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Survey: Admission Control Algorithms for Vehicular (Wi-Fi and Wi-Max) Network Technologies

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Abstract: Vehicular Ad hoc Network or VANET is a technology that uses street moving cars (cities or highways) as a node in a wireless network to create a mobile wireless network. The vehicular ad-hoc network converts each participating car in the network to a router or wireless node, allowing cars to distance from each other approximately 100-300 m to communicate, thus, creating a network with a wide range. Some cars and the result of mobility become outside the connection signal and this causes the network to be disconnected but other vehicles can come into the network and connect the vehicles to each other, so that, an internet connection is established over this mobile network. It is estimated that the first systems that will integrate this technology will be police cars, fire engines and emergency to communicate with each other for safety purposes. This is what, we are witnessing these days in some projects that implement the concept of smart taxi an idea associated with VANET.

Key words: Vascular, admission control, VANET, cars network technologies, MANET, vertical ad hoc networks

INTRODUCTION

The automotive industry is developing day by day with the introduction of new technologies of electronic minds and communication devices to make the road more comfortable and secure. Today, we will be talking about one of the tremendous developments that car companies have begun to embrace the idea of integrating wireless communications with cars for greater convenience. Road users through a new technology called Vehicular Ad hoc Networks (VANET) (Algur and Kumar, 2016). The contact of safety and emergency messages among drivers is one of the most important applications of VANET. It is possible to have a traffic accident about 300 m. One of the cars causing the incident or near, it sends a message to all the vehicles going to the scene to inform them of the accident site and some information about the condition of the road in front of them. Figure 1 shows the communication system of vehicular (Wi-Fi and Wi-Max) network technologies, the technology that can provide road and vehicular information among road users, parking spaces and restaurants with internet and email access as well as file sharing (Choukimath and Ayyannavar, 2014).

Most things related to Mobile Ad Hoc Networks (MANET) are related to VANET but differ in detail. Instead of moving vehicles at random as in MANET, vehicles tend to move in an orderly fashion following road rules such as stopping, speeding and changing direction (Priya *et al*., 2013; Ramraj *et al*., 2014). Finally, cars are limited by movement; for example, they are restricted by the paved road. In 2006, the term MANET was describing an academic research field. The term VANET describes a promising field of applications. VANET offers a wide range of benefits for users for example connecting high-speed internet to the car makes the car communicate with the world through the web. While such a network does not pose certain safety concerns (for example, cannot write an email safely while driving), this does not limit VANET's potential as a productivity tool. They allow time exploits (such as waiting in a long queue) to accomplish some tasks (Chen *et al*., 2008, 2009). GPS positioning techniques can be used by linking them to traffic reports to find the best route to the workplace. In addition, to connecting VoIP technologies and services to reduce communication costs among employees. The wireless communication technologies used in VANET are IEEE 802.11p, WAVE IEEE 1609 and IMAX which make communication easier and more efficient between vehicles in dynamic motion (Kim *et al*., 2011). There is a trend in the field of research today to make VANET play a better role by passing some of the determinants, finding the best

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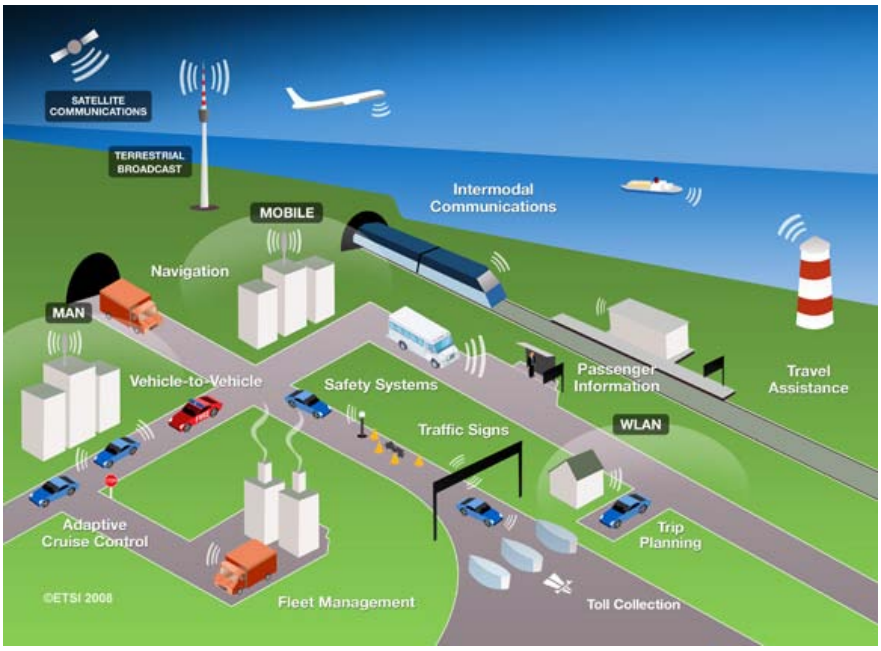

