An Extensive Comparison Among DSDV, DSR and AODV Protocols in Wireless Sensor Network

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ABSTRACT: *The field of Wireless Sensor Networks (WSN) is undergoing a major revolution, opening the prospect significant impact in many application areas (safety, health, environment, food safety, manufacturing, telecommunications. Routing is fundamental such a network because there is no infrastructure that manages the information exchanged between network nodes.Two major classes of routing algorithms are defined, the first is the class flat and the second is that of the hierarchical algorithms. The aim of this paper is to study the class of flat and make a comparative study between several routing algorithms and their impact on the performance of WSN.Our simulation is performed in NS2 (Network Simulator 2). It allows us to identify performance metrics such asthroughput, end to end delay and loss rate.*

Keywords: Wireless Sensor Network WSN, Routing Protocol, Simulation, NS2, Throughtput, Delay-End-to-End, Loss Rate

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1. Introduction

After the mobile phone networks and ad-hoc networks, research today is moving towards Wireless Sensor Network (WSN). The WSN is undergoing a major revolution, opening the prospect of significant impacts in many areas application (communication, manufacturing, safety, health, environment,..) [1]. This new technologie allow us to reduce the size, cost, energy consumption and increase the accuracy of sensors, processors and specific circuits. A large number of sensors can be considered, integrated and organized as a network [2].

Routing is fundamental in this type of network because there is no infrastructure that manages the information between network nodes. Indeed, that is to say each network node acts as a router [5], [6]. Thus, all nodes cooperate to route information to a certain destination. The routing algorithm is to provide a strategy to ensure at any moment, the connection between any pair of nodes belonging to the network [3].

There some difficulties to ensure routing in the WSN. So, these strategies use various techniques to solve this problem. According to these techniques, several classifications have appeared. In this paper, we classify the routing protocols into two classes. The first class is the flat routing protocol which is classified into two types: proactive and reactive. The second class is the hierarchical routing protocols [4], [5]. Finally, the paper aims to study the effects of routing layer on MAC layer.

This paper is organized as follows. In section II, a classification of routing protocols is described, especially those implemented in NS2. A comparison between the different routing protocols: AODV, DSR and DSDV, is elaborated in section III. In section IV, we define the different metrics of performance related to the WSN. Next, the simulations results are discussed. Finally, we conclude our report in section V.

2. Classification of routing protocols

2.1 The used methods of routing

2.2.1 Distance vector

Each node maintains a vector table distance vector that indicates the nodes with its neighbors over the cost of each path. It exchanges the routing updates periodically even if no topology change. According to [1], steps to a distance vector protocol are[3]: calculate the cost of each link with its direct neighbors and share this with neighbors only, to 'update its routing table according to the of neighbors.

2.1.2 State link

Each node periodically exchange information from all neighbors by building a routing table using a shortest path algorithm like Dijkstra [3]. Dijstra (pronounced dikstra) is an algorithm for finding the shortest path to reach the other nodes by starting the source. The steps of a protocol state of links are: know the direct neighbors using HELLO packets, giving a cost to each link,disseminate this information at any network, apply an algorithm to compute paths to all destinations in the network. LS does not trigger mail updates routing only when changing the topology.

2.2 Classification of routing protocol

Routing protocols are classified into two groups: flat and hierarchical routing protocols flat are classified into two types : proactive and reactive [7].

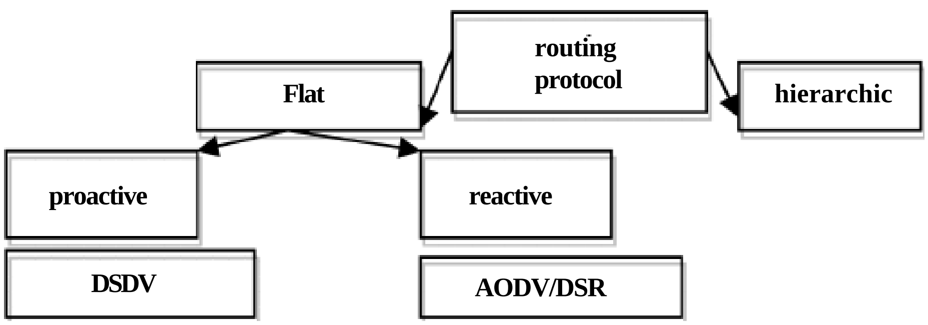

Figure 1. Classification of routing protocol

2.2.1 Constraint of routing algorithms

An algorithm must be able to optimize network resources, avoid routing loops, preventing the concentration of traffic around certain nodes or links, by proposing new routes acceptable, even in case of high mobility nodess [4], [5].

