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ANALYSIS OF WIRELESS MESH NETWORKS USING ROUTING AND SCHEDULING TECHNIQUES

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ABSTRACT

This paper represents the data rate allocation algorithms provide the average data rates at which the source must transmit data. They do not determine scheduling on a time slot basis. To address that, we consider transmission scheduling in wireless networks. We also compare the suggested algorithm with a centralized optimal data rate allocation algorithm to verify that our algorithm follows the optimal solution. Through simulations, we show that fairness provisioning leads to higher network performance. We show that the suggested algorithm outperforms the current algorithms in the literature in terms of both network throughput and fairness provisioning.

Wireless networks over the year have undergone huge technological advancements. Due to integration of all three types of services viz. voice, data, video, during improvement in wireless technologies, bandwidth has become the most crucial network resource that needs to be optimized for these bandwidth hungry services. In multi hop scenarios (in WMNs), performance depends on the routing protocol to properly choose routes, given the current network conditions. To efficiently optimize these wireless networks, efficient routing and scheduling techniques needs to be incorporated to improve Quality of Service (QoS). Routing and scheduling techniques have been analyzed. Different techniques in various technologies are discussed to improve network performance.

KEYWORDS: Wireless Mesh networks, Quality of services, Network Algorithms.

I. INTRODUCTION

Wireless Mess Networks are self-configured and self-organized in a dynamic manner, automatically establishing an ad-hoc network with the nodes in the network and also maintains connectivity in the mesh. Mesh routers and mesh clients are the type of nodes which comprises WMNs [1]. Because of multi-hop communications, a mesh router achieves more of the coverage with transmission power which is much lower. Multiple / many wireless interfaces which are made using the different access technologies or the same, is provided to a mesh router in order to improve the tractability of networking in mesh. Because of the minimal mobility, mesh routers constitute mesh backbone which is needed by the mesh clients. Though the mesh clients for mesh networking can also act as a router, simple and easy platform either software or hardware is needed for mesh clients than that for mesh routers. The advantages offered by WMNs are easy network maintenance, low up-front cost, reliable service coverage, robustness, etc. Mesh router's function of behaving as bridge / gateway results in desegregation of WMNs with many other type of networks. Mesh routers are also responsible for networking in a mesh amidst mesh clients and mesh routers [1]. Wireless Network Interface Cards (NICs) are used by the established nodes to get connected to MWNs in a direct manner though wireless mesh routers.

WMNs have undergone and are also undergoing rapid commercialization in many other application scenarios such as community networking, metropolitan high speed area networks, building automation, enterprise networking and broadband home networking. However, significant efforts in research are still required, for WMNs to be all it can be. For example, scalability is the issue in the present routing and MAC protocols; increase in number of nodes or hops in WMNs results in lowering of throughout [1]. Thus, the protocols which are presently available necessitate be reinventing or enhancing in case of WMNs. In order to improve networking in WMNs, protocols' design of present wireless networks are being revisited by the researchers and same is the case with wireless sensor, ad-hoc and especially of IEEE 802.11 networks. WMNs's new specifications are currently under discussion by IEEE 802.15, IEEE 802.11, IEEE 802.16 which are the industrial standard groups.

II. MATERIALS AND METHODS

Load Balancing Algorithm for WMN

The Cluster Header Load Balancing (CHLB) algorithm has been proposed to ensure the QoS for different streams of data through the design of cross-layer to achieve the balance in load without fetching extra heavy load [2].

In this CHLB algorithm data flows are classified into different priorities and channel for data streams is selected [2]. For channel selection a function is used for weight evaluation given all the information of QoS in the intermediate nodes next to a node, of the all allowable channels, as each of the data stream has its own requirements for QoS such as delay, (BER). Bit Error Rate, delayed. The actual flows' current value and the largest allowable links flow value are used to calculate the coefficient for load balance which in turn helps in the Periodical Load Balancing Lesser point-to-pint delay (average) and high throughput are the advantages provided by this algorithm. This has been shown by the simulation results that the proposed algorithm can give effective results of the load-balancing and has remarkably improved the performance of the WMNs.

Routing Algorithm for Inter-Cluster Load Balancing (RAILoB)

In order to improve the performance of traffic RAILoB has been set out in WMNs. This algorithm provides migration of traffic without the requirement of migration of the mesh route [3]. The scheme of clustering comprises additional two elements which are the boundary and the relay node other than the mesh router and the gateway. For the clusters which are heavily loaded the out points are the relay nodes, while for the clusters which are lightly loaded the connection points are the boundary nodes [3].

