International Journal of Information & Computation Technology.
ISSN 0974-2239 Volume 4, Number 17 (2014), pp. 1885-1894

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ORS Algorithm for Contention Mitigation in WSN

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Abstract

WSNs heavily rely on a dense deployment of sensor nodes in order to ease deployment, increase fault-tolerance and network coverage, so that events do not go undetected. A dense deployment however results in several sensor nodes close to each other detecting and transmitting event reports at almost the same time, resulting in severe contention for channel access. Channel contention is a serious problem in WSNs resulting in collisions, re-transmissions, energy depletion, and ultimately loss of event reports. TDMA-based protocols prevent contention, but require tight synchronization and may lead to severe wastage of bandwidth especially in event-based applications where the traffic is bursty in nature. Other approaches that handle spatially correlated contention are fairly complex and contradict the reason for dense deployment, by selecting only a subset of nodes that generate and transmit event reports, affecting the fault-tolerance and confidence of event detection. Motivated by the challenge to reduce contention and improve performance, we propose an ORS algorithm that generates optimal route for transmission in WSN. We evaluate the performance of our algorithm by using the OPNET simulator. Results show that our algorithm significantly reduces contention and thereby improving the performance of the network. For example purpose I also use MATLAB tool which shows optimal routes generation.

(1) KEYWORD: Optimal Route Selection (ORS), Contention problem, OPNET, MATLAB, WSN.

(2) INTRODUCTION:

Channel contention is a serious issue in event-driven WSNs. There are several protocols designed to avoid and recover from collisions due to contention in wireless networks. These can primarily classified into contention-free and contention-based approaches. Contention for channel access occurs when there are two or more nodes attempting to transmit data at the same time in a given transmission range. Contention-free MAC protocols are predominantly based on TDMA [3] [4], where each node has a preset slot only during which is it allowed to transmit. TDMA require tight network-wide synchronization, which bring extra overhead of clock synchronization, which involves frequent exchange of control packets between nodes. Other contention-free approaches like FDMA and CDMA face similar drawbacks. So they are usually not used in event-based WSN.

The other type of protocols that are predominantly used in WSN are contention-based protocols, usually based on ALOHA and CSMA [4]. In a contention-based approach, nodes compete for the use of the wireless medium and only the winner of this competition is allowed to access the channel and transmit.

ALOHA is again of two types: pure and slotted ALOHA. Pure ALOHA depend on back-off mechanism. An improvement to the original ALOHA protocol was Slotted ALOHA. Slotted ALOHA suffers the disadvantage of needing synchronization between nodes.

In CSMA, if node finds the channel busy, it postpones its transmission. It can't completely eliminate collisions, especially in event-based WSN scenarios.

ZMAC [6] combines the strengths of TDMA and CSMA while managing their weaknesses. It takes time to adapt to changes in traffic patterns, which may not be acceptable.

There are interesting protocols that improvise either on CSMA-CA or TDMA or work across network layers for additional benefits [7] [8] [9] [4]. ECR-MAC proposes a cross-layered protocol, which employs a DFS technique. ECR-MAC [10] depends only on randomness in wakeup schedules to avoid contention among nodes that are in the transmission range of each other. However, in dense deployments, it is very likely that there are several nodes within the transmission range of each other and active at the same time.Alert MAC [11] minimizes contention among nodes by using a combination of CDMA and TDMA. The performance does not truly reflect a real-world.

In this paper we represent a propose work for Contention mitigation Techniques.

(3) PROPOSED ALGORITHM

ORS has given below computational (reckon or calculate) Phases perform by ORS, which is given below:

3.1 Steps of the proposed algorithm:-

- Step1: Estimate the delay, bandwidth, availability, and mobility, of each node. We seek optimal routes with minimal end to end delivery time or bandwidth.
- Step2 Calculate the validity of each route for available packet forwarding/ transmitting for selecting an optimal path.
- Step 3: remove the routes, which does not satisfy the above condition.
- Step 4: randomly select any one route from the available routes, which provides optimal routes.
- Step 5: sends the packet using optimal route.

- Step 6: Exit.

