Performance Evaluation of Dynamic and Static Sensor Node in Wireless Sensor Network

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***Abstract*:** A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The main goal of this paper is to analysis and Evaluation of AODV routing protocol for wireless sensor network and compares the Static and Dynamic Scenarios for PDR, e2e Delay and throughput. The goal of this work is to perform a simulation with different metrics, analysis of the results and deriving a conclusion on basis of performance evaluation.

***Keywords*:** AODV, Sensor node, PDR, Throughput, End-to-End Delay

1. Introduction

WSNs provide a simple, economic approach for the deployment of distributed monitor and control devices, avoiding the expensive retrofit necessary in wired systems. WSN has been a trend of the past few years, and they involve deploying a large number of small nodes. The nodes then sense environmental changes and report them to other nodes over flexible network architecture. Sensor nodes are great for deployment in hostile environments or over large geographical areas [2].

Total working of wireless sensor networking is based on its construction. Sensor network initially consists of small or large nodes called as sensor nodes. These nodes are varying in size and totally depend on the size because different sizes of sensor nodes work efficiently in different fields. Wireless sensor networking have such sensor nodes which are specially designed in such a typical way that they have a microcontroller which controls the monitoring, a radio transceiver for generating radio waves, different type of wireless communicating devices and also equipped with an energy source such as battery. The entire network worked simultaneously by using different dimensions of sensors and worked on the phenomenon of multi routing algorithm which is also termed as wireless ad hoc networking.

1.1 Applications:

In the present era there are lot of technologies which are used for monitoring are completely based on the wireless sensor networking. Some of important applications are environmental monitoring, traffic control application, weather checking, regularity checking of temperature etc. Wireless sensor networks can also be used for detecting the presence of vehicles such as motor cycles up to trains [5]. These are some important wireless sensor networking based technologies which help us in our daily life. Some of these daily life applications are: used in agriculture, water level monitoring, green house monitoring, landfill monitoring etc.

2. Background of Routing Protocol: AODV

There are two kinds of on demand routing protocols used in wireless sensor network: AODV and DSR.

In AODV, the network is silent until a connection is needed. At that point the network node that needs a connection broadcasts a request for connection. Other AODV nodes forward this message, and record the node that they heard it from, creating an explosion of temporary routes back to the needy node. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The needy node then begins using the route that has the least number of hops through other nodes. Unused entries in the routing tables are recycled after a time.

The discovery of the route from source to destination is based on query and reply cycles and intermediate nodes store the route information in the form of route table entries along the route [4]. Control messages used for the discovery and breakage of route are as follows:

2.1 Route Request Message (RREQ):

A route request packet is flooded through the network when a route is not available for the destination from source. A RREQ is identified by the pair source address and request ID, each time when the source node sends a new RREQ and the request ID is incremented. After receiving of request message, each node checks the request

ID and source address pair. The new RREQ is discarded if there is already RREQ packet with same pair of parameters

2.2 Route Reply Message (RREP)

On having a valid route to the destination or if the node is destination, a RREP message is sent to the source by the node.

2.3 Route Error Message (RERR)

The neighborhood nodes are monitored. When a route that is active is lost, the neighborhood nodes are notified by route error message (RERR) on both sides of link.

2.4 HELLO Messages

The HELLO messages are broadcasted in order to know neighborhood nodes. The neighborhood nodes are directly communicated. In AODV, HELLO messages are broadcasted in order to inform the neighbors about the activation of the link. These messages are not broadcasted because of short time to live (TTL) with a value equal to one [6].

