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An Effective Study on Resource Allocation by Qos in Wireless Networks

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ABSTRACT

Wireless Networks are growing as a key solution to provide broadband and mobile wireless connectivity in a flexible and economical way. The wireless channel is a shared medium over which many users compete for resources, It is also a transmission network made up of mixture of wireless nodes accomplished in a mesh topology. Resource allocation is a paramount topic in Wireless Networks with unsuitable resource allocation causing congestion and unfairness to users, where it has been used in Wired Networks such as telecommunications and the Internet. Quality of Service (QoS) is particularly important for the transport of traffic with special requirements. This paper gives a survey and classification of the important QoS approaches proposed for various Wireless Networks. Finally, this paper presents the outcomes of survey which comprises significant observations, limitations and idea of further research in improving QoS in various wireless networks.

Keywords: Quality-of-Service (QoS), Resource allocation, Wireless networks, wirednetworks, Congestion

1. INTRODUCTION

A network is a set of devices (nodes) connected by communication links. Nodes can be computer, printer or any other devices capable of sending and / or receiving data generated by other nodes in the network.

The most important network criteria are performance, reliability and security. Performance is measured in many ways including transit time and response time. Transit time is the amount of time required for a message to travel from one device to another. Response time is the elapsed time between an inquiry and a response.

Performance is evaluated in two metrics: 1. Throughput 2. Delay. We often need more throughputs and less delay. While sending a data we may increase the throughput, but we increase the delay because of traffic congestion in the network. Congestion occurs in the network if the load on the network i.e., the number of packets sent to the network is greater than the capacity of the network i.e., the number of packets a network can handle.

1.1. Types of Connection

A network is two or more devices connected through links. The two possible types of connections are

1. Point-to point connections
2. Multipoint connections

A point-to point connection provides a dedicated link between two devices which is shown in Fig. 1.

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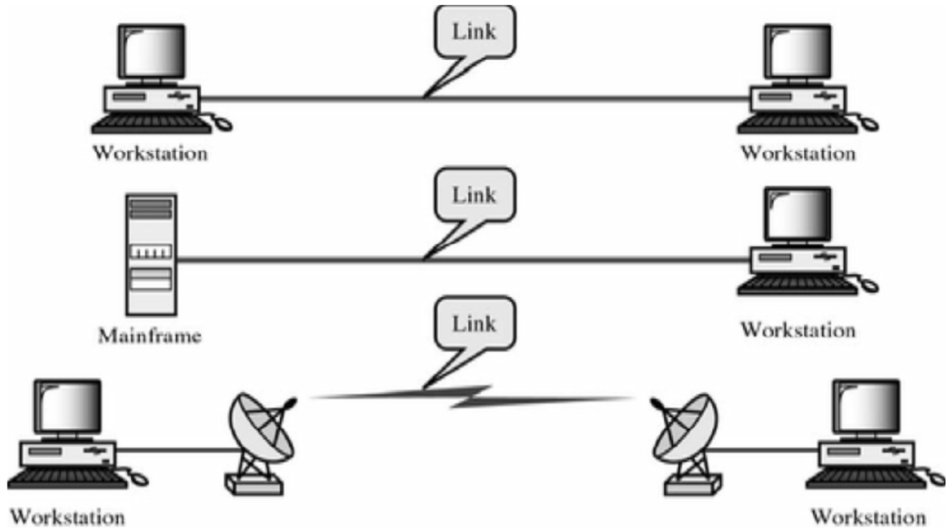

Figure 1: Architecture of Point-to-Point network

A multipoint connection is one in which more than two devices share a single link which is shown in Fig. 2.

