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FLOODING AND DIRECTED DIFFUSION PROTOCOL FOR WIRELESS SENSOR NETWORK

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Abstract — Wireless sensor network consist of thousand nodes which has a capabilities of computation, sensing an event and forwarding a packet. Most of nodes losses their energy during communication (when they are forwarding packets and receiving packets). Energy consumption is main concern of wireless sensor network, so by reducing the average energy required during communication by nodes, we can maximize lifetime of that particular network. There are many applications which require fast communication between nodes hence they require minimum delay between them.

Keywords: Flooding, Direct Diffusion, Comparison, Energy efficient

I. INTRODUCTION

To find out which protocol performs better (gives good result under certain circumstances), Here we have done a comparison between the network that implements flooding protocol and the network that implements directed diffusion protocol [1] based on factors (I) Average energy consumption during communication in the network, (II) Average e2e-delay (end to end delay) between source and destination (III) Lifetime of network implementing that protocol.

Objectives:

a) To analyze and simulate network that implements flooding protocol.
b) To analyze and simulate network that implements directed diffusion protocol.
c) A comparison is being performed between them on factor like average energy consumption in network by nodes, average e2e-delay (end to end), and life time of the network implementing that protocol

II. BACKGROUND

2.1 Overview of Flooding Protocol

In flooding source node sends packets to every other (neighbor) node. Network that implements flooding scheme containing all node have same characteristic. Every node in the network receives packets, makes many duplicate copies of those packets, then it forward these packets to all their neighbors (all paths) except from which neighbor (path) it came to that node. This procedure continuously a repeat until packet delivered to the destination node.It provides guarantee that packet reaches to the destination by forwarding a packet to every other node. By receiving and forwarding packets to every other node in the network it consumes high energy. Flooding technique has many disadvantages but it is used in case of we don’t know the structure of the network (Information not available).

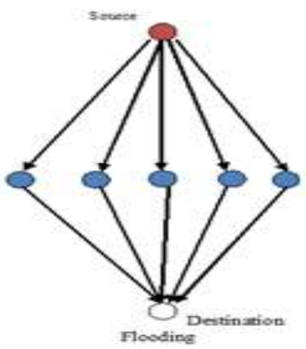

Figure-2.1 Flooding Protocol

2.1 Overview of Directed Diffusion Protocol

A Directed-Diffusion [1] is on demand and reactive protocol. It consists of data message, interest, reinforcement and gradient. Here sink node initiate interaction of message by sending an interest to its neighbor for a particular data. Here Data and interest are in the form of attribute-value form. A neighbor node who receives an interest from its neighbor, checks its cache whether it has already receive that particular interest or not if node does not find an entry for that interest in its cache, then it create a new entry in the cache. By using cache a node may control interest propagation. An interest receiving neighbor node, then draw a gradient toward sink node with specified data rate.

If a node has a data to send for particular interest, it sends via gradient toward the sink node. An Intermediate node who receives a data packet, checks whether its cache contain an interest matching that data packet. If that node doesn't contain entry, data packets are dropped otherwise a node checks a data cache, if a node contain data cache entry for that data packet, the data packets are dropped otherwise it sends to its neighbor nodes and it added to data cache. Better path is achieved using positive reinforcement if there is a multiple path is available from source node to sink node. By using Negative reinforcement we can remove loop in network and it also remove costly paths in terms of resources. Reinforcement also provide local repair of path in case of failure.

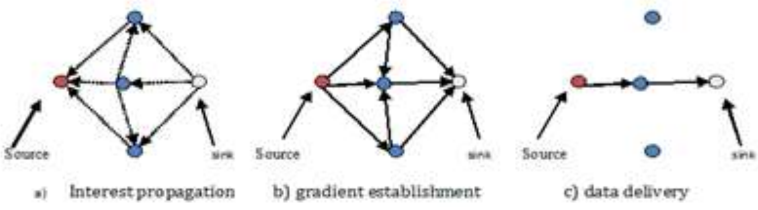

Figure-2.2 Directed Diffusion Protocol

III. OVERVIEW AND RESULT OF SIMULATION NETWORK

3.1 Overview of Simulation Network that implements flooding protocol

Simulation of network is performed over 10/15/20/25 nodes with simulation time 7/25s, each node having energy 1 joule. Here topology for flooding is random. In this case Source node start flooding the packet in the network and receiving node imitate a source node after receiving a packet until packet delivered to the destination node. A table shown below is represent network parameter.

