

V2X AND DSRC

I. Introduction

The autonomous car is a subject known by all but it remains a controversial subject. For several years now, the industry has presented their arrival in everyday life as imminent. However, it is not yet common to see driverless cars. Almost all modern vehicles do not drive alone on our roads but are increasingly automated. Indeed, the integration of sensors, controllers, on-board computers is implemented in new vehicles to help the user on the road (steering, speed, monitoring of the driving environment).

V2X, Vehicle to Everything, is a term that fits in this automated world, and includes communication technologies between a vehicle and any other entity. An entity can be a pedestrian, a cyclist, a road infrastructure such as a traffic light or a road vehicle. V2X is therefore a vehicular communication system. It integrates other more specific types of communication such as V2I (vehicle-to-infrastructure), V2V (vehicle-to-vehicle) or V2P (vehicle-to-pedestrian).

DSRC, dedicated short-range communication, is a means of communication that is part of V2X or V2V technologies. It allows the direct, wireless exchange of data from vehicles to different entities. In the context of vehicular networks, DSRC is not the only technology that allows data exchange. However, it is still the most widely deployed technology on various continents, including Europe.

DSRC is a technology that has been around for a few years now. It is already used by big names in the automotive industry and is also standardized by international organizations. However, it is constantly evolving and is being challenged by the arrival of 5G, which will allow new communication technologies to appear.

DSRC is at the heart of the debate and will be studied in this paper through the study of the following 6 documents:

[1] Sarah Penny, DSRC vs 5G for Connected Vehicles: 5 metrics compared, Jun 28, 2021, *SMATS*, <https://www.smatstraffic.com/2021/06/28/connected-vehicles-dsrc-5g>
Paper comparing DSRC protocol to C-V2X protocol.

[2] Chris Teague, Everything you need to know about V2X technology, May 3, 2021, *Autoweek*, <https://www.autoweek.com/news/technology/a36190311/v2x-technology/>
Article on the challenges of V2X technologies with emphasis on the difficulty of deployment, often hampered by politics and economic costs.

[3] Jon Gold, Congress fights for additional Wi-Fi spectrum, January 26, 2020, *Networkworld*, <https://www.networkworld.com/article/3516311/congress-weighs-in-on-additional-wi-fi-spectrum.html>

This article discusses the issues arising from the announcement of the reduction of the wi-fi band that had been allocated to the DSRC protocol.

[4] John Lipper and Todd Shields, Toyota to start deploying chips in battle to get cars talking, April 17, 2018, *Stuff*, <https://www.stuff.co.nz/motoring/news/103164444/toyota-to-start-deploying-chips-in-battle-to-get-cars-talking>

Article that exposes Toyota's choice to industrialize its vehicles with chips supporting DSRC and not C-V2X. It summarizes the reaction of the phone industry that does not validate this choice, preferring the deployment of 5G in vehicles.

[5] Nikki Gordon-Bloomfield, What's V2V? - And why will it make your car safer?, April 18, 2018, Transport Evolved, <https://www.youtube.com/watch?v=KnTpjyJXvwQ>

Video presenting the environmental and safety issues of V2X technologies such as DSRC.

[6] Current Status of V2X in US and Europe: as of September 2022, January 5, 2023, *V2X Supporters for Transportation Safety*, <https://www.youtube.com/watch?v=xh9Y9pJxVwM>

Video that reviews the laws and announcements made regarding DSRC and C-V2X protocols. The debate is not yet over regarding the deployment of V2X technologies around the world.

II. Reviews

1. Sarah Penny, **DSRC vs 5G for Connected Vehicles: 5 metrics compared**, Jun 28, 2021, *SMATS*, <https://www.smatstraffic.com/2021/06/28/connected-vehicles-dsrc-5g>

Sarah Penny, an employee of SMATS, publishes a paper in 2021 comparing the DSRC protocol to the C-V2X protocol. This paper is published at a time when the debate about the choice of the future vehicular communication protocol has really started to appear in the political and industrial sphere. SMATS is a group that specializes in the collection and analysis of intelligent transportation data. They have a blog of intelligent transportation related information that they update regularly. However, the majority of their articles are biased as they usually showcase their solutions. This article, taken from their blog, is different from their other publications since it does not present any of their technology. Instead, it presents the two vehicular communication protocols that will still be in conflict in 2023.