3.2 Formula's use for calculation purpose:-

Bandwidth: -

$$B(n) = \frac{(\text{Ns } (CH^{-1}(\text{n}) + 1))}{(\text{Length})} \quad \text{Eq. (1)}$$

Delay:-

d(nodal)=d(proc.)+d(queue)+d(Tran.)+d(prop.) Eq. (2)

Availability:-

$$\text{Ava.} = \frac{\text{MTBF}}{(MTTR+MTBF)} \quad \text{Eq. (3)}$$

Where,
MTBF=metrics of mean time b/w
Failure,
MTTR=mean time to repair.

Mobility: -

Mobility can be assumed and take a default value

3.3 For calculation of path between mobile sink node to static node:-

3.3.1 Square or rectangular shape [1]:-

$X_b = R*(H_{sr}/2)$ Eq. (4)
$X_e = X- (R*(H_{sr}/2))$ Eq. (5)
$Y_b = R*(H_{sr}/2)$ Eq. (6)
$Y_e = Y- (R*(H_{sr}/2))$ Eq. (7)

3.3.2 Circular shape:-

$r_{path} = H_{circle}*R$ Eq. (8)

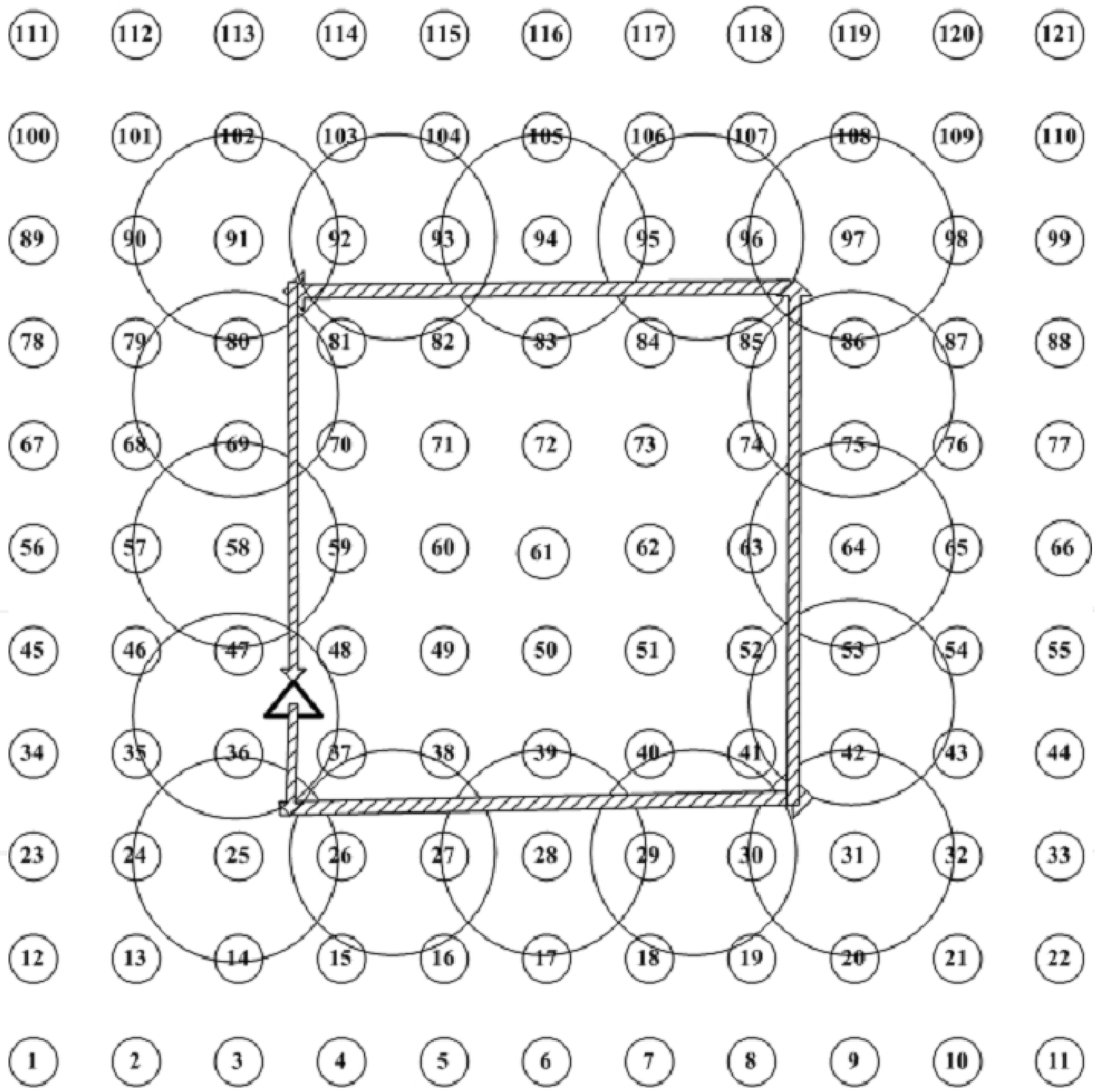

Figure 1. Path for a mobile node to follow in a 300mx300m application area.

3.4 Optimal path for multiple mobile sinks:-

For multiple sinks, the WSN application area should be sub-divided optimally [1]. Thus the Number of sinks and number of squares must be a square of a positive integer number.