3. Comparison Routing Protocols AODV, DSDV And DSR

3.1 The DSDV routing protocol

DSDV (Destination Sequenced Distance Vector Dynamic) is a proactive routing protocol based on the distributed algorithm of Bellman-Ford for finding shortest paths from a given source vertex in a weighted directed graph. Each node only needs to know the brands of its neighbors. Each network node main- tains a routing table containing the next hop and the number of hops for all destinations. To avoid formation of routing loops [5], DSDV uses the sequence numbers to distinguish the new discoveries of ancient roads. A road R is more favorably than another road R′, if R has the greatest sequence number. If these two roads have the same sequence number, R is more favorable If it has fewer jumps. The updated tables are periodically transmitted to maintain consistency of information over the networks [8].

Type	Description
Proactive	Broadcast routing table to all neighboring nodes. Update the routing table when topology change.
Reactive	Road trip at the request of an application . Flooding the network with Route Request (RREQ) and the response of the Road (RERP) message.
Hierarchical	Divise the network into groups that communicate through their clusters Head (CH)

Table 1. Classification Of Routing Protocols In RCSF

Criterion	Value
Number of nodes	20 node
network topology	600 × 600
Simulation time	80 s
Transmission interval	0.05 s
Packet size	512 bytes
transmission completed	Node 0 to node 3
Transmission Range	250 m
Routing protocol	AODV, DSR, DSDV
MAC layer model used	MAC/SMAC
Mobility model	Random Walk Mobility Model
Simulation environment	
Operating System	UBUNTU 10.4
simulator	NS-2.34

Table 2. Parameters Of Simulation

3.2 The DSR routing protocol

DSR (Dynamic Source Routing) uses the technique of source routing instead of relying on the routing table e.g is the source that determinate the complete sequence of nodes through the data packets are sent [5]. The DSR allows to the network to be completely self organized and self-configured, which is the specificaion of WSN without the need for an existing network infrastructure or administration. DSR is based on two mecha -nisms. The first is the discovery of roads when the second is the maintenance of road. When the source wants to send an information packet to a destination and that this road is not in hiding. In this case, the source broadcasts a route look up request to the entire network until the time came to destina- tion. The road is reached a Route Reply packet containing the appropriate sequence of nodes to reach the destination is returned in unicast to the source node.

3.3 The Routing protocol AODV

AODV(Ad hoc On Demand Distance Routing Vector proto- col)is a routing protocol that is considered a combination of DSR and DSDV and is based on the use of two mechanisms such as DSR: the discovery and maintenance of roads and DSDV [5], his routing "*hop by hop*", its sequence numbers and broadcasting the of updates to routing tables. This is a pr- otocol on demand distance vector that induces a route is established only upon request. When a source node needs to configure a route to a destination that is not in its routing table, it broadcasts a route request message (Route Request message, RREEQ) to the entire network until it reachs the destination. Nodes receiving this packet update their inform- ation on the source and set pointers back to the source in the routing tables [3].

