# A Novel Fuzzy-based Spectrum Allocation (FBSA) Technique for Enhanced Quality of Service (QoS) in 6G Heterogeneous Networks

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***Abstract*—This research focuses on Device to Any device (D2A) communication for 6G in unpredictable circumstances where the topology of the D2A network changes over time as a result of the mobility of D2A Devices. Extremely sophisticated applications with demands for ultra-low latency and ultra-high data rate can be made achievable by cellular D2A communications in 6G. The best way to ensure Quality of Service (QoS) is to make the most of the scarce MAC Layer resources. To share information between D2A systems and a variety of devices, spectrum allocation is crucial. In this paper, a novel Fuzzy Based Spectrum Allocation (FBSA) approach is established to efficiently and rational distribute resources for D2A. A system model for D2A transmission has been established for metropolitan regions, common security and non-secure services are implemented in the network to assess the network performance for this feasible technique. Comparing the proposed FBSA approach to its prior works, which could not deliver guaranteed services due to low resource utilization. Riverbed Modeler simulation results show that the proposed approach can significantly enhance resource usage and satisfy the requirements of D2A systems.**

***Keywords*—FBSA; D2A; 6G; spectrum allocation; QoS**

## I. Introduction

The academic and research community have been motivated by the search for new strategies to optimize heterogeneous infrastructure and boost network performance by 6G technical constraints. The emerging sixth-generation (6G) architectures core technology, D2A transmission, promises enhancements to spectral efficiency, overall system capacity and data rates. These network performance enhancements served as the impetus for a considerable amount of D2A research, which revealed important obstacles that must be overcome before these technologies can fully realize their potential in 6G networks and beyond. The sixth-generation (6G) mobile communication networks are anticipated to be a key component of D2A transmission. Due to its ability to support large bit rates and reduce delay, D2A can be used to implement several of the 6G specifications. Throughput, energy efficiency, latency, and accountability may all be improved by D2A communications gains in bandwidth utilization, spectrum reallocation, and noise reduction [1], [2]. Additionally, D2A can provide reduced electrical consumption for the D2A devices interacting due to shorter connection times. Since D2A can enable mobile traffic offloading, it is generally expected that non-D2A cells will also profit from it since they will have access to greater bandwidth for communication with the BS and experience less interference as a result. The use of mmWave communication, non-cooperative subscribers, disruption management, power regulation, privacy, cell expansion and outsourcing, device exploration, method choosing, QoS and trajectory choice as well as transition administration are some of the challenges that must be overcome in order for D2D to be fully realized [3], [4]. The paper analyzes the concept that the D2D communication is an optimization problem that should be independently solved using a fuzzy technique based spectrum allocation rather than being an international challenge that needs to be addressed remotely. The recent [5], [6] article makes a suggestion that the control be handled locally by the device in order to build communication links more quickly. We suggest that in the difficult and dynamic environment of D2A communication, distributed fuzzy technique based spectrum allocation control is most appropriate. To the greatest extent of our understanding, no approaches have been proposed in the literature that encompass every D2A demand. We selected the fuzzy technique because to its capacity to simultaneously answer a number of complicated problems.

In the past few years [7], [8], D2D transmission in 6G heterogeneous networks has received a lot of attention. Ad-hoc, multi-hop, heterogeneous transmission in 5G, in contrast to the D2D communications supported in 6G, offers more complex services. These services carry out more beneficial operations; however, require more effort and have stronger guidelines and they also use a lot of bandwidth and effort. D2D in 6G employs multi-carrier Time-division multiple access (MC-TDMA) at the MAC layer and enables channel widths of 1MHz at the 1THz band. Multiple successive resource channels in the same frame make up a sub-channel. 48 subcarriers with a frequency of 10 KHz each comprise frequency channel, which has a width of 90 KHz. The least amount of spectrum resources each device is capable of receiving. [9], [10] The data link shared channel is used to send data packets from physical layer channel, while the data link layer control channel is used to send channel state information, which stores the modulation and encoding scheme used for decoding at the receivers. The amount of spectrum that will be used for transmission depends on how much data will be sent.

