Performance Tradeoffs of Routing Protocols in Wireless Sensor Networks

Tarek Mosbah Abdala, Nasarudin Daud , Ezeddin Sanam , Mohammed Salah Ahmed , Abdalla Adam Abdalla and Salah Mohmad Aboghsesa

Abstract— Wireless Sensor networks are expected to play an important role in civilian and military settings where wireless access to wired backbone is either ineffective or impossible. Wireless sensor networks are effective in remote data acquisition. In this paper we conduct a survey of routing protocol properties of various wireless sensor network routing algorithms and analyzed them. The routing algorithms considered in this paper are classified into two categories proactive (table driven) and reactive (on demand). The algorithms considered are Ad-hoc On-Demand Distance Vector Routing (AODV) and Destination sequence Vector (DSDV) , the evaluation of routing protocols conducted using Ns-2 show that the proposed bandwidth-allocating congestion control and clustering mechanism are effective a WSN without any mechanism, in terms of Packet delivery ratio, throughput, and packet loss**.**

Keywords **—** Wireless Sensor Network, AODV, DSDV, Performance**.**

I. INTRODUCTION

A Wireless Sensor Network (WSN) consists of a large set of wireless sensors (also called wireless nodes) deployed over a geographic area known as the sensors field, to monitor specific characteristics of the environment or characteristics of specific subjects immerse in that environment. Wireless sensors also collect the data related to that phenomena and forward it to a central unit for processing and analysis.

The interests of wireless sensor networks (WSNs) have been widely expanded from environmental monitoring applications to infrastructure monitoring emergency medical response, and military surveillance applications. WSN consists of a large number of wireless sensor nodes spatially distributed to monitor changes such as temperature, vibrations, motion, and other such physical events that might be of interest.[3]

Department of Networking, Faculty of Creative Media and Innovative Technology, Infrastructure University Kuala Lumpur (IUKL) Kajang, Selangor, Malaysia.

Faculty of Science and Technology , Universiti Sains Islam Malaysia. Bandar Baru Nilai, 71800, Nilai, Negeri Sembilan, MALAYSIA.

Email IDs- tarek_mosbah2010@yahoo.com, nasarudin@iukl.edu.my, ezeddin_ss2008@yahoo.com, msai1989@gmail.com, tagmlla@ hotmail.com and Salahmohmad1978@gmail.com

Sensors are small devices with limited resources: limited battery power, low memory, little computing capability, very low data rates, low bandwidth processing, variable link quality, etc. However, despite their constraints, when the sensors are deployed in large numbers they can provide us with a very real picture of the field being sensed. WSN can provide an area coverage that was not possible with other wired and wireless networks.

II. WSN APPLICATIONS

WSNs have a wide variety of applications such as environmental monitoring and tracking. The particular applications are tracking of object, monitoring of health, fire detection and control of nuclear reactor. Deployment of sensor nodes in an area for collection of data is a typical application of WSN.

A. Monitoring of Area:

The common application of WSNs is monitoring of area. The events occurring in the environment are monitored by the sensor nodes deployed in the region. Monitoring of area involves detecting enemy intrusion by a large number of sensor nodes deployed over a battlefield. The detected events are then reported to base station for some action.

B. Monitoring of Environment:

A large scale wireless sensor networks are deployed for environmental monitoring including forest fire/flood detection, monitoring of the condition of soil and space exploration [4].

C. Applications in Commercial Area:

Wireless Sensor Networks have a lot of applications concerning commercial are such as office/home smart environments, health applications, controlling of environment in buildings, monitoring of industrial plants.

D. Tracking Applications:

In tracking area, WSN applications include targeting in tracing of doctors and patients inside a hospital. A search and rescue system is designed using connectionless sensor.

III. ROUTING PROTOCOLS CLASSIFICATION IN WSN

The routing protocols in the multi hop Ad hoc networks are classified into three categories: proactive (or Table-driven) , reactive (On demand) and Hybrid. Proactive routing protocols consistently maintain the route to all nodes in the network and the routing information is kept in the table in each node. Reactive routing protocols discover the route when the packets are sent to the sink. [3,4]

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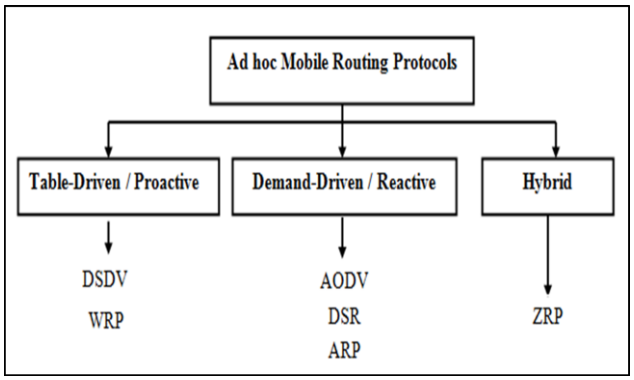