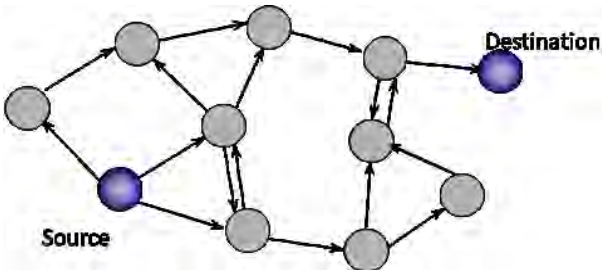

Fig1: Route Discovery (RREQ)

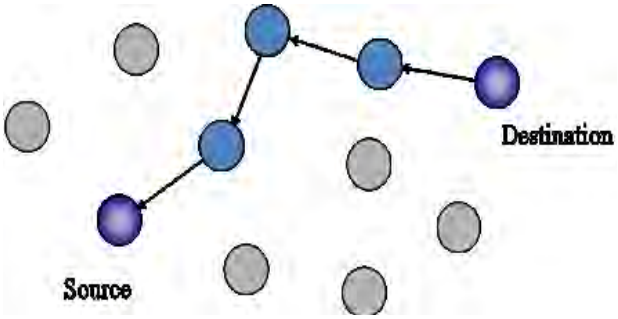

Fig2 : Route Reply (RREP)

3. Proposed Network Model and Scenarios

The network model considered for simulation is as shown in figure below. In this paper, we have proposed the industrial wireless sensor network environment. It consists of single sink node and multiple source nodes. Model is design for the Multi-hop situation. The simulation parameter and node configuration is listed in Table 1.