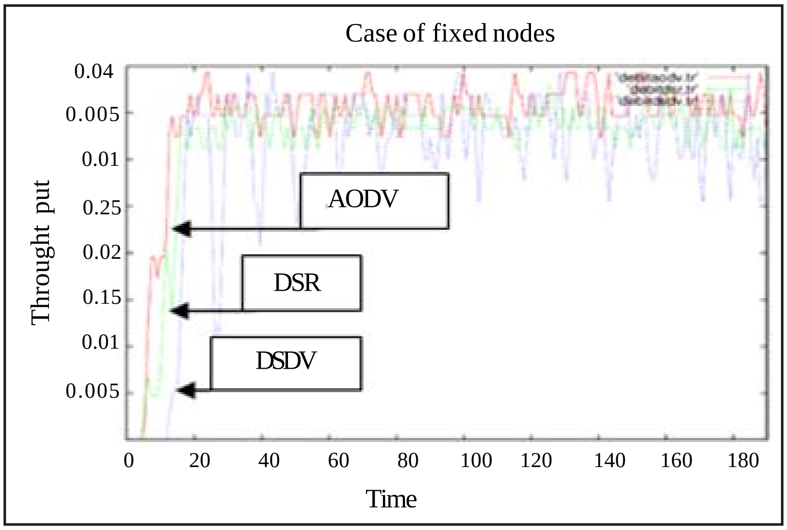

Figure 2. Evolution of throughtput vs. time

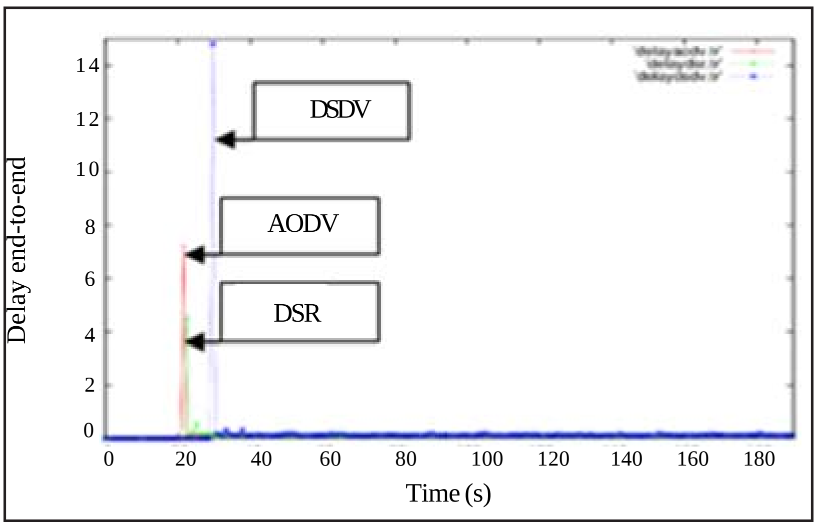

Figure 3.Variation of delay-end-to-end depending on time for a fixed topology

	AODV	DSR	DSDV
throughtput (Mbit/s)	0.035	0.032	0.025

Table 3. Average Throughtput (Mbit/S)

4. Simulation and results

4.1 Parameters of simulation

throughtput: represents the number of UDP packets at the destination node throughout the duration of the simulation.

Delay-end-to-end: also known as latency, or delay or response time: it characterizes the delay bettween transmission and reception of a packet (in our case we take the UDP packet). The delay is the average time for a packet is routed from source to destination. This metric is used to minimize the propagation time of packets of data exchanged during routing. Loss rate[8].

The table below describe the most important parameters of simulation.