Fig. 1: The communication system of vehicular (Wi-Fi and Wi-Max) network technologies (Choukimath and Ayyannavar, 2014)

solutions, finding new applications and examining the efficiency of these applications in the VANET environment which suffers from persistent traffic problems and interconnection of these vehicles (Waghela and Vithalani, 2014).

Signal-to-Noise Ratio (SNR): Signal-to-Noise Ratio (shortened SNR or S/N) is a measure utilized as a part of science and engineering that looks at the level of a coveted signal to the level of foundation noise. It is characterized as the proportion of signal power to the noise power, regularly communicated in decibels (Vetrivelan and Narayanasamy, 2012). A proportion higher than 1:1 (more noteworthy than 0 dB) shows more signal than noise. While SNR is generally cited for electrical signs, it can be connected to any type of signal (for example, isotope levels in an ice center or biochemical motioning between cells) (Raja and Kumar, 2013; Saeed *et al*., 2011). Signal-to-noise ratio is at times utilized allegorically to allude to the proportion of helpful data to false or immaterial information in a discussion or exchange. For instance in online talk gatherings and other online groups, off-theme posts and spam are viewed as "noise" that meddles with the "signal" of fitting discussion (Khan *et al*., 2008).

Signal-to-noise ratio is defined as the ratio of the power of a signal (meaningful information) and the power of background noise (unwanted signal):

$$SNR = \frac{P_{signal}}{P_{noise}},$$

Where P is average power. Either signal and noise power must be measured at the same or equivalent points in a system and within the same system bandwidth. If the variance of the signal and noise are known and the signal is zero-mean, SNR can be (Mai and Chen, 2014):

$$SNR = \frac{\sigma^2_{signal}}{\sigma^2_{noise}}$$

If the signal and the noise are measured across the same impedance, the SNR can be obtained by calculating the square of theamplitude ratio (Ali *et al*., 2011):

$$SNR = \frac{P_{signal}}{P_{noise}} = \left(\frac{A_{signal}}{A_{noise}}\right)^2$$

where A is Root Mean Square (RMS) amplitude (for example, RMS voltage).

Admission control scheme: Admission control is a validation process in communication systems where a check is performed before a connection is established to see if current resources are sufficient for the proposed connection (Karagiannis *et al*., 2011). Current admission

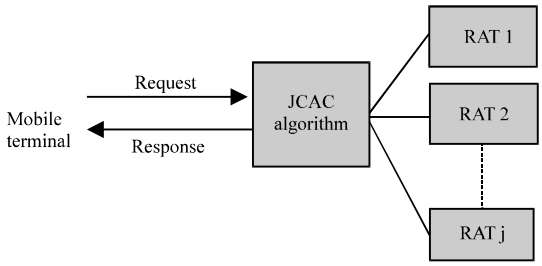

Fig. 2: The scheme of an admission control call in heterogeneous cellular networks (Choukimath and Ayyannavar, 2014)

control scheme strategies can be dealt with manage resources in heterogeneous wireless networks but are unable to deal with the issue in a heterogeneous manner wireless environment. Move from stations in the mobile communication environment makes the supplier assign a difficult task when resources are always in scarcity (Johann, 2012). Call control effective call policies should be developed that can take care of this contrasting environment to improve resources. Design of the call acceptance control algorithm must be considered as the quality of service at the package level parameters such as minimum delay, call may be dropped by a new access network due to low network resources for level is unacceptable. Figure 2 shows the scheme of an admission control call in heterogeneous cellular networks.

Bandwidth allocation techniques for remote systems can be characterized into four set to be specific complete sharing, complete partitioning, handoff call prioritization and service-class prioritization.

