sending and receiving devices. The base station sends the data request to the sensor nodes whenever it is in need of the data. The sensor node immediately sends the sensed data to base station. The base station process the data received from the sensor node and based on that information, it will take corrective action. The sensor nodes operate by using its battery power. So it has limited life span. But, nowadays the WSN is broadly used for the critical application. The reliable data transfer is important for emergency application. Some of the existing routing protocols for WSN is also considers the reliability of the data transfer.

The energy aware routing for real-time and reliable communication is proposed by Heo *et al*. (2009) for wireless industrial sensor networks. In that, the reliable delivery of data is considered. The data packets are routed via energy efficient nodes. The sensor which is in the need to transfer the data to the sink select the path based on the energy, delay and reliability of a path. This information is collected from the neighbor nodes. Then that node finds out the likelihood value of choosing the path. The path with low energy cost is expected to be selected in this scheme. The duplicate copy of each packet is transmitted through alternative path. So, the reliability is ensured by this scheme.

Location based energy efficient reliable routing protocol is mainly considers the reliability of data transfer which is presented in Saihood and Kumar (2013). In this, the authors propose the routing technique for the Wireless Sensor Networks with mobile nodes. The reliability ensures by the routing protocol by including the fault tolerant mechanism. The concept of fault tolerant mechanism is invoked to find out the failure link and the fault sensor node and also to reconstruct the failed path. This routing protocol is location aware routing protocol. So, it discovers the shortest path in an energy efficient manner. This scheme is mainly proposed to increase the lifetime and reduce the end to end delay.

Babbitt *et al*. (2009) proposed the self-selecting reliable path routing protocol is proposed. This protocol mainly considers the three challenges faced by Wireless Sensor Networks. The fist challenge is the end to end delay. The end to end delay is reduced by effectively use the bandwidth. The second challenge is the link failure in the WSN. The link failure reduces the packet delivery rate and increases the end to end delay. The ability of the network to maintain the stable path between source and destination increases the packet

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delivery ratio. The final challenge is efficient use o energy while transmitting the data from source to destination. The energy efficiency is achieved by efficient routing or clustering mechanism. The reduction of energy consumption will increases the life time of the network.

A Reliable multi-hop routing protocol is proposed by Patel *et al*. (2009) for WSN. This protocol can able find out feasible shortest path between source and destination. The author considers the energy as well as memory space while routing the data packets. The availability of energy and memory decides that the lifetime of the network. The light-weight reliable multihop routing protocol chooses the forwarder node or relay node based on the available energy and the memory capacity. The proposed routing protocol ensures reliability by invoking self- healing property.

Reliable Routing Protocol is proposed by Jawhar *et al*. (2008) for wireless adhoc and sensor networks. This protocol provides reliable route by using the parameter reliable factor. Each and every node maintains the reliability factor value. This value gets increased when that node is participated in the successful data transmission. The source node sends the route request to the node with high reliability which is determined by the reliability factor maintained by the node. The intermediate or relay node extends the route only through the high reliability node towards the destination.

This study proposes a reliable routing protocol for WSN named as Potentially Timeserving Reliable Routing scheme. This scheme uses the acknowledgement concept to ensure the delivery of data packets. This routing scheme extends the route after getting acknowledgement. The data transfer is in the hop by hop manner. The route is constructed by the sensor node dynamically towards the sink.

## PROPOSED METHOD

The wireless sensor networks are most widely used in the critical and safety application because of its sensing capability. So, the reliable transfer of data plays an important role in the wireless sensor networks. The reliable communication provides the assurance of the data delivery to the destination. The traditional technique uses the end to end acknowledgement concept to ensure the reliability. The main factor affecting the reliability in the multi-hop wireless sensor network is route failure. To reduce the route failure, this proposes a new routing protocol named as Potentiality Timeserving Reliable Routing (PTRR).

**Potentiality timeserving reliable routing:** In this scheme, the source node is not going to detect the complete path before the transmission. The source node sends the data in the hop by hop manner. The Source initially selects the next forwarder node based on its potentiality to transmit the data to the destination. The potentiality is decided based on its link strength, residual energy. After receiving the data packets, the intermediate node send the acknowledgement back to the node from which it receives the data. The acknowledgement packet consists of the details about the number of packets received. The source node checks that, whether all data packets have been reached or not by checking that the value of number of packets sent and the value of number of packets received. If both are equal in the sense, the source node sends the authentication ID to the forwarder node. After that, the forwarder node repeats the same process until the data reaches the destination. The proposed routing scheme follows per node acknowledgement pattern. So, this scheme avoids the packet collision and radio interference.

