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5G technology and its impacts towards road safety and Autonomous Cars

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Abstract

5G C-V2X (cellular vehicle to everything) will be the communication standard between vehicles, infrastructures such as traffic lights, intersections, cameras, or even the various sensors along roads and highways and other road users such as cyclists and pedestrians. The usage 5G cellular can help us avoid accidents on routes. The vehicle can send signals to other vehicles if something suddenly happens. 5G will have to be accompanied by all the proper technical solutions to frame the information and send it as quickly as possible. On the other hand, autonomous vehicles are the new generation of smart vehicles with the ability to self-driving by using various electronic devices and informatics methods. Autonomous cars rely on information and connection technologies based on a very efficient network. An intelligent driving system is one of many AV (Autonomous vehicles) features that can be realized via 5G technology by applying an intelligent transporting system. This paper aims to chew over the impact and intimation of 5G on AV from several dimensions and present an overview of IoT's role in our lives and how 5G will be affected in AV. In addition, 5G for AV is introduced in more detail.Keywords: wear-resistant coating, TiBN, DLC, scratch test, tribology

Keywords: Internet of things, 5G technology, Road safety, Autonomous vehicle, wireless communication

1. Introduction

The Internet of Things (IoT) is the third wave of the internet, and it has a considerable potential by the year 2021/2022 to connect over 29 billion items. The term (IoT) was given by the prominent British technologist Kevin Ashton. The Internet is now widely used for plenty of services: information retrieval, video streaming, file sharing, online shopping, banking, social networking, etc. It is known as "Web 2.0". However, the Internet continues its evolution and will enable objects to connect to get some information, take some action, or share information. [1]

This technology plays an important role in improving remote monitoring, energy efficiency, and control of physical assets.

As the 5G technology was released, it directly impacted the massive amount of IoT devices to connect and provides an enormous flow of data.

About this topic and after this invasion of the internet of things, autonomous vehicles and connected cars also became a matter of public record. In conclusion, the AV will directly relate to the 5G technology.

An efficient and safe road network is an essential requirement for the modern society. The

current technological shift in the automotive industry toward connected and increasingly autonomous vehicles will play a key role in improving road safety and enabling the future of autonomous driving. Hence, the 5G network makes it simple to operate without replacing the outdated vehicle tracking technology by enabling collaboration with existing networks. It is anticipated that the use of autonomous vehicles will rise as 5G technology is implemented.

A new era in transportation will start as a result. It is predicted that on-road vehicles will communicate with one another and share knowledge, increasing road safety.

In this paper, the 5G technology is discussed; how it helps to develop the shift towards autonomous cars, and its impacts on road safety.

2. Background

2.1 What is 5G technology? The usage of it.

When 4G was created, the main use was enhanced mobile broadband. With 5G, we will see a wide range of use cases, focusing on Machine Type Communication (MTC).

The 5G technology is for 5th generation mobile technology with very high bandwidth, fast and reliable network, and low latency. This new technology has given the communication and transportation of data a new concept. It has been planned to meet the enormous growth in data and connectivity of today's modern society, such as the Internet of Things with billions of connected mobile and non-mobile devices and tomorrow's innovations. 5G will initially operate in conjunction with existing 4G networks before evolving to fully standalone networks in subsequent releases and coverage expansions.

The 5G use cases are grouped into two classes, where the massive MTC classes are new market segments. Massive MTC means low-cost, low-energy devices requiring small data volume. These are the internet of things (IoT) devices that are supported already in GSM [2]and LTE.

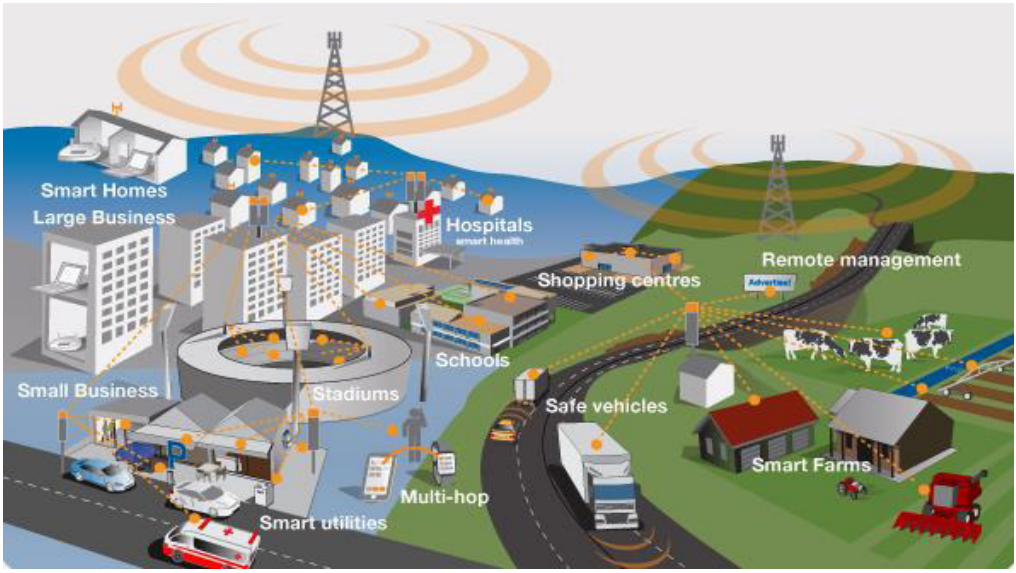

Figure 1. Connected community (EMF Explained 2.0, n.d.)