The preferred distribution of resources strategies can be reviewed in [11], [12]. The first one is a straightforward automatic allocation method, which chooses spectrum and sub-channels at unplanned for each request. A cellular user-aware distribution of resources approach is the alternative. The main goal of this strategy is to minimize the number of simultaneous connections in the network while minimizing beneficiary disruption. When cluster-cell, co channel disruption is not taken into account, these systems can achieve a packet delivery ratio of over 95% since the intra-cell interference is minimized to the utmost level. The previously mentioned methods, however, are unable to ensure excellent service because a sizable fraction of requests have been denied, meaning those users are unable to communicate with others in their network. Due to the size difference between two packets in two consecutive selections, this research [13], [14] identified the inefficiency of the channel sensing system in sub-channel reselection. Based on the research, it was suggested to change the original channel sensing to fully utilize sub-channels. An evolutionary algorithm-based strategy to ensure balanced simultaneous spectrum distribution and power management for fundamental D2D multi-hop communications analyzed in paper [15]. Additionally, in [16], the authors suggested a method for power regulation in two-tier NOMA microcell networks utilizing the swarms approach.

Other sophisticated method is described in study [17], [18], where the authors developed a method for allocating resources approach based on swarm optimization to address the issue of intelligence-based wireless allocation of resources for multi-hop-based D2D communication. As part of the assessment, we will contrast our findings with those of [19]. In order to find companions for bandwidth distributing, the authors in [20] apply a low-complexity method to match connections with cellular users. We will also compare [21], which analyzes the advantage collaborative multichannel transmission offers when utilized to increase the data rate in heterogeneous communication and enable user data distribution through the usage of nodes. which resolves a dual problem of subcarrier assignment and power allocation, none of the techniques listed above address more than one of the numerous problems mentioned. which asserts to provide a remedy for concurrent system admission control, mode and frequency channel assignment, and power distribution in energy-harvesting heterogeneous networks. [22] As far as we are aware, no other research has been done to address 6G D2A communication concerns employing many users and broader machine learning capabilities. In addition to gigantic cells, which offer extensive coverage, heterogeneous networks [23], [24], are among the possible methods for supporting 6G cellular networks.

There are distinct radio interfaces on the 6G D2A. The interface is for direct transmission between D2A, whereas the uU interface is a cellular interface for facilitating D2A infrastructure transmission via uplink. For D2D, the 5G standard specifies eight possible work scenarios. However, due to their various spectrum allocation strategies, only few interfacing modes can provide low-latency communications [25], [26]. Devices often transition to mode 5 and mode 6 choose frequency spectrum resources on their own using a sensing-based device scheduling technique when they are out of coverage. In contrast, device operate in mode 5 when they are inside base station communication range, where there are two choices for spectrum distribution. Base stations either control and periodically allocate the resources or reserve them using the channel sensing approach [27], [28]. The importance of the dynamic resource allocation approach in cellular is underappreciated because a lot of previous research involving physical resource allocation concentrate on transmission scheduling and resource schedule for cellular mode. However, a large proportion of devices are utilized in cities, where several devices exchange a great deal of data. Innovative resource allocation, one of the candidates in cellular mode, also has great potential to exploit resources more effectively and ensure QoS, especially when addressing the strict requirements of the D2A services [29], [30].

However, the device sensing-based scheme exhibits flexibility due to its distributed working manner. In this paper, we investigate the use of fuzzy approach-based channel allocation, one of the key elements, to address issues with resource allocation in cellular mode and to improve network performance in 6G D2A. It is crucial in artificial Intelligence because the fuzzy approach's workings are similar to those of the neurological system. Recent developments demonstrate how artificial intelligence is adopting fuzzier concepts. A methodology for data storage in cellular networks was proposed in the study in [31], [32]. The protocol combines fuzzy learning to assess long-term effectiveness and fuzzy logic to decide which carrier node to use. In paper [33], [34], artificial learning as well as fuzzy analysis are combined to evaluate Network of Everything resources. When defining the appropriate weights for QoS qualities, fuzzy analysis is used to handle uncertainties, and automated instruction is used to categorize resources [35], [36].

The following are the contributions we are making to this article:

*1)* To completely utilize the MAC layer resources and maximize the reuse of limited resources without explicitly tampering, a novel fuzzy approach-based resource allocation methodology is proposed.