Complete sharing: An incoming call is accepted, regardless of the class/type as long as there is enough radio resource to accommodate it.

Complete partitioning: Available bandwidth is partitioned into pools and each pool is dedicated to a call. An incoming call can only be admitted into a pool.

Handoff call prioritization: Handoff calls are given more access to radio resources than new calls. New calls may be blocked whereas handoff calls are still being admitted.

Service-class prioritization: Certain classes of calls are given preferential treatment over some other classes of calls. For example, class-1 calls may be blocked whereas class-2 calls are still being admitted (Khabazian *et al*., 2012).

As appeared in Fig. 3, a blending of a Policy Decision Point (PDP) and Policy Enforcement Point (PEP) exist in

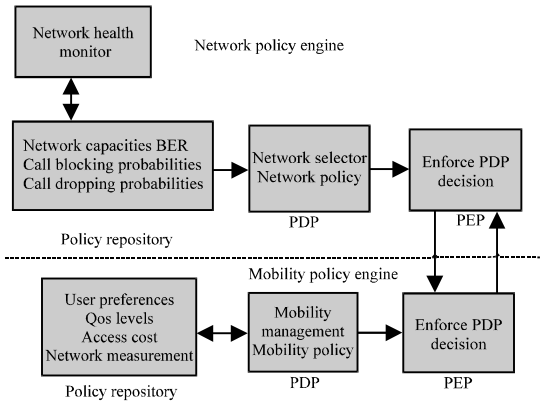

Fig. 3: Policybased call admission control (Choukimath and Ayyannavar, 2014)

both motors, alongside strategy stores. System is dependable for the execution of an approach that is chosen by PDP and the approach vaults characterize the arrangements that must be taken after for an appropriate handover choice (Tung *et al*., 2013). In the call confirmation control system, PEPs in the portable terminals counsel a PDP dwelling at the system for accessible assets. The PDP will settle on a choice available to come back to work confirmation in view of system limits, QoS level, call sorts, client inclinations and additionally estimations on current arrange load and exhibitions. This approach gives adaptability to the terminal and the system to make the best conceivable handover choice and executes stack adjust. In any case, there are a few disadvantages of this approach strategy, for example, high latencies to get setting data amid the hopeful get to point arrangement technique and no streamlining approach is characterized for asset allotment in incorporated systems (Kolate *et al*., 2012; Kim *et al*., 2011).

MATERIALS AND METHODS

Vehicle tracking mechanism: The idea of vehicle management and tracking depends on the use of satellite technologies and mobile networks using specialized equipment and programs designed specifically for the implementation of vehicle management and tracking services in the following detail:

- GPS satellites: determination of coordinates using satellite
- GPS tracking unit
- GSM mobile network: mobile network used database servers

- The servers on which databases are stored
- Internet
- Tracking application (smart client): the software used for tracking

In this study, the function of each process will be explained: first: the satellite function is the same as sending coordinates to the tracking device (latitude and longitude). Second; the tracking device, the tracking process inside the tracking device is a mobile SIM card (tracking SIM-tracking chip), the satellite sends coordinates to the tracking device and then the chip inside the device receives the coordinates and sends them via the mobile network used (Yang *et al*., 2006). Third; the mobile network used is a carrier medium that transfers the coordinates sent from the tracking device and transfers them to the servers where the data is stored. Fourth; the servers on which the databases are stored. These servers store not only the coordinates of the vehicle but the many data that the tracking device sends. Fifth; the internet is the means used to access the servers, so that, the persons can know any data want in any place by using the internet (Ott and Kutscher, 2004). Sixth: the program used for the tracking process is a specialized program in the process of tracking which enables the person to send a query to the server to see the coordinates of a vehicle is sent to person to appear on the map can see where the vehicle is located on the map (Bellavista *et al*., 2007). For example: (VN22057) VN means (Vehicle Number-Vehicle Number) 22057 It is (N24°36'43"S-W46°24'17"E) they are coordinates.

