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A COMPREHENSIVE STUDY ON EFFICIENT 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. A Wireless Network is 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, Wired Networks, Congestion

1. INTRODUCTION

Resource allocation plays a powerful role in designing efficient and predictable wireless networks. Wireless networks are anticipated to support a range of services with different QoS requirements. Wireless networks are also essentially multi-access, it is hard to direct the radio transmission to just a particular receiver or to avoid getting radio signals from any transmitter with abundant power in neighborhood.

When laptops are connected to Wi-Fi hot spots in public places, the connection is established to that business's wireless network. A network that can provide different levels of service is often said to support QoS.

The various QoS metrics are delay, jitter (delay variation), service availability, bandwidth, throughput, packet loss rate. Network performance is measured in two essential ways, they are bandwidth and latency. A bandwidth can also be called as throughput where a network is given by the number of bits that can be transmitted over the network in a certain period of time and latency also called as delay relates to how long it precedes a message to mobile from one end of a network to the other. Bandwidth and latency chain to define the routine appearances of a given link or channel. We can apply QoS according to per flow (individual, unidirectional streams) or per aggregate (two or more flows having something in common) basis. The architecture of Wireless networks is shown in Fig.1. [10].

Some types of networks include PAN (Personal Area Networks) which let devices to transfer over the range of a person. An example of PAN is wireless network that links a computer with its peripherals where LAN (Local Area Networks) is a confidentially owned network that works within and nearby a single building like a home, office or factory, MAN (Metropolitan Area Networks) are the cable television networks obtainable in many cities and WAN (Wide Area Networks) extents a large geographical area, frequently a country or continent.

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).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.1.

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.

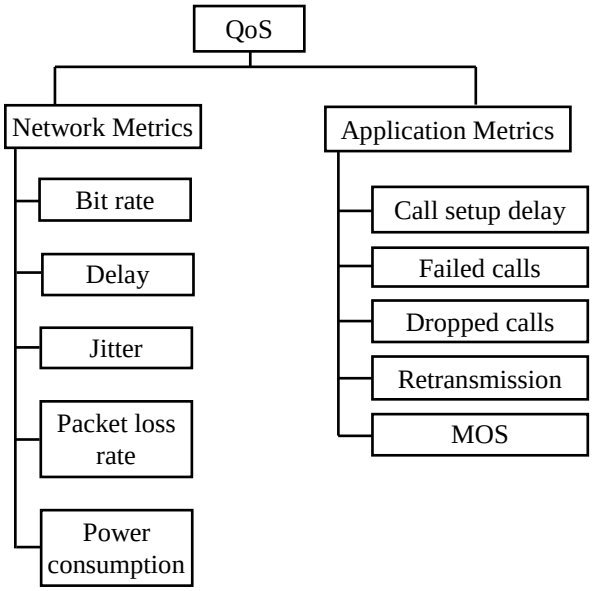

Fig.1. QoS Characteristics

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
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

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.

3. QoS SUPPORT IN WIRELESS NETWORKS

3.1 WIRELESS RELAY NETWORKS

Multiple-Input-Multiple-Output (MIMO), the Orthogonal Frequency Division Multiplexing (OFDM), and relay technology which have 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].

The objective of efficient QoS aware resource allocation algorithm 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

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

The MIMO, OFD and relay communication techniques 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 with two challenges namely:

- Design of WBAN is to increase the network lifetime in resource constrained network.
- 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

The concept of CSO is 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

Co-operative communication efficient technique supports the 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

A novel energy aware resource allocation scheme is used in LTE (Long Term Evolution) aims to reduce the energy consumption without losing system performance. System performance can be improved

- By grouping different users in a sub-optimal way.
- Propose multistage resource allocation scheme in system co-operative link, using the optimal multi-stage co-operative decoding system.
- Thirdly by reducing the traffic load, the energy consumption in system backhaul will be reduced significantly [7].

