East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

# Network Traffic Assignment Model for Vehicle-To-Vehicle Communication

***Nasser Al Musalhi**[1], Salem Mohamed Salem Otman* [2]

[1]Research Center, Mazoon College, Muscat, Oman.
[2] Faculty of Engineering, Cyprus International University, Northern Cyprus, Mersin 99258, Turkey.
*Corresponding Author.

**Received**: 08/02/2025, **Revised**: 12/02/2025, **Accepted**: 12/02/2025, **Published**: 13/02/2025

## Abstract

**The rapid advancements in automotive and communication technologies have paved the way for the development of connected and autonomous vehicles (CAVs), revolutionizing the future of mobility. However, the integration of human-driven vehicles (HDVs) and CAVs introduces significant challenges in traffic network management. This paper presents a multiclass traffic assignment model to address these challenges, using the cross-nested logit (CNL) and user equilibrium (UE) models to predict and manage mixed traffic flows. Dedicated short-range communication (DSRC) technology plays a critical role in facilitating vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, enhancing road safety and traffic efficiency. The study evaluates different traffic assignment models, such as user equilibrium, system optimum, and dynamic traffic assignments, to assess their applicability in real-world traffic scenarios. Furthermore, the advantages, limitations, and security implications of these communication models are discussed. The findings emphasize the potential of V2V and V2I systems in optimizing traffic flow, improving safety, and reducing travel time, while highlighting the need for robust security and data privacy frameworks to support widespread adoption**

**Keywords: Connected Vehicles, Traffic Assignment Models, Vehicle-to-Vehicle Communication, Dedicated Short-Range Communication, Network Traffic Management.**

## 1. Introduction

In the past few years, the automotive and technology sectors have shown the extent to which computerization has permeated both the driving experience and the car itself, prompting the possibility of a possible iteration of transport—self-driving cars (AVs). The latest developments in communication technologies have allowed for the introduction of an entirely new vehicle mode, capable of intelligent motion and even autonomous parking assistance [1]. The future of mobility will be drastically impacted by automated vehicles (AVs). Most of the current studies is built on models and simulations, as AVs are in their early stages of development and collecting observational evidence for further study is not yet feasible [2].

Although connected and autonomous vehicles (CAVs) give passengers the opportunity for decreased time value, improved driving environment, and smooth situational awareness and interaction, traditional human-driven vehicles (HDVs) have increased time value. This can lead to traffic patterns that are at odds with the HDV traffic trend, as some people use CAV and others use HDV. There is little quantitative understanding, owing to the absence of mathematical modeling, of how mixed traffic flows evolve in a traffic network. In this analysis, a multiclass traffic assignment model is proposed to partially fill this difference, where HDV users and CAV users have separate route preference concepts, all of which are defined by the cross-nested logit (CNL) model and user equilibrium (UE) model [3]. The CNL model represents the level of confusion that HDV users feel as a result of the incomplete information about traffic situations, while also accounting for the overlapping route problem of logit-based stochastic consumer equilibrium. The UE model describes the CAV's ability to obtain reliable traffic statistics. Multiclass models can describe features like the different importance of time spent driving HDVs and CAVs and their disparity in relationships, which leads to a more accurate model of behavioral realism[4].

Many of governments around the world have push forward to implements the V2V and V2I infrastructure in USA the Obama administration's efforts to help advance V2V technologies were introduced . This administration's goal is to unveil new guidelines for consideration by the time it leaves office in 2017, with the expectation that by the year 2020, cars will alert drivers of dangerous road conditions ahead. This week's events are all part of an elaborate and far-reaching strategy on the part of the National Highway Traffic Safety Administration [5].

A more direct way of doing it is that the first generation of V2V systems would warn the driver but would not have control of the vehicle. Later applications would focus on stopping or steering through barriers, merging with self-driving vehicles, and then improving.

## 2. Dedicated short range communication (DSRC)

DSRC makes car-to-car and infrastructure communications which assists with vehicle safety. Because of this feature, it may help save lives by alerting drivers to hazardous or unsafe conditions so that they can take necessary steps before an accident occurs. The band is also permitted for both industrial and private use [6] .

The DSRC operating in the 5.9 GHz allows direct, low-latency vehicle-to-infrastructure connectivity. A DSRC digital radio technology is available to licensees who have won the auction for that section of the spectrum in the 5.9 GHz in 2004 with a capacity of 75 MHz of bandwidth [7] .

There is a significant amount of security for DSRC. Receiving the communication ensures that the privacy of the driver. Vehicles report their position, heading, and speed information continuously for safety, including in an anonymous and secure manner. All the vehicles are aware of the danger, and each applies

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

the knowledge to its own risk calculation. Without being able to notice, it, this helps one to perceive, and then avoid circumstances where accidents can occur.

In addition to rapid motion-changing environments, DSRC delivers super-high speed even in the face of obstacles and enables the contact of vehicles as much as 500 km/h. This platform is designed to avoid blocking structures that "look around corners" (Line-Of-Of-Sight) and withstand adverse weather conditions [7].

On-board-units(OBU) and roadside units (RSUs). an antenna that is usually placed in or on a car or at vehicle stations is referred to as an OBU. OBUs are approved according to Part 95 of the Rules. Receiver Station Services are used to enhance reception along roads and walkways. A roaming security device can only be used when placed on a vehicle or when hand-carried. In a programmable ASIC, an RSU can broadcast to its user objects or a user of the R can exchange data with one of the user objects [8]. DSRC can operate in two modes.

- Vehicle to Vehicle (V2V).
- Vehicle to Infrastructure (V2I).

### *2.1 Vehicle to Infrastructure (V2I)*

A vehicle-the-to-infrastructure (V2I) communication model permits vehicles to communicate with infrastructure components. Other devices such as overhead RFID readers, sensors, streetlights, signposts, parking meters, and traffic lights need creative use in order to be cost-effective involve design and architecture. Mostly, such connectivity between vehicles and infrastructure is implemented using wireless bi-directional: data from infrastructure components may be transmitted to the vehicle as well as it is self-sourced. Car-to-to-car (or truck-to-to-car) communications operates using dedicated short range communication (DSRC) [9].