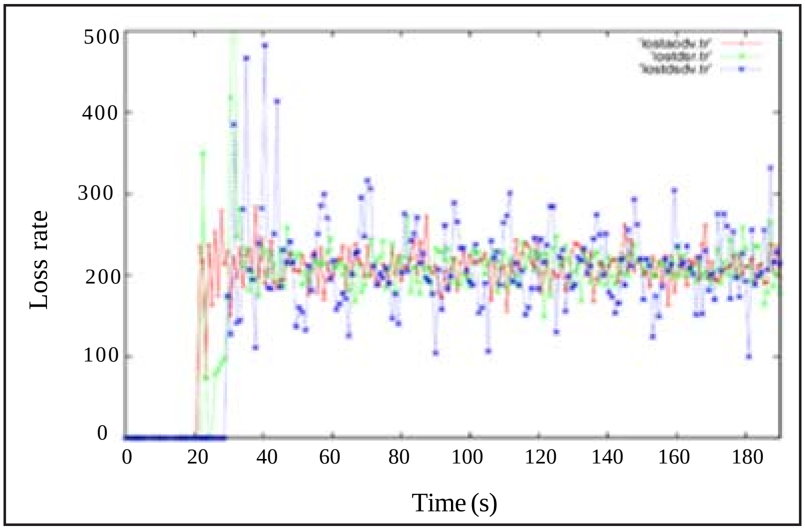

Figure 4. Variation of loss rate vs time

	AODV	DSR	DSDV
Average delay	0.17938	0.19215	0.21513

Table 4. Average delay

	AODV	DSR	DSDV
Loss rate	29%	35%	45%

Table 5. Loss rate

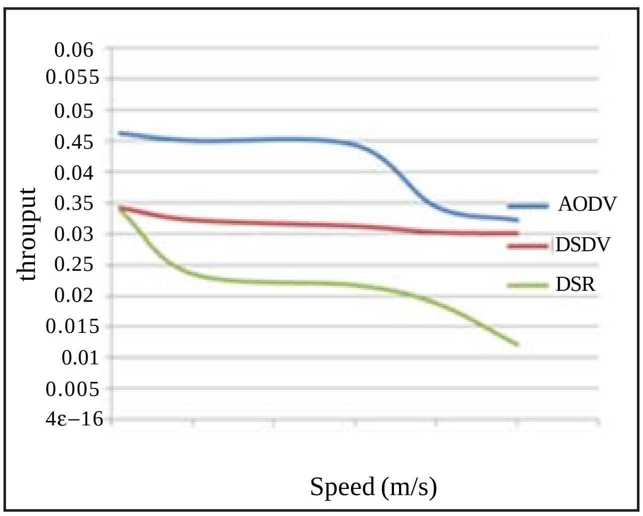

Figure 5. Variation of throughtput vs node speed

4.2 Results of simulation

4.2.1 Case of mobile nodes

We consider the same topology used in the previous scenario (topology 20 nodes) but in this scenario we do move the node N2, N3 and N4 at t = 20s with a speed of 20 m / s up out of the reach of node N1 which causes a power drive an hencelooking for a new path.

4.3 Interpretation of results

4.3.1 Fixed topology

AODV in our simulation experiment (figure 2)shows to have the overall best throughput performance. It has an improvement of

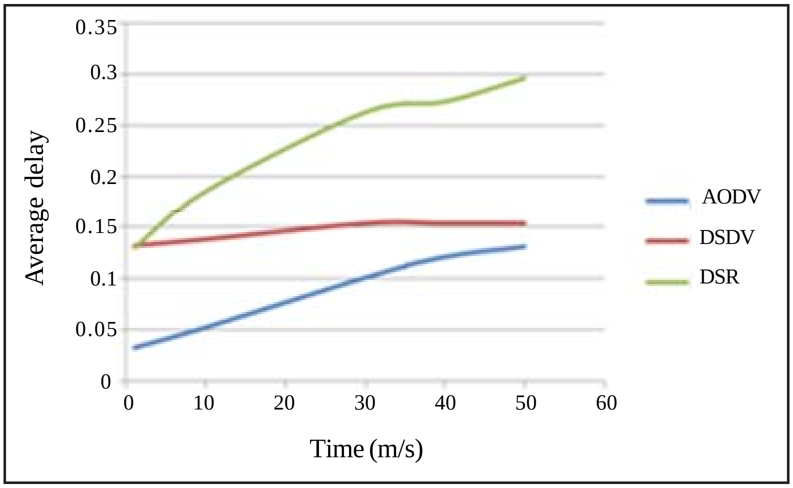

Figure 6. Variation of average delay vs node speed

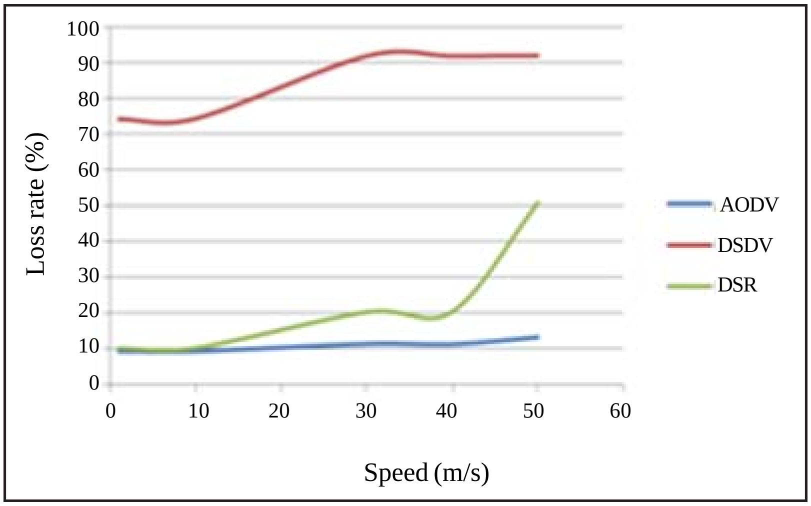

Figure 7. Variation of rate of loss depending vs node speed

DSR and DSDV and has advantages of both of them.

The AODV has much more routing packets than DSR because the AODV avoids loop and freshness of routes while DSR uses stale routes. Its throughput is higher than other two routing protocols at fixed topology.

