Network resource Allocation security techniques and challenges for Vehicular Communication Network Management

Vartika Agarwal[1*], Sachin Sharma[2], Gagan Bansal[3]

Graphic Era Deemed to be University, Dehradun, India

*vartikaagarwal_20942026.cse@geu.ac.in

Abstract- Internet of things describes the network of physical objects such as sensors, receivers, transmitters and other technologies which are used in VCN. In Vehicular communication network two or more vehicles are communicate with each other. VCN **use** advanced technologies to solve transportation related problems like long traffic delays, road accidents and air pollution. IOT based technologies make vehicular network smart. In this paper we reviewed about network resource allocation security techniques, challenges and also discuss how we can make vehicular communication network smarter. We reviewed about different models and schemes for V2V communication. These schemes were developed to ensure a fair, efficient and transparent allocation of resource in an intelligent transportation system.

Keywords – Vehicular Communication Network (VCN), Network Resource Allocation (NRA).

1 Introduction

Allocation means assignment of available resources for the best use. In vehicular communication network there are various resources such as sensor, transmitter, receiver which plays a major role in vehicular communication network. Such resources are helpful for avoiding any accident etc. There are various resource allocation models which is responsible for vehicular communication

- **Peer-To-Peer System Model** – In vehicular communication Network, there are a number of resources. Such resources help to transfer message from one vehicle to another. Peer to peer system model consist of task allocated to the resources and time taken by the resources to accomplish their task successfully.

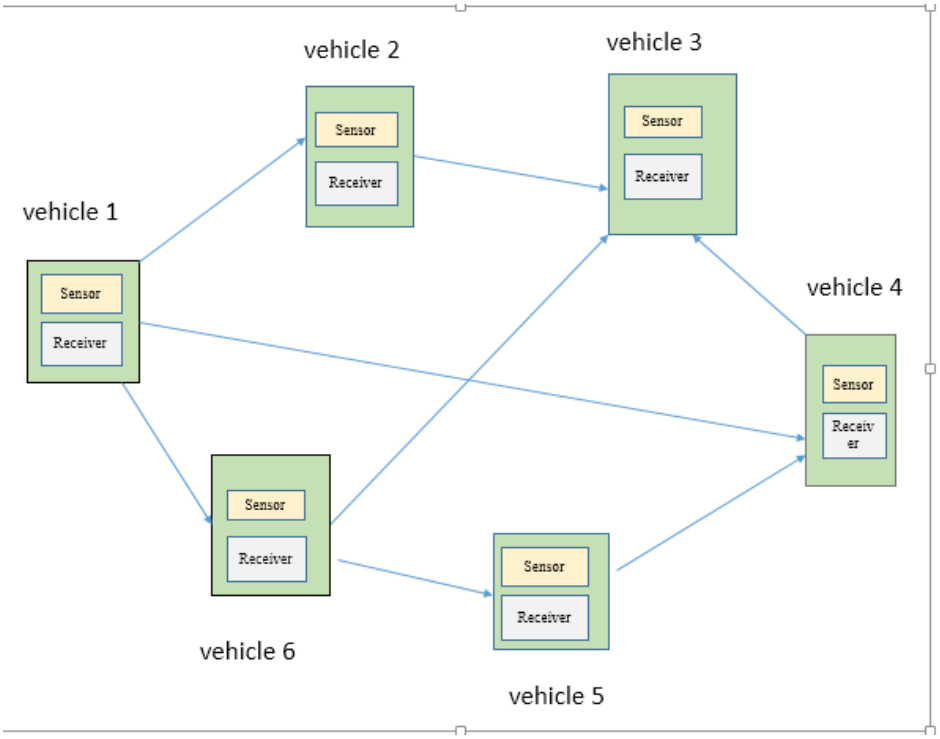

Fig. 1. Communication between Vehicles

In Fig. 1, there are 6 vehicles. Each vehicle contains sensors and receiver. Sensor and receiver are basically used for message passing among vehicles. They share message among traffic jams, accident etc. Peer to peer system model consist of n number of vehicles and n number of resources which plays an important role in communication process.

