

IMPACT OF 5G TECHNOLOGY IN GLOBAL ECONOMY. CYBERSECURITY AND LEGAL ISSUES

*Alexandru TĂBUȘCĂ¹
Silvia-Maria TĂBUȘCĂ²*

Abstract: *5G technology is nowadays seen as a step in the category of “revolutionary” steps in humankind history, related to the industrial and communications environment. This ubiquitous term now signifies the evolution of the industrial technologies that changed the face of the world through the introduction of new concepts on large scale industrial processes: printing press (15th century), steam engine (18th century), electricity (18th century), telegraph (19th century), the internet (20th century). The 5G tech, while not revolutionary in concept, is a complete game-changer in terms of enhancing previously available capabilities. The speed and amounts of data that can be reached and transferred would be enormous. As we see and live through an interconnected future, the focus on cybersecurity must increase exponentially. As more and more devices will be linked to the global network, will upload and download data through 5G connections, all these connections hold a very dangerous potential for being hacked and this exposing sensitive or even vital information to unauthorized people.*

Keywords: *5G, digital economy, cybersecurity, digital human rights*

1. Introduction

The 5G term has now become almost a mantra for all the foreseers of the interconnected future. It seems that everything will be solved by deploying and using the 5G world-wide network – the fields of communications, automotive, energy or even medicine will greatly benefit this technological upgrade. There are a few steps in humankind recent history that are considered milestones for general purpose technologies. These steps have triggered huge changes in the social landscape of their respective era, establishing completely new ways for different areas of life. Among these milestones we consider: the printing press that changed knowledge spreading around the world, the steam engine that modified all the transportation habits of humankind, the electricity that became impossible to live without, the telegraph that started the long-distance communication systems and, of

¹ PhD Associate Professor, Romania-American University, tabusca.alexandru@profesor.rau.ro

² PhD Lecturer, Romanian-American University, silvia.tabusca@profesor.rau.ro

course, the ubiquitous internet that we cannot exist during the 21st century. The 5G technology we consider worthy of staying in line with there game changers. Even though the 5G is not an absolute newcomer but actually an upgrade, its huge improvement over the predecessor 4G will absolutely trigger a new era for interconnected devices – a real implementation of the already widespread term of Internet-of-Things (IoT).

The plethora of 5G improvements are of course very, very important and bringing lots of new and existing possibilities but, on the other hand, there still stand some doubts related to the security and legal issue that might arise within this changed electronic landscape. While we will be able to interconnect huge amounts of devices, send and receive huge amounts of relevant data in a very short time, take advantage of different opportunities in a nick of time, we must think of the fact that all these data might be susceptible also to unauthorized access. The huge amounts of data we will be able to receive and process might not only give us a full view over a certain topic but also bring new challenges related to personal data collection, processing and storing.

2. The 5G environment

This 5G concept is actually, quite unspectacular, baptised as an augment of the 4G mobile connection (which had among its predecessors the plainly named 3G and 2G). The technology has seen its first real-life implementations during 2018 (with pre-5G, not standardized deployments starting even from 2011), has continued to spread in 2019 and is expected to explode world-wide during the 2020-2022 interval. The 5G implementations will deliver consistent speeds of at least 1Gbps for mobile data connections, a number that is more than suitable to sustain applications which were not usable in such remote-access scenarios. The self-controlled vehicles (autonomous or semi-autonomous) and the IoT devices will finally jump to become real game changers for the society we live in.

Of course, the technology companies are always trying to market new revolutionary names and techs, for normal commercial reasons. Besides this scenario, the 5G really has the potential to deliver on its promises, becoming the most important transformational concept in the IT communications. It will not only deliver a faster and improved mobile connectivity for the existing scenarios, but it will also offer ultra-connectivity between different devices, persons and applications, increasing both quality of life and industrial capabilities. The greatly improved reliability, together with the lower latency values, will greatly benefit the IoT applications and enable the definitive switch from the wired to wireless industrial environment. The smart-phones will be accompanied by a new breed of smart-cars, smart-drones and other more or less mobile “things” that will benefit from a cloud brain that will deliver its computing results over the network path.