In the RAILoB algorithm for the migration of traffic two sub-paths comprises the full path. In the two sub-paths the relay node and the selected node has a path between them called as intra-path whereas the lighter gateway and the relay node has a path between them called as the inter-path found by using Dijkstra algorithm [3].As the relay and boundary nodes are in transmission range of each other, information exchange with the adjacent clusters mesh routes is allowed by the boundary and the relay and boundary nodes. So accordingly the boundary node and the relay node carries the traffic of the node which is loaded heavily in a cluster and send this traffic in a clusters' gateway which is lightly loaded as shown in figure 1.

Analysis of the RAILoB performance has been done varying gateway number and the results proved the improvement in performance of traffic in WMNs with multiple gateways when RAILoB mechanism is used for balancing the load.

Architecture and Algorithm for an IEEE 802.11 Based Multi-Channel Wireless Mesh Network

Using just a single/one channel networks which are multi hop use only a single, these type of networks does not often fully used the total available bandwidth in the radio range/spectrum. For the improvement of performance of a network usage of mesh networks which are multi radio as well as multi-channel has been suggested as a solution. Architecture (named Hyacinth) of wireless mesh network (WMN) which is a multi- channel (5) equips each node of mesh network with several 802.11 Network Interface Cards (NICs).

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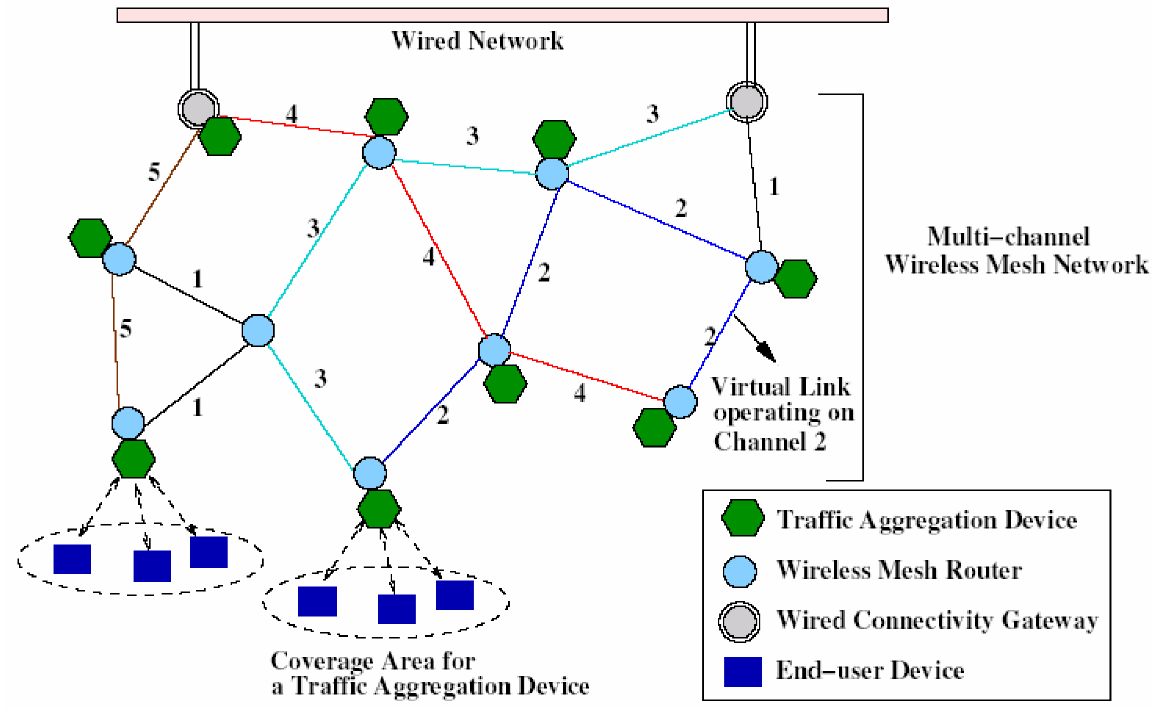

Figure 1. The Hyacinth Architecture

In this architecture core of multi-channel WMN is joined to a wired network with the help of connectivity of wired gateways set. Each node of a WMN has several interfaces where each interface operates at a different radio channel (5). Each node of A WMN is furnished with a device for aggregation of traffic (similar to an 802.11 access point) for its interaction with the each mobile station. The WMN which is multi channel relays aggregated data from traffic aggregated device of mobile station from/to the network which is a wired network. Over the channel for the denotation of direct communication there are links among nodes which is indicated on the link by the numbers on it. In the above example, two wireless NICs are equipped into each node. As a result no node can used the number of channels more the two simultaneously. As depicted in Fig 1 the network on the whole five different channels.

