ANALYSIS

5G Corridors, a Promising Investment in Europe's Technological Sovereignty

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The deployment of 5G networks, together with the new technologies fueled by the high-speed Internet it will provide, is set to shift the current paradigm of telecommunications. From the very diverse applications this new-generation network promises, autonomous driving provides one of the best prospects for Europe. Firstly, because it involves the European automotive industry, a domain in which Europe ranks among the champions on a global scale. Secondly, because it presents a major opportunity for the different actors involved in the autonomous-driving value chain to integrate and come together – including both the public and private sectors and academic and research institutions. This joint effort results in 5G corridors, a common initiative between European Member States that makes Europe the biggest experimentation area in 5G technology. 5G corridors connect several European countries through physical and digital infrastructures, representing a superb asset on the path to achieve technological sovereignty, one of the main guidelines of Ursula von der Leyen's new Commission. Therefore, this European cross-border connectivity will contribute to enhance Europe's strategic autonomy and ensure a secure environment for 5G technology and autonomous driving. This article will discuss in depth the functioning of these corridors and the benefits of this European program, along with other proposals that will ultimately lead to European technological sovereignty.

Innovations from the Past

In 1826, the railroad engineer George Stephenson provided the world with a figure that was going to make transport and trade possible on a European scale: 1,435 millimetres. This unit was the measure of the standard-gauge railway, first used in England to connect the cities of Manchester and Liverpool, and soon adopted by several like-minded European countries. Before that, in 1814, Stephenson had also contributed to European economic development with another major improvement in matters of transportation: the integration of the steam

machine in the locomotive. Together, these two advances were decisive in times of the First Industrial Revolution and changed the course of history; it is extremely tempting to draw a historical analogy between Europe in the early 19th century and Europe today.

Europe is currently heading towards another industrial paradigm shift, the Fourth Industrial Revolution. According to Klaus Schwab, the founder of the World Economic Forum, this revolution will be carried out by the implementation of innovative digital tools and services based on a higher connection speed. It can be argued that the steam machine that exponentially quickened the rhythm of trade exchanges has its digital replica in the present time: the 5G network. The deployment of the fifth generation of mobile network will lead to an immense progress in connectivity, creating a dynamic and flexible telecommunication system based on faster Internet connections and low latency (Andrews et al., 2014).

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The third analogy can be established between the application of the steam machine to the locomotive on the one hand, and the incorporation of 5G to automotive vehicles on the other, laying out the basis of autonomous driving. Self-driving vehicles are one of the most remarkable breakthroughs that accompany 5G, a vow for a more secure and decarbonised transportation. At the time of the First Industrial Revolution, the underpinning principle of technological progress was to increase the speed of commercial exchanges and travel. Now, Europe is determined to transition to an ecological and safer transportation system between Member States (MSs). With this in mind, the fourth and last analogy – and the main subject of this article – can be introduced: the standard-gauge railway and 5G corridors. If those 1,435 millimetres allowed countries to connect through railways, the project of 5G corridors will lead to the creation of common 5G networks between States, helping develop cross-border autonomous driving.

R&D and Stakeholder's Integration: The European Approach to Autonomous Driving

The EU seeks to remain a competitive player in the incoming digital revolution. In order to achieve this, the European Commission has shown a strong interest in the mastery of 5G technology since its very first steps. From the outset, the commission has promoted cooperation between public and private actors to carry out innovation in state-of-the-art 5G technologies. In 2013, the Commission made public its 5G Public-Private-Partnership (5G-PPP), a call to 31 leading organisations from the ICT sector, including research centres, leading mobile operators and 5G providers, funded with 700 million euros of public spending (European Commission, 2016c). By then, the Vice-President of the Commission, Neelie Kroes, set the basis of the European policy oriented towards technological sovereignty and its relation to the 5G network: "European 5G is an unmissable opportunity to recapture the global technological lead."[1] Superior-capacity broadband networks are a fundamental part of the existing ecosystem created by emerging technologies and new digital tools such as the Internet of Things (IoT) or cloud and edge computing, which explains why Europe was not willing to miss that train.