Many tracking devices and the most features and every device characteristics from other, tracking devices manufacturers compete by providing its organs properties that distinguish them from other for coordinates only to find out the vehicle untracked site; for example, tracking devices have been developed and equipped with so-called (digital inputs-digital inputs), the function of these digital entries for example, the user can a digital one input connected, so that, if the driver to open the vehicle door of the device sends a signal that it has opened the vehicle door and these approaches may be useful for some vehicles such as street sweepers motor vehicles may wish to know whether he opened the broom in his exact location or not clean and so, competing tracking devices manufacturers to increase the number of digital entrances where user find a device that has 6 digital entries and the last contains 10 and up to any number of China manufactures several digital devices up entrances to over 50 entrance the modern devices that are now manufactured also do not contain but also connected to the vehicl's electric circuit to see what the vehicle's driver

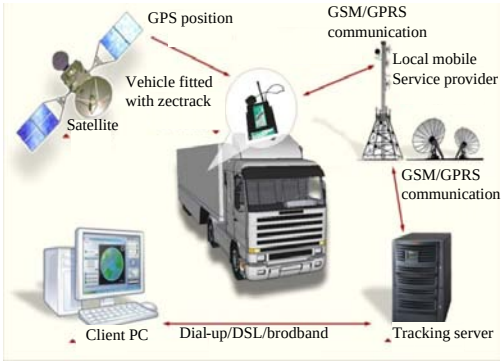

Fig. 4: The system of vehicle tracking mechanism (Algur and Kumar, 2016)

is doing in modern vehicles only (Yang *et al*., 2006; Kuo *et al*., 2009). There are also more advantages offered by the manufacturers of tracking devices. There are devices that have an internal battery so user can know the coordinates of the vehicle's presence even if it is transported without operation of the vehicle engine. Most of the tracking devices do not have an internal battery and are dependent on the battery of the vehicle and during the operation of the vehicle is operating device (FCC, 2002). There are companies that developed their devices, so that, user can control the vehicle by messages sent to the mobile segment that exists inside the tracking device, some can send a message. Figure 4 shows the system of vehicle tracking mechanism (FCC, 2017).

Tracking software is usually the most important in the tracking process (Kashibuchi *et al*., 2010). Can the tracking program meet its purpose with the person who wants to track its vehicle or its tracking software? One idea is to get the coordinates of the vehicle and display it on the map to show the location of the vehicle followed on the map. It has infinite possibilities. Many of these programs can get a historical record of each vehicle and its location at any moment on any day user wants (Sheu *et al*., 2010) (System history). These programs are also provided, so that, user can get weekly, daily, monthly or yearly reports about a specific vehicle or group of vehicles. User can also place a false fence on an area in the map in the program. An alert appears. There are many programs used and companies are working on the programs to work on all devices developed to comply with the system android and IOS, so that, the user to follow up using personal mobile phone (Tragos *et al*., 2013).

RESULTS AND DISCUSSION

Research issues in vehicular network: In fact, Wi-Fi and Wi-Max are important technologies that provide the

connectivity to the vehicular networks. Cellular network can provide such connection but it's expensive in terms of connection and has limited transmitted rate (Bejaoui and Naseer, 2008). Besides, WLAN can provide the same services but it has a limit data transmit and faces several connection problems. There are many issues faces Wi-Fi and Wi-Max in many aspects in terms of QoS, security and Performance Anomaly (PA). PA is an important issue in vehicular network. As it's known the vehicles passes many different coverage areas and experience different channel conditions during driving on the road (Algur and Kumar, 2016). Clearly, several conditions introduce based on the vehicle movement and Access Point (AP) distance in detecting the best channel (Tragos *et al*., 2013; Bejaoui *et al*., 2008). To overcome the performance anomaly problem, Signal to Noise Ratio (SNR) approach has been presented to this purpose. This approach will classify the vehicles to several groups and only the group that has better condition can get a service to enhance the network throughput. In Vehicular Network (VN), the vehicles drive through many Wi-Fi Access Points (APs) which deployed on the road side and the intersection and experience many channel condition (Liu *et al*., 2001). While they are on their way, mobile users experience intermittent connectivity because of the short range of Wi-Fi AP. When vehicles are in Wi-Fi networks deployed at intersections, more dynamic channel qualities can be observed compared with vehicles on the road side. This is because there are always exists stopped cars as well as moving cars at intersections. As it is known, the stopped cars have better channel qualities than the moving cars and vehicles also experience different channel conditions which are dependent on the distance from an AP. In addition, the stopped cars at any intersection have much longer association time with Wi-Fi aps than the moving cars in the roadsides (Wei *et al*., 2005). Therefore, the association time at an intersection needs to be used efficiently and this is known as a performance anomaly.