- **Rule Based Resource Allocation Model -** This method focusses on time allocation and effective use of resources. In this model, tasks are allocated to the resources on the basis of priority. This model uses queuing system. For example – In vehicular communication network, firstly task is allocated to the sensor, sensor have to provide response immediately if vehicle comes in dangerous situation.
- **Resource allocation for controlling of Congestion** – When multiple tasks are allocated to the same resources, chances of congestion will take place. So we have to use congestion control method for efficient use of resources.

These resource allocation methods are used for proper communication between vehicles. These methods make resource allocation effective and efficient.

Structure of paper is as follows: This paper has following sections

Section 2 examines about the connected work which involved in resource allocation process. Section 3 explains the overview of vehicular communication network. Section 4 represent the vehicular communication network properties and Section 5 represent the requirements of Network Resource Allocation for Vehicular Communication Network Management. Section 6 explain importance of VCN and Section 7 highlight internet of things in VCN. Section 8 describe challenges of network resource allocation techniques. Section 9 represent the techniques used for network resource allocation. Section 10 shows the comparative study of different resource allocation scheme. Section 11 conclude the importance of resource allocation in vehicular communication networks.

2 Literature Review

In 2010, Alia Asheralieva investigate about predictive resource allocation technique to predict network loading. Such algorithm can find out changes in feature of traffic. Main objective of this algorithm is to increase power consumption [1]. In 2012, Andres Farragut study about network resource allocation schemes that manage multiple connections through different routes. This schemes are implemented in NS2 and able to solve stability and fairness related issues [2]. In 2014, Farshad Shams reviewed about radio resource allocation techniques such as OFDM and OFDMA systems with its advantage and disadvantage. These techniques focus on energy efficient approaches. They highlight difference between different radio resource allocation schemes for better throughput [3]. In 2014, Georgios highlight cognitive radio networks. They proposed on dynamic resource allocation technique and discuss about game theory, linear programming as well as fuzzy logic [4]. In 2015, Hoon Lee focus on multi-user wireless powered communication networks. They proposed an algorithm for energy and time allocations. There algorithm provide better performance as compared to other conventional techniques [5]. In 2015, Wei Wu examined about the problem of secrecy outage probability minimization. They design the energy efficient and secure NOMA based MEC network. This network provides better throughput in comparison of other networking models [6]. In 2016, Sanjeevi pandiyan present a review on energy consumption. they highlight difficulties occur in existing energy reduction method. They compare different energy consumption techniques with their advantage and disadvantage [7]. In 2017, Belen Bermejo highlight important concept regarding energy consumption optimization. These concepts enable effective and efficient resource management [8]. In 2017, Quingyang propose the concept of proportional share resource allocation algorithm. They increased the network throughput and share network resources with other users [9]. In 2017, Le Liang proposed spectrum sharing and power allocation technique for reliable communication between vehicles and maximize the throughput of V2V communication. [10]. In 2019, Wei Wu investigate about NOMA based MEC networks. Goal of this network is to reduce consumption of energy. Experimental results are used to validate accuracy and correctness of system [11]. In 2020, Steffi Jaya kumar proposed various resource allocation schemes for improving the performance of device to device communication. This schemes enable high-speed data transmission, information transmission as well as improve the system performance [12]. In 2020, Sahrish khan Tayyaba proposed flow based policy framework on the source of software defined networking. Some deep learning algorithm such as LSTM, DNN and CNN are used in their research [13]. In 2020, Xuemei Li review about resources used in IOT. It highlights network resource allocation techniques such as RFID, Cache, Wireless etc. which are used in internet of things [14]. In 2020, Steffi Jayakumar analyze and evaluate different methodologies used for resource allocation they find out the research difficulties and drawn strong conclusion about device to device communication [15]. In 2020, Bodhaswar TJ Maharaj analyse highly resource allocation models for cognitive radio networks. These models are built for the hybrid architecture which is the most common technique in CR networks [16]. In 2020, J Praveenchandar proposed an efficient dynamic resource allocation algorithm to improve the efficiency of resource allocation. This algorithm reduce power consumption & provide better result as compared to other techniques [17]. In 2021, Kurdistan Wns introduced process of allocating workload among multiple resources. They use different resource allocation algorithm for 5G networks. Various resource allocation techniques are used in distributed system [18]. In 2021, Arwa Mohamed present a review paper on allocation of resources. They highlight operations of virtual machine, traffic Performance as well as conservation of energy. [19] In 2021, Vartika Agarwal highlight the different scheduling techniques in vehicular communication networks. These techniques help to plan the whole process in advance. [20]. In 2021, Miao Zhang investigate about power allocation schemes. Neural network is used to solve power allocation problem. This approach provide 95% accurate results as compared to other algorithms [21]. In 2021, Vartika Agarwal highlight the different technologies such as Lifi, LORAWAN, VANET and RFID. These technologies help in vehicle to vehicle communication. This paper reviewed about comparison in these different technologies [22]. In 2021, Vartika Agarwal reviewed about internet of things in transport management system. Such technology reduces road traffic and accidents [23]. In 2021, Vartika et al. investigate the deep learning techniques to solve radio resource issue in VCN.

