

Analysis of different Resource Allocation Techniques used in 5G Mobile Networks

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Abstract—The 5G cellular system will enable heterogeneous networks that incorporate 5G, 4G, Wi-Fi, and other telecommunication connectivity. This will result in huge changes. A fundamental problem for 5G heterogeneous networks is the development of resource management and scheduling techniques that meet the 5G Quality of Services criteria. A heterogeneous network (HetNet) actively investigates the network's resources while offering a better Quality of Service (QoS). The variety of HetNet makes it challenging to manage network traffic. Due to diverse interfaces and data transmission rates, network traffic in heterogeneous networks can be difficult to manage and control. This study examined how well the resource scheduling strategies of the round robin, resource fair, maximum throughput, BCQI, and proportional fair performed in 5G networks.

Index Terms—5G, 5G Core Architecture Model, Heterogeneous Networks, Resource Allocation, Scheduling Techniques.

I. INTRODUCTION

Everyone wants speed, mainly high-speed internet, that is not surprising that each better telecommunications industry is preserving to rectify it. Cell phones, wearables, workplaces, and transportation are all demanding more and more reliable wireless connections [1]. To succeed in a society where speed differs at every instant and requires more technologies, the fifth-generation technologies, or 5G, have succeeded. Additional efficiency, enhanced bit rates, reduce latency, and quality of services are among the major objective that must be assembled in the forthcoming, i.e., beyond 4G [2]. To achieve successful outcomes, 5G cellular architecture must be enhanced on a large scale. This study concentrates on the or 5G, wireless telephone architecture, as well as certain related topics [3]. The future of wireless technologies - 5G - aims to link UE, objects, transportation, and communities in intelligent virtual transmission system. It must transport a high quantity of transmission and link an extremely large number of devices with suitable resources [4].

A. 5G Core Architecture Model

5G NR is the 5th generation accessing Radio Access Technology, also known as 5G NR or New Radio, which has been advised to the worldwide standards of the 5th generation and completely under the 3G Partnership Project [5]. 3rd generation partnership project determined and presented the performances of fifth generation technique structures. One is the Reference Point System Architecture which displays the interchange of system components by accurate connection juncture. It works as a specific intersection between the two system ingredients [6]. The 5G core network design is at the core of the development of the new generation protocol,

enabling the better bandwidth requirements that the fifth generation necessitates [7]. The new core base network employs a virtualized, service-based architecture (SBA) which encompasses all the 5G services and transactions, such as concurrence, reliability, access control, and gridlock aggregation from edge equipment as described by 3GPP [8]. The new radio core places even more significance on NFV as an intrinsic concept architecture, with virtualized software functions that can be expanded using the Mobile Edge Computing network, which is at the heart of the 5G framework concepts [9].

B. Heterogeneous Networks

The portable participant, frequency counts, switching centre, telecommunications interaction, and fixed contributor are interconnected during cellular computing. There exist multiple machine learning methods for managing nodes and connections in 4G and 5G networks [10]. As the need for 4G networks expanded, other complications occurred. There are problems with increased system requirements, low performance, spectrum distribution, and radio radiation. But since each 4G user requires a positive opportunity, the installation cost is rising as more transmitters and equipment are required [11]. However, service quality is declining, necessitating the development of intelligent technologies designed to resolve these problems. Consequently, the need for machine learning originated, which is suitable for estimating or forecasting the adaptive outcome. It has been noted that in crowded interior environments, many individuals use mobile technologies to exchange or access images, movies, or information [12]. In these instances, a heterogeneous 4g/5g mobile network can solve problems created by the growing huge data produced by smartphones and tablets. Heterogeneous mobile networks use a combination of Channel and Macro base stations to improve signal quality per unit region [13].

C. Resource Allocation in 5G

The primary role of radio resource management is maximizing the spectral efficiency [(bit/sec)/Hz] per cell or per site in each geographical area under some fairness index (user requirement /satisfaction). User satisfaction is a Service Level Agreement (SLA) provided by the service provider [14]. Resource allocation approach applied to Medium Access Control and Physical layer to obtain these goals. The effective use of radio resource block is the essential key to providing effectiveness and user experience according to Quality of Services [15].