We consider that among the first industrial areas that will adapt, adopt and then embrace the 5G mantra, are transportation, utilities, health, retail, manufacturing and construction. The dream of a fully reconfigurable factory, time sensitive machines, very high-mobility robots, automatic interconnection of moving parts, fully automated transportation is on the verge of becoming reality. Even the long-awaited or dreaded, depending on the point of view, Artificial Intelligence controlled big systems will become a target easier to achieve.

Usually, in the field of data communications, something better means actually something that is faster. The wireless data transmission 5G refers to actually work over a certain range of radio frequencies. These frequencies are actually limited but the 5G technology uses an algorithm to aggregate different frequencies (bands) in order to obtain a cumulative bandwidth greater than 1 Gbps. The transfer of data within a 5G network will go around a “super-highway” – a way to hugely improve not only the speed for one device streaming a certain set o data, but to all the devices streaming the same data in the same time. This concept will actually give the possibility of tens or hundreds of thousands, even millions, of devices being interconnected in a certain physical area.

Taking into account an estimation by GSMA [1], in 2019 there were more than 5 billion mobile devices connected to the internet. All these devices require reliable, fast and secure connections in order to provide the services they were intended to deliver. We do not to think only about laptops, mobile phones or tablet in this respect – a huge array of wireless sensors (gas/electricity/water readers, positioning systems, automated industrial controllers, camera recognition access controllers etc.) must also use the internet. All these internet devices are forming the IoT world.



Fig.1 - The 5G future diagram³

³ Source: <https://meridiancoms.com/new-5g-network-coming-soon/>

Among the new technological features boasted by the 5G concept we have already mentioned two before:

- Reliability
- Low latency

The lower latency characteristic refers to the time needed for a full round-trip of data, between a request is launched and an answer is received. The present latency level of the 4G data networks is around 100ms. The 5G offers an impressive improvement of no less than 10 times, providing an average latency of no more than 10ms (and even lower). This lower latency means that the dreaded “lag” met during a video conference, the lack of fluence when watching video content or the delayed response of a remote sensor controlled system will become a thing of the past. This low latency capacities are already target for fast and large-scale developments of applications in fields such as:

- Drone management
- VR and AR (Virtual and Augmented Reality)
- Remote sensors
- Remote medical surgery
- Industrial level automations
- Military real-time applications

To provide a very easily understandable example, we can think of a video file with an 8 GB size. In the best-case scenario with a present 4G mobile connection we could download it in around 7 minutes. The same file might arrive on our device in 6 (six) seconds with a modern 5G mobile connection [2] ... almost an instantly available result for such a size.

Another huge advantage brought by the 5G technology relates to the positioning of the connected devices. Places with a lot of people gathered together (actually connected devices are the important thing for us at this time), like during special events for example (games, concerts, airports, public squares, aulas etc.), can bring down the current 4G networks quite easily. The 5G mesh provides a stable and fast mobile connection for everyone present in the same area, without anybody being left out, missing connection or having very limited speed.

3. 5G Hardware

The 5G technology is a great feat of technical prowess – no doubt about it. But the technology needs a champion to fully perform as the IT analysts predict. We should remember that the touch screen handheld devices were invented prior to the iPhone but almost everybody consider the iPhone as the game changer in this field.

For the technology to reach its full potential it has to be embraced by the vastest majority of users, not only the high-tech enthusiasts or the highly expensive and rare pieces of equipment. Most of the top companies in the filed of smartphones already presented 5G enable devices. Countries like South Korea already deployed a large-scale network of 5G infrastructure, other big players in the field, like USA

or Great Britain have deployed 5G infrastructure to highly populated zones and will continue the rollout during the next years, even smaller countries like Romania have their eyes set on the 5G large-scale deployment starting in 2020. But truth be said, by combining these things we can only argue for an evolutionary step in communications and for a revolutionary one. 5G will for sure bring “faster anything and everything” compared to today. The smartphone is today the ubiquitous companion which never leaves our side, which has to be tended and charged permanently, which keeps us up to date with everything in both personal and work areas. But we do not think that the smartphone is capable of sparking the 5G revolution. On the present category of devices there is actually nothing completely new that can over-excite the users. The 5G will bring lightning-fast downloads, 4/8/X K movie streams watched online but all these are just augmentations (smaller or bigger) of what we can already accomplish today. We need a new idea, an iconic device that can shake the world and bring real and unique value to the usage of 5G mobile communications.