Sensors can help in intelligent transportation: They detect infrastructure problems (including collisions, construction zones, and congested traffic), provide real-time information for travelers and commuters and issue alerts about them to drivers. It is possible to use infrastructure and car data to improve the vehicle's fuel economy and vehicle flow to achieve varying SPaT traffic controls. Connection between cars and the world around them is a critical element in driverless car growth [10].

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

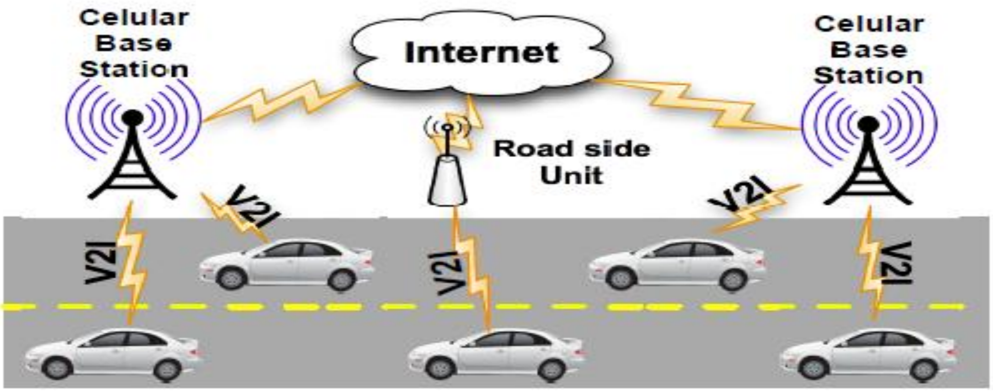



*Figure 1:Vehicle-to-Infrastructure (V2I) communication.* [11]

### *2.2 Vehicle to Vehicle (V2V)*

The V2V communications are only run on-the-fly and have no reliance on existing networks. Vehicular direct contact. The primary goal of V2V contact is to help the driver feel comfortable and be conscious of its surroundings. Many safety apps like V2V connectivity could include providing people with the following capabilities: warning when the vehicle is about to wreck, giving you time to slow down, warning when you are in the blind spot, increasing your awareness of the direction you are intending to turn left or right, helping you avoid running into an obstacle, warning when approaching a turn, and flashing lights in case of an impending collision, etc. A major use of V2V communications may be for non-safety promotions and roadside utility exploration, as well. Vehicle-to-vehicle packets will be used in a V2V transmission network when it's in use, cars can flash these beacons [10].

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

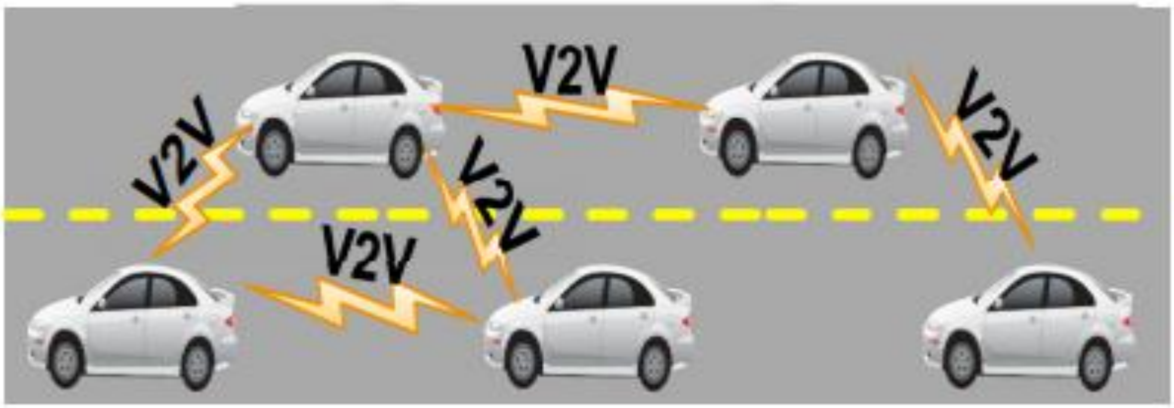



*Figure 2:Vehicle to Vehicle connectivity (V2V)* [11]

more time to respond than V2V-enabled drivers in critical data circumstances tells them of possible dangers, providing added time to think about them. Unanticipated incidents that trigger a warning are hard-braking, wet roads, disabled cars, and collisions. Cadillac is upgrading the next-generation customer interface infotainment so that passengers can personalize voice and head-up displays [12] .

## 3. Global Positioning System (GPS)

The Global Positioning System is a military satellites created by the United States Department of Defense. 28 geostationary satellites, each of which rotates around the Earth once every 12 hours. These types of errors which include timing errors, tropospheric delay, satellite errors, etc. Many errors can be eliminated by differential corrections, but DGPS can't get rid of multipath and receiver noise. Reflection multipath occurs when a satellite sends one or receives a GPS signal, as a result of one or more factors in the surroundings. GPS may be affected by these parameters both for pseudo ranges and carrier measurements. Earth, metal structures, houses, and bodies, and conductive metals are all good reflective of electromagnetic waves. Everybody using the same GPS receivers make all the work we must calculate the positional errors and uncertainties on the latencies for certain receivers before we look at the results. There are some important output and decisional functions that need to be modeled because of their involvement in that process. The delay results are attributable to the use of the GPS, but the accuracy of the embedded clocks is exact. Two receivers located close to each other are vulnerable to interference and distortion errors, which are closely associated [13], [14].