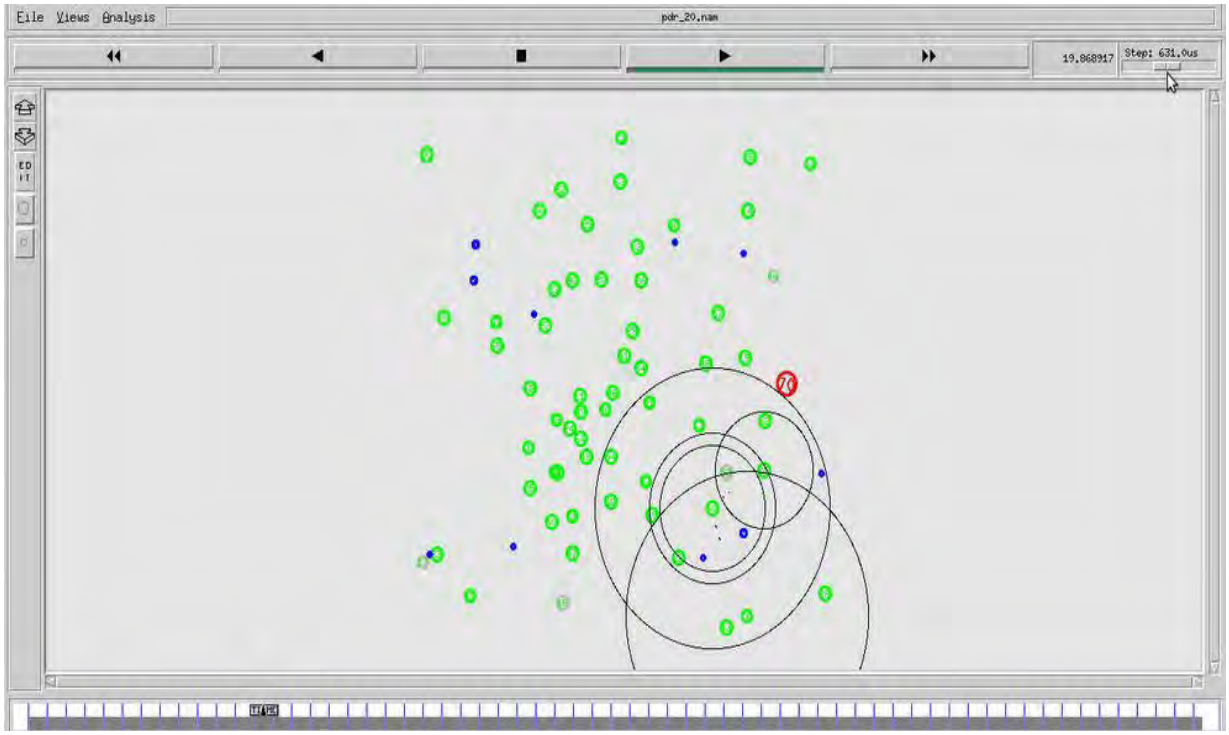

Fig 3: Simulation of WSN

Table 1: Simulation Parameter

Parameter	**Normal scenario**	**Scenario α**	**Scenario β**
Area Terrain	800 X 800	800 X 800	800 X 800
Routing Protocol	AODV	AODV	AODV
No of Environment Nodes	10	10	10
Sensor Nodes	Dynamic	Static, Dynamic	Static, Dynamic
Sink Node	Static	Dynamic	Static
No of Sensor nodes	60	40,50,60,70,80	40,50,60,70,80
No of Sink Nodes	1	1	1
Packets Type	CBR	CBR	CBR
Mobility	20	20	20

In the given Simulation Screenshot, Sensor nodes sense the phenom nodes and the required data is send to sink node (70). There are in all 60 sensor node and 10 environment nodes (Phenom Nodes) and 1 sink node (70) which contains information of whole scenario. The simulation area is considered as 800 meters by 800 meters.

In this paper, the results are created by using Network Simulator. It is simply an event driven simulation tool that has proved useful in studying the dynamic nature of communication networks. A network simulator is a piece of software or hardware that predicts the behavior of a network, without an actual network being present. Simulation of wired as well as wireless network functions and protocols (e.g., routing algorithms, TCP, UDP) can be done using NS2 [8].

3.1 Simulation Scenarios

Our Simulation results have different parameters namely Scenario α & Scenario β.

- Scenario α: Dynamic sink node and Varying Sensor Node
- Scenario β: Static Sink and Varying Sensor Node.

Scenario α: Dynamic sink node and Varying Sensor Node

In this simulation scenario, static and dynamic sensor nodes are analyzed with the dynamic sink node. Various Simulation metrics for the given scenario are analyzed and on that basis performance graph is plotted.

Scenario β: Static Sink and Varying Sensor Node.

In this simulation scenario, static and dynamic sensor nodes analyzed with the sink node static. Various Simulation metrics for the given scenario are analyzed and on that basis performance graph is plotted.

4. Simulation Metrics

The simulation metrics used in our simulation are:

1) Packet Delivery Ratio
2) End-to-End delay
3) Throughput

1) ***Packet Delivery Ratio***: Measures the percentage of total number of data packets received out of total number of data packets sent [1].

$$pdr = \frac{Recieved\_packets}{Sent\_packets} \times 100$$

2) ***End-to-End Delay:*** This metric measure the average time it takes to route a data packet from the source node to the destination node. The lower the end-to-end delay the better the application performance. If the value of End-to-end delay is high then it means the protocol performance is not good due to the network congestion [1].

$$Average\ delay = \frac{\Sigma(Tr - Ts)}{Number\ of\ Packets}$$

Where Tr = the receive time,
Ts= the send time

3) ***Throughput:*** Total data traffic in bits/sec successfully received and forwarded to the higher layer. Throughput shows protocol's successful deliveries for a time; this means that the higher throughput is the better will be the protocol performance [1].

5. Result Analysis

Scenario *α:*

Here we have compared static and dynamic nature of Sensor nodes by increasing the number of nodes and plotted a graph on the same basis for PDR, delay and throughput by keeping varying the dynamic sink node.