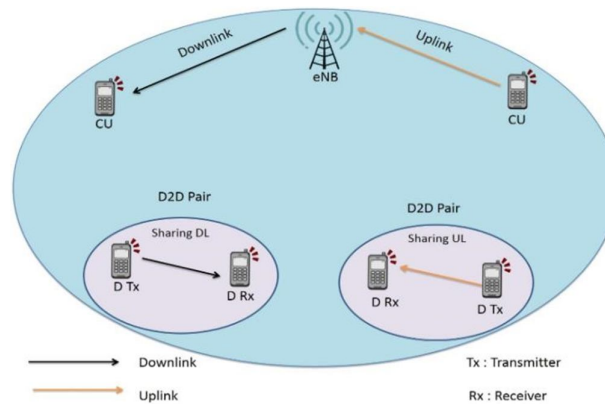


Fig. 1: Resource Allocation in Wireless Communication

The distribution of resources is a crucial component of mobile communication networks [16]. To fulfil consumer network needs in a 5G wireless medium, the network must be smarter and more flexible [17]. The system allocates resources based on power management, network throughput, distribution techniques, and associate scheduling. The mobile network design must include resource allocation as a key component [18]. It is key to maintaining mobile-based services accessible to consumers, service providers, and consumers [19]. The cellular network architecture uses data collected from resource allocation. The amount of fairness with which resources are distributed on the network affects how well it performs [20]. The degree of fairness and network efficiency are strongly correlated. Allocating resources fairly has four degrees of fairness: fair, perfect, unjust, and imbalanced [21]. There are four performance categories for networks: bad, less good, excellent, and perfect. Resource allocation in terms of the achievement of long-lasting high-powered products and the class of services of the software is a serious factor for 5G [22]. Improved resource management and allocation are required by users. Resource allocation is complicated and ineffective because of the inflexible products and restricted architecture of current networks. Due to the consumer nature of current radio communication network resources,

specifically those in 5G communication systems, efficient resource allocation is required to get service quality [23]. As a result, the primary problem presenting difficulty to the expanding demand for 5G mobile networks is improved resource allocation. The resources of a telecommunication system are explicitly specified in terms of control, frequency, bandwidth, etc., and they must be distributed per user needs [24]. Led to a dramatic rise in users and devices linked to the network, a mobile network may indicate a lack of spectrum resources. In this paper, the performance of the various resource allocation techniques for 5G wireless communications is studied and analyzed.

II. RELATED REVIEW

Based on an analysis of articles from several source materials, this review paper categorized the techniques utilized for allocating resources in 5G. The resource allocation strategies used by multiple researchers were examined in this comprehensive study, which categorized them according to the approaches used in each strategy. 3rd Generation Partnership project does not define an LTE-advanced resource scheduling mechanism [25]. On resource distribution in 5G networks, Capozzi et al. [26] Best Channel Quality Indicator (BCQI), Round Robin (RR), and Resource Fair (RF) scheduling methods while using close loop multiplexing (CLM). On concerning MaxMin (MM), edge throughput, and Proportional fair (PF) outperformed Best Channel Quality Indicator (BCQI). For example, Lukmanhakim et al. [27] contrasted resource fair–Sum and round robin scheduling methods in vehicular networks. RR excelled in a vehicular network, whereas BCQI excelled in a basic [28, 29] suggested novel scheduling strategy Public Safety (PS), Kwan Max. Throughput (KMT), Approximate Max. Throughput (AMT) and assessed the, and alpha-fair in MIMO. The suggested scheduler improved outcomes. Salman et al. [30] presented a round robin BCQI and round robin-CQI, upgraded versions of RR with the best channel quality indicator and channel quality indicator. Hoon Kim et al. [31] extended the PF scheduling to multicarrier systems. The suggested algorithms choose a high algorithm sum rate user carrier mapping. Sun et al. [32] suggested an ideal shorten complication PF resource allocation for OFDMA networks. Among all schedulers, BCQI and Max TP had the best throughput. A modified PF scheduler for 5G networks was suggested by Ismail et al. [33]. The comparative study of various resource management scheduling techniques is described in table 1.

III. ANALYSIS OF RESOURCE ALLOCATION TECHNIQUES

A. Proportional fair

A proportional fair resource scheduling method is suggested for 5G networks, which improves fairness and cell edge user bandwidths while offering an adaptable resource to the user who is suffering the most. Uplink and downlink throughputs, spectral efficiency, average throughputs, peak throughputs, and fairness index for 5G networks are used to quantify performance.

B. Round Robin

In the Round Robin technique, Radio Resource Management assigns transmission ability to the consumer in the terms of first come, first served, and each user equipment has an equal likelihood of obtaining radio resources. RR quickly delivers superior performance and fairness to all users.

C. Best Channel Quality Indicator

The information delivered from UE to the base stations is included in the CQI, which analyses the quality of the downlink signal. Across a physical uplink shared channel and physical uplink control channel, the user equipment transmits the essential data. In the best CQI, the largest amount of data is sent to the users whose channel quality is the highest.

D. Max throughput

The Max throughput (MaxTP) scheduler aims to optimize the base station's total throughput. The MaxTP allots each resource block to the users who can transmit data at the fastest rate feasible now. It is capable of operating in the frequency and time domain. The physical resources are allotted to the UE in the frequency domain with the greatest channel quality indication.

E. Resource Fair

Resource fair scheduling provides resources across users equally. Recursively using the round-robin technique to allocate an equal quantity of resources to each user is the most popular way of logically implementing the resource fair approach. The major goal of strategy is to increase the average rate of resources allotted to users while maintaining certain fairness standards.