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

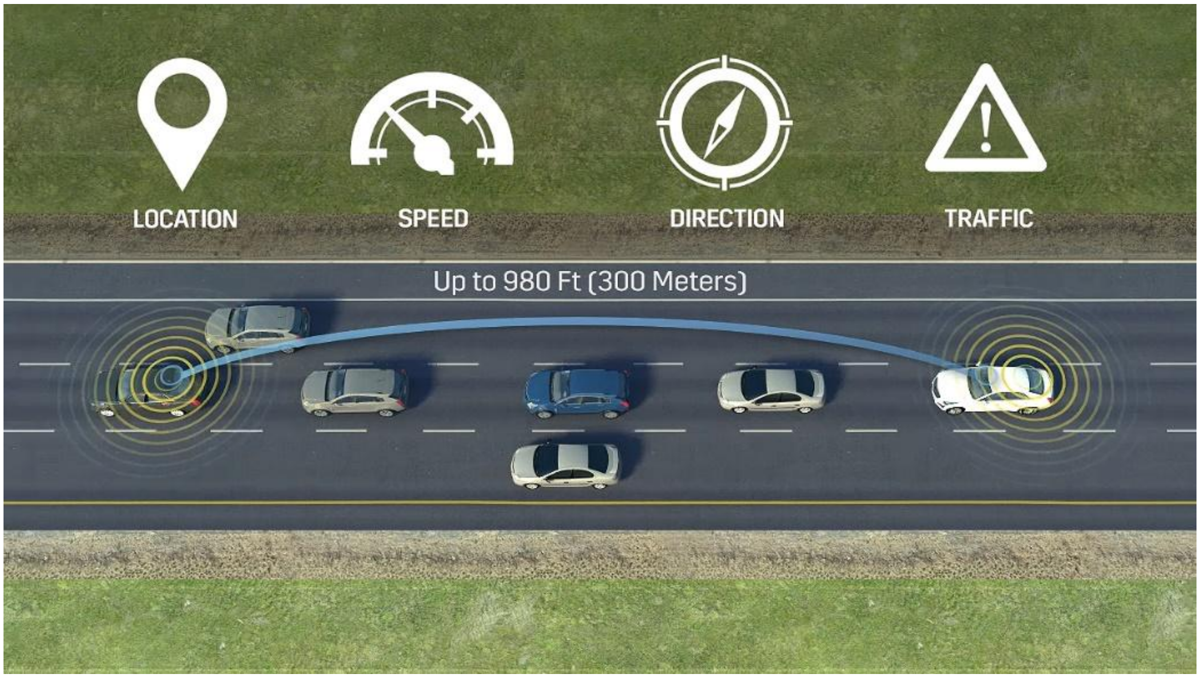



*Figure 3:Cadillac's Vehicle-to-Vehicle communications technology shares vehicles' locations, speeds, directions and traffic conditions up to nearly 1,000 feet away [12]*

## 4. Network traffic assignment models

a traffic model attempts to predict how much traffic there will be and what areas of the road network will receive it which you can judge how far you traveled, how long it took, how much fuel you used, and how polluted your journey was [15]. The traffic assignment models can also be used to investigate traffic responses (such as transport demand, information flow, and signal timings) to systems (decreased or changed) to see how it impacts traffic congestion.

### *4.1 All or nothing assignment*

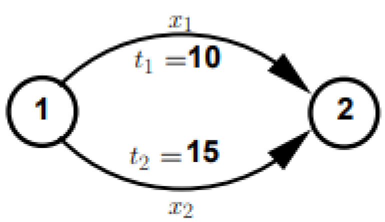
Simplest of all assignment technique takes advantage of all trips to the shortest route, incurring the least expense. At the outset, total costs are known: That is, the cost function (i.e., flow ratio) is assumed to be constant. There are no big disadvantages to using it, but it is basic. There is a lot of variation because of travel time within a route's travel section may lead to large alterations on which route is created to find the lowest overall expense [16].

Limits on each segment and the number of times each segment has been used are not taken into consideration, so the conclusion drawn could be inaccurate. Additionally, it's not flexible for use by

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

customers or various consumers. Because of these facts, when we do a new analysis, all trips will end up on the alternate route (so-called "cross-recruitment")[17].

To provide an example, here is an onred network. This network has two endpoints that are connected by two different routes. Let us consider what would happen if travel time was linear rather than constantly increasing, as in the above illustration [18].




Two Link Problem with constant travel time function  [18].

Solution The travel time functions for both the links is given by:

$t_1 = 10$

$t_2 = 15$

and total flows from 1 to 2 is given by.

$q_{12} = 12$

Since the shortest path is Link 1 all flows are assigned to it making $x_1 = 12$ and $x_2 = 0$.

### *4.2 User equilibrium assignment*

User equilibrium (equilibrium assignment to congested networks) after Wardrop (1952), according to academic papers, has since been very significant. The basic assumptions underlying UE assignment are that for each origin-destination pair, all used links have a known minimum cost, and all routes that are greater than that minimum have no longer have a specific cost. This principle differs from the absolute theory because of the well-called phenomena called effect known as Braess's Paradox [19].

According to [18] There are three assumptions in UE assignment :

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

1) The driver knows exactly how much it would cost to move down the path.
2) If the net flows down a given path at a given speed, the travel time on that path is simply depends on how long it takes to pass by.
3) Travel time functions are positive and increasing.

Bechmann's transformation is used to describe this model's mathematical program is represented in following equation [20].

$$\begin{aligned}
&\min.\ z(x) = \sum_a \int_0^{x_a} t_a(w)\,\mathrm{d}w \\
&\text{s.t.} \quad \sum_k f_k^{rs} = q_{rs} \quad \forall r, s \\
&\qquad\qquad \text{(Flow conservation constraints)} \\
&\quad f_k^{rs} \geq 0 \quad \forall k, r, s \\
&\qquad\qquad \text{(Non-negativety constraints)} \\
&\quad x_a = \sum_r \sum_s \sum_k \left( f_k^{rs} \cdot \delta_{a,k}^{rs} \right) \quad \forall a\,.
\end{aligned} \tag{1}$$

### *4.3 Stochastic user equilibrium assignment*

Stochastic assignment separates each Origin/Destination pair into several alternatives. Systems techniques can be divided into two categories: systems that are simulation-oriented, and systems that are based on ratios. The aim of many simulation methodologies is to simulate uncertainty with respect to user perceptions of network costs is generally includes the following two separate assumptions:

It is important to distinguish objective costs from subjective costs for each section, because objective costs are quantified by observers (models) and subjective costs are felt by each person. It's believed that the estimated cost of hitting the objective could approximately corresponds to the arbitrary costs that are allocated according to a random distribution. Depending on the literature we can produce various conclusions on how costs are distributed. However, Burrel [16] does or has the practice of using a regular distribution while some use a uniform distribution.