[24]. In 2021, Fan Liang introduce a Deep learning based technique for utilization of bandwidth in IOT based system. They perform various experimental results for efficiency of system. This scheme can improve efficiency of energy as compared to other schemes [25]. In 2021, Mariem Allouch reviewed about emerging technologies in radio resource management scheme. These technologies are cellular vehicle to everything, device to device communication etc. They highlight many algorithms to address resource allocation issue. [26]. In 2021, Heena wadhwa designed a novel approach for allocation of resources. This approach is used to ensure resource optimization at bottom layer. IFogSim simulator is used for simulation of this scheme. This scheme minimize time of execution as well as consumption of energy and network [27]. In 2021, Yanmei Cao proposed a deep Q-Learning based scheme for resource allocation. This scheme maximize the throughput and achieve high system spectrum efficiency [28]. In 2021, Muhammad Ali Jamshed propose a novel electromagnetic field scheme and K means approach to control the resource allocated to the number of users. This schemes makes resource allocation process more effective and efficient [29]. In 2021, Sumarga kumar shah tyagi propose a distributed artificial intelligence approach for resource allocation. This scheme is based on Bayesian neural network and back-propagation neural network [30].

3 Overview of Vehicular Communication Network

Vehicular Communication Network is a network which shared information between different vehicles. Goal of VCN is to allow different vehicles to communicate with their drivers, roadside infrastructures, pedestrian and fleet management systems. In this concept, every vehicle is turned a smart node on the highway, with its own compute, storage and networking capability. Vehicular communication network is important because it reduce accidents and traffic jams. Some statistical data represents that the main reason of road accidents are human mistake. These accidents can be reduced if driver had been warned half second beforehand. This could be done with the help of vehicular communication networks. It provides communication among vehicles with an onboard unit and nearby roadside unit (Fig.2).