As Jasmeet Singh⁴ said “When we’ve spoken with consumers who carry the latest smartphones today, and you talk with them about 5G, what these users are saying is that the current form factor and feature sets cannot take advantage of the promise of 5G”.

Maybe we did not even think of the best way to take advantage of the 5G potential. The technology enables new possibilities to connect data way beyond watching different forms of information on a beautiful screen. One of the possible game changers might actually be a reload of a discarded project. Those who remember the Google Glasses will probably remember that, besides the security and privacy issues, the equipment was actually not capable of really delivering some revolutionary experiences... at that time. In 2020, based on a whole armada of almost instantly connected sensors, a Google Glass like device might become a science fictional all-around piece of hardware that can act as seeing glasses (with optical and digital vision improvements), augmented reality helper (giving us instant statistics/information about the subject or landscape we look at), navigational system, personal assistant, smart phone, access control identifier or remote view screen. We consider that the highest potential for a 5G winning device is now found in the augmented reality area.

4. 5G for computers

Yes, 5G is a mobile connection concept. Nevertheless, because of the speed it boasts, the reliability and the low latency characteristics (even though the latency of 5G is not yet similar to an optical or even copper cable) the 5G might enter in power into the realm of the computer networks located in defined geographical areas (MANs, WANs or even LANs). Because of the excellent speed of a 5G

⁴ Lead researcher at Ericsson electronics company

connection – which might actually surpass most older computer networks on cables not only relying on wireless solutions – we consider that a lot of companies might actually migrate to an environment more and more based on VPN (virtual private networks). If the speed of the connection would not be an issue anymore, the enterprise environment can expand to use the remotely build private networks (which by design inflict a speed decrease) as a standard practice. Entire LANs (Local Area Networks) can in fact migrate to a VLANs (Virtual Local Area Networks) which would provide a completely similar environment to a present-day LAN, but with computer nodes coming together from Bucharest, Singapore, New York or Melbourne.

Any future laptop or tablet would actually offer a better and more personalized experience when connected to the network through a 5G mobile SIM instead of the classical Wi-Fi. We should also mention that this fact is considered only through the prism of the quality of connection (speed, latency, overall experience) and does not take into account the economic side – the possible cost increases inferred by the acquisition and deployment of 5G enable devices and the 5G data plan subscriptions.

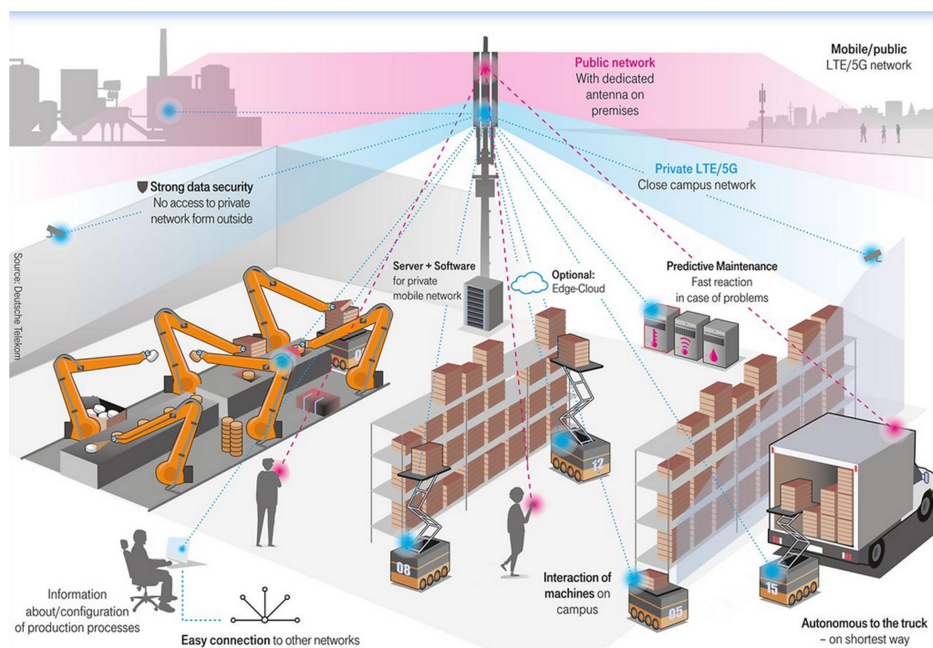


Fig. 2 – A diagram of an industrial interconnected area⁵

⁵ Source: <https://www.telekom.com/en/company/details/5g-technology-in-campus-networks-556692>