**Algorithm:**

```
PTRR routing {
        Set S source
        Set D destination
        While {RN! = D} {
                Foreach n in NL {
                        If {n with high potentiality}
            Set RN n
                }
                S transmits the data to RN
                RN send ACK to S//ACK consist of
number of packets received
//Source node analysis
                If {NPR = = NPS} {
                        Authentication key = R and
()*energy/Distance
                }
                S sends the authentication key to D
                Set S RN
        }
}
```

The proposed scheme is explained by using the example (Fig. 1). In that figure several sensor nodes are disseminated randomly in the sensing environment. The source node (sensor) intends to transmit the collected information to the base station. But it is in the out of range of the base station. So, it needs to transmit the data via some intermediate nodes. It uses the proposed scheme to discover the route between the source and destination. Initially the source node select the next forwarder node towards the destination based on the energy, link duration and distance to the destination. The source node transmits the whole data to the best forwarder node. Immediately the best forwarder node sends the acknowledgement back to the sender. To provide the security, the source node generates the Authentication Key (AK) by using the following formula:

$$AK = rand()*Energy/Distance$$

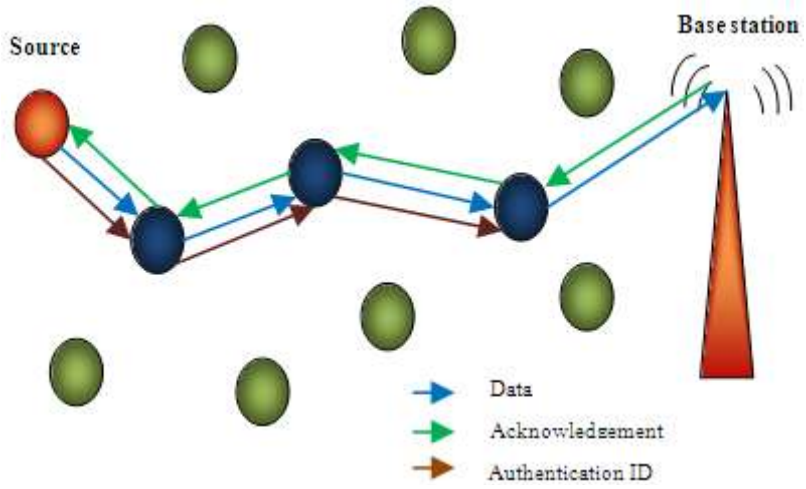


Fig. 1: Design of Proposed Routing Scheme (PTRR)

After receiving the authentication key only, the intermediate node can forward the data to the next forwarder node. The process will be repeated until the data packet reaches the destination. Whenever a node searches for the next forwarder node, first it checks that whether the destination node is present in the neighbor list or not which is specified in the above algorithm. If the base station is present inside the transmission range means the node can transmit the collected information directly.

## SIMULATION ANALYSIS

The simulation is done by using the simulator NS2. Network simulator is a discrete event time driven simulator. NS2 is open source software which uses C++ and Tool Command Language (TCL) for simulation. C++ is used for packet processing and fast to run. TCL is used for simulation description and used to manipulate existing C++ objects. It is faster to run and change. NS2 is widely used to simulate the networking concepts. The simulation parameter used in the simulation is tabulated below.

Table 1 describes that, 20 numbers of nodes are distributed in the simulation area 871 m×640 m. The mobiles are moving within the simulation area by using the random way mobility model with the speed 5 m/s. Each and every node has the direct link with the nodes within the range 250 m. The Constant Bit Rate (CBR) traffic model is used to control the traffic flow in the network. The performance or the proposed scheme is analysed by the parameters throughput, Link duration and delay. And the performance is evaluated by changing the mobility model such as Random way point and city section mobility model. The performance of the proposed scheme is analysed by using the parameters packet delivery rate, packet dropped rate and reliability analysis.

