Effect of Packet Size on Energy Consumption in Wireless Mesh Network

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***Abstract*—** Wireless mesh network(WMN) can be seen as promising technology in future access wireless netwok. Energy consumtion of WMN can represent significant portion of energy consumtion of Internet as a whole. This paper aims at highligting energy consumtion concern of WMN in perceptive of packet size in qualnet. Netwok wide energy consumption has been analysed.

***Keywords*—** Wireless mesh network; Energy Efficinecy; Packet Size; Delay

I. INTRODUCTION

Energy utilization is growing at an exponential rate with intense expansion in the number of access devices. Efficient management for wireless networks from a perspective of conservation of energy for operating and environmental reasons has begun to get attention. There is a need of the way networks are built and operated so that performance as well as energy consumption can be taken into account. The resources of wireless communication systems are not uniformly distributed in time and spatiality dimension, only a few percentage of the installed capacity of the Network Resources is effectively used and this result in high energy waste [1, 2]. Significant additional energy savings may result by incorporating appropriate mechanism for routing traffic from source to destination with effective utilization of network resources into the design of network protocols used for data communication.

Wireless Mesh Networks (WMNs) are considered as the most suitable architecture for providing services in mobile networks. Hence, Energy aware routing protocol in Wireless Mesh Network is desirable. The focus of this work is to introduce intelligence into the communication network by employing energy efficiency in different algorithms. It is proposed to develop better routing techniques for efficiency in terms of energy while retaining the satisfactory user experience on access segment and wireless backhaul links.

The paper is formulated into six sections. Section-II describe related area of study. Section-III presents related architecture of WMN and section and IV highlights importance of packet size in wireless mesh network. Results and discussion are given in section-V. Delay constrains has been taken as quality of service measure. And section-VI provides a conclusion.

II. RELATED STUDY

Number of studies have found in literature in energy consumption analysis of wireless mesh network. Approaches ranges from minimizing energy consumption of standalone

TABLE I. IMPACT OF PACKET SIZE ON ENERGY CONSUMPTION

Energy aware routing metrics	**Approach**	**Comments**
Minimum Power Total Routing [3]	Centralized and distributed manner	Choosing path Minimize energy per Packet from source to designation
Minimum battery cost routing (MBCR)[4]	hybrid evolutionary algorithms	The battery of the client will be exhausted quickly falling over minimum energy route via a specific client, Network may be partitioned. The total energy eating of whole network is reduced.
Min-Max Battery Cost Routing [5]	Multi-objective routing optimization approach	Pass up the route with nodes having the slightest battery power between every node in all probable routes. But there is no guarantee that minimum total transmission energy paths will be achieved in all cases.
hop-counts and Minimum battery cost [6]	Routing metric proposed	Energy consumption of every node is taken into account. Energy utilization is uniformly distributed

nodes to overall energy minimization of whole network. Few are depicted in table 1 as below. Control on packet size is slightly addressed in WMN literature.

III. WIRLESS MESH NETWORK ARCHITECURE

WMN has emerged from ad-hoc network. Hybrid WMN architecture can be divided into two parts. Backhaul network architecture is demonstrated in fig 1. Logically WMN consists of three kind of nodes wireless mesh router (MR), Wireless mesh access points (WAP) and gateway nodes. Gateway nodes are special nodes to act as bridge between

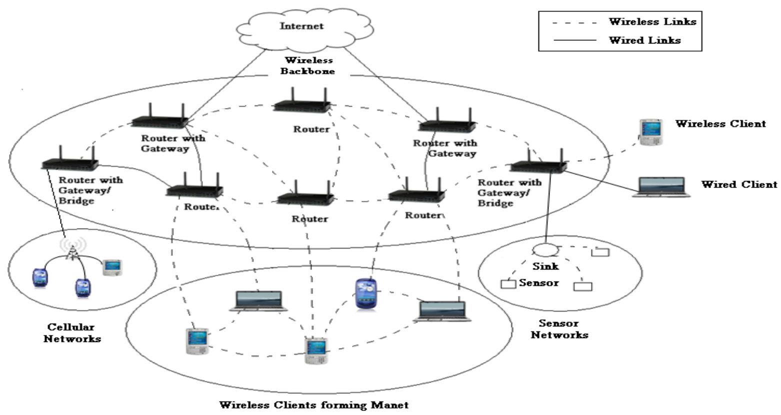

Fig. 1 Hybrid Wireless Mesh Network Architecture [3]