### *4.4 System optimum assignment*

Wardrop suggested an alternate method of assigning traffic: Under social equilibrium, it should be assigned to congested networks so that the cost of traveling between points (total) is reduced [19].

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

According to his first principle, he is attempting to model the actions of individual drivers who strive to keep their total travel costs to a minimum. The second concept involves transportation planners and engineers aiming to get people and vehicles into balance, allocating traffic more efficiently and reducing transit costs. The flows created by Wardrop's two principles cannot be anticipated to closely following each other, though one can only expect results in users' equilibrium. Clearly, this is not a feasible as a purely behavioral paradigm, but it is great for cost-saving, maximizing societal efficiency, and will help transportation planners and engineers do [16], [18].

The mathematical program that represents this model can be written as the following Eq.2 :

$$\begin{aligned} \text{min. } & \tilde{z}(x) = \sum_a x_z \cdot t_z(x_a) \\ \text{s.t. } & \sum_k f_k^{rs} = q_{rs} \quad \forall\ r, s \\ & \qquad \text{(Flow conservation constraints)} \\ & f_k^{rs} \geq 0 \quad \forall\ k, r, s \\ & \qquad \text{(Non-negativety constraints)} \\ & x_a = \sum_r \sum_s \sum_k \left( f_k^{rs} \cdot \delta_{a,k}^{rs} \right) \quad \forall\ a\ . \end{aligned} \tag{2}$$

### *4.5 Dynamic assignment*

Fig. shows the dynamic traffic assignment method in which three input variables, dynamic connection travel times, dynamic marginal travel times, and dynamic O-D matrices, all have different magnitudes and values that change from time to time. Bechmann's equation for UE assignment (Eq. (1)) is provided as an assignment in the subsequent pages. In contrast, Bechmann's equation for SO assignment (Eq. (2)) is given only for completeness. Although the objective function and feasible area are convex, within the static sense these formulations are solved analytically by using a mathematical program. Another possibility is that in the dynamic sense, the objective function is non-convex, making it more difficult to solve. To solve the problem, the solution has to be modeled using a computational method.

In this case, two mathematical models are used to derive solutions, which are used to provide a prediction of the market and compare it with the original solution. As long as there is a sufficient gap in the quantity of either of the two links' flows, the feedback loop keeps running, with both links' flows changing before the required margin of error or the full number of iterations are reached [19], [20] .

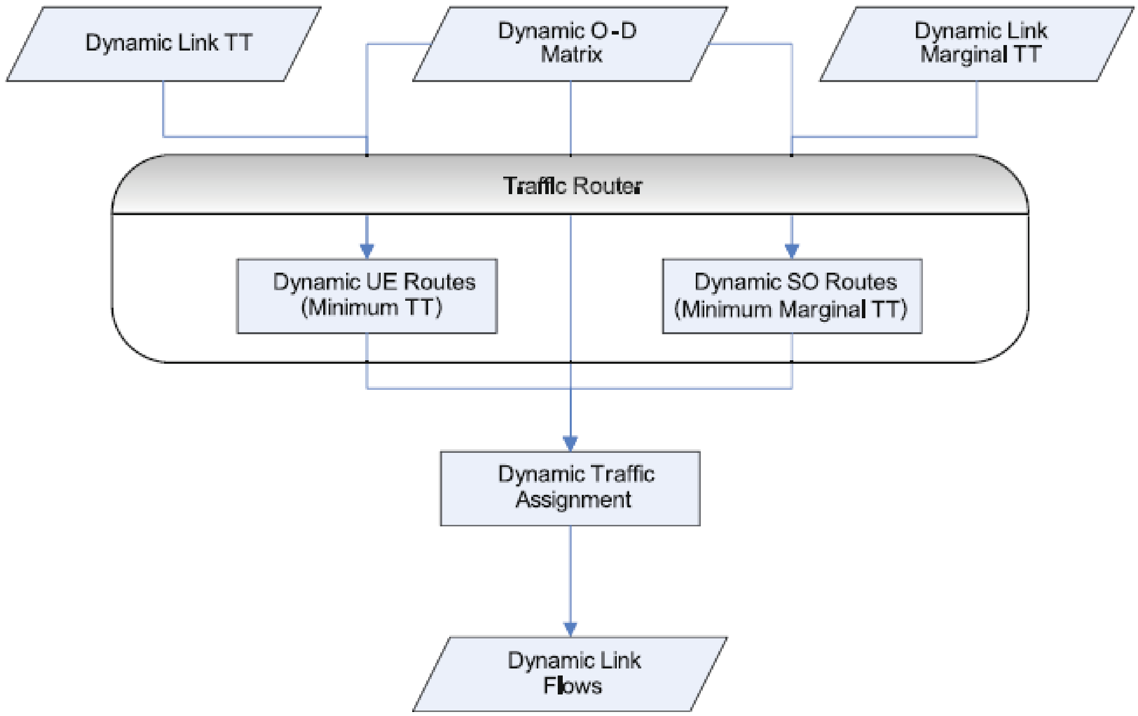



*Figure 4:Dynamic Traffic Assignment Framework* [20]

### *4.6 Capacity restraint assignment*

Many different capacity restraint equations have been developed and tested and are available for use. There are two basic characteristics common to capacity restraint models; (i) they are non-linear relationships and (ii) they use the volume-capacity ratio or v/c as a common factor. The underlying premise of a capacity restraint model is that the travel time on any link is related to the traffic volume on that link. This is analogous to the level of service (LOS) criterion, where LOS A corresponds to a low v/c and a higher vehicle speed. LOS E and the corresponding v/c = 1 represents capacity [21].