At the end of that same year, the regulation that established Horizon 2020 was approved. This program would also provide a solid budget between 2014 and 2020 to fund the Europe 2020 Strategy, a future-oriented investment in innovation and R&D (EU Regulation 2013/1291: Art. 3). The 5G-PPP was soon to be incorporated in Horizon 2020, thus gathering manufacturers and service providers both from the SME domain and the research community.[2] Later on, in 2016, another cornerstone of European 5G strategy was announced, the 5G for Europe: An Action Plan (5GAP). This document acknowledges the game-changing nature of this

1 See 5G-PPP History. Development of the 5G Infrastructure PPP in Horizon 2020.

2 See Advanced 5G Network Infrastructure for the Future Internet Public-Private Partnership in Horizon 2020. "Creating a Smart Ubiquitous Network for the Future Internet". Ref. Ares(2014)327845 - 10/02/2014.

technology, which deeply alters the dynamics of several business and public services across multiple sectors. Specifically, one of the more liable sectors for innovation is the automotive field, where Europe remains one of the main players in the global industry (OICA, 2019). That is reason why key stakeholders from the telecommunications sector and the vehicle manufacturing industry had already started GEAR 2030, a high-level dialogue about Cooperative Intelligent Transport Systems (C-ITS). For its part, the Commission was working on the regulatory environment for standardisation and resource efficiency (European Commission, 2016a).

Internet of Vehicles (IoV) is possible thanks to the advanced 5G features, mainly under the 5G New Radio (NR) standards prescribed by the 3rd Generation Partnership Project (3GPP): Enhanced Mobile Broadband (eMBB), Ultra-Reliable Low Latency Communications (URLLC); and Massive Machine-Type Communications (mMTC) (Mallinson, 2016). An enormous improvement of the network performance will allow real-time Vehicle-to-Vehicle communication (V2V), including with their environment, or Vehicle-to-Everything (V2X). C-ITS will benefit from Mobile Edge Computing (MEC), which is already present in several testbeds (Chochliouros, 2019). MEC is fundamental for faster data processing halfway between the sending device and the cloud. Many diverse services are involved in the functioning of self-driving vehicles, namely HD maps with improved positioning systems, infotainment, or predictive Quality of Service (QoS). These differentiated services are able to coexist without any interference as a result of Network Slicing, which increases the separation between different layers on the same network (NIS Cooperation Group, 2019).

C-ITS itself will lead to another form of understanding mobility, the so-called mobility-as-a-service, more efficient and safer (Ferreira, 2019). It stems from the necessity of an enhanced accident prevention, a better traffic management and a reduction in fuel consumption and CO2 emissions (Pandi et al., 2016). Concerning road accidents, C-ITS offers a major safety improvement that human drivers or other autonomous-driving–related devices like sensors fail to ensure. According to some studies, intelligent vehicles that eliminate stop-and-go driving and constant idling can contribute to drastic fuel economies, representing a 30% saving of total consumption (Gonder et al., 2012). C-ITS is interrelated with other key advances in transportation too, including platooning: autonomous trucks rolling along as a tightly packed column of vehicles that share information between themselves and their environment, saving energy and highway capacity (Saduki et al., 2016b). Taking into account that truck platooning seems to be one of the first applications of autonomous road vehicles to be spread, and that the EU strongly relies on the trucking sector for the transportation of merchandise, Europe would greatly benefit from this area of the C-ITS.

All these improvements in transportation make autonomous driving a crucial asset for the EU's Digital Single Market strategy. Yet for this technology to operate throughout Europe, MSs have to ensure network continuity. The 5GAP highlights the need for 5G network to be available at a regional level, avoiding fragmentation and the digital divide between MSs. The same philosophy is also present in the EC communication "Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society" (2016b). In fact, interoperability between networks is remarked in both reports as soon as the issue of cross-border corridors for self-driving vehicles arises. Gigabit connectivity furnished by 5G technology will open the way for road corridors, among other types of land and air routes, transited by autonomous transportation (2016b). Thus, service continuity between MSs is presented as a condition *sine qua non* for the correct functioning of European automated transport. The "Declaration of Amsterdam for Cooperation in the field of connected and automated driving", a statement signed in 2016 by EU MSs and the Commission, focusing on cooperative, connected, and automated mobility (CCAM), also echoes the principle of convergence between complementary technologies.

