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Study on Resource Allocation in Wireless Mesh Network

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***Abstract*-- Wireless Mesh Networks (WMNs) are emerging as a wide and mainstream solution for providing broadband and mobile wireless connectivity in a flexible and cost effective way. A survey has been conducted on investigating a possible user cooperation path to implement strategic resource allocation in WMNs. Many possible novel strategic situations can be highlighted like how much a mesh router can demand for attaining threshold value, how much it can obtain as collaborative way and how this shall depend on the interference with its neighbours. Interference management, collision avoidance and resource allocation mechanisms can be taken into account to avoid performance degradation during congestion cases between mesh routers.**

***Keywords*— Mesh Router, Mesh Client, Wireless Mesh Networks (WMNs), Resource allocation, Bandwidth.**

I. INTRIDUCTION

A wireless mesh network (WMN) is a communication network made up of combination of wireless nodes organized in a mesh topology. Wireless mesh networks deals with mesh clients, mesh routers and gateways to provide effective resource utilization. The mesh clients are often, cell phones, laptops, and other wireless devices while the mesh routers forward traffic to and from the gateways. The mesh cloud consists of radio nodes communicating with in that cloud transmission area. Radio nodes working in collaboration with each other can access this mesh cloud to create a radio network. A mesh network is always reliable and often offers redundancy. Suppose one of the node can no longer operating, the rest of the nodes can still communicate with each other, directly or through one or more neighbouring nodes. This mesh router provides quality specific allocation depending on the bandwidth of the channel and hop count. Wireless mesh network can be taken into account using 802.11, 802.15, 802.16, cellular technologies combining more than one type of such technologies. A wireless mesh network we can take as a special type of wireless ad-hoc network. An ad-hoc network, on the other hand, creates ad hoc when wireless devices come within communication range of each other. Compared to other nodes in the network mesh routers are not limited in terms of resources and thus more resources intensive function can be exploited to perform.

Thus the wireless mesh network differs from an ad-hoc network because these nodes are more often constrained by subjected resources.

A. Architecture of wireless mesh network

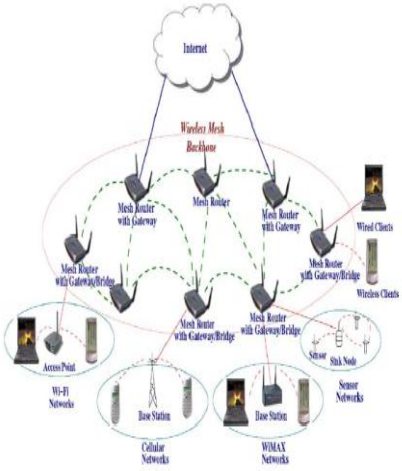

Fig: Dynamic wireless mesh network. [15]

Cost effective and dynamic high-bandwidth networks over a specific coverage area can be monitories in wireless mesh network. Long distance hops breaks down into a series of short hops by sustaining signal strength in wireless mesh network. Intermediate nodes boost the signal, making cooperatively forwarding decisions on network knowledge basis and consecutively perform routing. Such architecture provides high bandwidth, spectral efficiency, and economic advantage over the coverage area. To be cabled to a wired port like traditional WLAN access points do, it is built up of paired radio devices. Wireless mesh networks have a stable topology other then for the occasional failure of nodes or addition of new nodes.

As aggregated from a large number of end users, the path of traffic in WMNs changes infrequently to provide strategic allocation. All the traffic in an infrastructure mesh network is either towards forwarded to or from a gateway, but the traffic flow in ad-hoc network or client mesh networks is between arbitrary pairs of nodes.

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B. Resource Allocation

Resource allocation plays a significant role in designing efficient and reliable wireless networks. However, a generic approach is still not available due to the challenging wireless environments, the many degrees of freedom of the wireless resources, the heterogeneity of wireless networks, etc. We in this study investigate several resource allocation problems for typical wireless transmission scenarios. In particular, the study illustrates the roles of competition, effective learning, and coordination selecting all multiuser communication systems in the mesh network. Resource allocation may be decided by using computer programs applied to some specialized domain to automatically and dynamically distribute resources to applicants. It is taken as one of the issue of a specialized case of automatic scheduling. For example, taken into account the channel allocation in wireless communication may be decided by a base transceiver station using an appropriate algorithm.