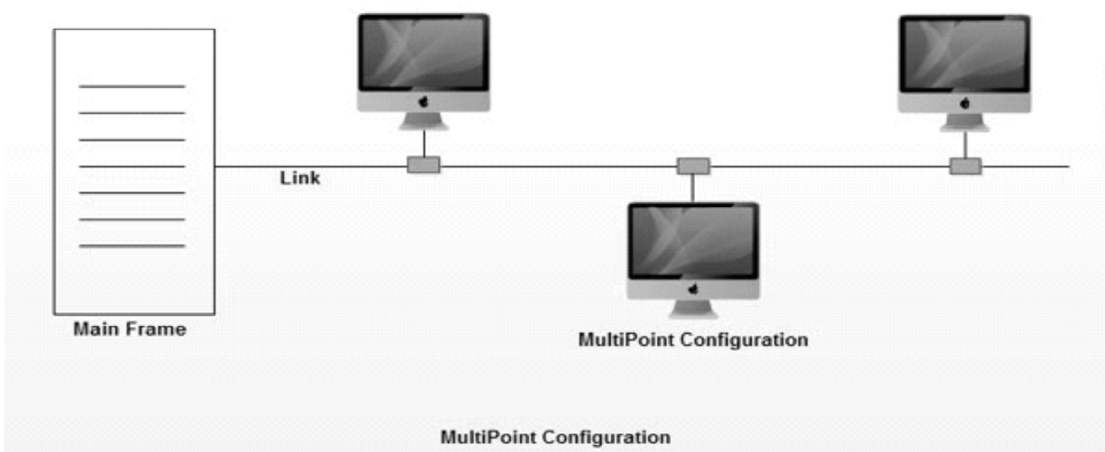

Figure 2: Architecture of multipoint network

Wireless relay networks, heterogeneous wireless networks, wireless communication networks, wireless body area networks, wireless cellular networks, optical wireless access networks, virtualized wireless relay networks, LTE-A networks and Wireless Mesh Networks (WMNs) are the various networks used in the survey.To assist the reader, acronyms used in this paper are composed in Table 1 as a convenient reference.

2. QOS – A BROAD INTRODUCTION

In the field of telephony, quality of service was defined by the ITU in 1994. The four types of characteristics are: reliability, delay, jitter and bandwidth.

- Reliability: It is a very significant characteristic. Deficiency of reliability means losing a packet or acknowledgement, which requires transmission.
- Delay: Delay is one of the major characteristic where the data or information has to flow from source to destination without any delay.

- Jitter: Jitter is defined as the variation in the packet delay. The two types of jitter 1. High jitter 2. Low jitter. High jitter means the difference between delays is large, low jitter means the variation is small.
- Bandwidth: Bandwidth is the measure of how fast we can actually send data through a network. The various QoS characteristics have been shown in fig. 3.

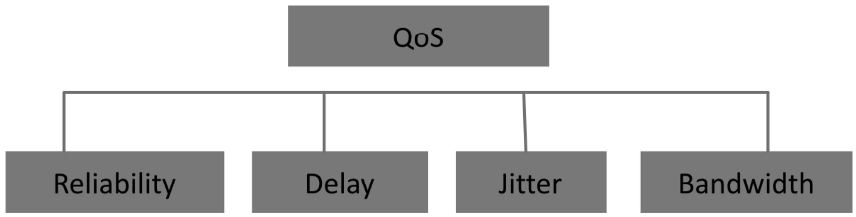

Figure 3: QoS Characteristics

2.1. QoS Techniques

Packets from different flows arrive at a switch or router for processing. Several scheduling techniques are designed to improve the Quality of Service.

- FIFO Queuing: In FIFO queuing the packets wait in a queue till the node is ready to process them. If the average arrival rate is higher than the average processing rate, the queue will block up and new packets will be rejected.
- Weighted Fair Queuing: In Weighted Fair queuing method, the packets are assigned to different classes and admitted to different queues. The queues are weighted based on the priority of the queue; higher priority means a higher weight.