Table -3.1 Network Parameter Definitions and their values

Parameter	**Flooding Protocol**	**Directed-Diffusion**
Radio model	Two Ray Ground (1.559e-11)	Two Ray Ground (1.559e-11)
Channel type	Channel/Wireless Channel	Channel/Wireless Channel
Ifq	Queue/Drop Tail/PriQueue	Queue/Drop Tail/PriQueue
ifqlen	50	50
Netif	Phy/WirelessPhy	Phy/WirelessPhy
macprotocol	Mac/802_11	Mac/802_11
No of nodes	10/15/20/25	10/15/20/25
Grid size	1000*1000	1000*1000
Topology	Random	Random
Simulation time	7/25 seconds	7/25 seconds
Initial energy	1 joule	1 joule
Packet size	64	64
Transmission range	250 m	250 m
Routing protocol	Flooding	Directed Diffusion

To check connectivity between nodes, I have used NSG2.1 tools. In case of 10 nodes the node placements are shown below.

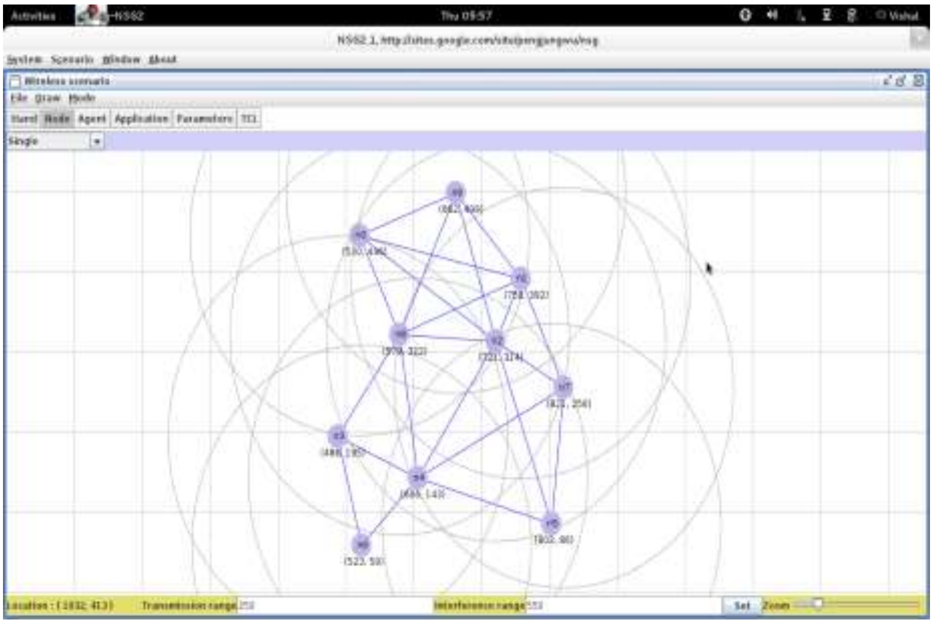

Figure-3.1.1 A graphical overview of node placement (10 nodes)

Here we have used an energy model, which helps to represent an energy change in nodes during their communications. As the simulation time increases a nodes is going to lose their energy this is showing in simulation by changing the color of nodes. The following snapshots represent a simulation of network (flooding) after time of 7s.