The 5G capabilities will also be used to develop and secure new industrial areas that might take full advantage of the 5G led opportunities. The present-day Wi-Fi (wireless) networks cannot actually meet the demands of such an intensively connected environment. The 5G capabilities offer features like huge bandwidth, very low latency and improved reliability. An industrial interconnected area is different from a normal public area which has to provide access to individual users. All the machines/equipment inside the area has to be connected and interconnected through wireless solutions and be able to get/send information in real-time. The current WLAN solutions are not enough for a mobile solution like autonomous transportation vehicles. The vehicles/equipment must be permanently and seamlessly connected to the network, otherwise they would have to “stop” and re-establish a connection each time they move into the area of another access point.

5. Economic impact estimates

By reviewing the latest reports of GSMA, the largest market (by far) for the mobile electronic world is the USA one. Most specialists in the field estimate that the end of 2019 will bring a total yearly revenue of around 280 billion dollars [1] for the mobile electronic field in North American (USA and Canada, but the biggest part comes from USA).

These huge numbers have pushed the North American operating telecom companies to forecast an amount of no less than 350 billion dollars to be invested in this field during the 2019 to 2025 timeframe [1].

The future use of 5G interconnected devices might also have a big impact on other economic and social issues of our present-day society. Perhaps the most important collateral advantage can come from the “eco” approach. The usage of large-scale remote sensors and the possibility to work/activate remotely, based on the benefits of 5G infrastructure, will help decrease the costs (in both financial and other resources terms) and reduce the pollution caused by transportation. This fact might help our society to make important steps towards a (closer to) 0-carbon economy that seems to have become the main target nowadays.

Further looks at the possible future economic trends that might appear based (primarily) on the widespread use of 5G mobile infrastructure let us summarize at least the following main areas that we consider having a very high probability of becoming real:

- Further consolidation of the telecom/TV/ISP businesses, with the largest companies becoming more and more capable of providing every type of connected service. The classical “cable TV” companies will have a hard time keeping their business afloat in the same conditions, as the wireless internet networks move to provide at least the same quality of experience as a standard cable TV can offer.

- The globalization (which seemed to stop a bit a take a break during the last couple of years) will come back strong, as the most important companies providing 5G infrastructure are actually quite few in numbers and they will have to integrate products all over the world. The Chinese Huawei, the Swedish Ericsson, the South Korean Samsung and the Finnish Nokia are in fact (and maybe surprisingly for most consumers) the only real solutions today. The legal issues faced by Huawei during the last years will have to end in one way or another, simply because the rest of the main producers cannot fill the market with enough infrastructure equipment instead of the Chinese company. On the other hand, even though the business is clearly a winner, any newcomer on this market would have to face huge obstacles in order to be able to compete with the established names (budgets for research and development, patent acquisitions, marketing, client trust etc.)
- Last, but not least, the hardware infrastructure will change the urban (mostly) landscape. The 5G technology allows for a change of implementation paradigm – from the very powerful 4G towers, covering large areas, to smaller and more efficient towers that consume/require way less power but also provide a smaller coverage area. According to TechRepublic⁶ [3], the current estimate for urban areas that will completely move from 4G to 5G infrastructure shows a staggering ratio of 400 : 1 needed replacements, in the case of a standard large-area 4G tower being replaced with the smallest and most modular 5G tower. These numbers will of course bring a lot of issues but on the other hand, the very small size, low requirement regarding power and reliability of the new devices can help them to be integrated almost seamlessly inside any urban area. We will probably have 5G (mini)towers all over the cities, maybe one on every street, and even more on longer ones.