*2)* The fuzzy approach is an adaptable approach that may proactively modify variables in the process based on analyzing the network's current state, ensuring the optimal performance at all times.

*3)* Riverbed Modeler is used to analyze a cellular D2A network in metropolitan regions and create a system-level simulation model based on an infrastructure and framework for heterogeneous networks.

*4)* Standard D2A services are implemented in the network, including both related to security and non-safety services, and the efficiency of the network is determined.

*5)* We describe a demonstration of concept approach that allows artificial intelligence to be used in the D2A transmission mode selection process while still maintaining good spectrum efficiency and minimal computational load.

*6)* We analyze this suggested modification in different circumstances and present clarifications of how it works.

The remainder of this paper is organized as follows: System Model on D2A communications and heterogeneous networks is provided in Section II. Section III demonstrates research in FBSA Technique for D2A Heterogeneous 6G Network. Section IV addresses Results and Discussion and the paper is concluded in Section V.

## II. System Model

Multiple cellular user smart devices are simultaneously given access to basic safety services, D2A services, and entertainment-related services in 6G heterogeneous networks. Our objective is to assign resources to those consumers in order to fulfill their demands for low latency, data rate, and packet delivery ratio. The system model taken into account in this paper is shown in Fig. 1.

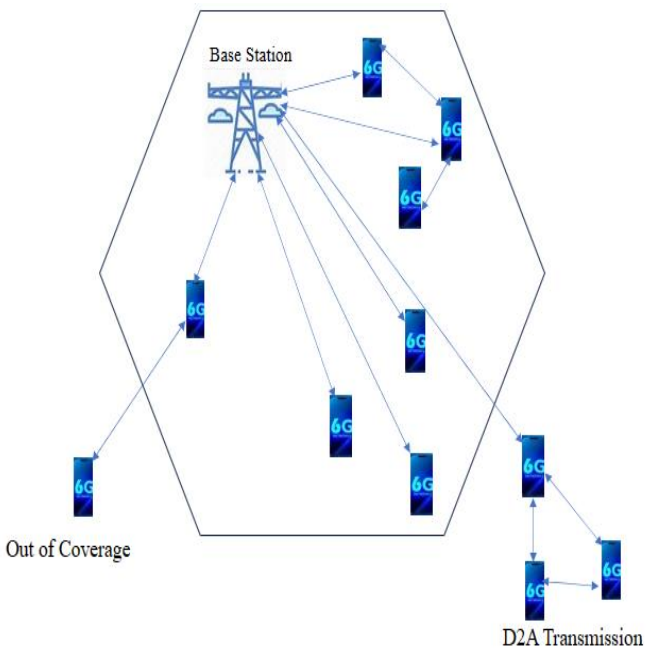


Fig. 1. System model D2A.

In the model, several user types connect to the base station, and they all come together to build a cellular network in an urban setting. A sensing device can be thought of as a static user. The base station's coverage area includes all users. Each sensing unit can communicate with other mobile users within the area it covers. Information sharing between cellular users operating in modes is possible through uplinks. On the other hand, the base station handles the resources in a statistical and dynamic manner. Every time a user distributes a message, it must first send a request to the BS via uplink to request authorization and physical infrastructure. The user can start transmitting depending on the resources allocated by the base station once it receives a response from the base station indicating which actual resources in the reservoir have been reserved for the users via uplink. In contrast, a request will be refused if the BS cannot provide the requested resources and the user will then end the transmission as a result. Additionally, we assume that the uplink radio interface in a semi-duplex mode, which prevents users from simultaneously sending and receiving data via uplink due to heavy interference. We take into account eight typical services in the system model. The chosen services comprise both security-related and non-security-related services, each with unique features, to clearly demonstrate how different applications affect the performance of the D2A heterogeneous network.

