WHITE PAPER

INSIGHTS FROM CONNECTED MOBILITY

5G in the Future connected car: How the new mobile standard makes the vision of connected driving become a reality

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CONNECTED MOBILITY SOLUTIONS

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INTRODUCTION

According to a study by Ericsson, 15 percent of the world's population will use the new 5G mobile standard by 2020, and the number of 5G subscriptions will break the 500 million mark in 2022. Forecasts also suggest that more than 1 million new mobile broadband subscribers will be added every day within the next six years – thus adding 2.6 billion subscribers by the end of 2022.

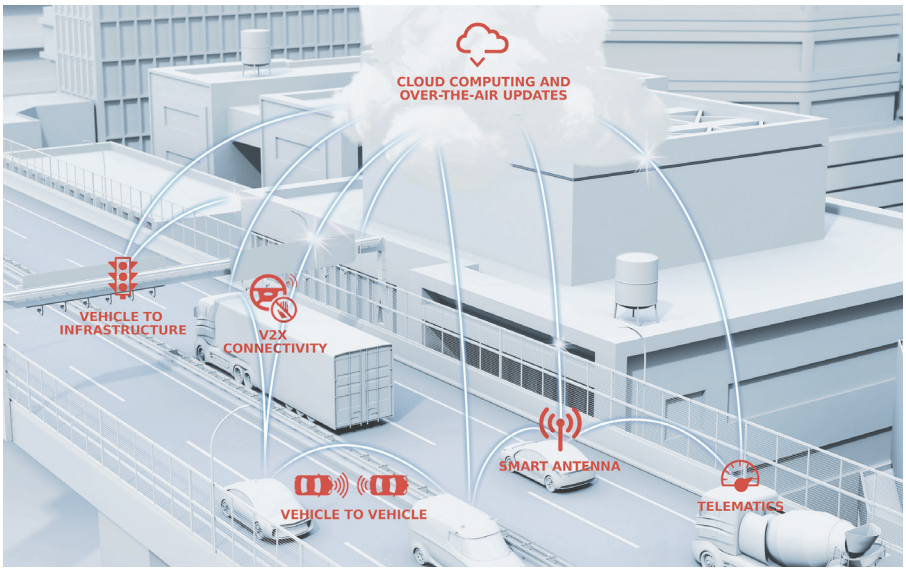

Figure 1 – The connected vehicle as part of the IoT environment

Those figures hint at 5G's incredible market potential, especially considering that the study does not include the Internet of Things (IoT) or connected cars. Yet they are a key target group for 5G devices – after all, the new standard pursues the goal of integrating "machines" optimally in mobile communications for the first time. 5G is therefore not just an issue for the telecommunications sector, but for other branches of industry as well. The automotive industry, for example, sees it as a means of achieving future visions – such as the connected car for self-driving – in the best possible way. That's a task that will require overcoming a number of obstacles ranging from the standardization of 5G guidelines to the implementation of security features in the connected car, to challenges like antenna alignment. This white paper addresses these 5G implementation questions, deals with challenges in relation to the development of powerful 5G antennas, and discusses the introduction of security standards in the connected car. Finally, it illustrates the possibilities that 5G offers the connected car and the economy.