Fig. 2 WSN Routing Protocols

A. *Ad Hoc On-Demand Distance Vector (AODV)*

AODV discovers paths without source routing and maintains table instead of route cache. It is loop free using destination sequence numbers and mobile nodes to respond to link breakages, changes in network topology in a timely manner. It maintains active routes only while they are in use and delete unused routes.[4,5]

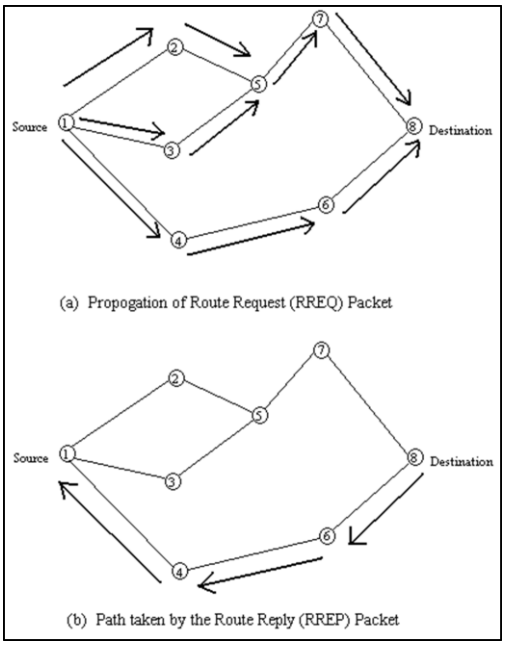


Fig.3 Route discovery in AODV

B. *Destination-Sequenced Distance-Vector Routing (DSDV)*

Destination-Sequenced Distance-Vector Routing (DSDV) is a Table-Driven protocol, which is based on the classical Bellman-Ford routing mechanism. Each node in the network has to maintain a routing table, which records all possible destinations within the network and the number of hops to them (see Figure 4). A sequence number is marked in each entry, and it can be used to judge the route - whether it is too old or not. This will help to avoid the formation of routing loops.

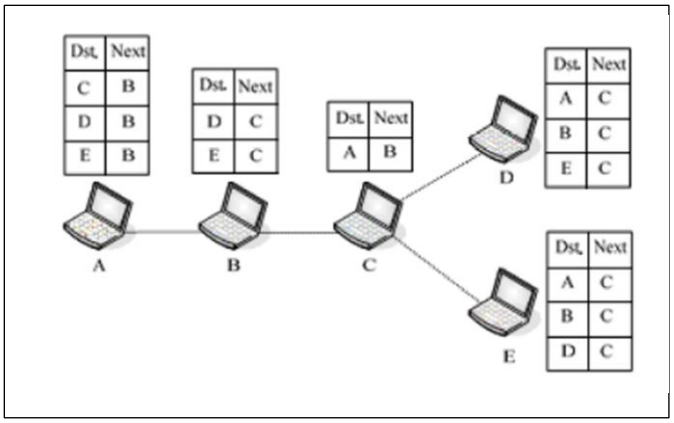


Fig.4 The Operation Diagram of DSDV

IV. Problem Statement

Wireless Sensor Networks (WSNs), consisting a large number of wireless sensor nodes, have been widely adopted for various applications. Each node in the network may be transmitting various types of information with different levels of importance. Therefore, the available resources in the network must be distributed in such a way that each user gets different levels of access according to the level of service required.

Every routing protocol in WSN has their own advantages based on their individual performances in the network. By give the constant values of parameters such as: number of nodes, data rate and packet size, this project is done to evaluate the performance of WSN routing protocols using appropriate metrics.

V. Objectives

The aim of this paper is to study the performance tradeoffs of wireless sensor networks routing protocols. This will be accomplished as following:

- To study the existing protocols for wireless sensor network, in order to acquire more detailed knowledge of the subject matter.
- To evaluate the performance of critical parameters that affects the quality of services of wireless sensor network routing protocols.
- To use NS-2 simulation to evaluate the performance of WSN routing protocols.

VI. Simulation Tool

In All simulations have been carried out using the NS simulator version 2.35 under Linux platform.

NS2 is an open source simulator software and used by a lot of institutes and researchers. The main goal of the NS2 simulator is to provide support to education and research in networking. It is one of the best programs in terms of comparing different routing protocols and designing new ones.

NS2 has been written in two languages: (TCL) and AWK programming languages [3].

A detailed simulation model based on ns-2. The network designed consists of basic network entities with the simulation parameters presented in table 1.