Capacity restraint models assign traffic to possible routes in an iterative manner:

1. For a portion of the overall traffic capacity, the link with the shortest travel time is allocated.
2. As volumes have increased, travel times for all possible connections are determined again.
3. Traffic volume still to be assigned is spread over the shortest-travel time link.
4. On both routes, travel time is measured and then updated as adjustments occur.
5. Once incremental assignments have been calculated, the new shortest travel times are calculated by relation.

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

Uidaho.edu shows that The capacity restraint model used by Federal Highway Administration FHWA is applied in an iterative manner [21]. The adjusted link speed and/or its associated travel impedance is computed using the following capacity restraint function as it shown in Eq.3:

$$T=T_o[1+0.15(V/C)^4] \quad (3)$$

Where:

T= balance travel time (at which traffic V can travel on a highway segment)

$T_o$= free flow travel time: observed travel time (at practical capacity) times 0.87

V= assigned volume

C = practical capacity

### *4.7 Incremental assignment*

Incremental assignment is a procedure that sequentially assigns fractions of traffic volumes. Total demand is evenly divided in the process, which means a set percentage of total demand is allocated to each phase. Travel time from one step to the next is updated each time a step is completed. The assignments might look like an equilibrium in that many increments are used, but the solution is not really an equilibrium. As a result, there would be inaccuracies in the estimation measures because of connection volume and travel time differences. O-D pairs allocated to the incremental volume go first, meaning they could introduce bias in performance [19].

## 5. Vehicular communication system

The key enabling technology is wireless communication and medium access technologies that have been tailored to the VC area. Networking technologies allow data transfer among nearby and remote devices, which is conceptual to put on top of them (vehicles, RSUs, and other servers). They in turn assist the vast array of usage scenarios across a variety of functionalities, in this case by collecting and storing data (mostly in the form of timestamped location data). It's based on the ITS (Intelligent Transportation System) station, which is comprised of a router and a host. It may also be a single-box solution that serves all of its purposes [22].The following figure represent the system architecture view of CVSI.

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

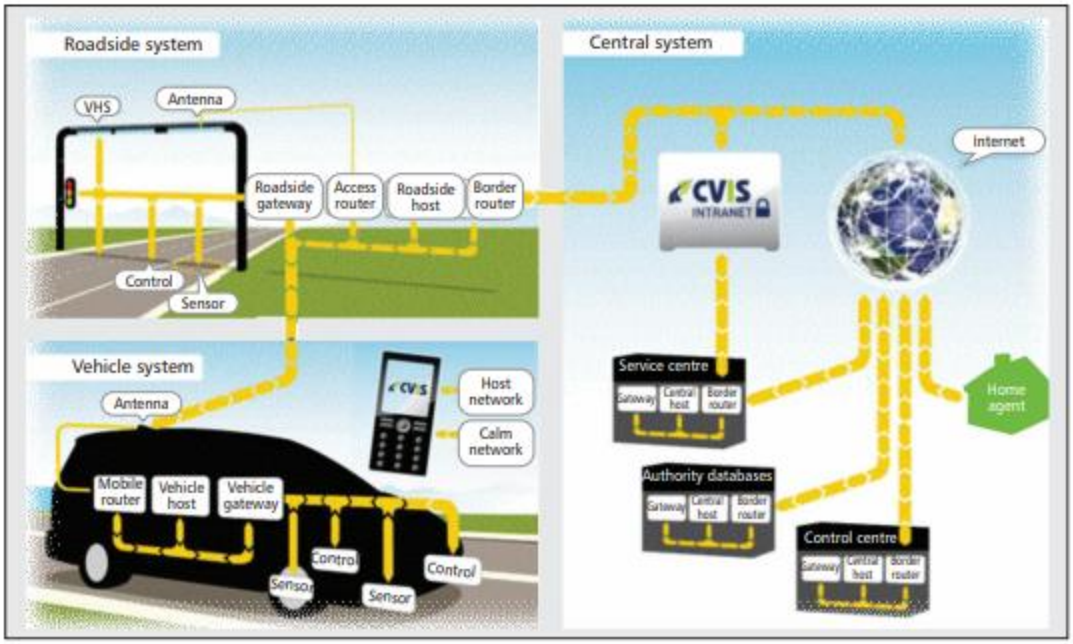



*Figure 5:System architectural view, as per the CVIS approach* [22]

## *5.1 Onboard Equipment's*

In the vast majority of situations, onboard computing, communication, and sensing equipment would be different from the newer VC computing, communication, and sensing equipment. VC systems will leverage on the wide range of equipment vehicles on the road today, using onboard or upgraded interfaces to collect data about vehicle service. As ongoing projects demonstrate, mature and well understood modules and their variants will form the foundation of future VC projects. This segment covers the various features that the onboard gear will have going forward [10], [22], [23] .

### 5.1.1 VC computing platforms

For Venture Capital functions, the system is exclusively devoted. There are several different kinds of microcontrollers (which control various mechanical parts of the car) already installed in vehicles; to help you understand this, we will call them microcontroller processors. Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) connectivity protocols and the assisted applications will be housed on separate but integrated vehicle computing platforms. The most recent platform available and running now days is Car to Car Communication Consortium (C2C-CC) [24] which aims at helping reduce the risk of accidents by the earliest possible date (by way of the vision zero goal). The initiative seeks to improve road safety while minimizing costs for end users and the community. To find effective solutions that address needs of

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

customers, types of cars, and drivers, the company explores particular aspects when focusing on solutions enabling every degree of driving from manual to fully automated. The C2C-CC is involved in ensuring a constant and smooth progression of critical functionalities. By incorporating technology from innovation and competitiveness, this element facilitates both principles of collaboration with road users and with the road infrastructure as well as innovations motivated by innovation and competition. The knowledge, memory, understanding, and intentions for each member are shared while simultaneously concentrating on tactical and strategic goals that may be needed.