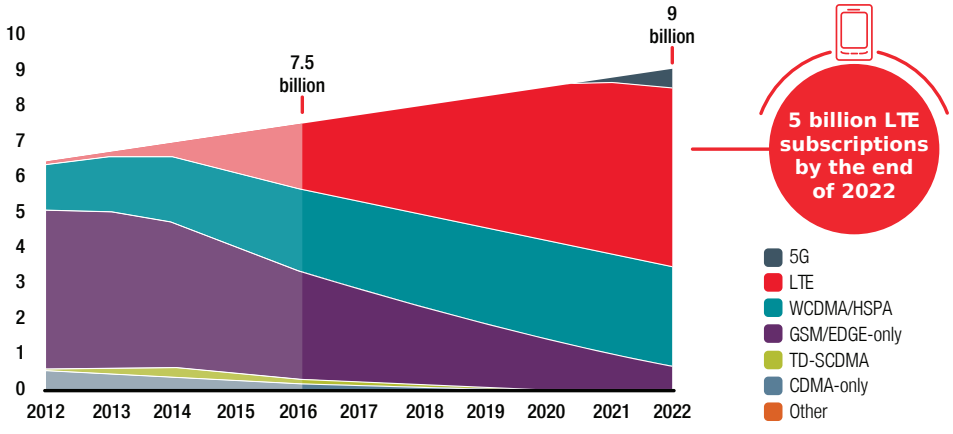

Figure note: IoT connections and fixed Wireless Access (FWA) subscriptions are not included in the above graph

Figure 2 – Mobile subscriptions by technologies (in billions)

SOURCE:
https://www.ericsson.com/en/mobility-report

Current status and application areas of 5G

The introduction of the new 5G mobile standard is currently being prepared. The requirements for the standard have been set initially and now its detailed definition and subsequent implementation are being launched. The successor to the current mobile standard LTE (4G) is intended to improve latencies, deliver higher bandwidth, and create the foundation for new possible applications thanks to its enhanced performance. There will be several development levels or "releases." Standardization of the first 5G Release 15 is expected for the fall of 2018 and will mainly set the specifications for the 5G new radio (NR) interface. Integration of higher frequency bands will be enabled, among other things, in the second release planned for 2020.

Experts currently see huge potential for 5G in three application areas:

The first application area regards the consumer sector (enhanced mobile broadband – eMBB), in which greater traffic and lower network power consumption are expected to enable a large number of devices to be used simultaneously without network losses. That willmainlyenhance user convenience and quality of experience (QoE). For instance, when there are large crowds like at concerts or sporting events where many private devices are used concurrently, network capacity must be adequate for these concentrated numbers.

A second application area is massive machine type communication (mMTC), an issue that is becoming relevant especially in relation to networking of all types of device as part of the IoT. The objective will be to enable communication of up to one million connected devices per square kilometer.

However, it is especially the third potential application that has aroused the automotive industry's interesting 5G: ultra reliable low latency (URLL), which ensures reliable connections and short transmission times. This is vital to progressing self-driving vehicle technology.

Since 5G optimizes the integration of machines and cars in mobile communications, several stakeholders are involved in defining the 5G standards. Whereas the big players in the communications industry defined the existing standards, such as UMTS and LTE, new players are getting into the act with 5G. For this purpose, the automotive industry has established the 5GAA, a body for defining requirements for 5G standardization. A common definition is important so that efficient communication between devices from different manufacturers is possible — for instance in road traffic.

MOLEX AS A 5G ANTENNA MANUFACTURER

Molex is a global leader in the field of radio frequency (RF) technology – from development and production to life-long system support. The company is uniquely positioned to help customers protect and network their products, components and systems so as to enable the Enterprise Internet of Things (EIoT). Molex is currently the only tier 1 vendor that can unite expertise in antenna design with experience in vehicle communication devices. Enhanced mobile broadband is crucial for Molex: 5G will use new frequencies that are based on mmWaves and use the 28 GHz band — which is 10 times broader than the LTE band. That is vital to the development of smart antennas, which Molex is steadily driving forward.

SOURCE: "Cybersecurity for Automobiles: BlackBerry's 7-Pillar Recommendation" by Sandeep Chennakeshu

5GAA

The 5GAA, which was established at the end of 2016, develops, tests and promotes communications solutions, supports their standardization and accelerates the commercial availability of relevant products and solutions. Its goal is to address the desire for connected mobility and safety concepts with applications such as connected autonomous driving and comprehensive access to services. Molex is currently the only tier 1 supplier that unites experience in antenna design and development of vehicle communication devices. As a member of the 5GAA, the company is bolstering its activities aimed at further accelerating the networking of cars and road traffic. Integration of 5G will make the connected car part of the Internet of Things ecosystem. Cars will then not only communicate with each other, but also with other vehicles, such as bicycles, or even with infrastructures like parking systems. This will increase road safety and pave the way to autonomous driving.