The characteristics and criteria are shown in Table I. The Common Attention Notification is a regular message that all devices transmit. Its main objective is to increase mutual awareness amongst devices nearby by exchanging speedy status information. It functions similarly to the basic safety message. Assisted movement is a service for enhanced device coordination, such as computerized grouping together and automated position changes. In comparison to the Common Attention Notification (CAN), a higher data rate and signal frequency are needed since it involves the exchange of information in a fast-moving environment. Simultaneous sensing, which is distinct from CAN and cooperative movement, refers to the extended sensors in D2A. Devices only begin transmitting data produced by sensors mounted inside them when specific triggering events occur. In this scenario, enormous amounts of data are transferred quickly to avoid accidents. Because sophisticated traffic scenarios that can occur at crossings may result in latent risks, we make the plausible assumption in our system model that devices broadcast such forms of data to prevent collisions only when they arrive at an intersection. In order to avoid collisions, a massive amount of data is transferred in this scenario in a brief length of time. Due to the potential for latent risks at an intersection caused by the complex traffic conditions that can occur there, it is fair to assume in our system model that devices broadcast such types of data to prevent crashes only when they reach at a crossover. Sensing units periodically broadcast messages to inform devices of the channel conditions and traffic scenarios as they relate to dynamic traffic control and warning. Regarding both of the last use cases, which both involve services unrelated to safety, it should be noted that real-time content is frequently used in cultural entertainment and media applications like multimedia online chat and streaming films over the Internet, whereas non-real-time information is required by data downloading and uploading activities like transferring and receiving messages and communication. We use Collaborative Sensibility Device (CSD) 1, Collective Action Device (CAD2), Communication in Sensing Device (CoSD3), Adaptive Congestion alert and Management (ACM 4), Safety and Real-time Management (SRM5), Safety and Real time Management (SRM6), Non-safety and Non-real time Management (NNM7), Non-safety and Non-real time Management (NNM8) to signify the eight services that will be deployed in our system model, as indicated in Table I, to make discussion in the following parts easier.

TABLE I. TYPE OF SERVICES AND BROADCAST IMPLEMENTED IN D2A TRANSMISSION

| Equipment | D2A Services and Transmission type | Signal Frequency | Latency | Data Rate |
|---|---|---|---|---|
| **Device 1** | Collaborative Sensibility Device (CSD 1) with Continuous Transmission Type | 50ms | 50ms | 100-500 Mbps |
| **Device 2** | Collective Action Device (CAD2) with Continuous Transmission Type | 25ms | 25ms | 50-250 Gbps |
| **Device 3** | Communication in Sensing Device ( CoSD3) with Broadcast Transmission Type | 20ms | 20ms | 50-100 Gbps |
| **Device 4** | Adaptive Congestion alert and Management (ACM 4) Device with Continuous Transmission Type | 100ms | 100ms | 10-50 Gbps |
| **Device 5** | Safety and Real time Management (SRM5) with periodic unidirectional Transmission type | 0.5 ms | 500-44595 ms | 10-20 Gbps |
| **Device 6** | Safety and Real time Management (SRM6) with periodic Bidirectional Transmission type | 0.5 ms | 500-44595 ms | 10-20 Gbps |
| **Device 7** | Non-safety and Non-real time Management (NNM7) with periodic Unidirectional Transmission type | 1 ms | 10 ms | 20-50 Gbps |
| **Device 8** | Non-safety and Non-real time Management (NNM8) with periodic Bidirectional Transmission type | 1 ms | 15 ms | 20-50 Gbps |

## *A. Performance Metrics and Analysis*

*1) Packet Delivery Ratio (PDR):* Packet Delivery Ratio is a ratio between the number of data packets actually delivered over the number of knowledge packets transmitted by way of the source node. The BS receives transmission requests from all cellular devices during this time, and based on whether resources can be located using the allocation approach, it either assigns substance assets to the cellular device or rejects the requests. As a result, it shows how many broadcasts the network can support.

The packet delivery ratio is defined as follows,

N - The total number of cellular users in the heterogeneous network,

$N_R(j)$ - Total number of requests made by users (j),

$N_T(j)$ - The total number of transmissions from users(j).

$P_T(i)$ -Total number of Packets transmitted from users(i)

$P_R(i)$ - Total number of Packets received from users(i)

The packet delivery ratio is mathematically represented as

$$\text{PDR} = \frac{\sum_{j=1}^{N} N_T(j)\, P_T(i)}{\sum_{j=1}^{N} N_R\,(j) P_R(i)}$$

Within a transmitter's transmission range, packet receiving is typically assured. The PDR, however, could be impacted by adjacent channel interference brought on by co-channel reuse. When a transmission k is connected to a receiving user j,

Let consider,

$N_{BC}$ - broadcast Communication

$N_{UC}$ - Unidirectional Communication,

The packet delivery ratio is defined as

$$PDR = \frac{\sum_{k=1}^{N_{BC}} \sum_{j=1}^{NR(k)} M(j,k) + \sum_{j=1}^{N_{BC}} M(j)}{\sum_{k=1}^{N_{BC}} NR(k) + N_{BC}}$$

Where $N_{BC}$ denotes the number of receivers included in a broadcast transmission's coverage area. For a unidirectional transmission, there is always just only one receiver.

