

# The digital geopolitics of 5G: elements to understand the Chinese technological development of the fifth generation of mobile telephony

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revista

**Geo**   
**USP**  
espaço e tempo

Volume 26 • nº 2 (2022)

ISSN 2179-0892

e-194823

## How to cite this article:

PRESTES, E. G. The digital geopolitics of 5G: elements to understand the Chinese technological development of the fifth generation of mobile telephony. **Geosp**, v. 26, n. 2, e-194823, aug. 2022. ISSN 2179-0892. Available in: <https://www.revistas.usp.br/geosp/article/view/194823>. doi: <https://doi.org/10.11606/issn.2179-0892.geosp.2022.194823.en>.



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# The digital geopolitics of 5G: elements to understand the Chinese technological development of the fifth generation of mobile telephony

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## Abstract

This article is intended to bring considerations about the Chinese technological development of the fifth generation of mobile telephony (5G) and what are its implications for the global digital geopolitics. The imminent deployment of technical infrastructure for 5G has become an important playing field in a broader struggle for control of the industries of the future. Our methodological perspective is based on an extensive review of bibliography, international scientific articles, scientific papers, media reports and media articles that address the theme. We conclude that China, through massive government investments in R&D in the telecommunications sector and extensive subsidies for innovation in the Information Technology sector, has consolidated itself as a pioneer country in the development of 5G and its infrastructure, which justifies the geopolitical tensions between China and the US.

**Keywords:** China. Technological development. 5G. Digital geopolitics.

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## A geopolítica digital do 5G: elementos para compreender o desenvolvimento tecnológico chinês da quinta geração de telefonia móvel

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### Resumo

O objetivo desse artigo é tecer considerações acerca do processo de desenvolvimento tecnológico chinês no setor de quinta geração de telefonia móvel (5G) e suas implicações na geopolítica digital mundial. A implementação iminente de infraestrutura técnica para o 5G tornou-se um campo de disputa importante numa luta mais ampla pelo controle das indústrias do futuro. Nossa perspectiva metodológica baseia-se numa revisão extensa de bibliografia, artigos e *papers* científicos internacionais e

reportagens e artigos midiáticos que contemplam o tema. Concluimos que, com massivos investimentos governamentais em P&D no setor de telecomunicações e amplos subsídios para inovação no setor de tecnologias da informação, a China consolidou-se como país pioneiro no desenvolvimento de 5G e sua infraestrutura, o que explica o tensionamento geopolítico entre China e EUA.

**Palavras-chave:** China. Desenvolvimento tecnológico. 5G. Geopolítica digital.

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## La geopolítica digital del 5G: elementos para entender el desarrollo tecnológico chino de la quinta generación de telefonía móvil

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### Resumen

El propósito de este artículo es traer algunas consideraciones sobre el proceso de desarrollo tecnológico chino en el sector de la telefonía móvil de quinta generación (5G) y cuáles son sus implicaciones para la geopolítica digital global. El inminente despliegue de infraestructura técnica para 5G se ha convertido en un campo de juego importante en una lucha más amplia por el control de las industrias del futuro. Nuestra perspectiva metodológica se basa en una extensa revisión de bibliografía, artículos y papers científicos internacionales, informes y artículos de los medios que abordan el tema. Concluimos que China, a través de masivas inversiones gubernamentales en I&D en el sector de las telecomunicaciones y extensos subsidios a la innovación en el sector de Tecnologías de la Información, se ha consolidado como un país pionero en el desarrollo del 5G y su infraestructura, lo que justifica las tensiones geopolíticas entre China y los EE.UU.