In the Wi-Fi based vehicular networks, users travelling by car usually come in range of multiple Wi-Fi Access Points (APs). Mobile users in the middle of their journey, experience intermittent connectivity because of the short range of a Wi-Fi AP (Yang *et al*., 2006). Furthermore, IEEE 802.11p and 802.11b provides a multi-rate transmission to solve the connection and channel access problem. Although, multi-rate produces a solution for the issue above, it does introduce another problem such as performance anomaly. This is due to the movement of vehicles and its relative distance from the AP causing the vehicles to experience varying channel conditions. The vehicle with low transmission range will use the channel for a longer period of time as compared to the vehicles with higher transmission rate. Also, leading to the significant reduction of the network throughput as mentioned in the paragraph above, this problem is referred to as performance anomaly (Niyato and Hossain, 2005; Goulding *et al*., 2004).

When N nodes exist in an IEEE 802.11 WLAN, the overall transmission time T (N) depends on MAC Protocol Data Unit (MPDU), constant overhead of the network and the MAC acknowledgement transmission time Tack. As it's clear, the nodes in the network have N different transmission rates and they can be classified into several groups depending on the transmission rate. It can be seen clearly the throughput is determined by the number of nodes and the transmission time. Since, a node with a low transmission rate leads to longer transmission time, the throughput X will be decreased significantly as the number of nodes with lower transmission rates increases which is a well-known performance anomaly problem.

Addressing and managing the super groups is an important issue especially in IEEE 802.11b where the size of the super groups is not equal and the total time is short which can be midget.

The fifth generation network and cellular communications: The fifth-generation network and cellular communications from the composite to the whole Cellular-V2X (C-V2X) for adoption in vehicles (Tsao and Lin, 2002). Qualcomm technologies and LG are planning to introduce models of the application of these very modern wireless technologies to cars in the first half of 2018. This collaboration is based on the close relationship between the two companies which is due to the development together of the first information systems in the year 2004.

On the road to access to the fifth-generation network, LG is developing advanced automotive communication solutions based on Qualcomm Technologies connected vehicle platform which features GIGABYTE LTE connectivity speed, via qualcomm snapdragon X16 LTE modem, complemented by the QAC65×4 Wi-Fi connection for 802.11ac connectivity. The connected car platform also supports solutions based on the standard 802.11p/DSRC and C-V2X, two standard standards supported by the 3GPP standard (Jaseemuddin, 2003).

The advanced wireless capabilities of the fifth generation networks add to the connection of the car to everything from mobile to the emergence of new modes of use that reflect our vision of connected vehicles and self-driving leadership that is evolving today very quickly. As a leader in the innovation of fifth generation

technologies, the study selected core information systems provider, Qualcomm technologies to be our certified company to create the next generation of wireless solutions that leading manufacturers expect and expect (Ahmavaara *et al*., 2003).

The future of vehicular (Wi-Fi and Wi-Max) network technologies: The future direction of this field is to implement the new algorithms in the whole coverage area of 802.11p. Furthermore, investigate more factors that could affect the network throughputs in 802.11b environment in the intersection. Furthermore, WiMAX instead of Wi-Fi and the possibility of enhancing the network throughput by using SNR issue. In addition, starvation issues in the previous study addressed by means of mobility in Wi-Fi based vehicular networks with multiple intersections. In this study, the researcher analysis different issue to overcome the network starvation. Investigate and deploy the whole coverage area of 802.11p which is one kilometer included all the transmission area which is between 27 and 1 Mbps in a highway (ETSI, 2003; Sallent *et al*., 2003).

The different issues that overcome the network starvation are: investigate and deploy the whole coverage area of 802.11b which is three hundred meres included all the transmission area which is between 18 and 1 Mbps in an intersection. Investigate more factors that could affect the networks throughput in the intersection like vehicles direction. Investigate the high speed in vehicles in the highway (above 100 km/h) and its effect on the network throughput using 802.11p. The possibility of deploying 802.11p in the intersection and how the performance anomaly will affect the network throughput.