# III. A FUZZY BASED SPECTRUM ALLOCATION (FBSA) TECHNIQUE FOR D2A HETEROGENEOUS 6G NETWORK

The optimal selection of resources for uplink transmissions in a heterogeneous network is specified by the proposed fuzzy-logic based spectrum allocation, which also maximizes spectrum reuse and enhances heterogeneous network performance.

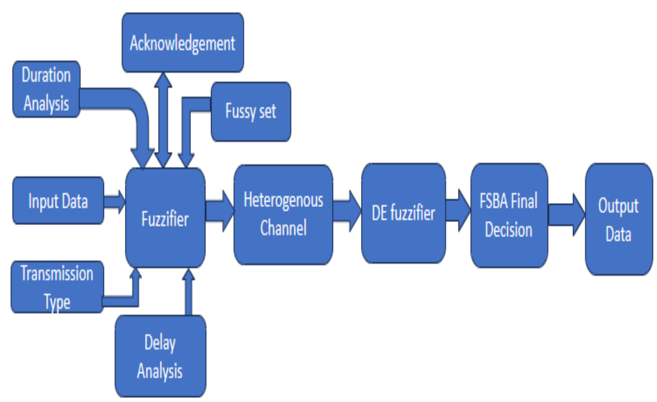


Fig. 2. FBSA technique.

The FBSA algorithm's workflow diagram is shown in Fig. 2. The use of fuzzy logic to solve the problem of understanding approach to get from one input to a desired outcome is known as fuzzy inference. Consulting the following diagrammatic representation may help with decisions. Fuzzy inference techniques have been successfully applied in a number of fields, including data classification, skilled systems, automatic control, evaluation of decisions, and visual analysis. Due to its vast application, the fuzzy inference system is also known as flexible-rule-based systems, fuzzy experts, fuzzy estimation, fuzzy memories, fuzzy logic control devices, and just fuzzy systems.

The fuzzy circuits at the heart of the FBSA algorithm are responsible for processing incoming data and producing precise results reflecting the availability of particular facilities. The input variables are Processing time, cross-talk, uni-directional, and operation priority will be used to evaluate if the spectrums are appropriate for a broadcaster. The user functions that transform single-valued inputs into the values of an array of fuzzy values will fuzzifier the six related factors in response to a request from a cellular user. The inferential function will evaluate the fuzzy values in accordance with established guidelines. Finally, the assessment that reflects the nature of a result will be defuzzied, and the amounts of data used in decision-making will demonstrate allocation. Additionally, the fuzzing function collects information from the instantaneous form heterogeneous network performance, which also serves as knowledge, and uses it as a key factor in altering the subscription functions' variables. In this research, the joining functions of the influence factor and the semi-duplex factor's values can be influenced in accordance with the properties of the inputs, and the precedence of the amenities that are offered in the network can also be adjusted correspondingly. Notably, the user should provide a training sequence containing information about its present location and packet reception during the previous transmission period before each uplink transmission.

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## IV. Results and Discussions

Riverbed Modeler is used to simulate the FBSA outcomes. The Fuzzy Logic rules were implemented using a simulation tool. The details of the FBSA rules and simulation parameters are provided in Table II.

TABLE II. SIMULATION PARAMETERS OF FBSA

| Simulation Parameter | Value |
|---|---|
| Maximum Capacity | 500 GHz |
| Front haul Distance | 80 KM |
| Number of Devices | 200 |
| Transmission distance of each devices | 1m Radius |
| Medium Access Control Protocol | IEEE 802.11 (1Tbps) |
| Device Mobility | Grid (500m x 500m) |
| Packet Size | 1024 bytes |
| Papulation size | 50000 |

We use the proposed FBSA technique to compare heterogeneous networks. The value of the spectrum allocation cost function, which should range between 100 and 600 when the suggested FBSA technique is used, serves as the primary indicator for evaluating the proposed technique. We invested our findings to the test by maximizing the weights of several goals. These goals have a loose connection to five alternative resource allocation scenarios that concentrate on heterogeneous network characteristics. The allocation function variation for the optimized parameters utilizing the FBSA approach is shown in Fig. 3.