Table 1: Simulation parameters of PTRR

| Parameter | Value |
|---|---|
| Simulator | NS2 (Ver. 2.28) |
| Simulation time | 10 ms |
| Number of nodes | 20 |
| Routing scheme | PTRR |
| Traffic model | CBR |
| Initial energy | 100 J |
| Transmission power | 0.9 J |
| Receiving power | 0.8 J |
| Sense power | 0.0175 |
| Simulation area | 871×640 |
| Transmission range | 250 m |

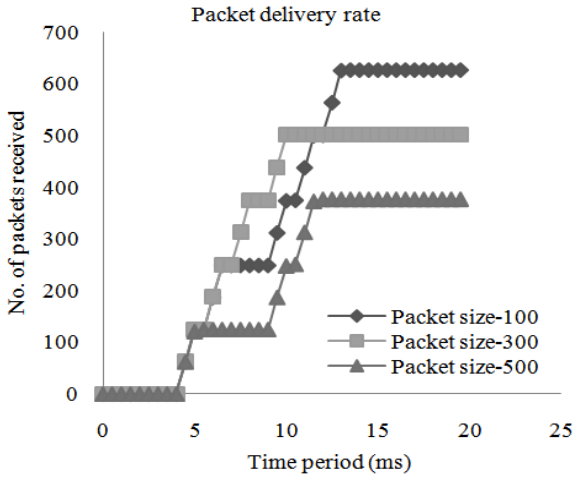


Fig. 2: Packet delivery rate analyses by varying packet size

**Packet delivery rate:** The packet delivery rate is the number of packets delivered to the sink without failure out of number of packets sent by the source. In this study, the packet delivery rate is found out for the proposed scheme by varying the size of the packet.

Then compare the obtained result which is shown in Fig. 2. The packet delivery rate for the proposed scheme is higher for the minimum packet size. If the size of the packet is very low in the sense it reduces the overhead and reduces the delay in the network.

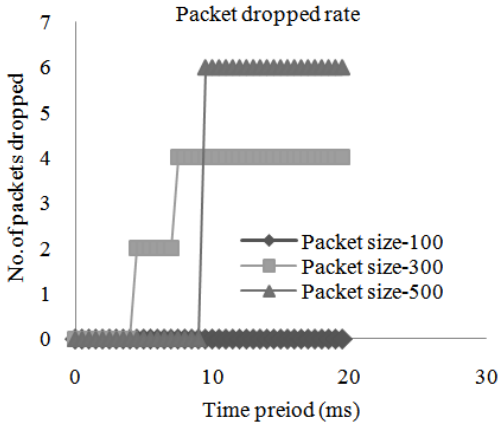


Fig. 3: Packet dropped rate analyses by varying packet size

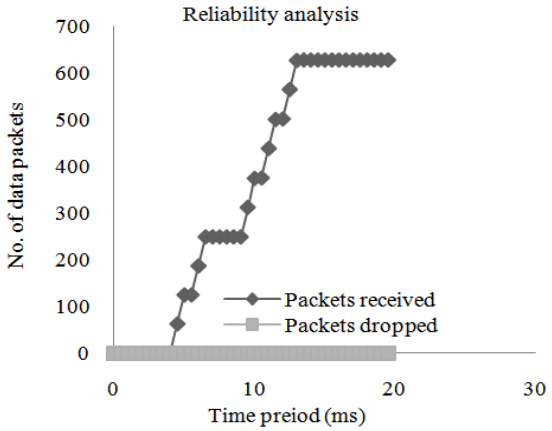


Fig. 4: Reliability analysis

**Packet dropped rate:** The packet dropped rate for the proposed routing scheme is estimated for the different packet size such as 100 bytes, 300 bytes and 500 bytes. The packet dropped rate is the number of data packets never reach the destination out of number of data packets transmitted by the source.

The lower the packet delivery rate indicate that, higher the reliability in the network. In the proposed scheme, the packet dropped rate is low for the packet size 100 bytes (Fig. 3). While increase the packet size, the packet dropped rate also increased.

**Reliability:** The reliability is the term which is used to indicate the data delivery to the destination without fail. The reliability is degraded as the number of data packets dropped increases. The reliability of the proposed scheme is evaluated by comparing the number of data packets received and number of packets dropped shown in Fig. 4. The proposed scheme provides the better reliability by reducing the number of packets dropped during the transmission.

## CONCLUSION

The Potentiality Timeserving Reliable Routing (PTRR) algorithm is proposed in this study. This scheme provides the reliability in multi hop Wireless Sensor Network. The route o the destination constructed dynamically. The intermediate node between the source and destination is chosen based on the link strength, residual energy and distance to the destination. Thus the proposed scheme reduces the radio interference and avoids packet collision in the network. The Simulation results show that, the proposed scheme provides higher reliability by reducing packet loss.

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