The delay is affected by high rate of CBR packets as well. The buffers become full much quicker, so the packets have to stay in the buffers a much longer period of time before they are sent.so, According to Figure 3 and table VI, we notice that DSDV has the largest value of peak time due to the time of discovering roads.

In figure 3 we analyzed that AODV reached approximately 29% for packet loss ratio except DSR which obtained 35%. DSDV remains the protocol that has the highest rate of loss around 57%.

4.3.2 Mobile topology

According to figure 5, we notice that throughput decreases with increasing speed. We see that the protocol AODV present the main rate. However, the DSDV protocol present a significant decrease in throughput by increasing the speed.

Following the same scenario as in the case of fixed nodes, we vary the speed from 1m / s to 50 m / s. By observing the Figure 6, we notice that AODV present minimum cost in terms of expected end-to-end delay (EED).

Figure 7 schows that AODV protocol maintains the same average loss rate for different speeds. the packet loss of AODV routing protocol was found less but for elevated node speeds, the packet loss increased. This may be due to the fact that, normally in the AODV, there are not many packets in the buffer that should wait for the transmission on the route but the loss rate of the packet are increase with the increase of speed because they were sent on the old routes.

5. Conclusion

In this paper, the focus has been put on a realistic comparison of three routing protocols DSDV,AODV and DSR in the context of wireless sensors networks. The significant observation is, simulation results agree with expected results based on theoretical analysis. As expected, reactive routing protocol AODV performance is the best considering its ability to maintain connection by periodic exchange of information, which is required for UDP, based traffic. AODV performs predictably.

It delivered virtually all packets at low node mobility, and failing to converge as node mobility increases. Meanwhile DSR was very good at all mobility rates and movement speeds and DSDV performs almost as well as DSR, but still requires the transmission of many routing overhead packets. At higher rates of node mobility it's actually more expensive than DSR.

References

[1] JAdjih, C., Baccelli, E. et Jacquet, P. (2003). *Link state routing in wireless ad-hoc networks*. Military Communications Conference, MILCOM. IEEE.

[2] Nejah, N. (2011). New approach for wireless underwater identification: acoustic frequency identification (Afid), 8th International Multi-Conference on Systems, Signals and Devices (SSD), IEEE.

[3] Kamal Beydoun. (2009). *Conception d'un protocole de routage hierarchique pour les réseaux de capteurs sans fil*, L'U.F.R des sciences et techniques de l'université de FRANCHE-COMTE.

[4] Jamal N. Al-Karaki, Ahmed E. Kamal.*Routing Techniques in Wireless Sensor Networks: A Survey*, Dept. of Electrical and Computer Engineering Iowa State University, Ames, Iowa

[5] Vivek Kumar. (2009). *Simulation and comparison of AODV and DSR routing protocols in MANETs*, Master of Engineering, Computer Science And Engineering Department Thapar University.

[6] Vivek Kumar. (2010). *simulation and comparison of AODV and DSR routing protocols in MANETs*, Master of Engineering, computer science and engineering thapr universitypatalia147004, juillet.

[7] Mounira OULARBI, Soraya KASSAB. (2010). élaboration d'un protocole de routage efficace en énergie pour les réseaux de capteurs sans fil.

[8] Sedrati Maamar, Aouragh Lamia, Guettala Leila, Bilami Azeddine. (2007). *Etude des Performances des Protocoles de Routage dans les Réseaux Mobiles Ad-Hoc,* 4th International Conférence on Computer Integrated Manufacturing CIP', Département d'informatique, Faculté des sciences de l'ingénieur, Université El Hadj Lakhdar - Batna.

[9] Vijay Raghunathan, Curt Schurgers, Sung Park, Mani B. Srivastava. (2002). *Energy-aware wireless microsensor networks*. *IEEE Signal Processing Magazine,* 19 (2) 40-50, March, 2, 13, 14, 22.

[10] Ya Xu, John Heidemann, Deborah Estrin. (2001).*Geography-informed energy conservation for ad hoc routing*. *In*: Proceedings of the 7th annual international conference on MobileComputing and networking (MobiCom'01), p.70_84, New York, NY, USA, ACM. 13

[11] Zonoozi, M., Dassanayake, *P.* (1997).*User mobility modeling and characterization of mobility patterns. IEEE Journal on Selected Areas in Communications,* 15 (7) September.