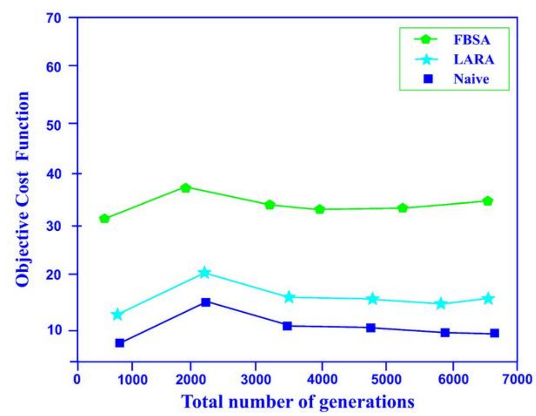


Fig. 3. Variation of objective cost function value for different number of generations.

Each generation has a 600 MHz spectrum allotment size, with an increment of 100 bringing the number of generations from 100 to 600. Beyond 60 generations, it is noticed that the value of the objective function stays mostly unchanged. It is observed that increasing the number of generations maximizes the value of the objective function. Additionally, a statistical analysis is done to evaluate whether the FBSA output is 99% accurate. It has been noted that results with fewer generations are likely to vary more; nevertheless, if the number of generations reaches 100, there is a very strong probability that the result will be optimal because the interval between the data points is fixed.

The 5G-optimized cost function value is optimized to 13.52, which is the multi-objective spectrum allocation function's score. However, the optimal score for the 5-G multi-objective function should fall between 5 and 10. The value of the multi-objective cost function could not be optimized as a result by the 5G heterogeneous network. As a result, we use our proposed

FBSA approach to optimize the weights of the objective function in order to enhance the outcomes of the spectrum allocation function. The outcomes shown in Fig. 3 demonstrate how the proposed FBSA reduces the value of the cost function to an optimal value of 1.8.

Based on the system model, a cellular D2A network is simulated in Riverbed Modeler to determine the performance of the proposed FBSA discussed above. It consists of a single base station, numerous cellular user using cellular handsets, all user devices are covered by the base station's coverage. additionally, taking into account that both intra- and inter-cell interference does indeed are available, as illustrated in Fig. 4, we simulate seven separate cells simultaneously and evaluate the performance of each cell.

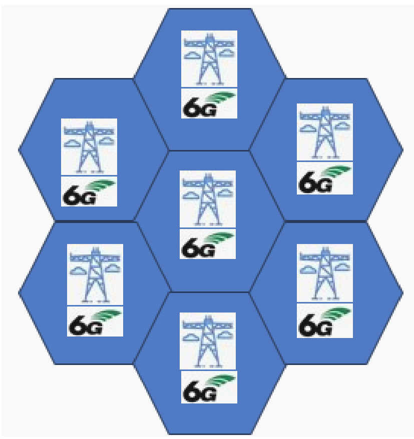


Fig. 4. Seven cells in a cluster in the simulation model.

The coverage region of a cellular network is typically depicted as a hexagon. The hexagon is not representative of the situation. A hexagonal cell, however, indicates that some of the devices may be connected might not be connected. Inter-cell interference and co-channel interference is also taken into account in the simulations that were run. Inter-cell interference typically has a major impact on devices traveling in a high speed near two cells. It is challenging to co-channel interference and show its influence on square cells. Therefore, a hexagonal cell is more suited to expose the actual performance of D2A heterogeneous networks for both realistic and simulational reasons.