C. Resource allocation in wireless mesh network

[14]A common for resource allocation in WMN model is based on OFDMA communications between mesh routers (MRs), where a user subscription for the installation of one MR at user premises; the local access can then be guaranteed using Wi-Fi and wired Ethernet connections. We investigate a user cooperation path for resource allocation in WMNs, under the assumption that users want a degree of control to adapt all the interconnection and resource allocation policies to their demands. How much a mesh router can demand, how much it can obtain and how this shall depend on the interference with its neighbours? All these questions pose an interesting research challenge. Interference can occur among neighbouring mesh routers, especially in those urban or emergency environments with a dense deployment of WMN equipment, when the coverage areas of Mesh routers overlap.. We can conclude to such networking cases as collaborative wireless mesh networks.

II. Literature Survey

[4]Provision quality-of-service (QoS) packet level in wireless mesh networks effectively giving a well built supporting heterogeneous traffic, medium access control with service differentiation is necessary. Non-altruistic non-reciprocal node cooperative resource allocation for wireless mesh network with QoS support taking power allocation, subcarrier allocation, partner selection, service differentiation, and packet scheduling taken into account to provide effective data traffic.

Further, simulation results show that packet-level QoS and enhance system performance. The study also sheds some light on the question of whether non-altruistic node cooperation is beneficial to wireless mesh network. These approaches are of less complexity, providing to a viable candidate for practical implementation.

A. Auctioning Approaches for Resource Allocation

Auction has been introduced to provide an interdisciplinary technology for radio resource allocation (e.g., sub channels, time slots, and transmit power) in the wireless systems. Participants of an auction have their own strategies for demanding the services that follow the incentives and rules brought by the auction. Auction theory is widely deployed in areas such as cellular networks, cognitive radio and wireless mesh networks. The reviews of auction approaches are applied in the multi-hop and single-hop wireless networks have been provided. Auction is a process to buy/sell commodities and services, which has been well researched in both economics and engineering areas. Basic terminologies in auction theory can be stated as follows:

- *Bidder:* A bidder is the one who wants to buy commodities in auctions. In wireless systems, a bidder is usually a user who wants to buy radio resources to complete tasks of transferring data, the user compete for the resources with other users. We may use buyer and user as synonyms for "bidder" in this paper.
- *Seller:* A seller owns and wants to sell commodities. The commodities can be bandwidth, licenses of spectrum, and time slots. in radio resource auctions. Buyers and sellers are all auction players.
- *Auctioneer:* An auctioneer works as an intermediate agent who hosts and directs auction processes. In general, a seller can be an auctioneer itself. For example in wireless systems, a base station or an access point can conduct resource auctions by its auction controller.
- *Commodity:* An auction commodity (also known as an auction commodity) is the object traded between a buyer and a seller. Each commodity has a value at which the buyer/seller wants to buy/sell.
- *Valuation:* In general, valuation is monetary evaluation of assets. A buyer/seller has a reserved valuation on every lot of commodities. Different buyers and sellers may value commodities with different valuations (which might be higher or lower than the inherent valuations) depending on their preferences. A valuation can be private that buyers do not know the others' valuations, or Public that is known to the others.

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B. Radio Resource Management

[11] Radio resource management is the system level control of co-channel interference and other radio transmission characteristics in communication system, for example cellular networks, wireless networks and broadcasting systems. The objective, utilize the limited radio spectrum resources and radio network infrastructure efficiently. Multi-user and multi-cell network capacity issues other than point-to-point capacity of each and every channel contributed radio resource management.

The cost for deploying a wireless network is normally dominated by base station sites (real estate costs, planning, maintenance, distribution network, energy, etc.) and sometimes also by frequency license fees. The objective of radio resource management is therefore typically to maximize the throughput and system spectral effectively and efficiently in bit/s/Hz/base station site or Erlang/MHz/site, under constraint that the grade of service should be above a certain level. Traditional telecommunications research and education often dwell upon channel coding and source coding.

The latter involves covering a certain area and avoiding outage due to all the co-channel interference, noise, attenuation caused by long distances, fading caused due to shadowing along with multipath Doppler shift and other forms of distortion. The grade of service is also affected by blocking due to the strategic admission control, scheduling starvation or inability to guarantee quality of service that is requested by the users.

C. Optimal bandwidth management for wireless mesh network with quality assurance

[7]Node clustering and subcarrier allocation are necessary to ameliorate system throughput and then allocating bandwidth to facilitate quality-of-service provisioning by standard means of maximum frequency reuse and effective interference control. A novel node clustering algorithm for wireless mesh networks with QoS support has been taken into account. With increased frequency reuse, the proposed approach achieves a higher system throughput than a conflict graph approach and a baseline approach.