2.2. Integrated Services

Integrated Services, also called IntServ, which is a flow based QoS model, which is designed for IP. IP is a connectionless, datagram, packet-switching protocol. A flow-based model can be implemented over a connectionless protocol using a protocol called Resource Reservation Protocol (RSVP). Guaranteed service and controlled-load service are the two classes of service. Guaranteed service is designed for real-time traffic that needs a guaranteed minimum end-to-end delay. Controlled-load service class is designed for applications that can accept some delays, bur are sensitive to an overload network and to the danger of losing packets.

Table 1
Acronyms used in this paper

Acronym	*Expanded Form*
QoS	Quality of Service
MIMO	Multiple Input Multiple Output
OFDM	Orthogonal Frequency Division Multiplexing
RF	Radio Frequency
ICI	Inter Carrier Interference
EE	Energy Efficient
UWA	Underwater Acoustic
TRAP	Transmission Rate Allocation Policy

contd. table 1

Acronym	*Expanded Form*
PLR	Packet Loss Rate
SINR	Signal-to-interference-Plus-noise ratio
MSs	Mobile Stations
FiWi	Fiber Wireless networks
ACO	Ant Colony Optimization
CSO	Cell Switch Off
LTE	Long Term Evolution
D2D	Device-to-Device
BER	Bit error rate
WBAN	Wireless Body Area Network
MOS	Mean Opinion Score
VoIP	Voice Over Internet Protocol
IP	Internet Protocol
PAN	Personal Area Network
LAN	Local Area Network
MAN	Metropolitan Area Network
WAN	Wide Area Network
VoLTE	Voice over LTE
CRS	Carrier Routing System
RSVP	Resource Reservation Protocol
WSNs	Wireless Sensor Networks

Metrics are used to specify presentation of exact scheme employed. We can apply QoS according to per flow (individual, unidirectional streams) or per aggregate (two or more flows having something in common) basis. The QoSarchitecture has been shown in Fig. 4.