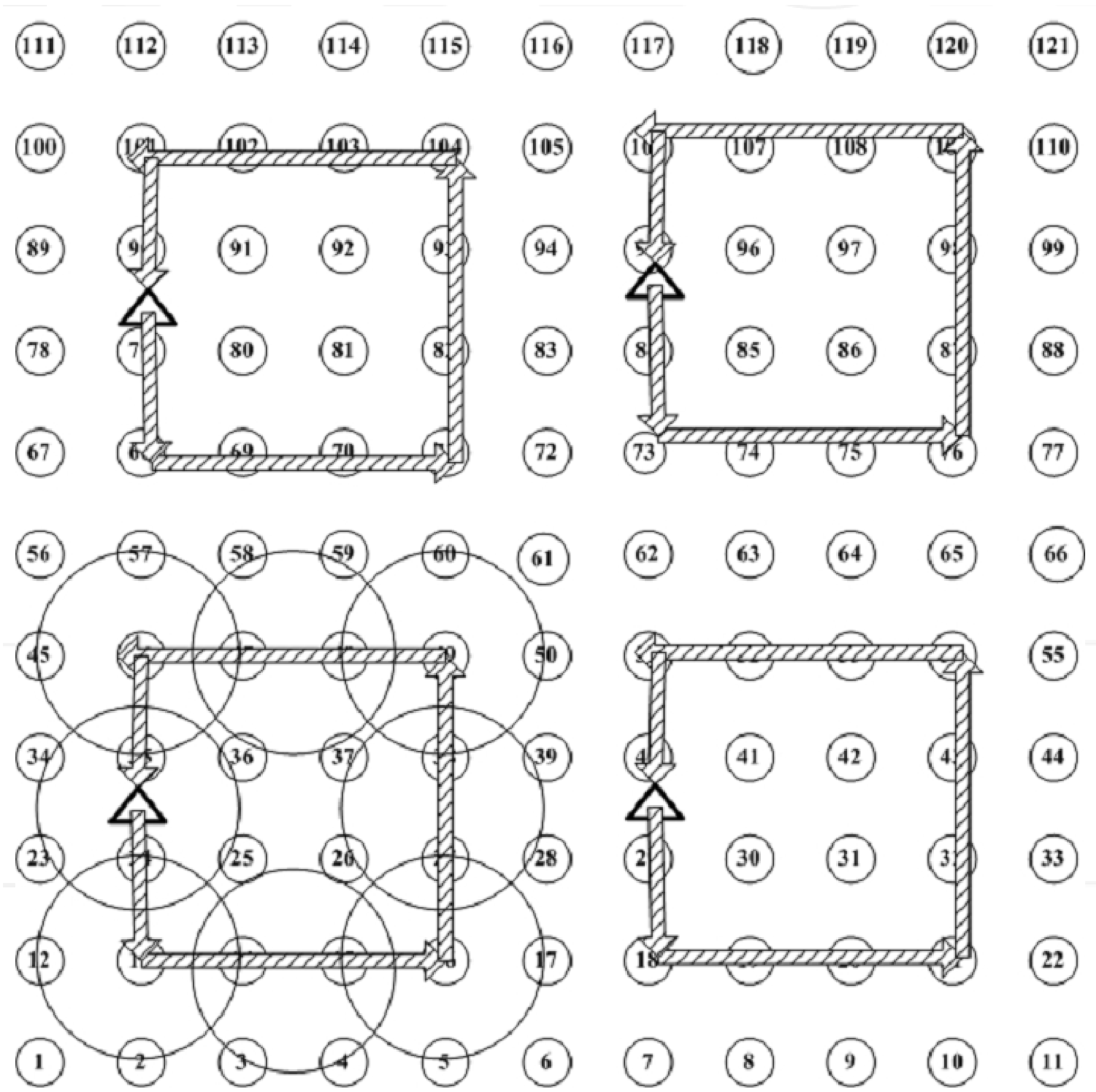

Figure 2. Four mobile sinks and each sink path in a 300mx300m application area.

3.5 Calculation of distance between each "hello" broadcast message from mobile sink:-

To ensure complete coverage of all nodes neighboring the path, the calculation of the distance between transmitting a "hello" broadcast message and waiting for responses from surrounding nodes is shown below [1]:

$$d = \frac{3*R}{2} \qquad \text{Eq. (9)}$$

The number of times the sink stops and broadcasts a "hello" type message is given by the following formula:

$$N_{hello} = \frac{2*(X_e - X_b) + 2*(Y_e - Y_b)}{d} \quad \text{Eq. (10)}$$

3.6 Time for a mobile sink to complete one loop around the path:-

The mobile sink first moves along the path and greets all nodes within communication range [1]. The mobile sink transmits a “hello” greeting message at every □ metres requesting any of the surrounding nodes to return any data messages they may have temporarily stored while waiting for the sink to return. The message contains the mobile sink’s ID, velocity and acceleration, sink direction, its intended path, and when it calculates it will return to its current position as well as a list of all nodes that have responded to its greeting thus far. Initially, during the first loop of the mobile sink, the path list will be incomplete, as the sink is not yet aware of all nodes in its path range. When the mobile sink completes its first loop, it will have obtained a reasonably accurate network topology of all nodes within communication range of its path and their locations. The mobile node will re-broadcast this list as it continues to loop around its path, so that even if some nodes were asleep during previous cycles, these nodes can still obtain the list to update their records.