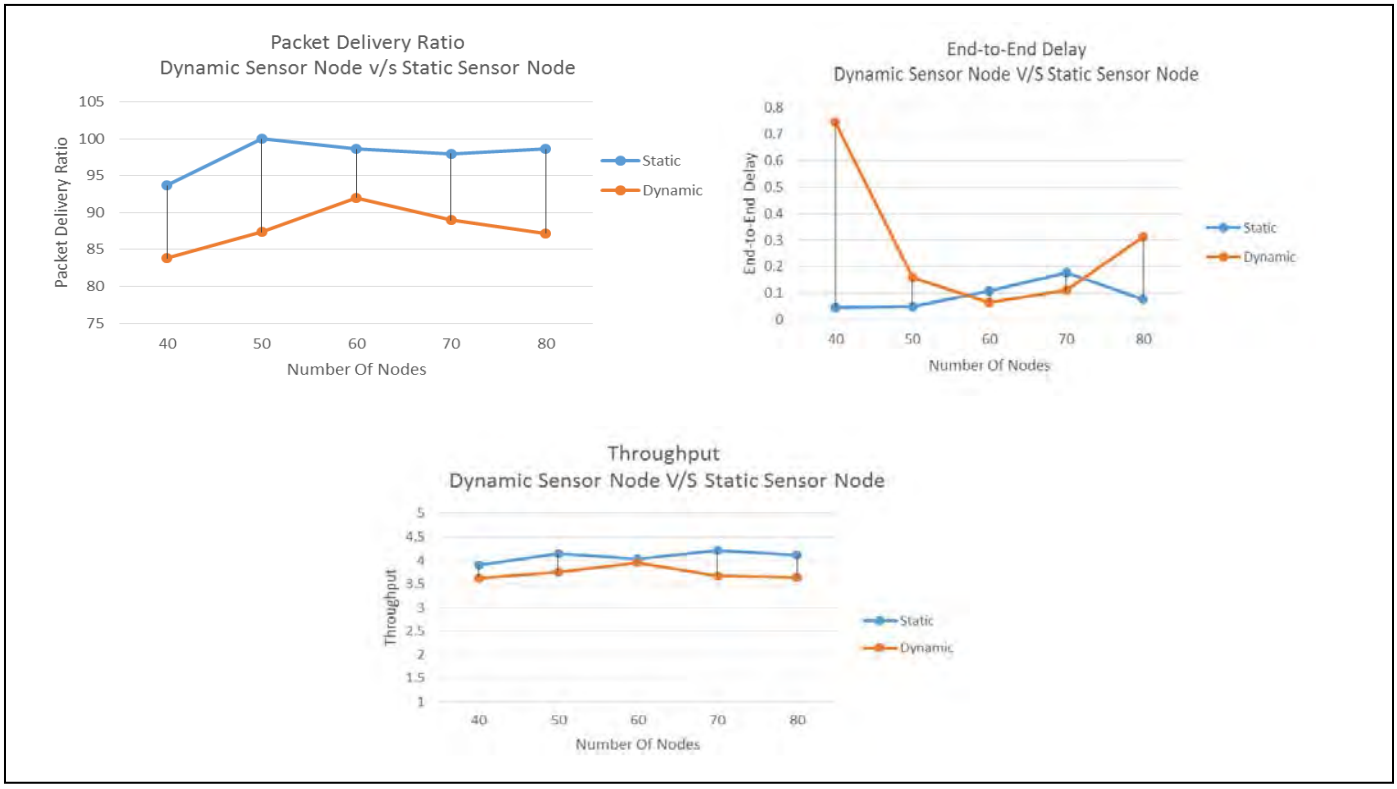

Fig 4: Graph of PDR, e2e delay, throughput versus varying number of nodes for dynamic and static sensor node with dynamic sink node

Scenario β:

Here we compare static and dynamic nature of Sensor nodes by increasing the number of nodes and plotted a graph on the same basis for PDR, delay and throughput by leaving the sink node static.