TABLE III. SIMULATION SETUP

| Parameter | Value |
|---|---|
| Required Frequency | 1 THz |
| Bandwidth | 80 MHz |
| Number of Cellular users | 200 |
| Transmission Range | 500m |
| Number of cells | 7 |
| Velocity | 100 km/h |
| Area size | 100m x 100m |
| Noise | AWGN |
| Channel Model | Rayleigh fading model |
| Modulation Scheme | 128QAM (Quadrature Amplitude Modulation) |

Table III shows the key simulation parameters. There are 44 subchannels and 200 subframes in the resource spectrum. If adequate resources can be found, a transmission request should be approved in the following ‘T’ subframes to prevent significant delays. The value of ‘T’ is based on various services. The variable ‘T’ for SRM5 transmissions is 0.5ms. If not, it would be the equivalent of an endless delay. Additionally, within a sender's transmission range, successful packet receipt can be guaranteed; nevertheless, cellular device outside of the range may still have a lesser likelihood of receiving the transmitted data. Different service combinations have been investigated in the simulations to better assess how various D2A services affect the network throughput. We use typical basic safety services, four D2A services, and four entertainment services to evaluate the performance of the suggested allocation mechanism. SRM5 is the most bandwidth-intensive and has the strictest requirements of the eight services. Additionally, a very brief delay of 10 ms or 15 ms is needed for NNM5 and NNM6, respectively. We have chosen these several service kinds to see if the proposed FBSA can meet the needs of various services.

Numerous simulations have been used to compare the FBSA scheme to the naive and LARA schemes in order to assess network performance in terms of packet delivery ratio, successful transmission ratio, and network throughput.

Fig. 5 shows the PDR performance for case 2 for each of the three approaches. The naïve scheme, which is followed by the LARA and the FBSA, has the highest PDR. Because the naive has no intra-cell interference and the LARA has very little intra-cell interference, both have better PDR, and the accompanying curves are extremely close to 100%. Their propensity for avoiding conflicting transmissions in the same cell to the greatest extent determines this. However, in order to accommodate additional demands from cellular users, the FBSA permits as many simultaneous connectivity as is practical. Thus, intra-cell interference will unavoidably manifest and lower the PDR. Additionally, because resource allocation in each of the co-channel cells operates separately and the interference primarily impacts cellular devices that are close to the boundaries, co-channel interference severely affects PDR for all four schemes virtually to the same extent.

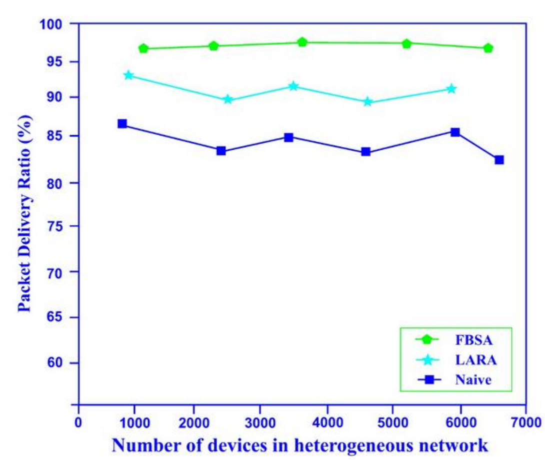


Fig. 5. Packet delivery ratio for various number of devices in heterogeneous network.

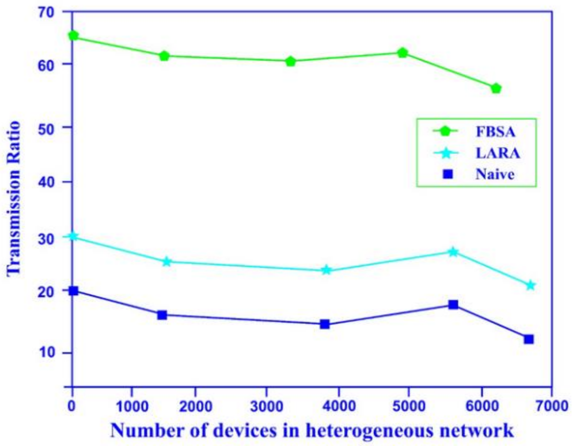


Fig. 6. Transmission Ratio for number of devices in heterogeneous network.