In the event that a real-time event message needs to be reported to the mobile sink, the initial node that is elected to receive the event message, as it is within communication range of the sink or the actual node that detected the event, can transmit the message to the sink, using this list and its knowledge of the mobile sink's velocity and intended path, to determine the optimal nodes to use to route the message to the sink. The messages transmitted between the nodes will travel faster than the mobile sink so the message will be delivered to the sink faster than waiting for the sink to pass by again.

3.7 Calculation of the total time it takes a sink to complete one loop across the mobile path:-

3.7.1 Sink stop-start movement with non-uniform velocity:-

The total time for a node to complete one loop along the calculated path is given by the following formula:

$$T_{total} = N_{hello} * (T_{stop} + T_{av} + T_{cv} + T_{dv}) \quad \text{Eq. (11)}$$

3.7.2 Sink movement with uniform velocity:-

$$T_{total} = \frac{2*(X_e - X_b) + 2*(Y_e - Y_b)}{V_f} \quad \text{Eq. (12)}$$

4. PERFORMANCE EVALUATION

The performance of the proposed algorithm has been verified by computer simulation. The simulation environment is summarizes in table 1 which considers the operation of an AODV, MANET, WLAN, routing protocols. For comparison, the performance based on previous & propose work has also been evaluated by using different parameters, which is given below:-

TABLE 1 SIMULATION PARAMETERS

Parameter	Value
simulator	OPNET
protocols	AODV,MANET,WLAN
Simulation time	100s
No. of nodes	50
Simulation area	300x300
Transmission range	200m
Node speed	10[m/s]
Traffic type	udp