Assignment of a channel in the architecture of a multi-channel WMN is the central design issued. In case of a multichannel WMN the goal of assignment of channel is in a way that radio channel is bounded to each and every network interface such that for each link which is virtual the bandwidth which is available is proportional to the traffic/ load it required to carry. The important constraints that needs to b satisfied by an algorithm of channel assignment are

(a) The number of NICs in a WMN node binds the total number of distinct channels which can be allotted.
(b) Two nodes that require communicating directly with each other it is must to have at least one of the channel to be common.
(c) A radio channel's raw capacity is limited within a zone of interference.
(d) The number of radio channels which are non-overlapped is fixed.

So a proposition of distributed algorithm is made in which only load information of the local traffic to assign channels dynamically is utilized and also it has proved its better performance than centralized algorithm. With the mesh network having multi- channel there is a possibility that network throughout gets improved by a factor of 6 to 7 as compared to that of conventional mesh network having single channel.

In the above explained algorithm there is no prioritization of the service requests and also there is no scheduling involved using state information of dynamic link so that network resources get optimally utilized in WMN.

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Differentiated Queuing Service (DQS) Scheduling Algorithm

Wireless Networks and effective and efficient Algorithms for Scheduling in order to maximize throughput of the network.

For rendering services at different levels in networks there are two paths mentioned as data and control path in. Mechanisms of data path render different services by classification and mapping of packets of user to destined class of service and also control the networks resources' usage that each class of service can have. Mechanisms of control path allow network and users to agree on definitions of service identification of users intended for the service given and appropriate allocation of network resources to each service. Mechanisms of data path critical providing QoS to application as they mention what action need to be taken on the packet of data such as to satisfy some service level.

Bandwidth and buffer are the two significant network resources. Algorithms for scheduling and for management of buffer are mechanisms for management of the mentioned resources. Algorithms for scheduling determine the next data packet to be transmitted and which packet to be kept in buffer is decided by mechanism of buffer management, both are used jointly.

For wireless networks many algorithms for scheduling have been proposed. "The distinctive ones are CSDSPS plus CBQ. The Earliest Deadline First (EDF) and the idealized Wireless Fair Queuing (IWFQ) etc. Channel state Dependent Packet Scheduling (CSDPS) and Class Based Queuing (CBQ) are combined in CSPDS plus CBQ, flows of traffic are sorted into different classes, and each of the class in devoted with a fixed bandwidth amount. To preserve high throughput, batter and fair wireless channels sharing this algorithm is used, but other issues of QoS for example guarantee of loss rate and delay limit are not resolved.

The characteristic which is common in the above mentioned algorithms for scheduling is that the granularity is based on per class or per flow such that the scheduler is aware of exact per flow or per-class requirements of QoS accordingly. The main reason for the problem of scalability is storing bulk of information in units of network for per-flow management and thus implementation will get complicated.

The most challenging issue for algorithms required for scheduling is supplying of granular QoS in WMNs for different applications. Mostly scheduling algorithms provide per-class or per flow QoS without counting on path lengths for applications based on end services. From alike applications, path length is the main consideration for a node to render end-to-end QoS.

To get rid of the above mentioned problem, a new algorithm for scheduling is proposed in called Differentiated Queuing Service (DQS) which provides cost effective end-to end QoS according to its requirements and applications end-to end state for example path lengths. However, originally DQS was proposed for the usage in wired networks. Here, it is improved for WMNs by usage of cross layer implementation, which attempts to utilize the routing operations' available information for the support of DQS algorithm for scheduling.

III. RESULTS AND DISCUSSION

Ns-2 is a discrete event simulator targeted at networking research. Ns provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless (local and satellite) networks Ns-2 an object oriented simulator, written in Matlab, with an OToI interpreter as a front-end. The simulator supports a class hierarchy in Matlab (also called the compiled hierarchy), and a similar class hierarchy within the OTcI interpreter (also called the interpreted hierarchy). Here NS-2 [8] has been used as the platform for simulation. Model for simulation which is adopted here for WMNs is originated by the CMU Monarch project which was for ad hoc networks.