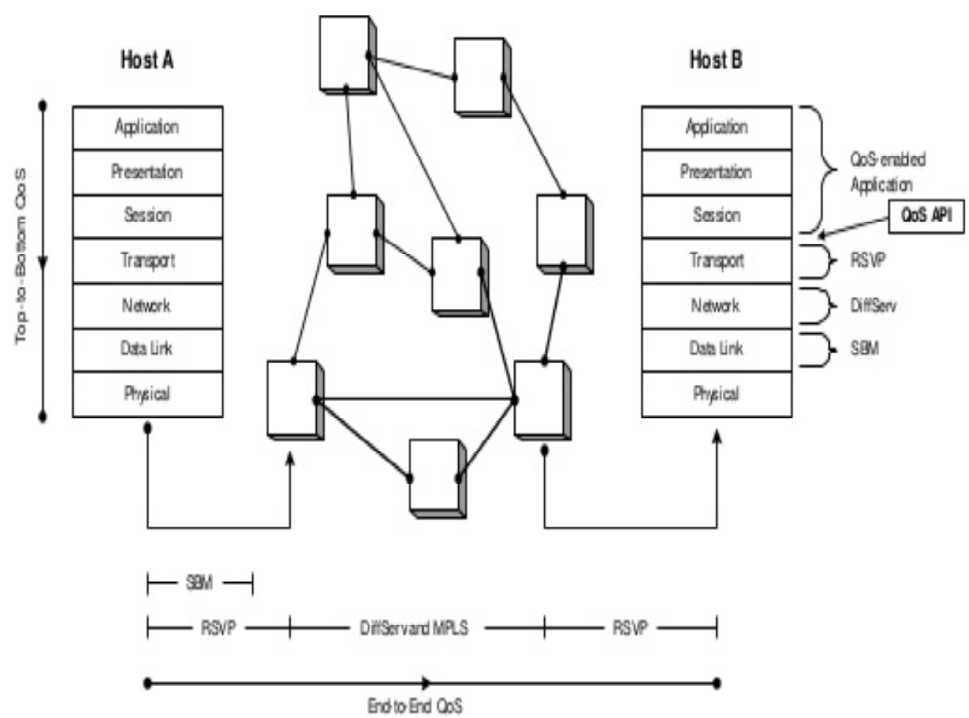

Figure 4: QoSArchitecture

3. QOS SUPPORT IN WIRELESS NETWORKS

3.1. Wireless Relay Networks

Ping Wang, Xi Zhang, Mei Song in 2013 proposed a technique called Multiple-Input-Multiple-Output (MIMO), the Orthogonal Frequency Division Multiplexing (OFDM), and relay technology which have played a major role in Radio-Frequency (RF) communication networks, which have significantly improved the RF wireless network performance, such as spectrum efficiency, Bit Error Rate (BER), and delay bound guarantee. These technologies are used in underwater acoustic wireless networks and the problem occurred is Doppler shift problem which result in ICI also he proposed a Doppler compensation resource allocation scheme, where the goal is to maximize the entire network throughput also guaranteeing the QoS requirements [1].

ShahinVakilinia in 2013 proposed an efficient QoS aware resource allocation algorithm, where the objective is to minimize the transmission power considering the support of QoS parameters also proposed another extended Kalman filter which is used to estimate the residual times and vacation times of relays and sub carriers.

3.2. Heterogeneous wireless networks

JingweiZou, Qi Xi, Qian Zhang Chen in 2015 proposed the iteration based energy efficient resource allocation algorithm which allocates the bandwidth and power has been applied in Heterogeneous wireless networks. Previous study aim to optimize the total throughput or total power consumption. Here the algorithm is divided into three stages and resource allocation in each stage is energy efficient [2].

3.3. Wireless communication networks

Ping Wang, Xi Zhang , Mei Song in 2013 implemented MIMO, OFD and relay communication techniques which have improved the performance of wireless communication networks and these techniques were applied in UWA wireless networks. The method power efficiency resource allocation scheme is used to minimize the total power/energy consumption while supporting the QoS guaranteed services for multimedia applications in UWA. To achieve these goals a method called joint optimization of source and relay network transmit power with QoS constraint for relay based MIMO-OFDM used in underwater acoustic co-operative wireless networks [3], [10].

3.4. Wireless Body Area Network

WBAN is a network that provides applications such as real time health monitoring and e-health services. Zhiqiang Liu, Bin Liu, Chang Chen, Chang Wen Chen in 2015 proposed two challenges used here are 1. Design of WBAN is to increase the network lifetime in resource constrained network. 2. The QoS requirements should be guaranteed such as PLR, throughput and delay must be guaranteed under highly dynamic environment due to changing of body postures.

To face the challenges the methods used are unified framework of energy efficient resource allocation scheme for QoS metrics and characteristics of dynamic links. The other method used is TRAP which is used to carefully adjust the transmission rate at each sensor. The PLR requirement achieved even link quality is very poor. QoS optimization method is proposed to optimize the transmission power and allocated time slots for each sensor which minimize the energy consumption [5], [9].

3.5. Dense Cellular Networks

David González G in 2014 proposed the concept of CSO and recognized as a promising approach to reduce the energy consumption. The method used is novel framework to CSO based on multi objective evolutionary optimization. The technique takes the traffic behaviors in both space and time. The number of cell switch on/off transitions as wells as handoffs are minimized also the computationally heavy part of the algorithm is executed offline, which makes the real time implementation feasible [6].

3.6. Virtualized wireless relay networks

Qixuan Zhu, Xi Zhang in 2015 proposed a Co-operative communication efficient technique that support statistical delay bounded QoS multimedia (audio/video) services in Virtualized wireless relay networks. Applying Co-operative communication efficient technique provides significant improvement on time sensitive multimedia services. The challenges are how to efficiently allocate the wireless resources of physical wireless networks to multiple virtual wireless network users also novel game theory based scheme is used to resolve the wireless resource allocation problem in terms to transmit power [4].