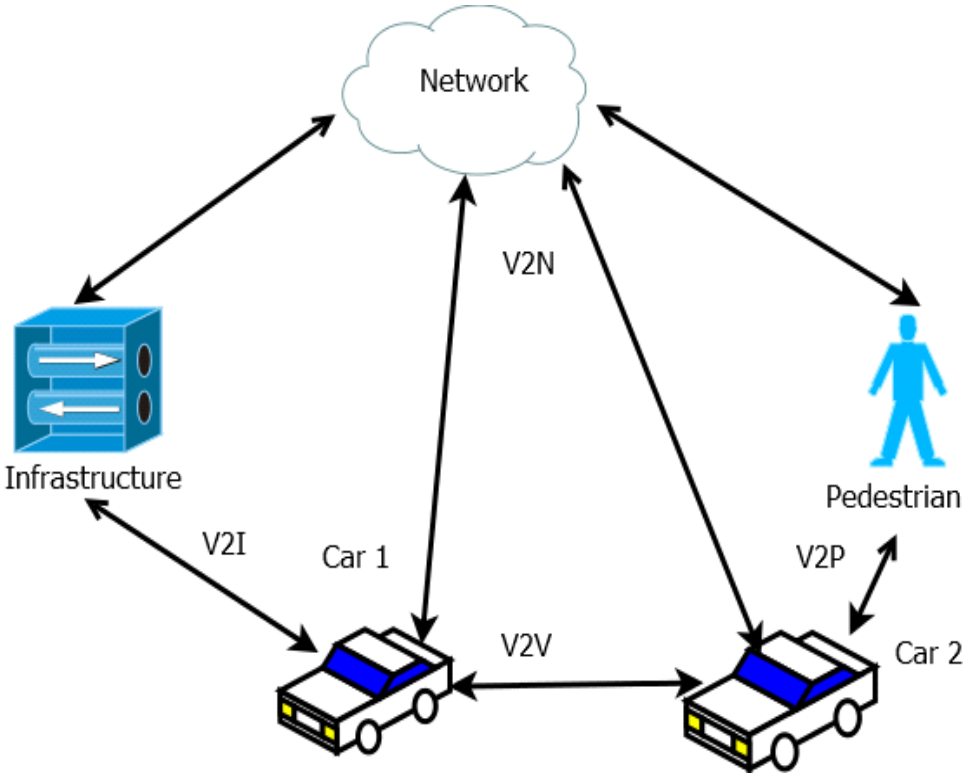

Fig. 2. Vehicular Communication Network

Vehicular Communication network offer following benefits

i. **Cost Reduction –** Many IOT devices are used in vehicular communication network. These devices are responsible for communication between vehicles. Sensors, transmitter, receiver are used for message passing between vehicles.
ii. **Efficiency –** IOT devices increase efficiency of whole processes in vehicular communication network. These devices warn driver about any mishappenings or suggest shortest route for reaching the destination quickly.
iii. **Mobility and agility -** IOT devices helps to track vehicle from any location. This technology helps to reduce crime and help to improve traffic congestion.
iv. **Security –** IOT devices are highly secure and safe. These devices validate that message between vehicles has not been modified during transmission process.
v. **Save Time –** IOT devices save time of passenger by informing advance about the current situation of road.
vi. **Boost Productivity -** Resource allocation gives a clear picture about work done by resources for vehicular communication. It increases productivity.
vii. **Changes in order of resources -** If any resource does not work properly in run time situation. we can change the order of resources.
viii. **Effectiveness -** Resource allocation makes vehicular communication process effective and significant. IOT devices are responsible for proper execution of whole communication process.

4 Properties of Vehicular Communication Network

Following properties of vehicular communication network makes communication process more effective and efficient (Fig.3).