The performance analysis was carried out using network simulator NS-2.34 version in a topology area of 500 x 500 m, with simulation time of 600 seconds.

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Table 1: Simulation Parameters

Simulator	NS-2.34
Area	500 x 500 m
No. of nodes	50
Simulation time	600 Sec.
Radio propagation model	Two – ray ground
Traffic type	CBR
Antennae type	Omni Antenna
MAC protocol	IEEE 802.11
Ad – hoc routing protocol	AODV for EDF, DSR with DBF for DQS
Transmission power	0.6 W
Receiving power	0.3 W
Channel type	Wireless channel
No. ofchannels	4
Buffer size	200
Loss factor	1.0

Comparison with EDF is done because of previously discussed similarities among DQS and EDF.

Performance metrics used here for evaluation of the two algorithms are following:
(1) Average throughput
(2) Packet delivery Ratio
(3) Average delay.

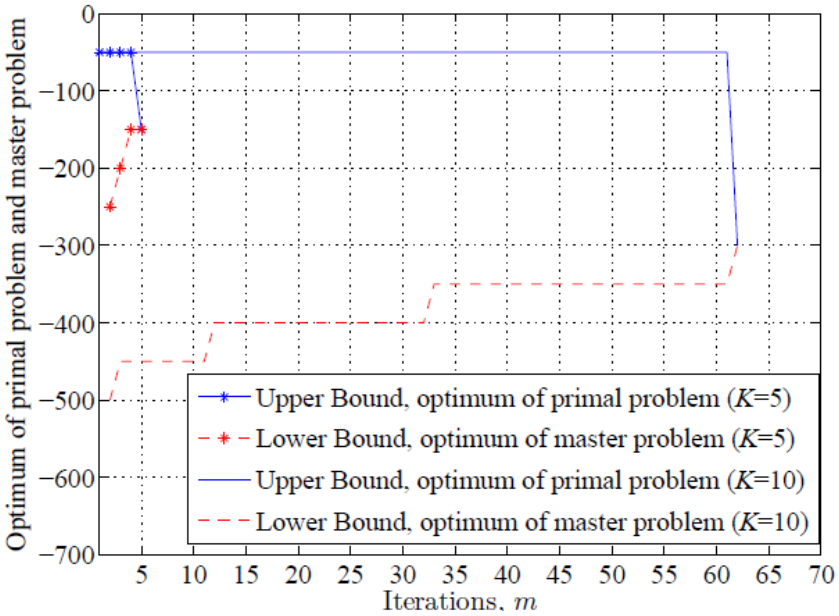

Figure 2. SIA algorithm is shown in one time slot when there are 5 and 10 users in the network.