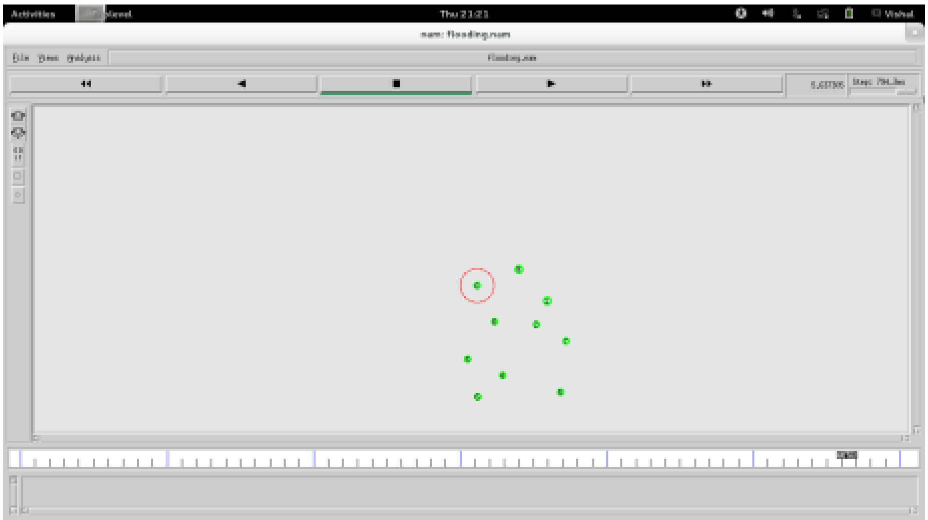

Figure-3.1.2 Simulation of flooding after 7s (10 nodes)

By repeating cycles of receiving and forwarding packet, nodes of the network continuously loses their energy, so after fix simulation time all nodes in the network loses their energy and network is going to collapse. In this case for 10 nodes lifetime of flooding protocol is 14.13 seconds. This is shown in following figure. In this Figure red color nodes represents as a dead nodes. Yellow color nodes represents as a nodes who losses their most of energy during communication.

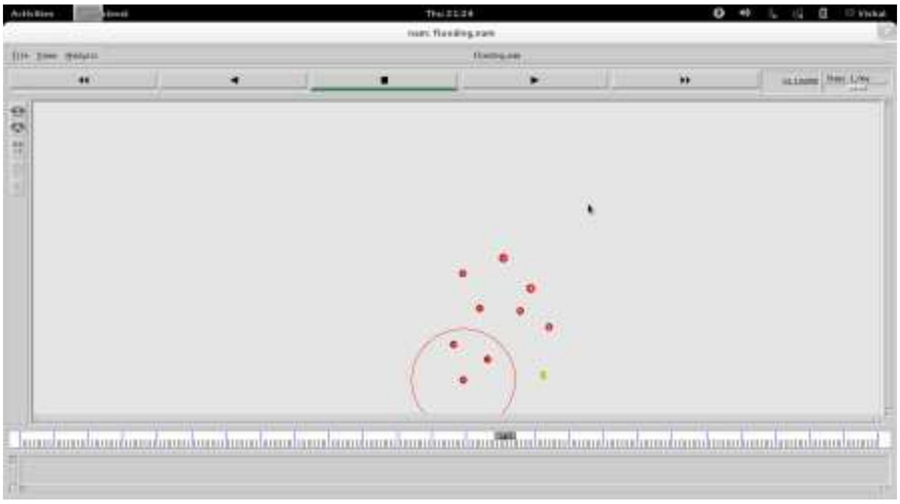

Figure-3.1.3 Lifetime of flooding protocol for 10 nodes

Result of Simulation of Network that implements flooding protocol

Table -3.1 Values obtains in Energy consumption and e2e-delay (end to end) parameters after 7 s of simulation while in case of Lifetime Parameter value obtains in 25 s of simulation

No of Nodes	Average Energy consumption (Joule)	Average End to end delay(Millisecond)(between source and destination)	Lifetime (Second)
10	0.336351	288.698	14.13
15	0.289127	316.84	12.29
20	0.447315	348.402	10.12
25	0.472635	361.385	9.87

To find average e2e-delay (end to end) here we have use a node 6 as a source node and node 3 as a destination node (sink node).

3.2 Overview of Simulation Network that implements directed diffusion protocol.

Simulation of network is performed over 10/15/20/25 nodes with simulation time 7/25s, each node having energy 1 joule. Here topology for directed diffusion is random. To make a fair comparison between this two protocol (flooding and directed diffusion [1]) I have used multiple sink nodes in directed diffusion. Here we have used a same node placement which has been used in flooding by using NSG2.1 tool for different number of nodes (10/15/20/25).