The DSRC protocol has as main objective the safety on the roads. However, this is not the only objective expected from the deployment of the DSRC protocol. Another example of use would be traffic flow.

Thus, this protocol allows high speed, secure communication without the need to access a cellular network. Indeed, the user using this protocol does not need to be within range of a cellular antenna in order to communicate with a surrounding vehicle. This is because the communication channel of the DSRC protocol is a wifi channel.

DSRC is, in 2022, predominant in the United States. But while for 20 years the 5.9GHz wifi band was dedicated to the exclusive use of DSRC, since November 2021, 45 lower megahertz have been made available for unlicensed wifi. This has put the C-V2X protocol in an advantageous position. Indeed, unlike its competitor DSRC, C-V2X does not communicate through wifi bands but uses 5G.

The 5G network which moreover seems to develop faster in cities. Indeed, 5G in addition to offering cities the possibility to set up automated cars offers extremely fast Internet access and allows the deployment of IoT.

Also, the installation of antennas would not be at the expense of governments, unlike the DSRC protocol. The privatization of 5G therefore facilitates its installation and deployment.

Everything seems to lead to believe that 5G is the V2X solution of tomorrow. However, this technology does not have only advantages. Indeed, despite the fact that 5G has a sending range similar to the DSRC protocol (about 300m), 5G waves are more easily blocked by obstacles. The 5G technology remains very expensive to deploy, which still slows down its arrival in our vehicles.

This document briefly explains the main objective of V2X communication by focusing on the decrease of the wifi bandwidth assigned to the DSRC protocol, potentially leaving the C-VTX protocol running on 5G cellular data. However, this paper does not present the objectives that the policies set for its deployment. It also does not present the opinion of the car manufacturers on these protocols.

2. Chris Teague, **Everything you need to know about V2X technology**, May 3, 2021, *Autoweek*,
<https://www.autoweek.com/news/technology/a36190311/v2x-technology/>

Chris Teague is a former technology employee who earned an MBA in data analysis. Chirs Teague has focused on writing new vehicle reviews, detailing industry trends. He published this article in January 2020 on Autoweek an American motorsports journal. The paper focuses primarily on two areas. The first being how the DSRC protocol fits into V2X technologies. V2X, Vehicles to Everythings, is a term for the ability of a vehicle to use in-vehicle communication tools, technologies, to provide and receive real-time traffic information.

V2X technologies enable preemptive responses to changing road conditions by sharing and receiving information from other entities. These entities can be other vehicles or roadside devices, such as cameras. In the case of exchanges between two vehicles, these communications are called V2V (vehicle to vehicle). In the case of exchanges between a vehicle and a road infrastructure, these communications will be called V2I. The objective of this technology is to be able to create around each vehicle a 360° awareness bubble. This bubble is built by the exchange of wireless messages. The second subject treated by this article concerns the difficulty that the legislations have in front of the potential industrialization of 2 different protocols. Indeed, the inter-vehicular communication technology must be the same in each country (in Europe), or state (in the United States) to ensure its proper functioning. Each vehicle must use the same communication language, and therefore the same protocol, so that they understand each other. One of the problems is therefore the implementation in different legislations. It would be necessary to coordinate the deployment of sensors on the roads in each state. This requires a significant organization and budget. Especially since the appearance of a technology in everyday life is a long process. It has to be tested, validated, standardized and then industrialized before it can be deployed on public roads.

This document does not present the DSRC protocol in its entirety. However, it is interesting because it is the most detailed exposition of the term V2X, the principle of the DSRC protocol, and it informs the reader of the importance of retaining only one V2X technology globally to enable vehicular communication in the future.

3. Jon Gold, **Congress fights for additional WI-Fi spectrum**, January 26, 2020, *Networkworld*, <https://www.networkworld.com/article/3516311/congress-weighs-in-on-additional-wi-fi-spectrum.html>

Jon Gold is a journalist who covers IoT and wireless technology topics for Network World. Network World is an online newspaper that exposes server, virtualization, networking and Internet of Things technologies. This article focuses only on the problems caused by the announcement of the reduction of the wifi band that had been attributed to the DSRC protocol until then. This article was written before the outcome of the lawsuit that aimed to see the reduction of the band refused. DSRC, a standardized protocol that allows point-to-point communication between vehicles, has seen its communication band reduced by half. This reduction comes to limit its deployment on a large scale. This change proposed by the FCC (Federal Communication Commission) had not been welcomed by all. The 2021 U.S. Secretary of Transportation, Elaine Chao, raised "significant concerns" about the proposal at the time, citing potential damage to public safety as it would reduce the spectrum available for DSRC by more than half. The FCC explained their decision on the fact that few industries have adopted DSRC technology despite the fact that the spectrum was reserved 2 decades earlier.