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2016 ended with the creation of the European Alliance of Telecoms and Automotive, where both industries, along with several MSs and supranational entities, joined their efforts to propose solutions for cross-border CCAM.[3] The following year in Frankfurt, this willingness was reinforced by the round table on Connected and Automated Driving (CAD).[4] As a result, and with the aim to make 5G corridors a flagship of European CCAM, today around 11 corridors that involve public and private participation have been set up in Europe, according to the European 5G Observatory. These initiatives make Europe the biggest experiment area in 5G technology. Among these corridors, there are three particular projects that depend on the financial support of the Commission, which are part of the 5G-PPP and the funding of Horizon 2020, particularly with the budget of the 2018–2020 period, oriented towards green vehicles and automated road transport.[5]

The first corridor supported by the Commission is 5G-Carmen. This project connects a 600 km road system through the cities of Bologna (Italy) and Munich (Germany) via the Brenner Pass, covering the regions of Bavaria, Tirol, and Trentino/South-Tyrol. 5G-Carmen is a testbed for cooperative manoeuvring, notably lane changing, with the subsequent data sharing of information about speed, positions, and intended trajectories. An advanced system of situation awareness is put in place which reflects the traffic situation, weather conditions, and potential dangers. The second project is 5G-CroCo, which triangulates the cities of Metz (France), Merzig (Germany), and Luxembourg (Luxembourg). In this case, the emphasis is placed on tele-operated driving where the remote control is taken by a human, HD maps that provide accurate location of static and dynamic objects, and Anticipated Cooperative Collision Avoidance (ACCA).[6] Finally, 5G-MOBIX, which connects the Iberian Peninsula across two corridors: Evora (Portugal) – Merida (Spain) and Porto (Portugal) – Vigo (Spain). Another testbed has been deployed in the Greek-Turkish border, enhancing collaboration between European MSs and extra-EU countries. The case of 5G-MOBIX is notable as it involves urban sites in six European cities (Noussan et al., 2020).

There is another project developed in the Horizon 2020 framework that operates on a global scale: 5G-DRIVE, which involves the two main regions invested in 5G technology in the world, Europe and China. The approach of this partnership is three-dimensional, focused on technical development, regulation, and business. Under the supervision of EURESCOM, up to 17 European actors from 11 countries encompassing the whole value chain of CCAM participate in 5G-DRIVE. 5G-DRIVE has been conceived as a twin initiative of the National Science and Technology Major Project (NSTMP) launched in China in 2018, implying an excellent opportunity to test network interoperability. One of the main interests of this project is the optimisation of band usage in scenarios with different coverage and geographic features, looking to implement testbeds in both regions.[7] Apart from that, 5G-DRIVE aims to conduct trials with the rest of the end-to-end 5G deployment scenarios mentioned above, such as eMBB and V2X.[8]

3 See EU and EEA Member States sign up for cross-border experiments on cooperative, connected, and automated mobility.

4 See Cross-border corridors for Connected and Automated Mobility (CAM).

5 The commission shows a strong commitment to promote strategic technologies belonging to the autonomous vehicle value chain. Also under the umbrella of Horizon 2020 and the European Investment Bank, European loans have recently financed several projects related to the production of lithium-ion batteries, a market with optimistic forecasts (European Commission, 2019a).

6 This system facilitates a more fluid reaction than sensors at the moment of avoiding potential dangers (Hetzer et al. 2019).

7 See ICT-22-2018: EU-China 5G Collaboration.

8 See 5G-DRIVE. About 5G-Drive.

Strategic Autonomy to Overcome Power Rivalries around 5G

Nevertheless, as many will be aware, the EU-China partnership in the realm of 5G is not currently at its best. Their relations are already complicated on account of their idiosyncratic differences (European Commission, 2019b), and the ongoing trade war between the USA and China is pushing Europe to reconfigure its system of alliances. At the centre of this confrontation is Huawei, the Chinese tech giant, world-leader in 5G technology, accused of being the CCP's Trojan horse. Huawei is present in the telecommunications network of the majority of MSs, and in 5G corridors like 5G-Croco. However, the transatlantic alliance is in no better shape. On the one hand, just after the entry of the GDPR into force in 2016, US president Donald Trump approved the CLOUD Act in 2017 requiring American cloud service providers to grant access to any data in their possession regardless of where it is stored (Daskal, 2018). On the other, the American GAFAM[9] are also a major concern for the EU, as they stand as giant tech corporations with the hidden power of big data, on the margins of any democratic process (Calzada, 2019).