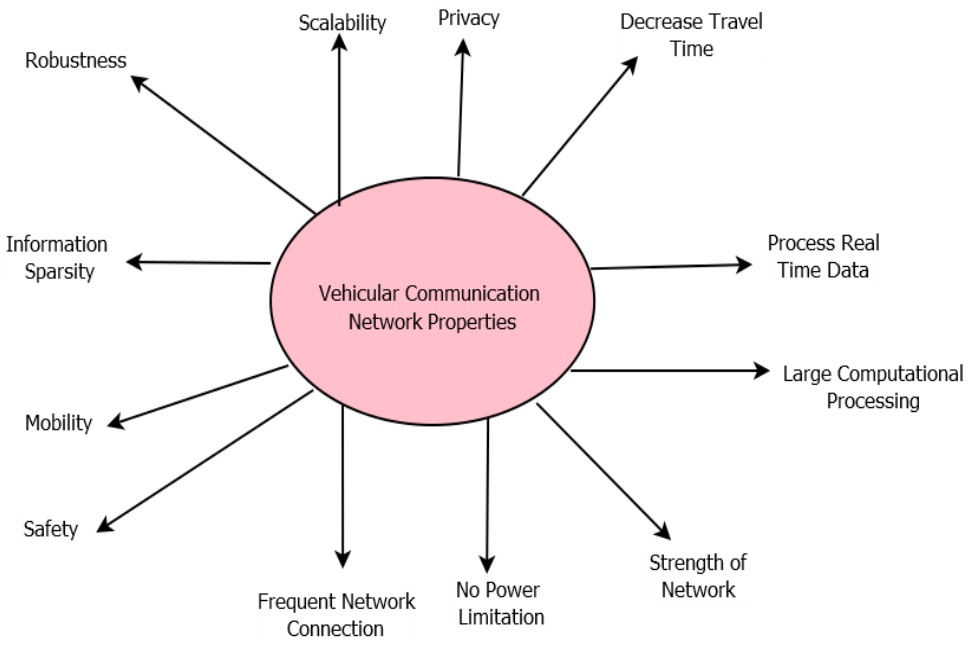

Fig. 3. Properties of Vehicular Communication Network

- **Scalability:** It is needed for proper communication between vehicles. Sometimes large no of vehicles passing through the network may be higher. In case of an emergency situations, driver have to take decision very fast. He has to receive information from trustworthy sources and network should be scalable.
- **Privacy:** In vehicular communication network, there is a need to be care of owner's information such as their address, vehicle registration no etc. driver have to use public key encryption technique for sharing information with other vehicles.
- **Robustness:** In vehicular communication network, there are some malicious nodes which modify the information and misguide the network. network have to identify such nodes and remove it from the network.
- **Information Sparsity:** It means weightage of information. Information which has highest priority should be delivered first.
- **Mobility:** The mobility of vehicular communication networks is too high. mobility is an important feature that plays a major role in this network. It reduces communication time in the network.
- **Safety:** VCN enhance the safety of the driver, passenger comfort and improve the flow of traffic. Main benefit of VCN is that vehicles can communicate directly with another vehicle through sensors, transmitter, receiver etc.
- **Frequent network connection:** Important property of vehicular communication network is frequent network connection. This network avoid any disconnection between communicating vehicles due to weather conditions or other issues.
- **No power limitation :** In vehicular communication network, vehicles can communicate through transmitter, receiver etc. So there is no need of power or long lasting battery just like vehicular adhoc network.
- **Strength of Network:** In vehicular communication network, strength of network is depend upon the flow of traffic. If there is a traffic Jam, it can be high otherwise it can be low.
- **Large Computational processing:** For VCN, vehicles should be embedded with sensors, transmitter, receiver, Global positioning system, antenna etc. These resources provide

reliable communication to obtain the exact information about speed, position and location of another vehicle.

- **Decrease Travel Time :** Through VCN, we can find the shortest route for reaching the destination quickly. It reduce travel time and increase passenger comfort.
- **Process Real Time Data:** Main motive of VCN is to avoid traffic and process real time data. It can be save time and fuel. VCN update their data from time to time so that user can get current information.

5 Requirements of Network Resource Allocation for Vehicular Communication Network Management

Vehicular Communication Network exhibits how resources have been allocated over the network. Vehicular network consists of transforming vehicles into an intelligent mobile entity that are able to interact with roadside units, Today, due to high Urbanizations, there are problems associated with road networks. New technologies and systems have been developed that can change way of life and example is VCN.VCN establish communication between vehicles and other road side entities. It saves money, ensure safety and reduce environmental impact as well as traffic congestion. Trend of vehicular communication network has increased with the enhancement in technologies and development of smart capitals across the country. VCN has a major impact in traffic services enhancement as well as reducing road accidents. Information shared in VCN are robust and secured but sometimes its security is being interrupted by different types of attackers.

6 Importance of Vehicular Communication Network

Vehicular Communication Network allow a wide range of applications such as

- Collisions prevention
- It gives post-crash notification.
- Traffic optimization
- Inter-vehicle communication,
- Intelligent traffic system
- Vehicular communication network can help you to find an alternative route to your destination if there is traffic on one route.
- Use of Vehicular communication network was to provide safety and comfort to drivers in vehicular environments.
- E-ZPass is a very good example of a payment service application of vehicular communication network
- Vehicular communication network could help in preventing crime by reporting on-demand.
- Traffic signal violation warning.

7 IOT in Vehicular Communication Network

Internet of things plays major role in vehicular communication network. IOT devices makes communication process more effective. In Fig. 4, we can see that there is an application server which is used to maintain the record of whole communication process. There is a network which is used to connect vehicles from other road side units. Sensors are basically used to find the speed and location of vehicles. Transmitters are very effective for vehicular communication network because it transmits information from one vehicle to another vehicle.