3.8 WIRELESS OFDMA NETWORKS

The 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

An architecture discovery enabled resource allocation (ADERA) mechanism in networks 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

A channel queue and delay aware policies for formulating and solving the joint routing and resource allocation problem decides the 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

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].

4. RESULTS

4.1 BCQI ALGORITHM

To perform scheduling, the scheduling strategy assigns resource blocks to the user having the best radio link conditions. The user sends the Channel Quality Indicator (CQI) to the base station. A reference signal (downlink pilot) to users by the BS in the downlink for the measurements of the CQI UE uses these reference signals. Better channel conditions are indicated when CQI value is high. Cell capacity can be increased with a little. To find a trade-off between fairness and throughput, the scheduling algorithm is proposed to operate with the Best CQI scheduling and Joint User Scheduling Scheme (JUS). The new scheduling algorithm will result in improvement regarding throughput and fairness. The proposed scheduling algorithm assigns the RB to the user that maximizes the CQI in the first time slot of each subframe; whereas in the second time slot the scheduler assigns the RB according to the priority function. In this way, a compromise between throughput and fairness can be reached. One LTEA frame is divided in 10 subframes of 1ms duration each. One subframe contains two time slots of 0.5ms duration.

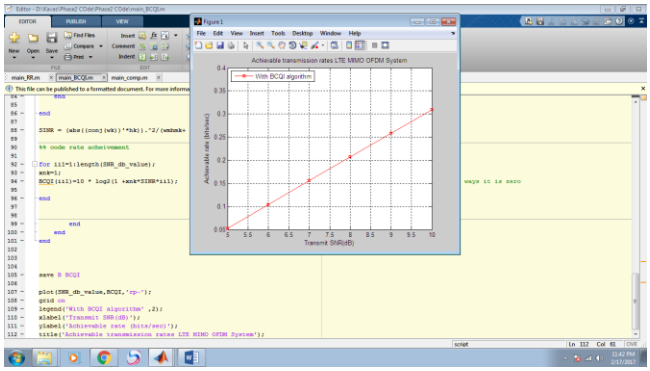

Fig.2. BCQI Algorithm

4.2 ROUND ROBIN ALGORITHM

Round-robin (RR) is one of the algorithms employed by process and network schedulers in computing. As the term is generally used, time slices (also known as time quanta) are assigned to each process in equal portions and in circular order, handling all processes without priority (also known as cyclic executive). Round-robin scheduling is simple, easy to implement, and starvation-free. Round-robin scheduling can also be applied to other scheduling problems, such as data packet scheduling in computer networks. It is an operating system concept.

Round-robin algorithm is a pre-emptive algorithm as the scheduler forces the process out of the CPU once the time quota expires. For example, if the time slot is 100 milliseconds, and job1 takes a total time of 250 ms to complete, the round-robin scheduler will suspend the job after 100 ms and give other jobs their time on the CPU. Once the other jobs have had their equal share (100 ms each), job1 will get another allocation of CPU time and the cycle will repeat. This process continues until the job finishes and needs no more time on the CPU.

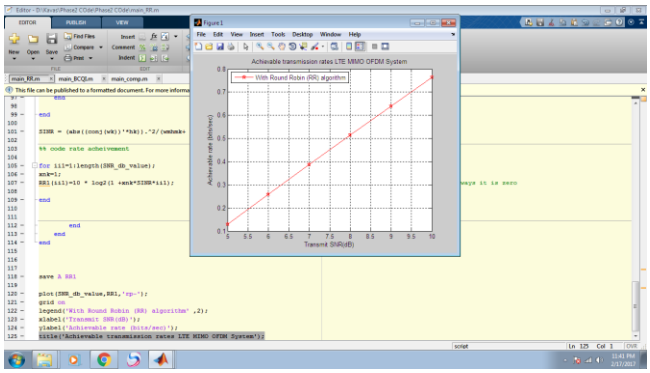

Fig.3. Round Robin Algorithm

5. 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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