4.1 Comparison between previous & proposed with "total packets dropped" parameter in AODV routing protocol.

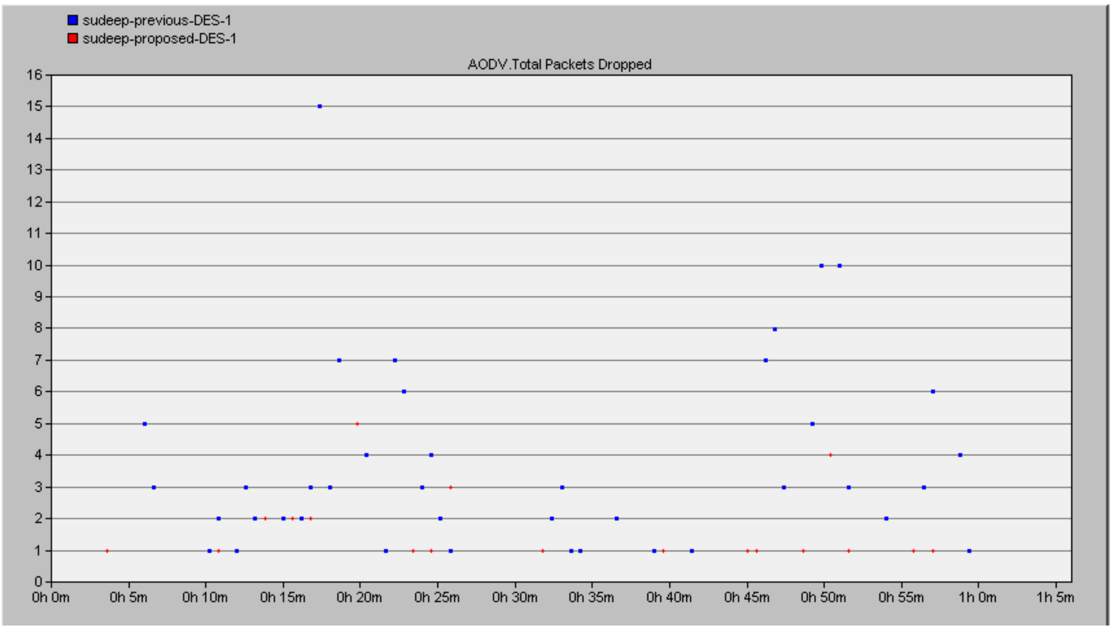

Figure 3. Total packets dropped.