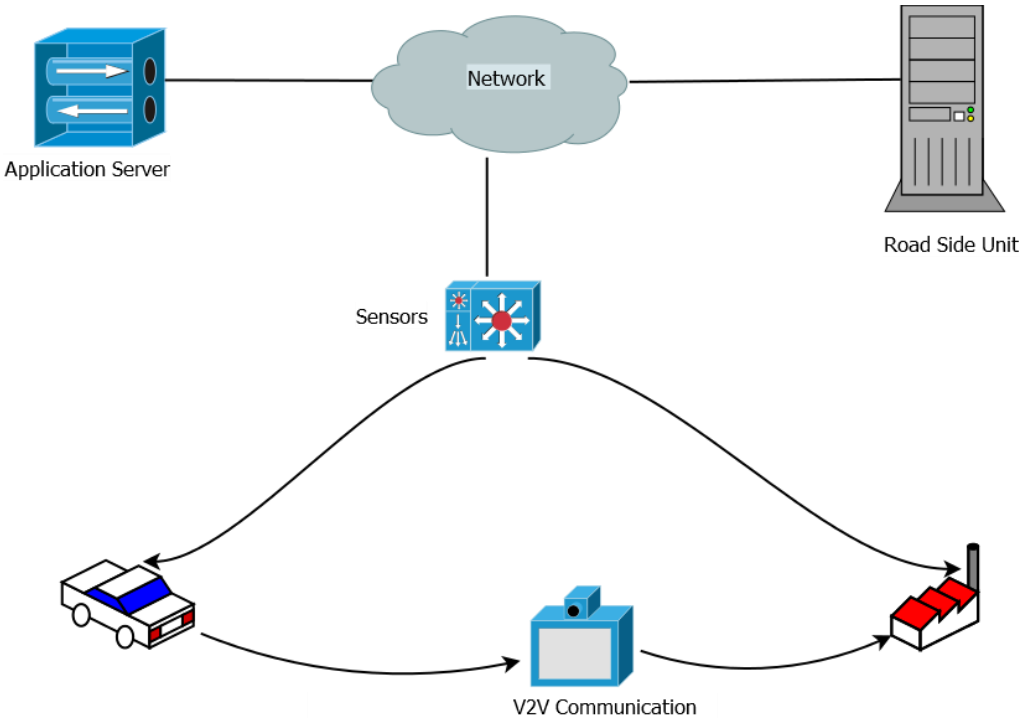

Fig. 4. IOT Devices in Vehicular Communication Network

- IOT enables vehicular communication network where large number of sensors are connected with each other for sharing status about vehicle.
- IOT devices detect collision in advance and avoid any mishappenings.
- IOT devices help drivers to know in advance about the road condition, traffic jams etc.
- IOT devices enhance safety and security of passengers by sharing information at right time.
- IOT devices use advanced technologies to solve problem related to transportation like long traffic delays, road accidents etc.
- IOT devices can monitor traffic jams, animals on road, car accidents. These devices improve the quality of life, safety, security. Vehicular network offers a range for monitoring and data sharing on various aspects of traffic so, vehicles can share different kind of data.
- Vehicles are now moving towards becoming computer on wheels. Through IOT devices there will be vehicle-to-vehicle and vehicle-to-roadside communication has been proposed for enhancing safety. It is the foundation of Intelligent traffic system.

8 Challenges of Network Resource Allocation security techniques

There are different challenges which occurred in vehicular communication process. We have to work on them for providing secure and reliable network (Fig.5).