Balancing packet delay and end-to end the transmission rate taken into consideration. This resource allocation achieves the optimality in presto basis, demonstrating efficient use of network resources.

There are many typical balancing throughput and analyzing admission control schemes are there by providing scheduling algorithms to balance the load and scatter the resources throughout the wireless mesh network.

Optimizing the cost can provide better improvement of services in the multi-channel radio resource management.

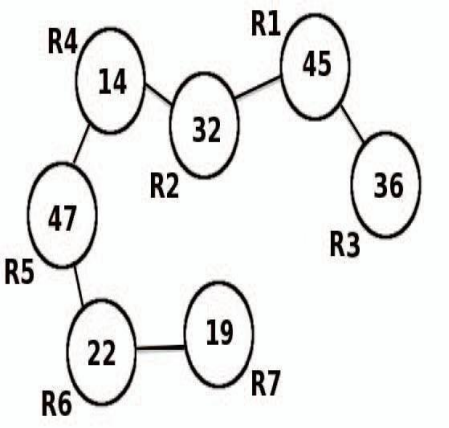

Fig: A 7-node Wireless Mesh Network; a link indicates an interference relationship and the value indicates node's demand. [14]

D. OFDMA fair allocation of subcarrier and power in wireless mesh network

[5]This is a new scheduling scheme for fair orthogonal frequency division multiple access in wireless mesh network. Fairly allocates subcarriers and more power to mesh router. In wireless mesh network all the information needed for scheduling is available at a center of scheduling like mesh router making it advantageous to involve the mesh routers and as many mesh client as possible so that al the network topology can follow in distributed scheduling. This distributed scheduling is based on the limited information making it available locally at all the node. Decoupling the subcarrier and power allocation problem hierarchically into two sub problems, one is the mesh router allocating subcarriers in groups to the mesh client and al the mesh clients allocates transmission power in its subcarriers to its entire outgoing links. Transforming the mesh client's problem, a closed form solution can be obtained. Instead of solving global control problem, the sub carrier and power allocation problem has been decoupled into two sub problems that can be solved hierarchically into a distributed manner.

E. Maximum throughput and fair bandwidth allocation in multichannel wireless mesh networks

[12]Wireless mesh network is comprehensive solution for last-end broadband Internet access. The bandwidth allocation is taken into account in multichannel network. Solution is to maximize the network throughput at the same time, to enhance fairness.

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First, they formulate and present the Linear Programming algorithm so as to maximize throughput Bandwidth Allocation problem Max-min guaranteed Maximum throughput Bandwidth Allocation problem. For the former one, present a linear programming formulation to provide optimal solutions and for the later one polynomial time optimal algorithm is taken into account. It increases the fairness and maximizes throughput and Multi channel wireless mesh network and bandwidth allocation.

III. Working Problems

Admission Control

[13]In this section extend the primal-dual framework to support admission control to handle dynamic settings where flows enter and exit the network. To achieve a good tradeoff between fairness and throughput, take a simple maximum-minimum fairness model which leads to high value throughput solutions and providing guaranteed maximum minimum bandwidth allocation.

A. Handling Infeasible Quality requests

[13]The resource allocation framework attempts to achieve both fairness and the quality requirements problem. If sum of quality requirements of the various sources on a link exceeds the link capacity, the link cost, with not converge; it will increase continuously as progressively go through time (in terms of slots) and this leads to an infeasible solution. In such a scenario, the only solution would be to gradually drop a subset of the sources until the rate requirements of all the rest of the sources are met. The objective could be to drop as few sources as possible. In one of the paper consider three dropping policies or rules. As per the first policy, choose the source for which, the difference or gap between the required rate and the assigned rate is the maximum.

B. Admission Controls

[13]An admission control strategy is to provide protection to the sources that are currently being serviced. In other words, the quality of existing flows in terms of a minimum rate cannot be compromised in order to accommodate new incoming flows. This resource allocation framework can be easily adapted to support admission control throughout in the network.

IV. Future Work

As a future work, we can approach how the cooperative interaction among independent mesh router can be seen taking into consideration user mobility patterns and cheating behaviours of Mesh clients.

The issue of routing needs to be taken into Consideration. Resource allocation in the MAC layer affects that in the network layer and vice versa. Inclusion of multiple gateways efficiently and effectively in WMNs is vital in practice in the research field. The gateway deployment problem into joint node clustering along with subcarrier allocation approach is an open experimental problem. Providing energy efficient routing using cluster based resource utilization is open in the field of joint node channel allocation.

Acknowledgement

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