### *5.2 Sensing Equipment's*

A programmable, portable, digital recorder is often referred to as a Data Recorder. RapidM2M is used for the CAN Gateway. The instruments supplied make it possible to develop the application in a short time. Machines provide a direct access to data via the CAN bus, which can be sent to a central server for processing. A multi-GNSS module for exact position determination is also included in the CAN Gateway. This rail mounting system was created specifically for the top-hat control cabinet and makes it easy to install Figure Shows CAN Gateway .

The GPS receivers rely on the precision of their signals to pinpoint position and time. For eg, using small-footprint receivers, the receiver can achieve synchronization and localization errors of 10–15 ns and an angular accuracy of 6–30 m. which works with the U.S.-built GPS but is also interoperable with the forthcoming European Galileo system (currently with one operational satellite while the rest of the constellation is being deployed).

*Figure 6:CAN Gateway*

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

### *5.3 The Communication Equipment:*

The communications standards used in this application basically focus on short-range V2V communication in order to allow for V2V and V2I communication, and on long-range infrastructure-based communication for V2I use. When users purchase additional long-range broadband transceivers, including broadcast receivers, it is possible to incorporate them into the network[22].

### *5.4 Wireless Data Link*

Vehicles are expected to hold various models of wireless transceivers. Some layers have a physical layer (a collection of symbols used to represent bit sequences to be sent through the airwaves), an implementation of methods to transmit and receive data (operations that conduct bit sequences across the airwaves), and a medium access control layer (algorithms that regulate access to the wireless medium), in order to reduce the possibility of or avoid collisions (of transmissions overlapping in frequency and/or time).

*Table 1: Summary information on representative VC wireless data links* [22]

| Indicative wireless data link characteristics | Technology | | | |
|---|---|---|---|---|
| | 802.11p WAVE | Wi-Fi | Cellular | Infrared |
| Bit rate | 3–27 Mb/s | 6–54 Mb/s | < 2 Mb/s | < 1 Mb/s<br>< 2 Mb/s |
| Communication range* | < 1000 m | < 100 m | < 15 km | < 100 m (CALM IR) |
| Transmission power for mobile (maximum) | 760 mW (US)<br>2 W EIRP (EU) | 100 mW | 2000 mW (GSM)<br>380 mW (UMTS) | 12800 W/Sr pulse peak |
| Channel bandwidth | 10 MHz<br>20 MHz | 1–40 MHz | 25 MHz (GSM)<br>60 MHz (UMTS) | N/A (optical carrier) |
| Allocated spectrum | 75 MHz (US)<br>30 MHz (EU) | 50 MHz @ 2.5 GHz<br>300 MHz @ 5 GHz | (Operator-dependent) | N/A (optical carrier) |
| Suitability for mobility | High | Low | High | Medium |
| Frequency band(s) | 5.86–5.92 GHz | 2.4 GHz, 5.2 GHz | 800 MHz, 900 MHz<br>1800 MHz<br>1900 MHz | 835–1035 nm |
| Standards | IEEE, ISO, ETSI | IEEE | ETSI, 3GPP | ISO |

*The communication range depends on parameters such as data rate, power, bandwidth, and topography; values given in this table are estimates and may vary.

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

### *5.5 Network protocols*

Beaconing is a basic method, used in many other networks, that broadcasts short updates (i.e., a one-hop or local broadcast). VC systems also use beacons to provide a lot of useful information about the transmitting vehicle and itself, including position, going, and other status information. It is done at 10 times a second, for example, and there is no coordination among the vehicles. This were important to the next section's transportation and cooperative knowledge applications.

Beacons are normally sent as broadcast packets on the WAVE data link, and are then routed via the 802.11p control layer. Beaconing is a case of sending broadcast messages repeatedly for a certain protocol for a period of time (e.g., a safety related warning triggered by an in-vehicle event). The implementation specifications demand that safety-related beacons be sent to the adjacent nodes within a maximum delay, and they should have a low degree of reliability, given that criterion.

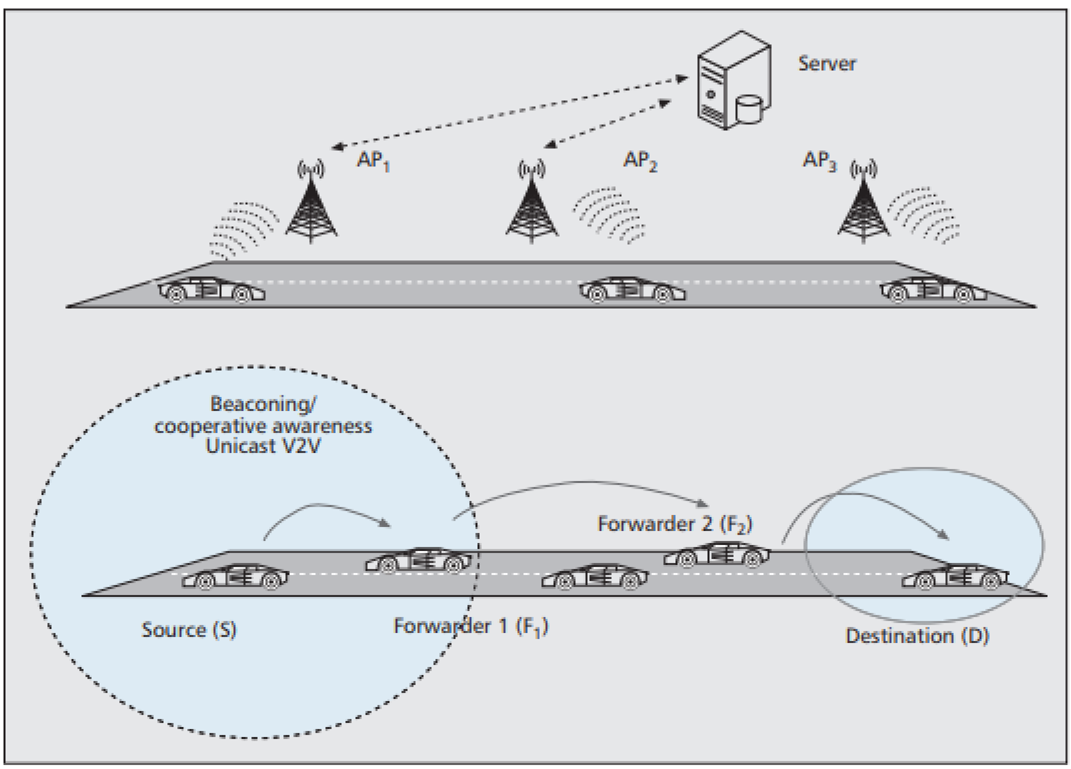



*Figure 7:Illustration of networking protocols for VC systems* [22].