4.2 Comparison between previous & proposed with "Delay (secs)" parameter in MANET routing protocol.

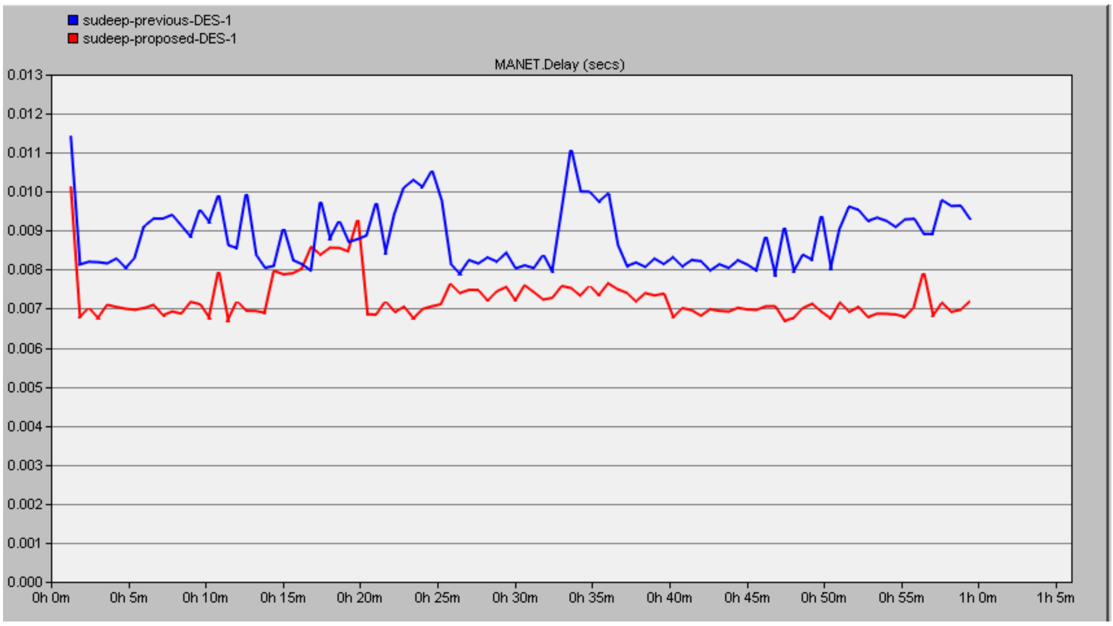

Figure 4. Delay (secs)

4.3 Comparison between previous & proposed with "Retransmission attempt's (packets)" parameter in WLAN routing protocol.

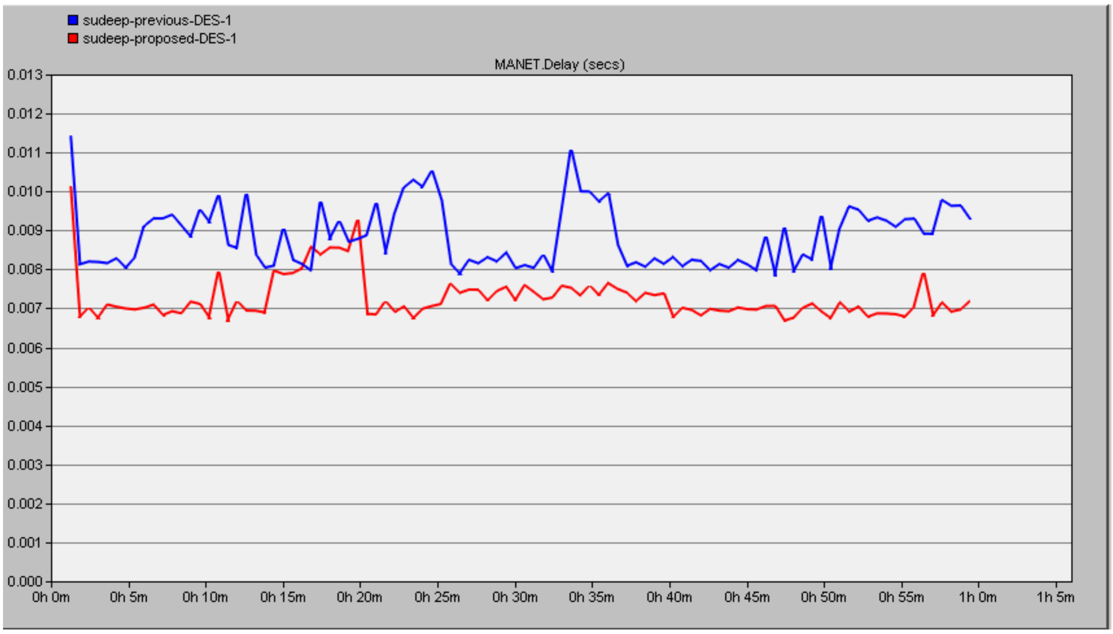

Figure 5. Retransmission Attempts (packets).

5. CONCLUSION:

ORS does what it is designed to do, and it does it well. First of all take optimal sensor node database then make-up there routing table then make optimal routes. After that select one optimal route from those group of optimal routes and finally send data with their approximation result. we reduce contention and the number of collisions in the network, thereby improving the packet delivery ratio. As collisions reduce the number of retransmissions and hence the energy wastage also goes down. Simulation results show that the proposed algorithm significantly reduces the collision rate and improves packet delivery and energy efficiency in the network. For result comparison purpose use AODV, MANET, WLAN protocols with OPNET simulator.

6. Acknowledgement:

Here I acknowledge my work has completed with my passions. This is a paper to introducing my work. My paper based on ORS Algorithm.

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