Challenges relating to omni-directional antennas and signal strength

Even though the automotive industry is very optimistic about the future of 5G, there are still many details that have to be addressed to implement the technology. One challenge is integrating mobile communications in respect to antenna technology, with the ultimate goal of creating a "smart antenna." Currently, signals are transmitted via cable connections from an antenna on a vehicle's roof to the onboard electronics, which are often located in the driver's cockpit. With the need for more bandwidth, 5G will explore a wider operating frequency range from 6 GHz up to 100 GHz, where sending signals from the antenna to the electronics via cable would result in large losses. That means the electronics, and thus signal processing, must be positioned close to the antenna – i.e. directly under the roof or in the antenna. One problem with that is the fluctuating weather conditions the electronics are then exposed to. High temperatures and fluctuations under the roof and in the antenna itself take a heavy toll on the electronics performance and operating life cycle. Only a few manufacturers are able to combine the electronics and antenna under such conditions.

Moreover, the expansion of the frequency range from a current 6 GHz up to 100 GHz increases radio field attenuation, which means that signals can only be received at a lower distance. That results in problems with omni-directional antennas, which cannot then receive signals or can only do so to a limited extent. Although the distance can be increased through pinpointed alignment of the antennas, devices then have to be fitted with a large number of antennas. As the result, only the antennas in the direction of the transmitter can be used. Roadside units must also be equipped with directional antennas in order to transmit the signal to devices in passing cars. Some antenna manufacturers and car makers are already working together to solve this problem.

SECURITY IN THE CONNECTED CAR

Security testing will be of special importance in the future in the battle against cybercrime. Penetration tests in particular enable security gaps to be revealed. In these tests, the tester tries to penetrate the system deliberately with the means and methods used by hackers. The results supply information on the current degree of security and are used as the basis for developing countermeasures to eliminate critical weaknesses. In addition, the organization and development processes need to be adapted to the new circumstances. End-to-end risk analyses, for example, have not traditionally been the rule, but should be one of the absolute requirements manufacturers have of their suppliers. Such an analysis investigates potential attacks on all the components in the chain and their effects on data security and ultimately functional safety. The results can then be used as the basis for defining suitable protective measures. This success of this procedure can only be guaranteed if the OEM, the supplier of the back-end solution and the control unit manufacturers cooperate from an early stage of development.

The future of 5G in the connected car

5G will soon replace the current mobile standard LTE. Experts assume that there will be 250 million networked cars and trucks on the road worldwide by 2020 and that all new vehicles will be connected with the IoT in 2025. The future vision of the connected car appears within reach. Until that can become reality, car makers are attaching great importance to installing all safety- and security-related sensors in the car itself so that it can act autonomously without any networking and does not have to rely on wireless connections. Functions that operate using wireless connections will be used to enhance convenience for drivers. For example, through wireless networking the car is informed of a traffic jam caused by an accident ahead, and can independently select an alternative route to avoid unnecessary waits. Even though all the cars on our roads will not become "smart" at one stroke from 2022 on, our experience to date with the introduction of new mobile standards means we can expect the dawn of a new age in which mobile communications act more and more as an enabler for future visions as part of the IoT.

5G AS A BUSINESS MODEL FOR SERVICE PROVIDERS

5G not only offers new possibilities for the automotive industry, as service providers will also be able to tap new business models with the data generated as a result of the new mobile standard and the innovations it produces, such as the connected car. For example, road operators could conceivably use connected vehicle data to establish a toll system based on vehicle traffic models. The toll fee could be calculated using vehicle data, such as the vehicle's weight class and the distance traveled. Likewise, self-driving vehicles could use privileged lanes and thus enable convenient driving and mobility. Another business idea is to adapt insurance premiums to driving habits calculated on the basis of vehicle data. Playing sponsored customer-specific content (e.g. sports news) while a driver is waiting at a red light is another way for service providers to get aboard the 5G bandwagon.

www.molex.com/connected-mobility

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