**Palabras clave:** China. Desarrollo tecnológico. 5G. Geopolítica digital.

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## Introduction

With the declining cost of making phones and the improvement of overall *internet* access infrastructure throughout the 2000s, a replacement of personal television and computer with mobile phones as a tool for access to news, leisure, and other services, is gradually taking place.<sup>1</sup> In 2020, China emerged as the country with the highest number of mobile phone users in the world: 1,746,238,000 mobile subscribers, followed by India with 1,151,480,361, with the US ranked in third place with 442,457,000 subscribers (The World Factbook, 2021). There were approximately 1.6 billion mobile *internet* subscribers in China at the end of 2019 (China ends..., 2020), using mobile phones, *tablets* or similar for *internet* access. These numbers are greater than the 1.4 billion country's own population (National Bureau of Statistics of China).

This process presents qualitatively new contours with the advent of 5G, a technology designed to deliver higher peak data speeds, lower latency (better responsiveness), massive higher network capacity, and increased availability. As stressed by Brake (2018), analysis of 5G and its economic impact can be somewhat amorphous, with the catchall term “5G” being used to different components of all the various changes being implemented in the realm of telecommunication technology. But our aim is to understand the historical process of 5G's technological development, which qualitatively overcame previous 4G services, launched in the late 2000s.

As Woyke (2018) explains, “1G let you walk and talk [with the cellphone], 2G let you send texts [to other mobiles], 3G got you onto the *internet*, and 4G let you *stream*”. 1G is the analog mobile network launched in 1979. The phones did not use SIM cards (the number was encoded by the device itself). 2G technologies such as CDMA, GSM and TDMA were the first generation of digital mobile technology. 3G connection-based ensured faster results and *internet* speed increased from 200 kbps to a few Mbps. Introduced in 1998, it was essential for the development of wireless voice communication over the *internet*, video calls, and mobile television. Finally, 4G technologies were officially introduced in 2008 as a further step in mobile network technology, offering a high-speed broadband *internet* connection, (reaching several hundred Mbps and even Gb levels (Pisarov; Mester, 2020).

5G is far faster still, providing a significantly first-rate set of utilities. As we will discuss later in this article, the fifth generation of mobile communication achieves speeds up to 100 times faster than 4G and becomes a platform that is envisioned as impacting the innovation potential in areas such as artificial intelligence and the *Internet of Things* (IoT) – since it promotes a massive and low-cost machine-type communication. In industry-driven production, 5G is the backbone of the so-called industrial *internet*, which integrates information technologies into manufacturing sectors. This is an entirely new type of infrastructure that generates both productivity gains and changing relations of production.

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<sup>1</sup> Due to the rapid development of the mobile communication industry, *smartphones* have outpaced personal computers as the largest application market for global semiconductor businesses (Chen; Kang, 2018).

According to Andrews et al. (2014), 5G is not only incremental technical progress in 4G. Notably, each of the past four generations has each been a major paradigm shift that has broken backward compatibility with previous versions. Thus, 5G will be a complete restructuring of current telecommunications infrastructure and, unlike previous ones, it will be highly integrative in providing universal high-rate mobile coverage to many kinds of devices (cell phones, personal computers, household appliances, industrial sensors, machines etc.) that suits this technology to it. Although telecom operators plan to achieve continuous network coverage through a short-run joint development of 4G and 5G infrastructure, the ultimate goal is to operate an independent 5G network to replace the current 4G build-up.

5G can be considered a watershed, enabling industrial transformations through wireless broadband services with multi-gigabit per second speeds possible, and can provide support for new types of applications connecting devices and objects. According to GSMA's report (2021), by 2025 80% of the expected total amount of US\$ 900 billion projected to be invested in the network mobile industry budget will be allocated to 5G, and China will respond to nearly half of the world's connections. The result is that by the end of 2022, 5G networks are expected to cover 1/5 of the world's population.

A fierce competition is underway to determine which countries will be responsible for developing and directing the guidelines for this technological trajectory. Liu et al. (2017) point out that there are massive investments in research and development (R&D) in 5G worldwide, notably among relevant institutions and companies in the core of the capitalist system, such as NASA and Machine-to-Machine Intelligence (M2Mi) Corporation (USA), the South Korean R&D program IbjngT, research centers such as NYU Wireless University (New York University) and the University of Surrey (UK), companies such as Telefonica, Vodafone, Samsung, Fujitsu, Alcatel Lucent, Ericsson, Nokia, Verizon and Google, among others. It is a process that is restructuring the geopolitics of this early TWENTY-FIRST century.