TABLE I
NETWORK PARAMETERS

PARAMETERS	VALUE
ROUTING PROTOCOLS	DSDV, AODV
MAX. NUMBER OF NODES (N)	20
MAC TYPE	IEEE 802.11
PROPAGATION MODEL	TWO RAY GROUND
TRAFFIC TYPE	CONSTANT BIT RATE
AGENT	UDP
QUEUE LENGTH	50 PACKETS
AREA	200M X 200M
PUASE TIME	50S,100S,150S PAUSE TIME

VII. PERFORMANCE METRICS

Wireless sensor network uses a multiple number of metrics to evaluate the performance of protocols in the network. In the paper we have considered three important metrics to calculate the network performance.

A. *Packet Delivery Ratio*

Packet delivery ratio is the ratio of total number of data packets that were delivered successfully to intended destinations to the total number of data packets generated[10].

B. *Throughput*

It is used to calculate the average throughput of the application traffic between the nodes.
Simply the time taken for a packet to travel from source to destination when it reaches the destination that particular time is said as a throughput.

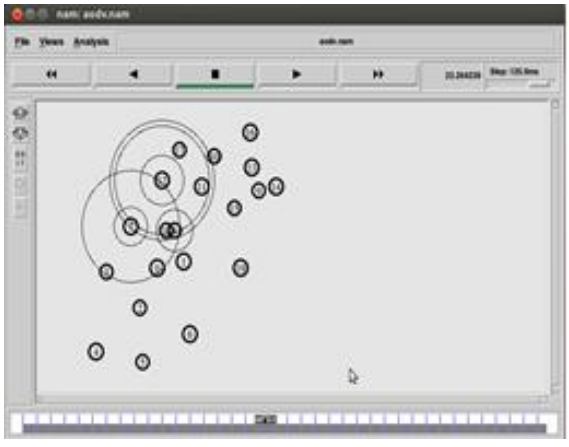
C. *Packet Loss*

Amount of packets lost / dropped between the nodes due to traffic congestion and overloading in the network.

VIII. RESULT AND PERFORMANCE ANALYSIS

The In this paper we analyzed the performance between on-demand and table driven routing protocols namely Destination Sequenced Distance Vector (DSDV) and Ad-hoc On-demand Distance Vector Routing (AODV) by calculating their metrics (Packet delivery ratio , Throughput and Packet loss) . The results are analyzed below.

A. *Generated NAM files of AODV:*



B. *Generated NAM files of DSDV:*

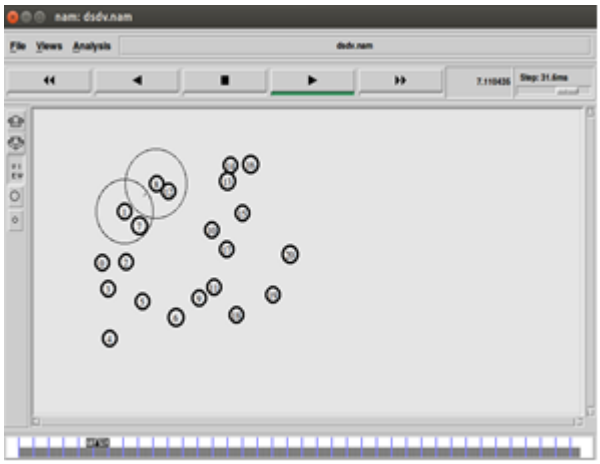


TABLE II
ACQUIRED RESULTS OF AODV AND DSDV

PROTOCOLS	METRICS	50S	100S	150S
AODV	PACKET DELIVERY RATIO (%)	89.87	77.24	60.1
	THROUGHPUT (BPS)	367	480	489
	PACKET LOSS	1201	3120	6550
DSDV	PACKET DELIVERY RATIO (%)	67.10	50.30	44.50
	THROUGHPUT (BPS)	215	201	215
	PACKET LOSS	3509	7301	9630

The simulation results reveal that AODV routing protocol is better than DSDV routing protocol, the following is the explanation of the result gained.
Packet delivery fraction, AODV has better performance than DSDV in the considered scenarios. PDF increases with an increase in the pause time for both protocols.
As far as throughput is concerned, AODV performs by far better compared to DSDV. Average throughput in both protocols decreases steadily with an increase in the number of expired nodes and in case of pause time, the average throughput increases with increasing pause time.
Also in packet loss AODV has better performance than DSDV in the considered scenarios.

IX. CONCLUSION

In this paper, two routing protocols named DSDV and AODV are simulated and compared under specific scenarios with WSNs environment. With the help of the NS2 simulator, DSDV and AODV are evaluated in respect of packet delivery fraction , throughput and packet loss.

In this paper, the performance analysis of AODV and DSDV done in specific criteria, the simulation result obtain that AODV is better than DSDV in terms of packet delivery ratio, packet loss and throughput.

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