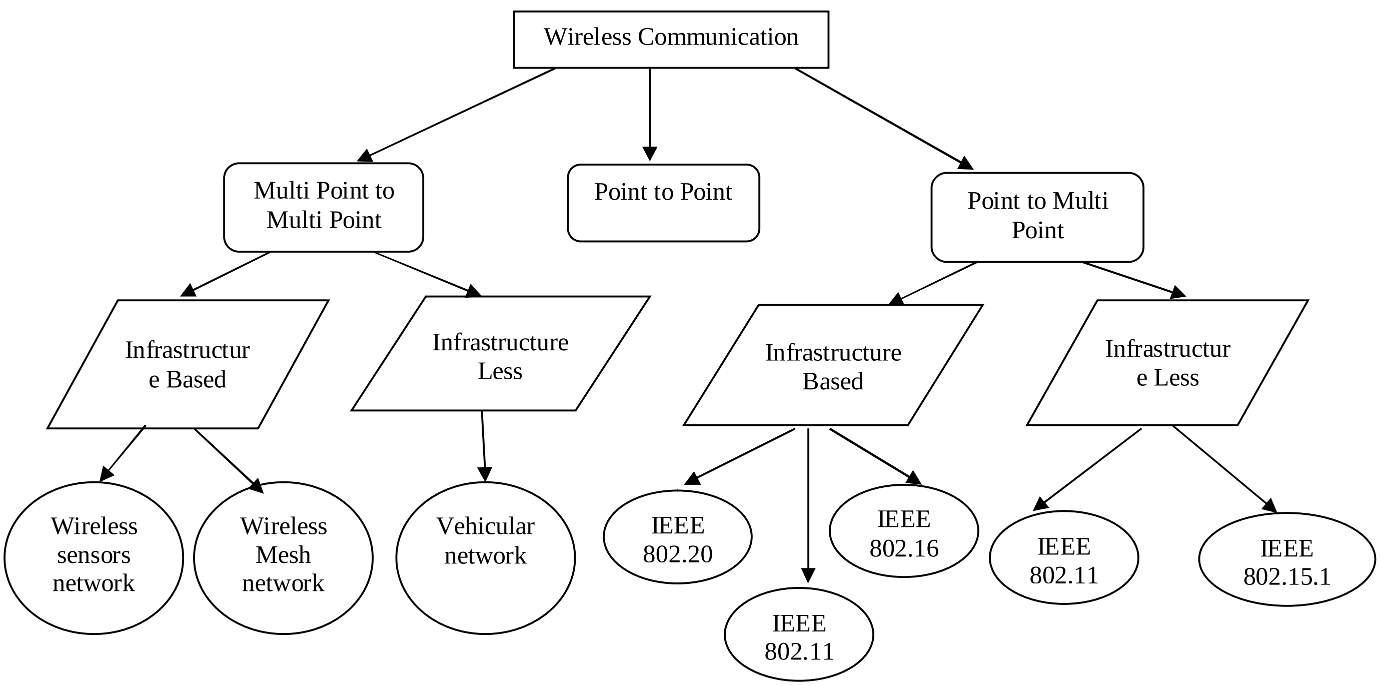

Fig 2.Classification of wireless communication

WMN and outer network. Outdoor traffic flow is to and from gateway nodes. For indoor traffic any client nodes can be source or destination. Request from client nodes are forwarded via WAP. Which in turn route traffic to destination nodes over multi-hop communication by using mesh router or WAP. A mesh router is a node with only routing functionality. They do not have any data traffic of their own and assist in routing traffic of other mesh nodes in backhaul network. WAP receive and route all the requests of client node under its coverage area to destination nodes. Client nodes form the access part. Due to battery size constraint client nodes have limited energy resource, similar in rural area or defense region energy supply for mesh nodes may be limited. WMN is self organizing, self configuring, low deployment cost, more reliable, scalable, interoperability, self-healing, etc. It is becoming favorite option among network operators. In this scenario it's very important to analyze parameters impacting energy efficiency of WMN.

Fig. 2 represents WMN as multi to multi point communication network. Point-to-point link requires sender and receivers to in tightly beamed line of sight communication. Point to multi point communication assumes a central entity like base station to which multiple client nodes can initiate communication in parallel. Multi point-to-multi point communication network are extension of point to multi point to give WMN.

WMN had been evaluated from single to multi radio. Single radio WMN are less complex and economic. But it comes with price of degraded quality of service. Nodes at client and backhaul part shares common radio depicted in fig 3. With increasing nodes or traffic performance of network decrease exponentially. WMN Access point (AP) for single radio are less complex and are commonly cheaper to successive WMN generations. As 2.4 GHZ is a better choice for local wireless network, this band is more popular among computer equipments. Hence due to single radio nature of first generation WMN spectrum choice is bounded by 802.11b/g. Due to economic benefits this may be good option for rural area. With Multi Radio WMN shortcomings of previous generation have been resolved. Separate radios for client and