Despite the efforts of countries that dominated the old generations of mobile telephony, historically the US and Japan, China emerged as a world leader in the development of 5G and its technical infrastructure. For the first time in modern history, this Asian country is in the privileged position of leading the establishment of a new and revolutionary technological paradigm in the human production realm. Not by chance, since Donald Trump's administration, this perspective has caused high-level resistance from the US government that, in turn, is engaged in pressuring Europe and allied countries to not build investment contracts with Chinese companies such as Huawei and ZTE (Zhongxing Telecommunication Equipment Corporation) in the 5G area.

How can one explain Chinese global dominance in 5G networks? In a nutshell, China sees this technology as a strategic sector of technological innovation that strengthens its hegemony in the existing correlation of political and economic forces, taking 5G as the best chance to lead wireless technology development on a global scale. In a TV interview, Jianzhou Wang, the former chairman of China Mobile, China's largest mobile operator, described the development of China's mobile communication industry from 1G to 5G as "a process of from nothing to something, from small to big, and from weak to strong." (Abu-El-Haj, 2018).

The central objective of this article is to historically contextualize the technological development of the Chinese telecom industry, underlining the main internal determinants towards a “technological *catching-up*” and its pioneering role in the development of the cutting-edge 5G technology, chiefly through bibliographic review. The consequences of this process in the US-China geopolitical rivalry in establishing a new technological paradigm are also discussed. We are aiming at bringing a sort of contribution to the theoretical and empirical discussion on the significance of technological innovations for the world political organization.

## **The historical process of Chinese technological development: paving the way for national innovation and 5G**

I propose to understand Chinese technological development from two theoretical frameworks based on dialectical historical materialism: first, as a movement of reality, it is a process that must be taken by its material historical changes that, in turn, is specialized by the specific dialectical relations between center and periphery of world space; therefore, this process is fundamentally linked to capitalist imperialism. The capitalist class is the first ruling class in history whose interests are intimately bound to technological change and not only to the maintenance of the *status quo* (Rosenberg, 2006).

Marx (2014, 2017) and Marx and Engels (2007) set forth the idea that technical progress is essential for the development of the productive forces of capitalism. Technology is therefore something that only find its meaning as a relation of production, that is, the concrete materiality existing among social relations.<sup>2</sup> This ontological debate on technical progress was deepened by Lukács (2013, 2018) through the conception of praxis (i.e, work) as an innate condition of social beings in its reproduction and in the “complexification” of corresponding productive forces.

Historical industrial revolutions (steam and combustion engine, electricity, robotics etc.) established a dividing line between central countries capable of sustaining new production cycles towards superior economic development outcomes and the peripheral ones, those countries limited by most vulnerable productive relations that, in turn, found themselves subjugated by qualitatively superior technological paradigms (Dosi, 2006).

The economic hegemony of countries such as England, Germany, US and Japan have historically always kept its productive technological capacity on track assuring internal cycles of economic development and setting an exemple to be followed, imported or imitated. Imperialism as the concentration and monopolization inside capitalism in its highest stage of development,

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2 Based on Marx (2014), a critical history of technology would show technological innovations cannot be taken as the work of a single individual. Technology reveals the active relation of man to nature, the direct process of the production of his life, and thereby it also lays bare the process of the production of the social relations of his life, and of the mental conceptions that flow from those relations. In other words, the more the mechanisms of nature are controlled through technical progress, the more man achieves self-consciousness.

materialized itself in the technological advance of a bunch of companies that forcefully dominate global economy.<sup>3</sup>

Nevertheless, apprehension and theoretical categorization of world space from the relationship between center and periphery translate into the contradictions between hegemony and economic and technological dependence. This subject was discussed by Mamigonian (1982), that pointed out that peripheral economic backwardness can become a technological advantage, and by Santos (2002, 2014), in his very relevant contribution to the understanding of geographic space as technical systems that overlaps verticality and horizontality. The theoretical and empirical debate about technological development is then crucial for geographic science.