6. Security and privacy in the 5G world

Another set of issues which has to be very seriously watched, in relation with the 5G concept, are possible security issues, management of collected personal data and privacy concerns.

The 5G interconnected devices will be found in (just to name some of the most futuristic cases) autonomous cars, critical infrastructure and medical equipment. Imagine what can happen if an unauthorized person gets access to read or even control the device activity. Similar to catastrophic movies, we could actually see hundreds of cars colliding, power plants taken down from afar or murders done through a remote surgical procedure.

⁶ TechRepublic is a highly recognized community of technical blogs, forums, vendor white papers and published research results.

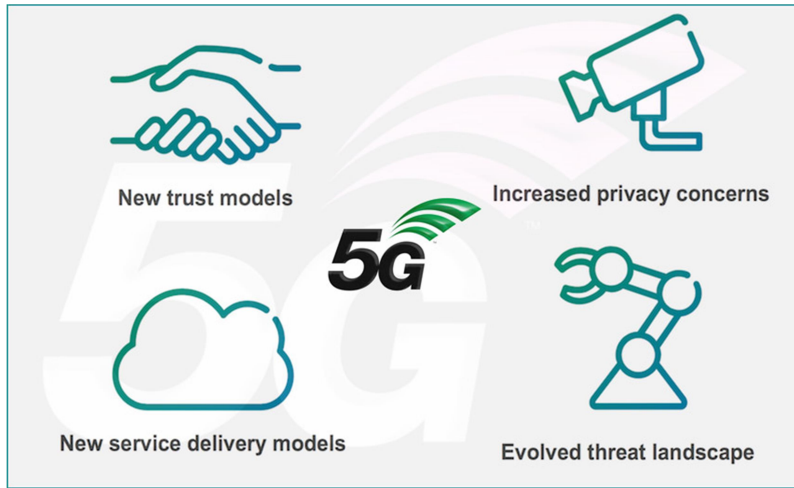


Fig. 3 – 5G specific security concerns overview⁷

The huge increase in sensors and other connected devices brings along an also hugely increased attack surface for the malevolent electronic experts. The delocalized computer networks and the heavy reliance on the “cloud”, made easier and very comfortable by the 5G speed and latency, also bring a larger boulevard for any possible attackers to try and get a hold of unauthorized data/processes.

One of the best guideline directions we consider pertinent is to continuously require the software producers to implement individual security solutions built into their applications. The data transmission process (either 5G or previous versions) have their own security measures in place, of course. But, any (almost) simple process of encrypting data inside a certain application operational environment brings an exponentially more difficult challenge to any attacker. Basically, instead of having to “break” one security procedure (the 5G transmission for example) he has to tackle at least two (the second one being the encryption of the respective application). All IoT considered devices (sensors, automation switches, Wi-Fi plugs, Web/security cameras, smart TVs etc.) must upgrade their security protocols and/or internal applications. If they are to become the new surrounding reality, we must be (reasonably) sure that they do not bring more harm than good into our way of life.

Another very important aspect of 5G security defers on the well-known problem of the hardware infrastructure. The case of USA against Chinese Huawei company is of public news and many other countries have started to question the way in which

⁷ Source: <https://www.bankinfosecurity.com/whats-riding-on-5g-security-internet-everything-a-10618>

Huawei equipment operates. There are several governmental or private reports that show the results of different analyses made on Huawei networking equipment.

The most reliable report on such an issue comes from a widely known and first-grade player on the telecom market – Vodafone.