Critical MTC, on the other hand, requires high availability, low latency, and high reliability. These are use cases like remote traffic control and its impact on road safety and self-driving systems. These use cases are the main reasons why 5G is needed. This technology will take traffic to the next gear by connecting vehicles, and roadside infrastructure, digitalizing the entire traffic system.

2.2 Improving road safety with 5G and the impact of that on Autonomous Driving

Transportation is one of the major problems that 5G can help us solve in our lives.

Scientists are developing an intelligent transport system. One of the significant inventions in this field is building and developing autonomous vehicles, which generally refer to self-driving vehicles or transport systems that move without the intervention of a human driver [3].

The 5G network will offer new application options advancing the development of autonomous cars. Not only will these vehicles be able to make autonomous decisions in the future, also communication and cooperation with each other can be achieved [4].

The amount of cars and trucks on the road has been steadily increasing. By 2030, it is anticipated that their number will approach two billion. This is partially a result of global urbanization, according to which, up from 12% in 2013, the UN predicts that by 2050, 21% of the world's population will reside in cities. The latter point to pressing issues that must be addressed, like the rising toll of traffic accident fatalities and the deteriorating global natural environment in order to increase road safety. [5]

Since the end of the previous decade, interest in vehicle communications and networking (VCN) has grown as one of the key supporting technologies for the subsequent generation of ITS and IVs.

VCN needs low latency and high-reliability connections to promote a wide variety of apps, including entertainment, effective transportation, and vehicle safety. Hence, due to increased car industry competitiveness and the popularity of electric mobility, the production of fully autonomous vehicles is rising quickly. However, specific potential applications do not require a high degree of automation. Through cloud connectivity, the data from onboard sensors, like cameras or lasers, also enables the delivery of warning apps to the drivers.

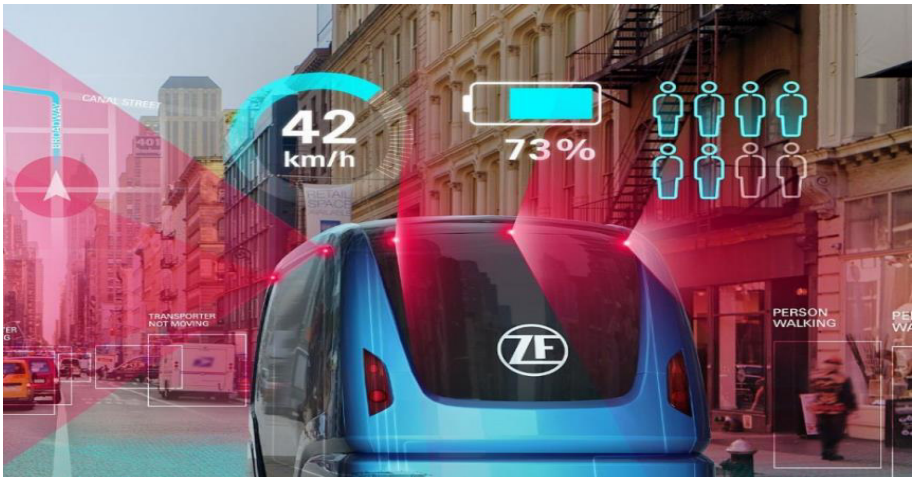

Figure 1:Intelligent transport system (ITS) [3]

Vehicle communication will benefit both drivers and passengers by enhancing efficiency, safety, and comfort. The next generation of mobile communication networks will need to overcome several technical, societal, and economic challenges to achieve this goal before autonomous vehicles go on sale [6].

An efficient and effective Intelligent transport system needs a great network which is going to hold and transmit this huge amount of data. Big data will become more challenging with IoT, which is expected to be a norm in 5G networks. As we know, the 5G technology is 100 times faster than 4G at peak speed. That speed is imperative for connected cars.

The fully autonomous cars are the future and the dream of many of us. That is the reason why scientists are competing for the time to make this dream real. With an advanced Wi-Fi connection, it would take 230 days to transfer a week to transfer worth of data from an autonomous car; with 5G, it would take a few days.

The fast real-time latency, which can reach 5ms, can alert drivers to safety information before it is visible. So, these cooperative Advanced Driver Assistance Systems (ADAS) will help drivers drive safely and avoid accidents. The future of transportation worldwide will be possibly unlocked by the usage of 5G. [7]

3. Opportunities and challenges

In this section, the possible opportunities and challenges are discussed for road and autonomous vehicles-based 5G technology.