In addition, as 5G technology gains popularity in recent years, some automakers, such as Ford, are preparing to introduce C-V2X in their new vehicles. Ford is not the only manufacturer to lean towards the 5G protocol as Qualcomm and Audi have announced the start of testing on cars with C-VTX protocol in 2020.

This document summarizes the impact that the decrease of the wifi band has on the choice of the future V2X protocol.

4. John Lipper and Todd Shields, *Toyota to start deploying chips in battle to get cars talking*, April 17, 2018, *Stuff*,
<https://www.stuff.co.nz/motoring/news/103164444/toyota-to-start-deploying-chips-in-battle-to-get-cars-talking>

John Lippert started his career building cars. He then made the decision to write about them. He published this article in April 2018 on Stuff, New Zealand's most popular news site. This paper generally outlines all the current points of the DSRC protocol, and is more comprehensive than most other papers.

Indeed, the article exposes the choice of the Toyota company to industrialize its vehicles with chips supporting DSRC and not C-V2X. It summarizes the reaction of the telephone industry that does not validate this choice, preferring the deployment of 5G in vehicles.

The Dedicated Short Range Communication protocol, called DSRC, is however already present in various recent vehicles. In fact, since 2021, manufacturers in the automotive industry have decided to industrialize their vehicles with chips allowing DSRC exchanges.

Toyota, the world's leading car manufacturer, is the first to make this choice. Moreover, Toyota had organized a campaign to bring the rest of the industry to adopt DSRC technology.

In the United States, in Europe (France, England, Germany...) and in Japan the implementation of DSRC cards on the roads had also started.

However, Toyota, after their announcement, saw itself at the doorstep of a conflict with the telephone companies. Indeed, the latter would prefer to see the manufacturers turn to the protocol: C-V2X.

This document is also interesting because it is one of the only ones to expose a major drawback of the C-VTX protocol. This problem lies in the sharing of the 5G band. Indeed, the GAFAs want to share the available waves. This slows down the deployment of 5G in the world of automated vehicles because this sharing could increase the risk of message collisions. A real risk would be the collision of messages with the waves emitted by planes and airports. Andrew Coetzee, vice president of Toyota's North American product planning group said: "Not convinced automakers should share the spectrum band with cable or tech companies. We need to make sure we're got super reliable and very quick transmission speeds," Coetzee said. "More testing will be needed to show you can do this" while sharing airwaves.

This document shows the important weight that telephone companies have on the choice of the future V2X protocol despite the fact that the DSRC protocol is already well established.

5. Nikki Gordon-Bloomfield, *Wha's V2V? - And why will it make your car safer?*, April 18, 2018, *Transport Evolved*,
<https://www.youtube.com/watch?v=KnTpjyJXvwQ>

Nikki Gordon-Bloomfield has been writing about cars since she got her license in the 1980s. Specifically, she specialized in electric cars. She later founded her own company: Transport Evolved. Transport Evolved is an LGBT friendly creative company that publishes content related to the world of safer, smarter and greener vehicles. The company is now based in the United States but originated in the United Kingdom. The video presented by Nikki Gordon-Bloomfield presents the safety and environmental issues of V2X technologies such as DSRC.

The article explains how the automation, even the autonomy, of cars could help drivers in their driving and thus avoid accidents. Indeed, the application of the DSRC protocol could save lives in

many circumstances. Numerous examples could be cited, such as helping to locate vehicles in fog or in intersections.

These messages would allow to fluidify the traffic and thus to save energy.

Today, this technology is already used to improve the fluidity of public transport services in some cities. Terminals are placed on the side of roads used, for example, by a bus network and receive messages when a bus is at hand. These messages can be used to find out how long it takes for the bus to complete its route, as well as to warn users of possible delays. These statistics can also be used to adjust routes according to time.