TABLE I: COMPARATIVE STUDY OF VARIOUS RESOURCE MANAGEMENT SCHEDULING TECHNIQUES

Author	Scheduling Techniques	Finding Best Scheduler
Habafbi et al. [26]	BCQI, RR, PF	20 Best-CQI in T
Lukmanhakim et al. [27]	MaxMin, Resource Fair, Best Channel Quality Indicator, Round Robin, Resource Fair -Sum	Round Robin in Veh. Best Channel Quality Indicator in peak T
Stefan Schwarz et al. [28]	Best Channel Quality Indicator, Resource Fair, Proportional fair, Max-Min, α -fair, Public Safety, Round Robin	2,15 $\propto$ -fair
Stefan Schwarz et al. [29]	Best Channel Quality Indicator, Round Robin, Approximate Max. Throughput, Kwan Max. Throughput, MaxMin, Resource Fair, Proportional fair	2, 25 Proportional fair and Resource Fair
Salman et al. [30]	Round Robin Best-CQI, Round Robin - Channel Quality Indicator	10, 20, 30, Round Robin - Channel Quality Indicator
Martin Klaus Muller et al. [33]	Round Robin, Proportional fair, DF, TL	30, 40, 60 Proposed in Avg- latency

IV. SIMULATION AND RESULT ANALYSIS

To simulate, the simulation of various 5G multiuser resource scheduling techniques analyzed and measure throughput, SINR, and spectral efficiency. MATLAB-based simulator [34] is considered to evaluate the simulation.

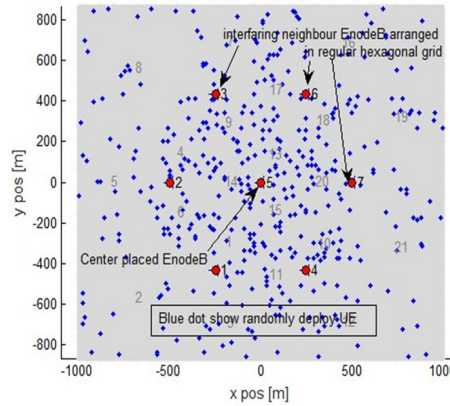


Fig. 2: eNodeB and User Equipment Positions

The system model is shown in figure 2. Tri-sector tilted antenna with the power of 43 dB and 1.4 bandwidth deploy in a simulation scenario. Twenty User equipment with SISO transmission mode is equally distributed and deployed along with the radius of $r = \{50, 120, 210\}$ meters. The angle of user propagation is specified as $\phi = \{0, \pi/12, \pi/6\}$. User Equipment throughput result (Mb/s) is shown in figure 3., to simulate the five above mention schedulers, the result reflected that max- throughput and best CQI scheduler provide the long throughputs as compared to the other three. The round robin approach does not have any channel condition feedback, so the throughput peak is high where it allocates the resource because in RR resources are allocated in an equally fair share. Proportional and resource fair are channel aware schedulers both provide the throughput after estimating the channel condition.

Spectral efficiency is measured in bit/cu in figure 4. Resource fair scheduler best CQI and max throughput outperform the result while round-robin achieves the best between spectral efficiency and fairness. The performance results indicate that the RR, BCQI, and FFR scheduler outperformed conventional schedulers regarding throughput, achieving the greatest average cell throughput.

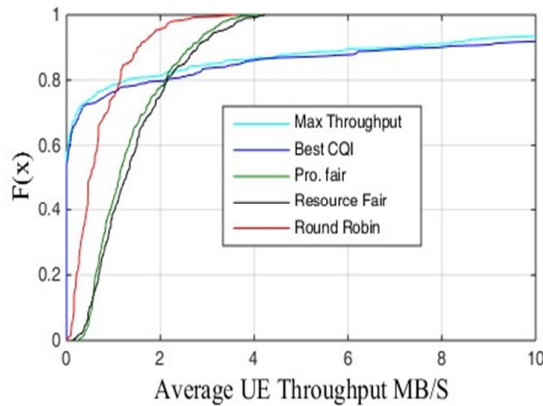


Fig. 3: User Equipment Throughput

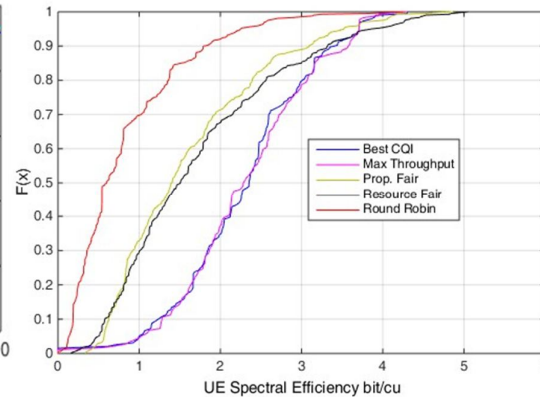


Fig. 4: User Equipment Spectral Efficiency

V. CONCLUSION

In this review and analysis research paper, several resource allocation algorithms such as RR, resource fair, maximum throughput, proportional fair, and BCQI, are analyzed and examine the performance of existing resource allocation strategies for 5G. The fairness index, average UE throughput, and UE spectral efficiency ratio performance parameters are taken for evaluation. Best CQI and max throughput outperform the result while round-robin achieves the best between spectral efficiency and fairness. Proportional and resource fair are channel aware schedulers both provide the throughput after estimating the channel condition and they achieved the efficient throughput and spectral efficiency.

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