Between 2009 and 2012, several network devices used by Vodafone (primarily in Italy but in many other countries too) and bought from Huawei were found as having a security breach by being accessible through a possible backdoor based on a telnet connection [4]. The simple use of a telnet server inside networking equipment is not uncommon, as lots of manufacturers implement this for testing and remote configuration/access. What was uncommon it was the fact that Huawei did not mention this characteristic to the buyer Vodafone. While the first stage of this dispute might have been indeed considered as an error from Huawei and not a deliberate backdoor left on the devices, the internal Vodafone documents made public by the media show that the escalation of the issue almost surely point to a deliberate backdoor. At Vodafone's specific request Huawei updated the devices software/firmware in order to block the telnet access. A later audit made by Vodafone together with an external security company showed that in fact Huawei just concealed the telnet better, but it was still there and accessible! Because the manufacturer specifically answered Vodafone that the exact signalled issue was solved it is a clear case of lying from Huawei. One might argue for different causes, beside espionage-prone backdoors, of these backdoors: to difficult to create new firmware, to expensive to operate maintenance processes remotely at a later stage etc. But even in such a case, the security issue is huge and the "why" becomes almost irrelevant. The equipment has a backdoor and from the security point of view the cause is irrelevant – the possible damage has to be taken into account. Both Vodafone and Huawei, publicly at least, considered the problem solved at a later time and the equipment deemed safe after further updates. Anyway, Vodafone seems not to keen to rely on Huawei equipment for 5G infrastructure, even with the lowest market-prices for such components boasted (and real) from the Chinese company. In fact, at this time, Vodafone publicly restricted the use of Huawei equipment in the critical areas of its British 5G infrastructure to be deployed.

From a 2018 IMF report, countries which have a combined GDP of almost one third of the entire world have banned or restricted Huawei equipment for 5G infrastructure development. Romania has also agreed to a joint US-Romania memorandum in the field of 5G infrastructure development, a fact that might be followed by at least some restriction in the deployment of Huawei equipment in Romania.

Stance on Huawei	Percentage of World GDP
Ban in effect Australia, Japan, Taiwan and U.S.	32.6%
Likely to ban Canada and New Zealand	2.3%
On the fence Belgium, Czech Rep., Denmark, India, Norway, Poland, Sweden, U.K. and Vietnam	9.9%
Unlikely to ban Argentina, Austria, Brazil, France, Germany, Italy, Philippines, Russia, Singapore, South Korea, Spain, Switzerland and Thailand	21.6%
Embracing Huawei China, Indonesia, Saudi Arabia, South Africa, Turkey and UAE	19.8%

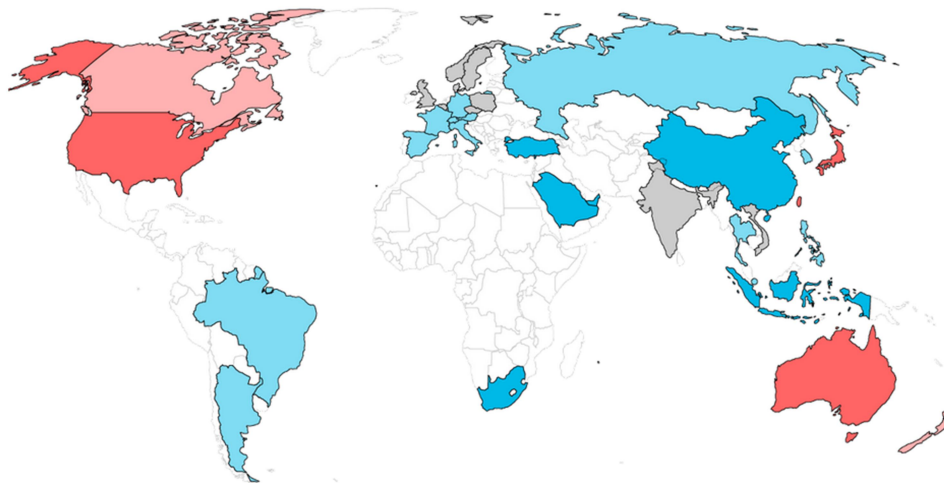


Fig.4 – Huawei stance in 5G infrastructure at world level⁸

Regardless of any governmental or international organization rule that might have to do this issue, we consider that, as a general rule, all companies/bodies involved in the development, deployment and maintenance of 5G hardware and software should abide by the following guiding lines:

- The final users must be fully informed about the technical and practical aspects and given the possibility to fully control their connected devices
- The enterprises should use an encompassing envelope as regarding electronic resources security, taking into account the levels of protections need for three different layers of the environment fabrics: users, devices and communication channels
- Implement the highest possible security and data protection measures, keeping the amounts of collected data to the absolute minim (both from the point of view of quantity and retaining time). These measures must be

⁸ Source: <https://www.bloomberg.com/news/articles/2019-04-30/vodafone-found-hidden-backdoors-in-huawei-equipment>

constantly monitored and audited by both an internal body as well as an external, independent body

- Corporate responsibility and transparency must be in full accordance with all the requirements implied by respecting human rights.