DSRC technology works by using "radio" chips located in each vehicle. These chips transmit the speed and location of the vehicles. The chips communicate on a dedicated channel: 5.9 GHz.

This document does not talk about the impact of the decrease of the wifi band or the development of the 5G network on the development of DSRC. It is a short video allowing a first general approach of the V2X technologies and thus of the DSRC protocol.

6. *Status of V2X in US and Europe: as of September 2022, January 5, 2023, V2X Current Supporters for Transportation Safety,*
<https://www.youtube.com/watch?v=xh9Y9pJxVwM>

V2X For Supporters for Transportation Safety is a 650-subscriber YouTube channel specializing in V2X. They have been posting informational videos since 2020 about the deployment of technologies that enable car communication. This video covers the laws and announcements made regarding DSRC and C-V2X protocols. Indeed, the debate is not yet over regarding the deployment of V2X technologies in Europe, USA and Japan. This is the most recent of the links studied in this paper. Since 2018 the situation remains at a standstill but the debates, them, not.

In 2022 more than 700,000 vehicles were sold with chips allowing V2X exchanges. The purpose of this technology is to reduce the number of road accidents which are counted at 1.3 million deaths and over 20 million injuries worldwide. Europe has announced its goal of zero deaths from road accidents by 2025. Japan and the United States have made similar statements. V2X technologies could be the solution, especially after the results of a study conducted by the American insurance institute showed that V2X technology would help drivers in intersections to the point that it would avoid 1/3 of the accidents of users over 70.

However, the decrease in wifi bandwidth used for the DSRC protocol led to a lawsuit. This lawsuit took place in June 2021 and was led by the American ITS who was against this change. After 1 year and 2 months, on August 12, 2022, the court gave its verdict: only 30 MHz remain for the DSRC protocol. This choice is still very much contested.

Indeed, it benefits the deployment of the C-V2X protocol, and therefore the use of 5G. However, the 5G network remains very expensive to implement. A publication exposing these costs was expected at the end of 2022 but it has not yet been published. The transition from DSRC to C-VTX technology is not minimizable from an economic or logistical point of view. Indeed, many road infrastructures are currently operating with DSRC cards, which would mean replacing them all.

But the use of C-V2X is encouraged by the telephone companies. The democratization of this protocol would be a real economic gain for these companies. Indeed, if the manufacturers use this protocol, the messages will transit on their 5G network, on their infrastructures, and therefore they will get money. The manufacturers will have to pay a fee per car to allow the use of the 5G band. The consequence of this additional cost will be passed on to the buyers, and therefore to the citizens, which is not necessarily something desirable. Finally, the main drawback of the C-VTX protocol is that it only works on 5G antennas and is not backwards compatible with 4G or 3G antennas.

This video, in addition to being very recent, covers all the important points to know about the DSRC protocol, but he takes the side of the DSRC protocol and doesn't seem to see the C-V2X protocol winning the race. The points and arguments described do not contradict any of the other articles which make the video really reliable.

III. Conclusion

In an increasingly connected world, automated and autonomous cars are more important than ever. The stakes are high, the main objective being to drastically reduce the number of road accidents. In addition to saving lives, this protocol could facilitate the life of drivers by making traffic flow more smoothly, and thus reduce pollution in cities.

This protocol, which is part of the V2X technologies, uses wifi frequencies. It is extremely reliable, standardized and tested. DSRC is already present in many vehicles since it is industrialized by Toyota since 2021 in all their cars. It is the most widespread protocol in the world for V2X communications. However, the decrease of its bandwidth in 2021 is shaking up the world of connected vehicles.

Phone companies, as well as political choices, are pushing the deployment of 5G C-V2X protocol. A doubt hangs over the manufacturers who no longer know which protocol to industrialize. Indeed, 5G is not yet standardized and infrastructures are not equipped with 5G cards but with DSRC cards, so C-V2X is not yet ready to operate on a large scale.

In addition, 5G band sharing is also an issue. A release should take place in 2023 to expose the choice of 5G bands assigned to the world of connected vehicles.

In the meantime, as it has been the case for the last 3 years, V2X seems to be at a standstill since no one wants to launch the industrialization of vehicles that would not, potentially, speak the language of tomorrow. The coming months may be decisive for the future of connected cars.

Number of words: 3195