3.1 Opportunities

5G is supposed to provide massive new business opportunities for both industries and telecommunication providers; it will transform countries, industries, and societies all over the world. As a result of using the 5G networks worldwide, the collection of a huge amount of data will be allowed. In addition, the companies will be able to use Artificial intelligence (AI) to increase productivity and efficiency. The automotive industry delivers a perfect break into the transformative capability of 5G for the entire value chain.

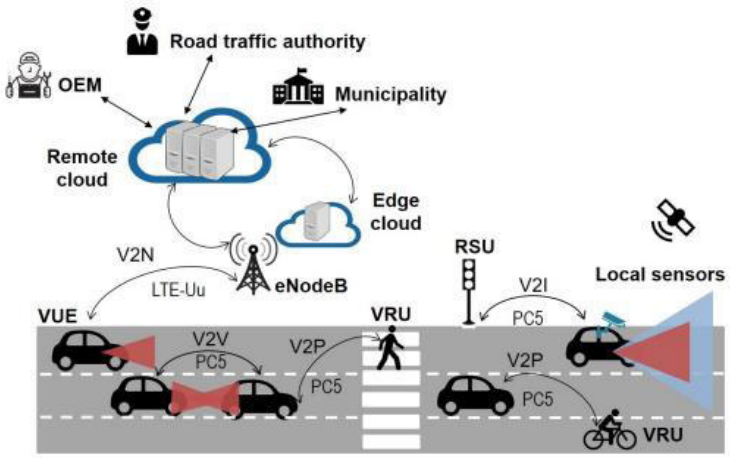

Figure 2:V2X communication modes, interfaces, and entities.

IT will offer traffic efficiency, improve road safety, reduce traffic congestion, and intelligent navigation via high and stable connectivity and low latency for smart cities, and build reliable and robust communication for vehicular networks [8]. Cities and road authorities operate connected infrastructure services for road traffic to monitor and control traffic flow, such as traffic guidance systems, parking management, and dynamic traffic signs. [9]

3.2 Challenges

According to the Fifth Generation Public-Private Partnership (5G-PPP), 5G will connect about 7 trillion wireless devices or things [11]. Using the 5G technology to build AV networks will be a big challenge. The 5G aims at a digital society that requires high service availability and security using diverse technologies.

The primary objective in the upcoming years is to turn the idea of vehicle communication into usable implementations. Several technological obstacles must first be solved in order to achieve such a satisfying aim. Leading specialists in inter-vehicle communication gathered to discuss and identify the open issues in R&D from both a scientific and an industry point of view, as well as the current state of the art. The top researchers have selected heterogeneous vehicular networks, vehicular networking applications, field operational tests, and the scientific underpinnings of inter-vehicle communication as the most crucial and difficult study areas.

Even in advanced countries, there is still a considerable lack of available networks able to handle connecting the vehicles to each other. So, more time and resources are needed to meet the requirements. As it is known, the different areas of the world have various amounts of resources and levels of development. In this case, the challenges will be very high to establish this project that will quantum leap and a significant shift in the level of transportation.

5G technology is a new telecommunication standard. It can be used with several other technologies such as heterogeneous networks (HetNets), Device to Device Communication (D2D), Software Defined Cellular Networks (SDN), Massive Multiple Input/ Multiple Output (MIMO), 3D MIMO, Third Generation Partnership Project (3GPP), and Machine to Machine Communication (M2M) [12].

One of the main challenges facing this type of communication is the cyber-threats and security in general. The random connection of mobile devices to the network poses security threats, such as packet sniffing and the injection of unauthorized codes to manipulate network services [13]. Security threats are becoming more prevalent as vehicles connect to the Internet, provide onboard Wi-Fi hotspot services, communicate with other vehicles and ITS infrastructures, and support advanced applications like over-the-air (OTA) ECU firmware updates. Many attacks that formerly required physical access to a vehicle can now be carried out remotely through wireless networks. As a result, attackers can easily compromise a larger number of automobiles. A vehicle that has been compromised might potentially be used to attack other cars. [14]

The challenges are enormous in both making our road safer using 5G technology and the race towards fully connected autonomous vehicles. Still, technology is growing every day, and those challenges are vanishing day by day due to the hard work of engineers and researchers.

4. Conclusion

The 5G is a great opportunity that will open doors for getting our roads more connected, which means more security and fewer accidents, and the Autonomous vehicle idea to become more reliable with an extremely high speed, low latency, high performance, and massive connectivity. In 5G, fully cloudified applications enable vehicles to autonomous driving and a connected experience for users.

Connected and intelligent transport systems will continue to rely on ubiquitous broadband connectivity as expected by the automotive.

However, it faces many challenges and obstacles for users and network providers. Hence, this paper presents a general overview of the technology, opportunities, and deployment challenges. In particular, the paper indicates how 5G can increase the fortunes of Autonomous cars to become part of our technological progress and its impacts on road safety by connecting vehicles to everything surrounding them. Eventually, as many experts thought, security issues will be one of the biggest obstacles to developing this technology and making it spread worldwide.

One of the megatrends of the future is digital transformation, which is all based on new technologies based on the 5G technology like AI, cloud computing connectivity, or quantum computing in the future.

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