The following snapshot shows a simulation of network (Directed Diffusion) after 7s. (For 10 nodes)

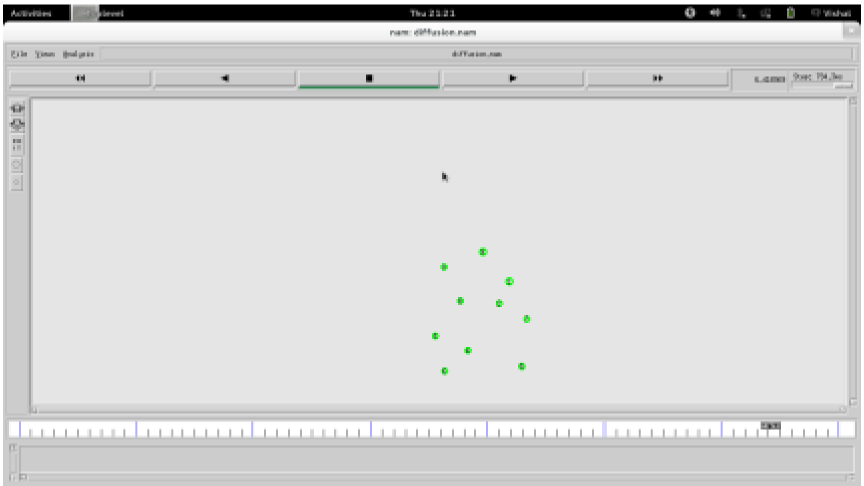

Figure-3.2.1 Simulation of direct diffusion after 7s (10 nodes)

The following snapshot shows a lifetime of directed diffusion. (10 nodes)

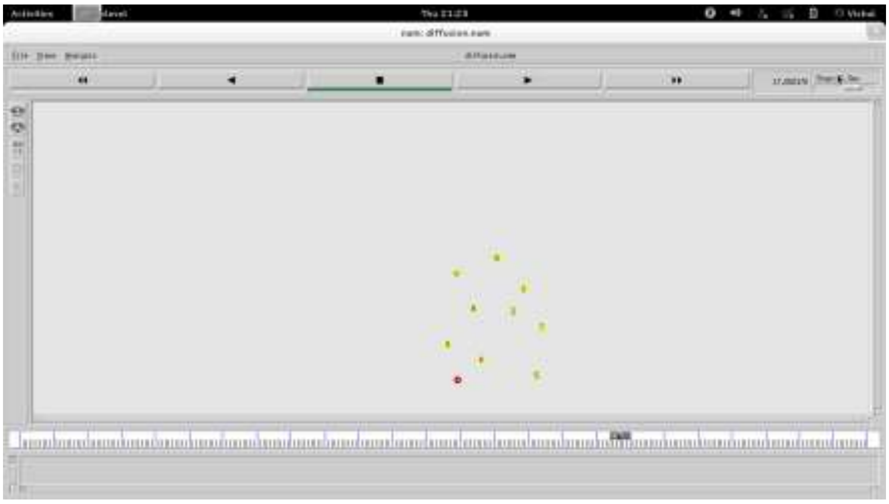

Figure-3.2.2 Lifetime of directed diffusion protocol for 10 nodes

A lifetime of directed diffusion protocol for 10 nodes is 17.68 s.

Result of Simulation of Network that implements Directed Diffusion protocol

Table-3.2 Values obtains in Energy consumption and e2e-delay (end to end) parameters after 7 s of simulation while in case of Lifetime Parameter value obtains in 25 s of simulation.

No of Nodes	Average Energy consumption (Joule)	Average End to end delay(Millisecond)(between source and destination)	Lifetime (Second)
10	0.236587	262.597	17.68
15	0.205076	247.029	15.98
20	0.37408	294.571	12.99
25	0.369136	341.24	12.69

To find average e2e-delay (end to end) here we have use a node 6 as a source node and node 3 as a destination node (sink node). To make a fair comparison between this two protocol (flooding and directed diffusion) we have used multiple sink nodes in directed diffusion.