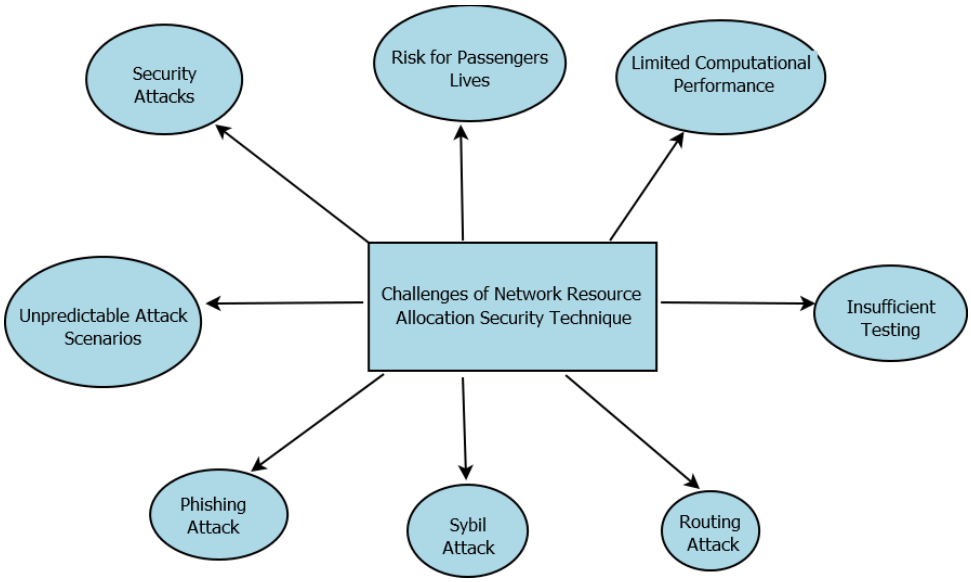

Fig. 5. Challenges of Network Resource Allocation Security Techniques

- **Security Attacks -** Since vehicles are completely dependent on their resources for all aspects of their operation, they are vulnerable to a broad spectrum of cyber security attacks. For solving security issue, communication efficiency, we have to design a smart vehicular communication network because present system lacks security and reliability.

- **Risk for lives of Passengers or Drivers -** Sometimes sensors are not working properly, In this case, missing information place the lives of drivers or passengers at risk.

- **Computational Performance is limited** – Computational performance of vehicle is limited as compared to the computer. As a result, vehicles are more likely to be hacked than computers.

- **Unpredictable Attack Scenarios** – A vehicular communication network has different entry points. attacks are continually being developed, automakers will find it difficult to predict the information about hackers.

- **Insufficient Testing** – In Vehicular communication network, concept of cryptography can be used for sharing information between vehicles. But sometimes this technique destroy the authenticity of an information. Means hackers may be able to find this information and misuse it.

- **Phishing Attacks** – Phishing is a tricking attempt to obtain credentials of users. In VCN, hackers send wallet key and steal information of an author using false hypelinks.

- **Sybil Attack** - In a Sybil attack, hackers crash the system using false network identities.

- **Routing Attack-** In routing attack, attackers tries to interrupt the information and extracted confidential data .

9 Network Resource Allocation Security Techniques

There are different network based resource allocation security techniques which is responsible for Faster communication between vehicles (Fig.6).