3.7. LTE – A networks

PhondPhunchongharn in 2013 proposed a novel energy aware resource allocation scheme which is used in LTE (Long Term Evolution) – A networks to reduce energy consumption without losing system performance. System performance can be improved 1. By grouping different users in a sub-optimal way. 2. Propose multistage resource allocation scheme in system co-operative link, using the optimal multi-stage co-operative decoding system. 3. By reducing the traffic load, the energy consumption in system backhaul will be reduced significantly [7].

3.8. Wireless OFDMA networks

AlirezaSharifian in 2016 proposed a novel jointRT and NRT flows disutility based packet scheduling and RB allocation in a common pool of RBs. The proposed approach enlarges the effective capacity of the wireless system compared with the separated pool of RBs. The joint approach is particularly relevant for improving Voice over LTE (VoLTE). Our approach can be extended for broader QoS requirements and for the utility of future applications [8].

3.9. Optical wireless converged networks

Elaine Wong, Christina Lim **i**n 2013 proposed a technique called architecture discovery enabled resource allocation (ADERA) mechanism in networks. ADERA incorporated with a near future traffic forecasting mechanism for efficient resource allocation. Using simulations ADERA algorithm evaluate the performance and compare with existing resource allocation mechanisms. The output improves the overall QoS performance [11].

3.10. Buffer aided relay enhanced OFDMA networks

JavadHajipour in 2016 implemented a method called novel channel queue and delay aware policies for formulating and solving the joint routing and resource allocation problem. The methods decide on set of users considered in the utility function. Numerical results show significant improvements in throughput and delay performance of the proposed resource allocation mechanism also, time domain scheduling and frequency domain resource allocation methods are used to solve the joint routing and resource allocation problem [12].

3.11. LTE cellular mobile systems

An optimization problem concerning joint RB assignment and power allocation used to maximize the energy efficiency measured by “bits joule” metric. Energy efficient resource allocation problem is converted into tractable equivalent problem. By Lagrange dual method decouple RB assignment and power allocation on different sub channels using dual decomposition. To be applicable in LTE systems both MIMO and OFDMA and RBs are considered in this network[13].

3.12. Radio sensor networks

Mubashir Husain Rehmani , NaveedUl Hassan in 2013 made a survey on the recent advances in radio resource allocation in CRSNs. Radio resource allocation scheme in CRSNs is classified into three major categories: 1. Centralized 2. Cluster based 3. Distributed. The scheme further divided into several classes on the basis of performance optimization criteria which include energy efficiency, throughput maximization, QoS assurance, interference avoidance, fairness and priority consideration and handoff reduction. The spectrum insufficiency problem has been overcome by incorporating the opportunistic spectrum access capability of Cognitive Radio (CR) into the existing WSN [14].

3.13. Wireless Mesh networks

Yong Yang , Jennifer C. Hou , Srikanth V. Krishnamurthy in 2015 proposed a cross decomposition method used to overcome the optimization problem.

A mesh offers several advantages over other network topologies. The use of dedicated links guarantees that each connection can carry its own data load, thus eliminating the traffic problems that can occur when links must be shared by multiple devices. Also a mesh topology is robust. The output maximizes the aggregate utility of traffic flows in multihop wireless networks. Admission control module is used to determine if new flows can be admitted without violating the rate requirements of the existing flows in the network[15],[16].

4. CONCLUSION

Wireless Networks is an active research area over past few years. It is anticipated that the bulk of access technologies in the near future will be wireless. Quality of Service is particularly important for the transport of traffic with special requirements. In this paper, we have surveyed various QoS enhancement techniques proposed for various wireless networks such as Wireless Sensor Networks (WSNs), wireless relay networks, heterogeneous wireless networks, wireless communication networks, wireless body area networks, etc. Based on the survey our discussion encompassing both QoS resource allocation algorithm and Cross decomposition method to minimize the transmission power considering the QoS parameters and the optimization problem can be overcome.

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