IV. COMPARISON BETWEEN FLOODING AND DIRECTED DIFFUSION PROTOCOL

4.1 Comparison based on average energy consumption

Table- 4.1 comparison between flooding and directed diffusion based on average energy consumption, Values obtains after 7s of simulation

No of Nodes	Flooding(joule)	Directed Diffusion(joule)
10	0.336351	0.236587
15	0.289127	0.205076
20	0.447315	0.37408
25	0.472635	0.369136

The following snapshot represents a graphical comparison of energy consumption between these two protocols. In this graph x- axis shows no of nodes while y-axis shows energy consumption. A red line is for flooding protocol while a green line is for directed diffusion protocol.

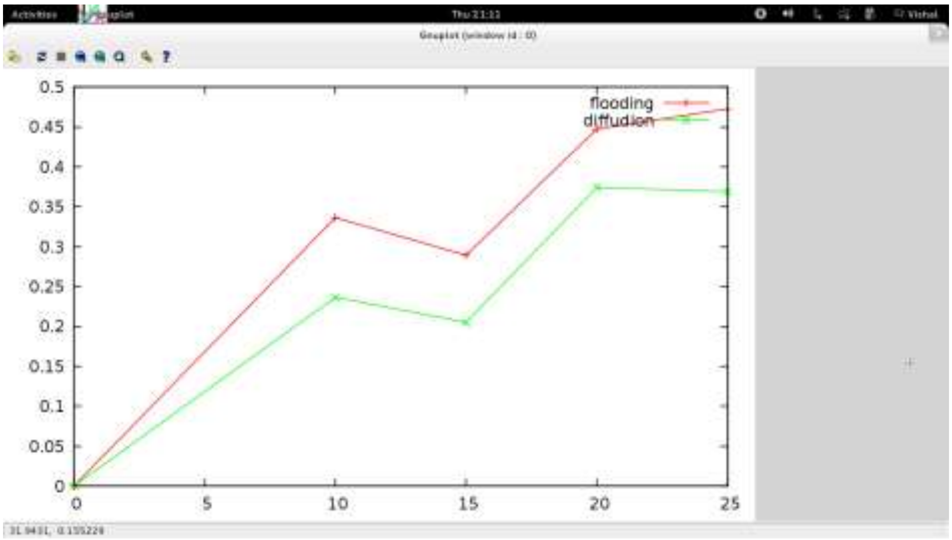

Figure-4.1 Comparison between flooding and Directed diffusion protocol based on energy consumption

Energy consumption graph between flooding and directed diffusion with different no of nodes as a parameter (10/15/20/25) using value obtains after 7 s of simulation. From graph and table provided above we can clearly say that energy consumption in Directed- Diffusion is lower than Flooding protocol. We see such kind of result because the directed diffusion protocol is an on demand, reactive protocol and no need to maintain global topology.

4.2 Comparison Based on Average e2e-delay (end to end)

Table-4.2: comparison between flooding and directed diffusion based on average e2e-delay (end to end), Values obtains after 7 s of simulation.

No of Nodes	Flooding(millisecond)	Directed Diffusion(ms)
10	288.698	262.597
15	316.84	247.029
20	348.402	294.571
25	361.385	341.24

The following snapshots represent the graphical comparison of averagee2e-delay (end to end) (between sources to destination) between flooding and directed diffusion protocol. In this graph x- axis shows no of nodes while y-axis shows average e2e-delay (end to end).