7. Human Rights and the 5G environment

The 5G infrastructure will allow a lot more companies/individuals/bodies to collect and hold huge amounts of data. The human rights activists and the national/international bodies with legitimate interests in this field should already discuss with the governmental entities (or supra-state ones) in order to make sure that those entities fully understand what the challenges might be and how best to address them, from the point of view of respecting the human rights in this new social context.

Since 2011, Finland stated that internet connection is a right enforced by the law [5]. The intervention of the internet in virtually all aspects of modern life has led the society to even think of enlarging the human rights list with an item related to the internet [6]. During 2016 the UNHRC⁹ made a first official step towards this goal, by publishing a resolution (even though without enforcing power) that condemns internet interruptions by national governments, arguing that the right to access the internet is similar to any of the other established human rights [7].

For the coming years, as we will most probably rely more and more on the connected universe based on 5G infrastructure, the right to internet access might become even essential. Unfortunately, over the last couple of years we have seen more on-purpose internet interruptions than during all the previous years, since the global network emerged. Countries like Turkey, India, Bahrain, Algeria and China have all implemented different restrictions based on political reasons. Even more, while the first countries from the above list usually restrict on temporary bases, China has a lot of restrictions and censorship rules that are permanently in place.

8. Conclusion

To sum up our review of 5G related issues from the point of view of the economy, security and human rights, we can conclude that the impending revolution has the main characteristics of a... real revolution. It might bring a whole new paradigm in place, with lots of advantages and new (maybe not even discovered) directions but also with a whole new plethora of possible issues to be addressed.

Our society must pay all the due attention to these issues, as not to waste a very promising opportunity to make a huge step forward towards an interconnected

⁹ UNHRC = United Nations Human Rights Council

future that might bring us closer to 20 or 30 years ago science fiction blockbusters. In the same time, if we keep to the same type of analogies, we might also end up in science fiction nightmare, similar to a dystopic universe in which hackers rule the underworld and the machines rule the formal society.

References

- [1] –, “The State of Mobile Internet Connectivity 2019”, GSMA, 2019, <https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/07/GSMA-State-of-Mobile-Internet-Connectivity-Report-2019.pdf>, last access: 2019-12-04
- [2] Bonnie Cha, “What Is 5G, and What Does It Mean for Consumers?”, <https://www.vox.com/2015/3/13/11560156/what-is-5g-and-what-does-it-mean-for-consumers>, last access: 2019-12-04
- [3] –, “5G Research Report 2019: The enterprise is eager to adopt, despite cost concerns and availability”, <https://www.techrepublic.com/resource-library/whitepapers/5g-research-report-2019-the-enterprise-is-eager-to-adopt-despite-cost-concerns-and-availability/?promo=7214&ftag=LGN-10-10aaa0h&cval=content-top-leaderboard&source=zdnet>, last access: 2019-12-04
- [4] Jeremy Kirk, “Vodafone, Huawei Dispute Report of Telnet Backdoor”, <https://www.bankinfosecurity.com/vodafone-huawei-dispute-report-telnet-backdoor-a-12435>, last access: 2019-12-04
- [5] Tăbușcă Silvia-Maria, “The Internet Access as a Fundamental Right”, JISOM vol.4 no.2 ISSN 1843-4711, pp.206-211, Ed. Universitara Publishing House, Bucharest, Romania, 2010
- [6] Tăbușcă Silvia-Maria, “The Internet between Promotion and Infringement of the Fundamental Rights. Freedoms v. Cybercrimes”, JISOM vol.5 no.1 ISSN 1843-4711, pp.519-525, Ed. Universitara Publishing House, Bucharest, Romania, 2011
- [7] UNHRC, “The promotion, protection and enjoyment of human rights on the Internet”, https://www.article19.org/data/files/Internet_Statement_Adopted.pdf, last access: 2019-12-04