Context-aware multimedia middleware solutions: Innovative context-aware middleware approach working at the application layer, without requiring any modification to the existing Wi-Fi standard had been proposed to overcome the performance anomaly for multimedia transformation in IEEE 802.11a/b/n. Unlike (Shu'Aibu *et al*., 2011), the significant point in this solution is no changing in the protocol that permitting to maintain the current wide base of installed equipment. This middleware portably detects anomaly situations via decentralized standard mechanisms available at clients. Anomaly awareness is used to promptly react with application-level management operations (flow quality downscaling and traffic shaping) that both preserve the good throughput at nodes in well-covered areas and minimize quality degradations at clients generating the anomaly. By Jang and Yang (2011), performance anomaly had been addressed when multi-rate traffic was presented in IEEE 802.11b WLANs. Stations with different data rates were categorized into different traffic classes. To solve performance anomaly problem, two fairness indices were introduced to quantify the fairness in both time and throughput among the different traffic classes. This method regulated the channel occupancy time and the aggregate throughput among the different traffic classes by adjusting the minimum contention window sizes and MAC frame sizes. However, initial contention window adaptation has some limitations when solving performance anomaly. When the channel quality is poor, unnecessary back-off at the low-rate nodes results in performance degradation because low-rate nodes initialize their contention window only based on their data rate (Al-Mistarihi *et al*., 2012). A new multi-rate MAC mechanism which allows nodes in two hops to get each other's data rate information by introducing modifications to the control packet had been proposed to improve the channel utilization; nodes initialize their CWmin based on the ratio of their own data rate to their competitive node's data rate.

COTRC-TCP: IEEE 802.11a have variety of multi-rate range between 6-54 MB is suffering from two main issues which is performance anomaly and uplink/downlink unfairness. To solve these issues, a window control scheme in the Transmission Control Protocol (TCP) for the IEEE 802.11 DCF mode had been proposed. This scheme is called channel occupancy time based rate control for TCP (COTRC-TCP). COTRC–TCP controls the maximum window size based on the throughput estimated at the TCP layer, so that, each station can use the wireless channel for equal duration. The throughput estimation is based on the number of active stations and the channel occupancy period used by each station in the BSS which are monitored at the Medium Access Control (MAC) layer. The proposed scheme forms a cross-layer approach that involves both MAC transport layers. In contrast, the control of this scheme is that need to change in the current base stations which it's sure costly (Kassim *et al*., 2012).

VCAS: There are two types of connection in the vehicular networks which are between RoadSide-Units (RSU) and On-Board-Units (OBU). RSU acts like a wireless LAN access point and can provide communications with infrastructure. Also, if required, RSU must be able to allocate channels to OBUs via. Serves Channel (SCH). The adopted contention-based medium access control protocol which confronts the performance anomaly problem would severely downgrade transmission efficiency between RSU and OBU because they may use

diverse data transmission rates to access channel. As a solution by Vehicular Channel Access Scheme (VCAS) had been proposed to group a number of OBUs with similar transmission rates into one channel to optimize the channel throughput. A marginal utility model had been proposed to flexibly compromise the trade-off between throughput and fairness. The key concept of VCAS is to group the OBUs with similar transmission rates into one SCH by using the WSA frame to carry the transmission distance threshold per SCH. A marginal utility with given prices of system throughput and throughput fairness is adopted to determine the appropriate transmission distance threshold per SCH (Kassim and Kassim, 2011).

SNR based admission control: A novel analytical model which combines the vehicular traffic theory and Wi-Fi properties to show the impact of performance anomaly at the intersection, had been presented by Kassim and Kassim (2011). Moreover, a Signal-to-Noise Ratio (SNR) based admission control scheme that excludes vehicles with bad channel qualities to address the performance anomaly problem. SNR-based admission control scheme can improve the overall throughput but the starvation issue happens. However, starvation issues can be addressed by means of mobility in Wi-Fi-based vehicular networks with multiple intersections.

CONCLUSION

Vehicular Network (VN) became one of the most developing networks in the field. Because of the Wi-Fi domination, it has been implemented and used on both version 802.11b and 802.11p in the VN. In Wi-Fi-based vehicular networks, the performance anomaly problem can be serious because different vehicles with diverse channel conditions access the channel by a random access protocol. The enhancement on Signal-to-Noise Ratio (SNR) based admission control scheme has been implemented to exclude vehicles with bad channel qualities to address the performance anomaly problem in both 802.11b and 802.11p areas. This research analyses the communication uses 802.11b. The maximum transmitting coverage of 802.11p is 100 m and it is no widely used for vehicular networks communication.

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