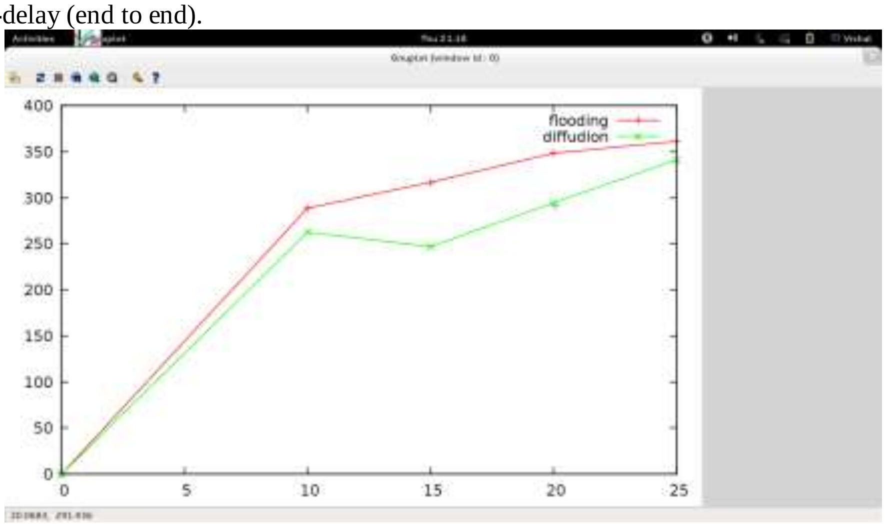

Figure-4.2 Comparison between flooding and Directed diffusion protocol based on e2e delay

Average e2e-delay (end to end) graph (for flooding and directed diffusion) with different no of nodes as a parameter (10/15/20/25) (between source and destination) using value obtains after 7 s of simulation. To make a fair comparison here I have used multiple sink nodes in directed diffusion. From the result of table and graph provide above we can say that an e2e- delay in directed diffusion protocol is better than flooding protocol. We see such kind of result because directed diffusion protocol uses reinforcement (positive and negative) technique to find out lower delay path amongst all available paths. Average e2e-delay (end to end) depends on many factors like placements of nodes, traffic between them, how many neighbors they have, etc. There might be a case where average e2e-delay (end to end) is better in flooding. This case is possible when the nodes in the directed diffusion protocol losses their energy and may not be able to send an event on lower delay path.

4.3 Comparison based on lifetime of the protocol

Table - 4.3 comparison between flooding and directed diffusion based on Lifetime of network

No of Nodes	Flooding(second)	Directed Diffusion(s)
10	14.13	17.68
15	12.29	15.98
20	10.12	12.99
25	9.87	12.69

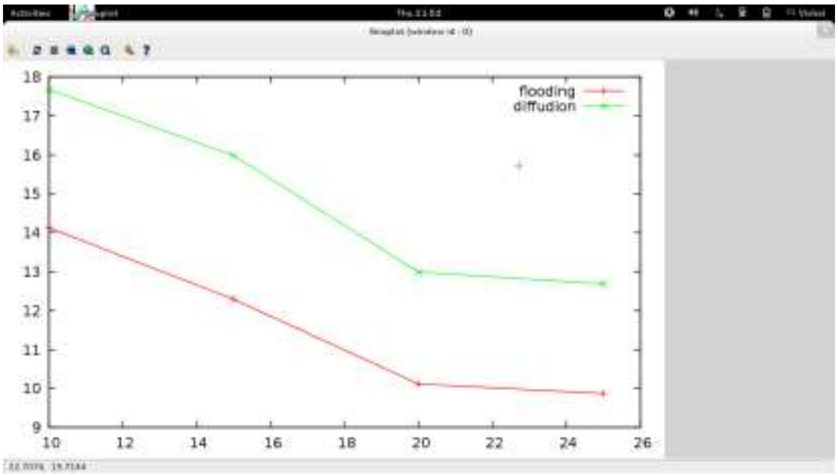

Figure-4.3 Comparison between flooding and Directed diffusion protocol based lifetime of their networks

From the above table and graph we can clearly say that lifetime of network implementing directed diffusion is higher than network implementing flooding protocol.

V. CONCLUSION

The objective listed above has been carried out properly. In this case I have compare two protocols (flooding and directed diffusion) based on common factor like average energy consumption, average e2e-delay (end to end) and life-time of the network implementing this protocol. From the result of the above four scenarios we can conclude that average energy consumption in directed diffusion is less than flooding protocol, average e2e-delay(end to end) is also better in the case of directed diffusion, and Life time of network implementing a directed diffusion protocol is much better than lifetime of network implementing a flooding protocol.

So from above results we can say that directed diffusion protocol perform better than flooding protocol. We see such kind of result because the directed diffusion protocol is an on demand protocol and no need to maintain global topology. Here we have assumed that each node do data aggregation, sensing and caching (data and interest) in case of directed Diffusion protocol.

There might be a case (under some circumstances) where flooding protocol perform better than Directed Diffusion protocol which is not considered here.

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