This delicate situation forces Europe to question its technological sovereignty. Although this issue had already been raised at the time of Edward Snowden's revelations (Ilves & Osula, 2020), which claimed that several MSs were victims of an espionage network led by the USA, it has gained force with regards to Europe's current circumstances. Looking eastwards, they see the emergence of a Chinese "technological nationalism", in which government and tech make profit form a reciprocal relation to develop a hyper-vigilant State (Calzada, 2019). Then, westwards, big tech multinationals are colonising an increasing amount of domains in their user's daily lives to make private profit and accumulate even more power. The EU is not willing to depend on any of these technological paradigms, proposing in contrast a sustainable regionally rooted and inclusive third way-out (Calzada, 2019). In the words of Ursula von der Leyen, president of the Commission: "[…] it is not too late to achieve technological sovereignty in some critical technology areas" (2019).

5G corridors are a promising investment in Europe's technological sovereignty because they enhance many of the principal European assets in the domain of tech. Due to EU's interstate features, the opportunity to develop standard procedures and know-hows between countries that can later be replicated in different geographical contexts is unique. Innovation in domains like cloud computing, supported by initiatives like GAIA-X, is more than pertinent, despite what some skeptics of European techno-sovereign momentum may argue (Laurent, 2019). CCAM will demand a superior data processing capacity, opening a window of opportunity to this kind of projects. Besides, in the spirit of the GDPR, Brussels can stimulate the creation of new regulatory frames to be applied to CCAM like the recent EU Cybersecurity Act that can set an example for the rest of the world (Ilves & Osula, 2020). The logic of this regulation is to create a safe environment for the functioning of C-ITS, an extremely necessary advancement considering its own particularities and its global value chain. Finally, these corridors encourage greater political and economic cohesion between supranational institutions and European tech projects, a positive practice frequently used by the United States and China (Mazzucato, 2013; Boschet et al., 2019).

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In sum, the technological sovereignty approach does not aim towards any kind of technological autarky: instead, it assures Europe's strategic autonomy. The guarantee that a country or region is technologically sovereign does not lie in its capacity to host most of the supply chain of the main strategic technologies within its borders. To secure its sovereignty and cybersecurity,

9 Acronym that includes five information technology companies with the largest volume of data storage, based in the United States: Google, Apple, Facebook, Amazon, and Microsoft.

Europe can resort to other means and mechanisms. Concerning 5G corridors, strategic partnerships developed for instance with China can contribute to reducing the uncertainty created by the globalisation of 5G value chains and cybersecurity risks (Timmers, 2019, 2020). However, these partnerships might not be viable in the long term, as an exacerbated interdependence in the area of strategic technologies can be a source of high instability.

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Cybersecurity concerns can consequently be mitigated through a holistic risk management strategy. The three corridors under the scope of Horizon 2020 collaborate with more than two 5G providers, as recommended by the NIS Group toolbox (2020). In parallel, technology certification systems are being developed to accomplish effective checks, like the Common Criteria certification. Other multilateral initiatives like the Paris Call for Trust and Security in Cyberspace help associated key stakeholders to develop international legal frames (Timmers, 2020). These initiatives promote multilateralism and have a positive effect on coexistence and dialogue at the international level.

Yet, they can be challenging to maintain over time, inefficient at times, and expensive. For this reason, all hopes are most fundamentally being placed in new technologies for distributed authentication, like blockchain. These trust technologies configure a new paradigm of automated "security by design" that could ultimately lead to "autonomy by design" whose integrity is shielded against any exterior interference (Ilves & Osula, 2020).

As Ilves and Osula rightly point out, despite a plethora of measures that mitigate cybersecurity issues linked to technological sovereignty, they do not solve the European problem of long-term tech dependency (2020). Nevertheless, "they do give policy-makers more leverage, allowing them to focus on developing domestic technologies and supply chains in a more targeted manner" (Ilves & Osula, 2020). For now, innovation based on 5G technology in the automotive sector, backed by strategic partnerships and adoption of common regulatory frameworks, enables Europe to compensate its technological backwardness, a delay which should by no means stand as a reason to hinder its progress. Ultimately, 5G corridors can contribute to enhancing Europe's strategic autonomy by creating a proper domestic field of expertise, giving Europe more economic and political leverage in years to come. ■

About the author:

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