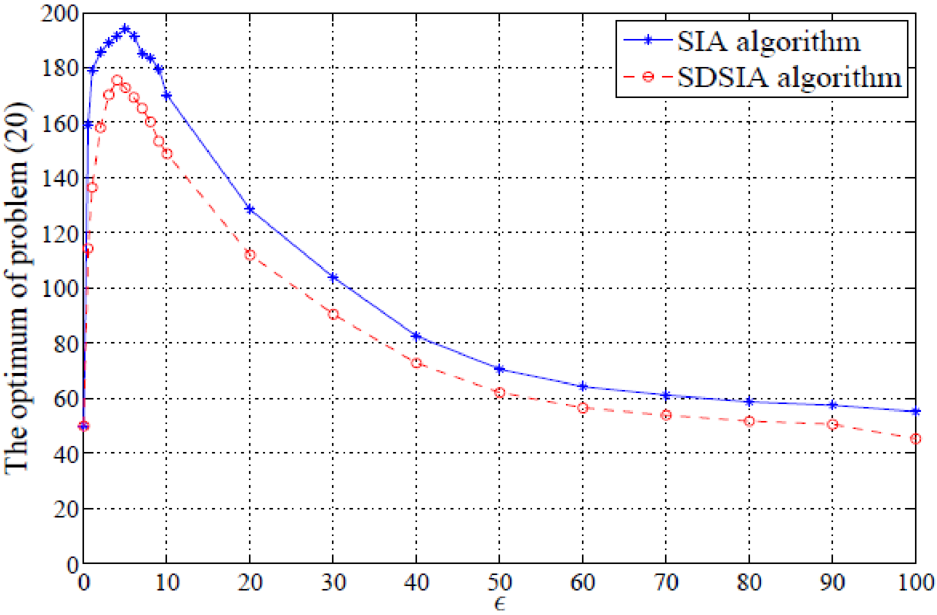

Figure 3. Optimum SIA Thresholds

IV. CONCLUSION

Future Wireless Networks (FWNs) are anticipated as a convergence of various kinds of technologies which are wireless, for example cellular technologies, Wireless Metropolitan Area Networks (WMANs), Wireless Local Area Networks (WLANs), Wireless Sensor Networks (WSNs), and conventional wired networks. Though the users will be unknown to the particular underlying network which is being utilized by the users' applications, the networks must be capable of providing the resource (hand/width) with assured Quality of Service (QoS). The users must be capable of moving smoothly among different technologies of networking, e.g., among Wi-MAX, Ethernet, 2G/3G/4G and WLANs, with rigorous requirements of QoS. As the hand width has become a critical network resource that needs to be optimized because of hand width hungry services that integrates voice, video and data, several techniques need to be developed.

So there is a requirement of efficient routing and scheduling techniques to utilize resources optimally. These efficient routing and scheduling techniques tend to reduce delay, packet loss and promote the efficient usage of bandwidth available. Thus efficient routing and scheduling techniques will provide an important solution to the future wireless networks.

The performance of the network is improved via network coding. An interesting future work is to use Lyapunov techniques to develop transmission scheduling and admission control algorithms in wireless networks in which intersession network coding is enabled. In such network settings, the weight of each wireless link for data transmission would depend not only on the data backlog of that particular link, but also on the backlog of the other link which is going to participate in the network coding scheme. This extra dependency creates new challenges to be solved.

V. REFERENCES

[1] I.F. Akyldiz, X. Wang, and Kiyon, "A Survey on Wireless Mesh Networks", IEEE Radio Communications, Vol. 43, pp. 523-530, September, 2005.
[2] J. Zhong, R. Hu, X. Zhu, "A Novel Load – balancing Algorithm for QoS Provisions Over 802-11s Wireless mesh Networks", WiCOM, pp. 1-4, 2010.
[3] V.C.M. Borges, E. Dimitrov, M. Cuardo and E. Monteiro, "RAILOR – A Routing Algorithm for Inter-cluster Load Balancing in Wireless Mesh Networks", IEEE Consumer Communications and Networking Conference, pp. 904-909, 2012.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

[4] V. Gabale, B. Raman, P. Dutta, and S. Kalyanraman, "A Classification Framework for Scheduling Algorithms in Wireless Mesh Networks", IEEE Communications Surveys and Tutorials, Vol. 15, No. 1, pp. 199-222, 2013.

[5] A Raniwala, T. Chiuch, "Architecture and Algorithm for an IEEE 802-11-Based Multichannel Wireless Mesh Network", INFOCOM, Vol. 3, pp. 2223-2234, 2005.

[6] H. Jiang, W. Zhuang, X. Shen, A. Abdrabou, and P. Wang, "Differentiated Services for Wireless Mesh Backbone", IEEE Communications Magazine, Vol. 44, No. 7, pp. 113-119, July 2006.

[7] X. Teng, S. Jiang, G. Wei and G. Liu, "A Cross-Layer Implementation of Differentiated Queueing Service (DQS) for Wireless Mesh Networks", Vehicular Technology Conference IEEE, pp. 2233-2237, 2008.

[8] X. Lin and N.B. Sinroff, "The Impact of Imperfect Scheduling on Cross Layer Rate Control in Wireless Networks", INFOCOM, Vol. 3, pp. 1804-1814, 2005.

[9] F. Akyildiz, X. Wang, and W. Wang, Wireless mesh networks: A survey, *Computer Networks Journal*, vol. 47, no. 4, pp. 445–487, March 2005

[10] P. Gupta and P. R. Kumar, The capacity of wireless networks, *IEEE Transactions on Information Theory*, vol. 46, no. 2, pp. 388–402, March 2000.

[11] U. Javaid et al, "Towards Universal Convergence in Heterogeneous Wireless Networks using Ad Hoc Connectivity," 9Th Intl. Symposium on Wireless Personal Multimedia Communications (WPMC'06), 2006.

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