#### *5.5.1 Road Side Unit (RSU)*

While most traffic signal management systems have mostly been used to support roadway vehicle connectivity, roadside units (RSUs) are used to support infrastructure vehicle connectivity as well. The methods for RSU implementation that typically rely on the use of fixed placements, applying geometric principles, are prone to a variety of problems due to lack of coverage or uneven network load (i.e., some RSUs exhibit extremely high network usage, while others do not). In order to surpass those limits, we suggest a genetic algorithm for roadside unit deployment (GARSUD), which is based on the evolutionary computation branch of artificial intelligence [25], [26] .

## 6. Advantages and Disadvantages of network traffic assignment Model for V2V

### *6.1 Advantages of V2V and V2I implementation*

In today's world, vehicle-to-vehicle (V2V) connectivity offers several advantages in fleet management, with safety being chief among them. With motor vehicle accidents happening on the roads each day and resulting in several deaths, it becomes a worry for the welfare of the people on the road. However, so far, only protection has been recorded as a clear advantage. On the other hand, there are many commercial fleets using eco-friendly options. They are searching at more environmentally friendly ways to boost their public profile. It is a technology that has far-reaching implications for both fleet management and the general transport sector, and one that deserves research.

- Traffic Management Improvement: Real-time vehicle to vehicle communications are essential for law enforcement officers as they allow control and handling of traffic by sending out warnings in real time from the cars to clear up traffic. Vehicle communication systems are used to redirect traffic, to map vehicles' position, to establish speed limits, and to adjust traffic light services. Drivers like V2V connectivity because it lets them stop traffic tie-ups and stay at a safe distance from other cars.
- Driving Assistance: allows drivers to take complete control of their cars. Fleet truck or oversized freight truck drivers would greatly benefit from timely alerts like the level of a nearby bridge. One potential use for this technology is helping to make parallel parking, or "secure parking," possible, as it will warn drivers of other parked cars. Lane-keeping could theoretically be assisted by this, as it could aid drivers in preventing dangerous drifts.
- Route Optimization: Route optimization is a critical factor in fleet management schemes, which enables fleets to save time and money. This new technology makes driving more effective. Vehicle-to-vehicle (V2V) connectivity is designed to provide drivers with travel-related information in a variety of ways, such as through systems mounted on vehicles. This technology enables the positioning of the destination, maps, and path optimization tips to be delivered.
- reduces the risk of crashes: According to estimates [27], about 33,000 people are killed last year in motor vehicle crashes. The numbers keep that as new highways and high-speed vehicles are

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

increasingly unveiled. Road protection is our main priority. Even though stakeholders have all done their best to increase people's understanding of the need for safe driving, human error still remains the leading cause of car crashes. In the future, such incidents will be reduced by up to 70 to 80 percent by V2V connectivity technologies.

### *6.2 Disadvantage of V2V and V2I implementation*

Although high-profile entities push for V2V connectivity, factors that impede implementation of the technology thwart their efforts. For both public and private sectors, commercial incorporation poses several significant obstacles, the most serious of which is stability. Overlapping frequencies and incompatible protocols are some of the other roadblocks.

- Security risks : Vehicles equipped with V2X connectivity are vulnerable to hacking. Once hackers gain access to the car, they will take ownership of it.
- Privacy risks: The protection of the personal information of owners and users of vehicles is critical. This happens when details like the location of the car, everyday schedule, regularly used software, and so on leak. Data that has been stolen and then compromised will be used for illegal purposes. Although they are often used by companies and government departments, they may also be used by companies and agencies.
- System Failure: When the system fails, the autonomous driver system can trigger fatal consequences.
- Faulty communication: Vehicle failure, sensor malfunction, or network malfunction lead to inaccurate results.

## 7. Worldwide implementation of Road traffic network

According to [5] Most of the European countries using the system of HERE360. Which is one of the platforms used in traffic network, Also the middle east countries are significant used of the traffic network and the most live data available from Bahrain, Oman, Kuwait and the figure is shown the fifty countries using the HERE360.

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

*Figure 8: Countries using HERE360* [5]

## 8. Conclusion:

In conclusion, this paper represents the different traffic network assignments models and also the infrastructure and implementation of V2V and V2I models. The countries that implemented or organize the law for using the data generated and collected by traffic automated systems. The limitations and advantages of the implementing the system is also overview and discussed.

## References

[1] X. Zhang, W. Liu, and S. T. Waller, "A network traffic assignment model for autonomous vehicles with parking choices," *Comput. Civ. Infrastruct. Eng.*, vol. 34, no. 12, pp. 1100–1118, Dec. 2019, doi: 10.1111/mice.12486.

[2] A. Soteropoulos, M. Berger, and F. Ciari, "Impacts of automated vehicles on travel behaviour and land use: an international review of modelling studies," *Transp. Rev.*, vol. 39, no. 1, pp. 29–49, 2019, doi: 10.1080/01441647.2018.1523253.

[3] J. Wang, S. Peeta, and X. He, "Multiclass traffic assignment model for mixed traffic flow of human-driven vehicles and connected and autonomous vehicles," *Transp. Res. Part B Methodol.*, vol. 126, pp. 139–168, 2019, doi: 10.1016/j.trb.2019.05.022.

[4] G. E. Cantarella and A. Di Febbraro, "Transportation Systems with Autonomous Vehicles: Models and algorithms for equilibrium assignment," *Transp. Res. Procedia*, vol. 27, pp. 349–356, 2017, doi: 10.1016/j.trpro.2017.12.090.