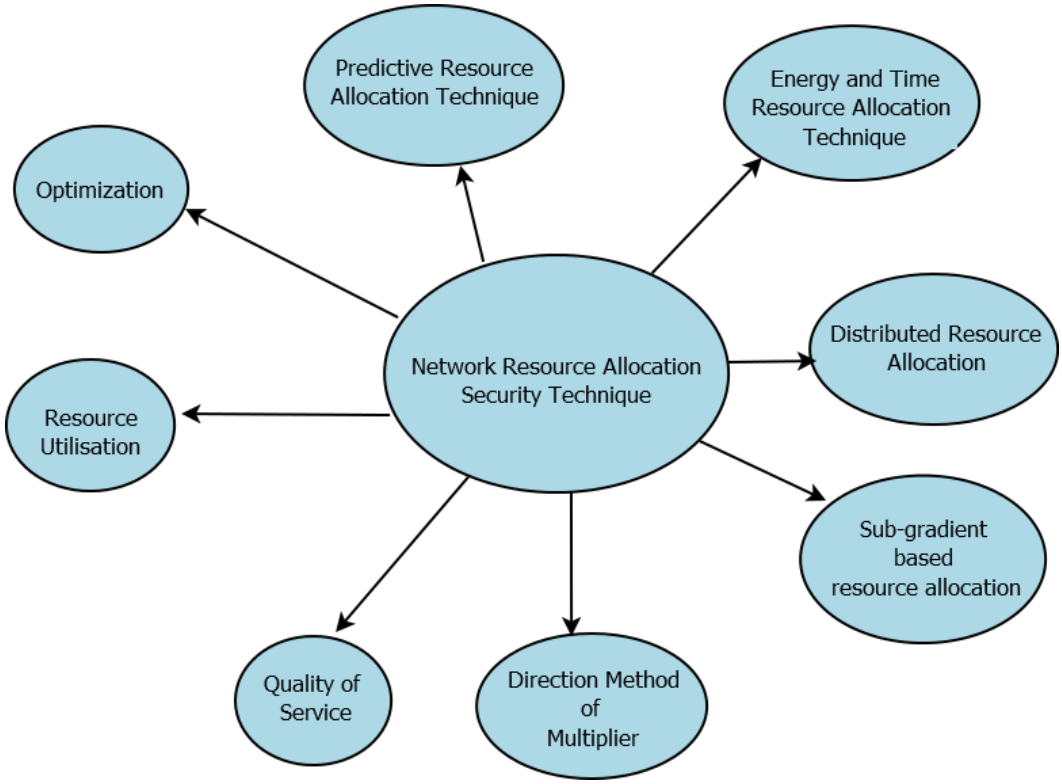

Fig. 6. Network Resource Allocation Security Techniques

- **Optimization** – Optimization of resource allocation means efficient resource utilization for an environmental safety. This scheme improved the throughput by increasing the use of virtual and physical resources. In vehicular communication network, sometimes we have to use additional resources due to problem occur in run time situation. Such resources are responsible for proper flow of whole communication process.

- **Resource Utilization** – Main objective of resource utilization means proper allocation of resources among the tasks for efficient resource utilization and at the same time minimize the operational consumption of data centers. It is the measurement of effectiveness of resources.

- **Quality of Service** – Main objective of this technique is to accomplish resource requirement of vehicular communication networks such as speed, stability etc. This technique minimizes response time.

- **Predictive resource allocation technique -** This technique is based on prediction of network loading. It analyses the uncertainty which occur during communication process and improving the network stability.
- **Energy and time resource allocation technique -** This technique is based on optimizing energy and time resource allocation . In Vehicular communication network, multiple drivers can communicate with multiple vehicles. This scheme maximize the speed of communication among vehicles.
- **Distributed Resource Allocation Algorithm – I**n this algorithm various types of base stations such as heterogeneous cellular networks, macrocell base stations are used for communication between vehicles. This scheme enhances throughput and focus on security aspect of communication process.
- **Direction method of multiplier algorithm –** This scheme is able to resolve the problem of resource allocation in software defined network architecture. This scheme focus on privacy aspect of communication process.
- **Sub-gradient based resource allocation algorithm –** This scheme is able to achieve resource allocation in heterogenous network.

10 Comparative Study and Discussion

Table 1. Comparative study

Author	Proposed Scheme	Advantage	Future Scope
Alia Asheralieva et al [1]	Predictive Resource Allocation Technique	This technique can improve policies of network resource allocation in radio network.	We can enhance this technique by using different kinds of traffic generators.
Georgios I. Tsiropoulos et al [4]	Cognitive radio network in resource allocation technique	This technique uses the unused portion of spectrum and allocate to the user.	We can add more parameters including adaptability, reconfigurability, energy efficiency in cognitive radio network
Hoon Lee et al [5]	Energy and Time resource allocation Scheme	This scheme offer 30% average sum rate performance over other schemes	Improve its performance by adding concept of wireless powered communication network
QINGYANG SONG et al [9]	Distributed Resource Allocation algorithm	Enhance network throughput with the help of heterogenous cellular network.	We can improve this scheme by increasing resource utilization.

Hama Ali et al [17]	Direction method for multiplier algorithm	Solving resource allocation problem in software defined networking environment.	We can improve the cost of implementation and application.
Zhang et al [31]	Proposed resource allocation optimization Scheme for distributed joint computation.	Reduce power consumption	Energy efficiency and data rates are significantly improved.
Deng et al [32]	Proposed Distributed Sub-gradient Scheme	Solving resource allocation problem in heterogenous networks.	We can explore this scheme for better throughput.
Kim et al [33]	Design a resource allocation controller	Decrease upto 45% latency and maintaining the QOS of application.	We can improve this scheme by maintaining operational request rate.
Toporkov et al [34]	General Window allocation algorithm	Maintaining non-dedicated and heterogenous resources.	We can refine this algorithm to decrease the computational complexity
Wang et al [35]	Distributed continuous time algorithm	Minimize cost function	We can achieve better result if we can use energy storage system in grid connected battery.

11 Conclusion and Future Scope

In our research, we discuss about vehicular communication network. Its importance, properties, advantage, limitations, challenges etc. After conducting comparative study we can understand that Vehicular communication network is distributed network. It enhances the safety features while driving. It enable different vehicles to communicate with each other. It reduces accidents. It help us to know about current situation of road so that we can search next route for destination. It warns the driver about any mishappenings. In future, we need to make vehicular communication network smarter because present system lacks data reliability, security and easy deployment.

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