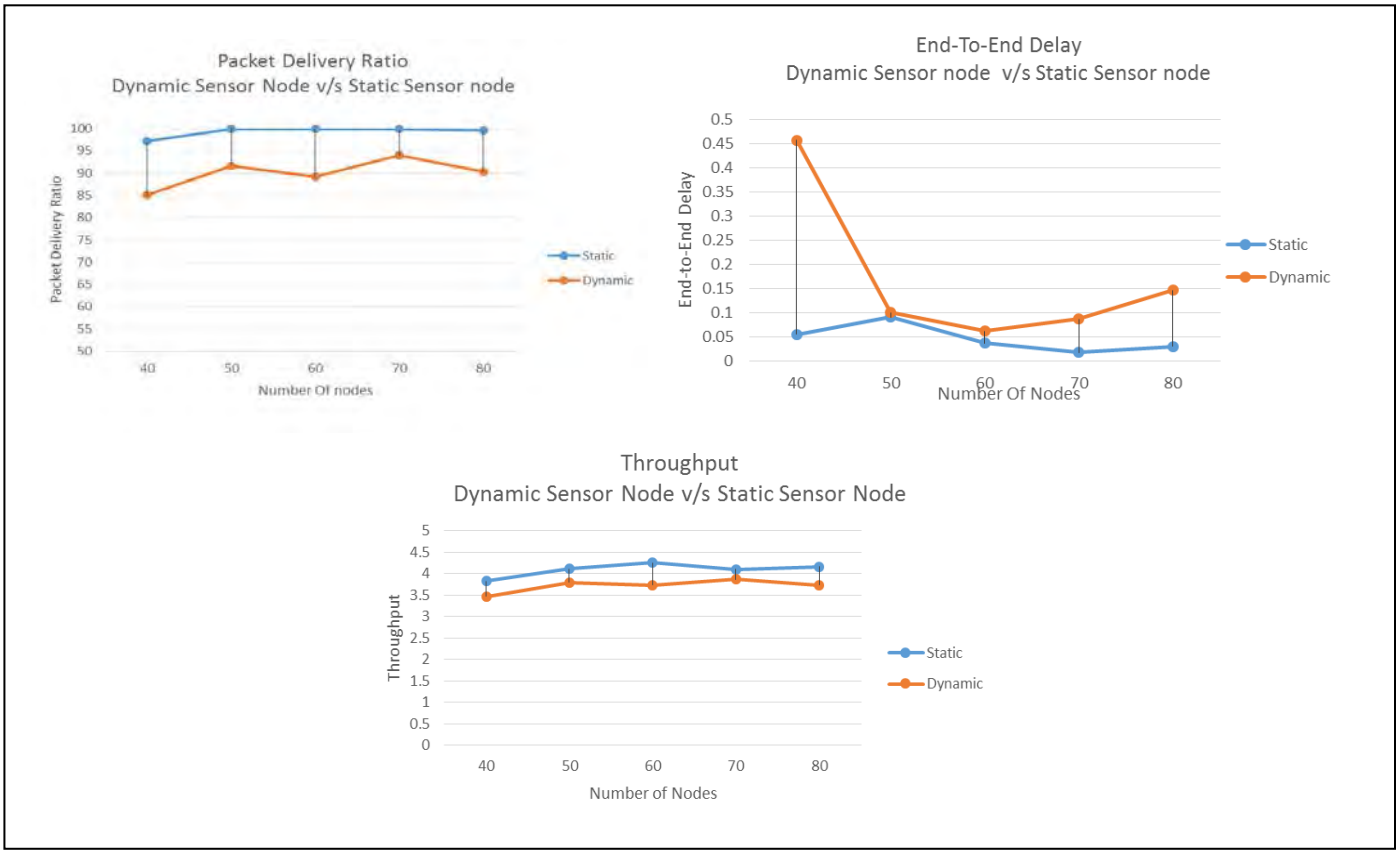

Fig 4: Graph of PDR, e2e delay, throughput versus varying number of nodes for dynamic and static sensor node with static sink node

7. Conclusion

From the result it is quite obvious that the static sensor nodes perform better than dynamic sensor nodes. Our simulation also concludes that it is preferable to have dynamic sink node if the sensor nodes are dynamic. Out Simulation results show that the difference in Packet Delivery Ratio with static nodes and dynamic sensor nodes is about 8-9 %.Thus, out results for PDR, End-to-End Delay and Throughput is found better in Dynamic sensor node & dynamic sink node.

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