[5] by Leo Kent, "50 countries with HERE Real Time Traffic, and counting," *HERE*, 2015.

East Journal of Computer Science
ISSN: 3079-9406
Volume 1, Issue 1
Publisher: East Publication & Technology
DOI: https://doi.org/

https://360.here.com/2015/06/22/50-countries-real-time-traffic-counting/.

[6] C. Dong, H. Wang, Y. Li, Y. Liu, and Q. Chen, "Economic comparison between vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) at freeway on-ramps based on microscopic simulations," *IET Intelligent Transport Systems*, vol. 13, no. 11. pp. 1726–1735, 2019, doi: 10.1049/iet-its.2018.5537.

[7] Editorial Team, "What is DSRC (Dedicated Short Range Communication)," *everything RF*, 2019. https://www.everythingrf.com/community/what-is-dsrc (accessed May 22, 2021).

[8] Federal Communications Commission, "Dedicated Short Range Communications (DSRC) Service," 2019. https://www.fcc.gov/wireless/bureau-divisions/mobility-division/dedicated-short-range-communications-dsrc-service (accessed May 18, 2021).

[9] Tech Target, "vehicle to infrastructure (V2I or v2i)," *Tech Target*, 2017. https://whatis.techtarget.com/definition/vehicle-to-infrastructure-V2I-or-V2X#:~:text=Vehicle-to-infrastructure (V2I,streetlights%2C signage and parking meters. (accessed May 20, 2021).

[10] K. Ullah, "On the use of opportunistic vehicular communication for roadside services advertisement and discovery," no. October, 2016, doi: 10.13140/RG.2.2.24995.04643.

[11] F. Cunha *et al.*, "Data communication in VANETs: Protocols, applications and challenges," *Ad Hoc Networks*, vol. 44, pp. 90–103, 2016, doi: 10.1016/j.adhoc.2016.02.017.

[12] Chris Bonelli, "V2V Safety Technology Now Standard on Cadillac CTS Sedans," *Cadillac*, 2017. https://media.gm.com/media/us/en/cadillac/news.detail.html/content/Pages/news/us/en/2017/mar/0309-v2v.html (accessed May 22, 2021).

[13] A. J. Alami, K. El-Sayed, A. Al-Horr, H. Artail, and J. Guo, "Improving the Car GPS accuracy using V2V and V2I Communications," *2018 IEEE Int. Multidiscip. Conf. Eng. Technol. IMCET 2018*, 2019, doi: 10.1109/IMCET.2018.8603032.

[14] G. Challita, S. Mousset, F. Nashashibi, and A. Bensrhair, "An application of V2V communications: Cooperation of vehicles for a better car tracking using GPS and vision systems," *2009 IEEE Veh. Netw. Conf. VNC 2009*, pp. 3–8, 2009, doi: 10.1109/VNC.2009.5416382.

[15] B. G. Heydecker and J. D. Addison, "Analysis of dynamic traffic equilibrium with departure time choice," *Transp. Sci.*, vol. 39, no. 1, pp. 39–57, 2005, doi: 10.1287/trsc.1030.0075.

[16] M. Rojo, "Evaluation of traffic assignment models through simulation," *Sustain.*, vol. 12, no. 14, 2020, doi: 10.3390/su12145536.

[17] E. S. Lee and P. G. Oduor, "Using multi-attribute decision factors for a modified all-or-nothing traffic assignment," *ISPRS Int. J. Geo-Information*, vol. 4, no. 2, pp. 883–899, 2015, doi: 10.3390/ijgi4020883.

[18] G. E. Cantarella and A. Sforza, "Traffic Assignment," *Concise Encycl. Traffic Transp. Syst.*, pp. 513–520, 1991, doi: 10.1016/b978-0-08-036203-8.50107-3.

[19] M. G. H. Bell, "Stochastic user equilibrium assignment in networks with queues," *Transp. Res. Part B*, vol. 29, no. 2, pp. 125–137, 1995, doi: 10.1016/0191-2615(94)00030-4.

[20] H. Rakha and A. Tawfik, "Traffic Networks: Dynamic Traffic Routing, Assignment, and Assessment," *Encycl. Complex. Syst. Sci.*, pp. 9429–9470, 2009, doi: 10.1007/978-0-387-30440-3_562.

[21] uidaho.edu, "Travel Demand Forecasting Theory & Concepts," *uidaho.edu*, 2020. https://www.webpages.uidaho.edu/niatt_labmanual/chapters/traveldemandforecasting/theoryandconcepts/tripassignmentanalysis.htm (accessed May 22, 2021).

[22] P. Papadimitratos, A. La Fortelle, K. Evenssen, R. Brignolo, and S. Cosenza, "Vehicular

communication systems: Enabling technologies, applications, and future outlook on intelligent transportation," *IEEE Commun. Mag.*, vol. 47, no. 11, pp. 84–95, 2009, doi: 10.1109/MCOM.2009.5307471.

[23] J. Harding *et al.*, "Vehicle-to-Vehicle Communications: Readiness of V2V technology for Application," *U.S. Dep. Transp.*, vol. 339, no. 3, pp. 247–257, 2014.

[24] Car to car team, "Car to Car," *CAR 2 CAR*, 2021. https://www.car-2-car.org/ (accessed May 16, 2021).

[25] L. Xue, Y. Yang, and D. Dong, "Roadside Infrastructure Planning Scheme for the Urban Vehicular Networks," *Transp. Res. Procedia*, vol. 25, pp. 1380–1396, 2017, doi: 10.1016/j.trpro.2017.05.163.

[26] M. Fogue, J. A. Sanguesa, F. J. Martinez, and J. M. Marquez-Barja, "Improving Roadside Unit deployment in vehicular networks by exploiting genetic algorithms," *Appl. Sci.*, vol. 8, no. 1, pp. 1–21, 2018, doi: 10.3390/app8010086.

[27] A. MT, "Advantages of Vehicle to Vehicle Communication," *Azuga MT*, 2020. https://www.azuga.com/blog/vehicle-to-vehicle-communication-benefits (accessed May 20, 2021).