In a D2A network, transmission ratio is plotted versus the number of cellular devices in Fig. 6. Due to increased competition, it is harder for the base station to locate resources for excessive transmission demands when the number of vehicles on a cellular network increases. As can be seen from the figure, the transmission ratio decreases noticeably for both the LARA and naive schemes in any situation when the number of cellular users increases. In addition, in the most extreme case, if all eight services are activated and the naive technique is used, the transmission ratio turns out to be at a fairly low level of 0.5 even if there are just 500 devices dispersed over a 100 km region, not to mention the case with more cellular devices. In other words, more than 90% of requests are turned down, which makes it challenging to meet the needs of many D2A applications. Even while the LARA system, when compared to the naive, can increase the transmission ratio in some way, it is still not adequate. For all four instances and device volumes, the FBSA can keep the transmission ratio at least 99%. When D2A services are enabled or disabled, however, FBSA outperforms the other two techniques in terms of transmission ratio. This is based on the findings that, for a given resource allocation scheme, the gaps between different services for three schemes, with the FBSA having the shortest gaps.

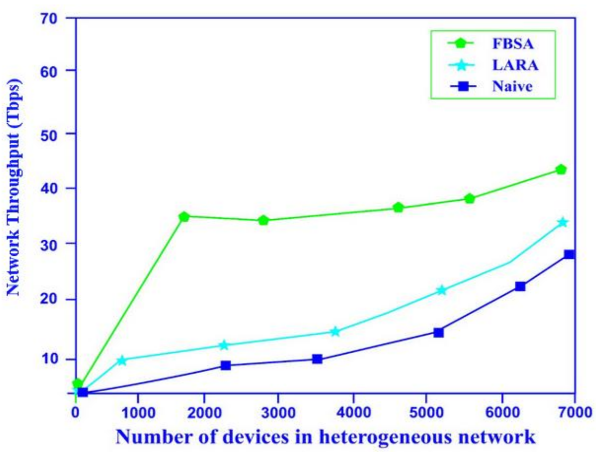


Fig. 7. Network throughput for number of devices in heterogeneous network.

The network throughput is displayed in Fig. 7. Because the network is already congested and cannot allocate any more resources to cellular devices in Fig. 7, the throughput of the naive and the LARA are insensitive to the number of cellular devices. The network speed attained via FBSA approach, however, progressively increases from 100 Gbps to 1 Tbps, exceeding its competitors by a factor of more than 100 times. Because example 1 only comprises six safety D2A services and includes all services, each scheme's relevant curves in Fig. 7 are fairly similar. The likelihood of sending four non-safety services, however, is barely 0.5, and they both have the lowest priority. They cannot significantly increase network throughput.

Contrarily, it can be shown from a comparison of the bottom curves, that the four D2A services have a greater impact on throughput than the FBSA for the naïve and the LARA. The throughput will be reduced from 1000 Mbps to 100 Mbps dramatically if one or more of the D2A services are removed. If FBSA is implemented in the network, these changes in the services offered do not, however, result in such a significant variation in throughput. The advantage comes from the FBSA adaptability, which can dynamically elevate a service's priority to a higher priority by network state. However, the LARA and naive always treat various service types equally and operate in a first-come, first-served manner, which may be impacted by the proportion of requests with various priorities.

## V. Conclusion

The 6G mobile communication networks are expected to include D2A Communication at its heart. We have researched the unique resource distribution for 6G D2A transmission. We start by outlining the various categories of resource allocation. We concentrate on centralized resource allocation, where the base station controls all dimensional frequency resources because User and cellular devices are within the base station's coverage area. The D2A standard, however, fails to offer for any centralized resource allocation. A flexible logic-based resource allocation mechanism called FBSA is suggested in the paper as a result of this. The FBSA evaluates all available variables as input parameters and uses fuzzy thinking to its ability to consider how to allocate appropriate resources to various users. To ensure optimal resource consumption, it may also centrally modify the fuzzy system's parameters in accordance with the state of the network. Then, using Riverbed Modeler tool, a simulation model is created to simulate D2A communications in heterogeneous cellular networks with co-channel interference. The outcomes of the simulation imply that the FBSA may significantly increase resource usage, enhance information distribution among diverse users, and enhance network throughput when compared to existing methods. The FBSA maintains reasonable complexity while offering an effective resource allocation solution. Future directions could involve applying the suggested technique to newer heterogeneous networks, particularly when it comes to resource allocation and compute offloading in heterogeneous dense networks. Additionally, OpenFlow and Mininet may be used to test the suggested approach.

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## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

## DECLARATION OF INTERESTS

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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