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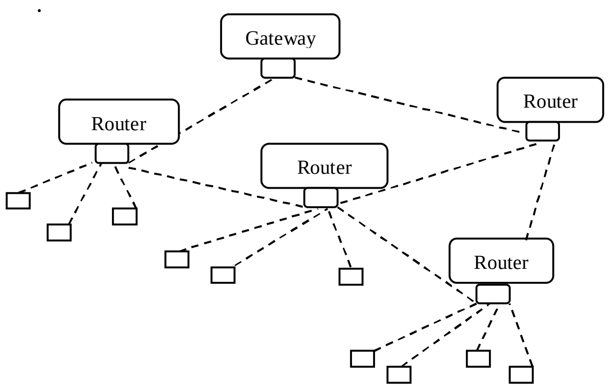

Fig 3. First Generation WMN

backhaul have been introduced as in fig. 4. Hence communication over two doesn't interfere with each other. Nodes at backhaul part can operate over one or more radios. With single radio at backhaul due to congestion around gateway nodes performance degrades, this is improved with introduction of multi radios for example with two radios one can be used for downlink and another for uplink communication at backhaul. But performance enhancement comes with price of hardware cost of multi radio AP.

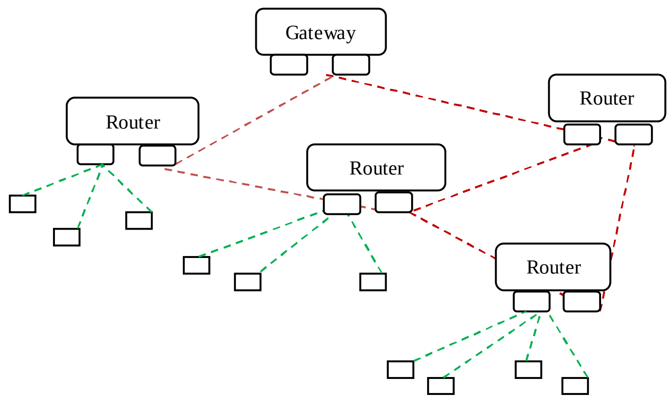

Fig 4. Second Generation of WMN

IV. PACKET SIZE

In wireless network packet is composition of data payload and packet header as demonstrated in fig 5. Higher data payload is attractive in sense that it consists of ultimately wanted information by end recipient. Header consists of sender, destination node id, error control information, packet total length, packet header length, version, time to live, checksum etc. Header is assumed as overhead part called supplemental data. Higher ratio of payload to header size is desirable. Packets with large packet size are less likely to be received by end user in error prone area. So, frequent retransmission is required, resulting in wastage of resources. While packets with small size are have likely higher success rate of successful reception. But higher no of small packets is required for sending same data payload. Energy resources are not utilized efficiently. There exists a balance between packet size and environment conditions, at which resources are utilized at their optimization level with better quality of service. Keeping this in view an experiment has been performed as detailed in next section.

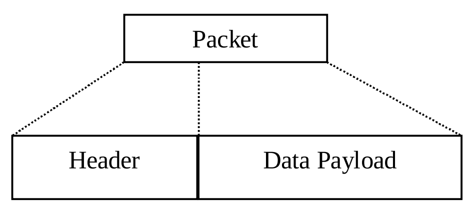

Fig 5. Packet Structure

V. RESULTS AND DISCUSSION

In the study, an experiment has been setup in NS3 to capture the effect of packet size on energy consumption and Quality of Service parameters i.e. average delay and no. of received packets. The WMN communication based on 802.11b with AODV routing protocol and 1 Mbps data rate were analyzed. Values of various parameters recorded during the simulation study are tabulated in Table-II. Following observations has been recorded.

TABLE II. IMPACT OF PACKET SIZE ON ENERGY CONSUMPTION

S. No	Packet Size (Bytes)	Energy Consumed (Joules)	Average Delay (Seconds)	Total no. of Packets Transferred	% of Received Packets	No of Bytes Transferred	Energy Consumed per Byte (Joules)
1.	512	0.49554	2.32278	100	90	51200	9.67851563 *10 -6
2.	1024	0.61460	3.10296	100	83	102400	6.00195313* 10 -6
3.	2048	0.79543	4.86854	100	66	204800	3.88393555* 10 -6

It is observed that energy consumption per bit decreases with increases in packet size, but simultaneously increases average delay and decreases percentage of received packet. This implies that size of packet impacts the energy consumption as well as quality of service. Hence, technique must be designed to decreases energy consumption while maintaining the same quality of services. From this preliminary study, it is felt that the no. of factors can effect energy consumption of WMNs and strengthens the motivation that an energy efficient routing mechanism in WMNs needs to be explored.

VI. CONCLUSION

Number of factors can impact energy consumption in WMN; packet size is one of them. A balance between packet header and payload information to be strike out. Optimal packet size under given traffic condition needs to be configured out in WMN energy saving perceptive.

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