In the transition to twenty-first century, China consolidated a clear position of centrality in the International Division of Labour. One of the main determinants explaining this process is the State-guided technological development from medium and long-term development planning.<sup>4</sup> The success of Chinese technological *catching-up* against traditional core capitalist countries lies in the investment priority on research and development, generating innovation strategies in line with its industrial policy such as formation of human resources, intellectual property, and selective use of foreign direct investment.

Once known as the “factory of the world,” China caused a steady-pace disruption, over the past decade, of an export-oriented and low- and medium-value-added manufacturing economy to structure an industrial ecosystem that harbors high-tech innovations. The massive development in the technological environment in past decades, the Chinese *catching-up*, is deeply rooted in the centralized efforts carried out by the Chinese government, state-owned enterprises, national champions, universities and research institutions, among other actors.

Since Deng Xiaoping’s open-door policies in 1978, investments in the country must be carried out by *joint-venture* contracts, addressing foreign-owned companies to form joint business partnership with Chinese state-owned partners. The technology transfer strategy devised by Deng Xiaoping thus became central to Chinese development. The establishment of special economic zones have played a tremendous role in pushing forward this efforts, since it gradually and selectively open parts of the national territory to foreign capital, an outwardly-oriented development policies that boost Chinese national economic *catching-up* project.<sup>5</sup>

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3 The export of goods has been replaced by the export of capital in the current stage of imperialist capitalism, a process that steps up economic internationalization and competition among nation-states. For Lenin (2021), imperialism is a specific stage of the capitalist mode of production, resulting from a substantial change in its organizational structure: the stage of monopoly capitalism. Having started only in the last quarter of the 19th century, imperialism was the result of the inherent tendencies of the process of capital accumulation – in which concentration and centralisation prevail

4 As stated by Jabbour and Paula (2018, p. 18), after the 1980s China has begun to play a greater role in controlling industry and finance at a large scale, also acting towards coordination and socialization of investment through the control of economic, monetary and fiscal policies, foreign trade and especially launching new and superior forms of economic planning.

5 It should be noted that FDI destined for Chinese territory in the 1980s-90s was mostly for industrial activities, which today represent approximately 40% of GDP and occupy 28% of the Chinese economically active population (The World Factbook, 2020).

At the turn of the 21 century, 2006 became a milestone for Chinese technological development due to the launch of the Medium- to Long-Term Plan for the Development of Science and Technology (2006-2020), aiming at attaining economic advantages for national Chinese companies. This document symbolizes China's posture in foregoing importation of foreign technology to promote a national innovation system. It was made clear in the specification of strategic areas for research on STI and by identifying key areas to push technological boundaries and engineering megaprojects (CaO; Suttmeler; Fred, 2006).<sup>6</sup>

Subsequently, in 2015, Beijing has launched a master plan called Made in China 2025, inspired by the German Industry 4.0 plan aimed at the development of intelligent manufacturing<sup>7</sup>, and established the 13th Five-Year Plan (2016-2020), changing the course of industrialization by prioritizing the development of scientific and technological capacities that could save resources thereby promoting improved economic productivity (Lo; Wu, 2014).

The 13th Chinese Five-Year Plan (2016-2020) sets forth China's strategic intentions to overcome the economy's internal (national) and external (international) contradictions by overtly using technological innovation for economic growth. The need to promote innovation and build a playbook for boosting domestic demand through investment-led stimulus, to make the economy less dependent on exports, was highlighted. The plan's presentation document describes 5G technology as a crucial "strategic emerging industry" and a "new driver of growth", an indispensable condition for the success of Made in China 2025 plan, which strives to secure China's position as a global powerhouse in high-tech industries (Aglietta; Bai, 2016). In an official speech in early 2016, China's former ambassador to Brazil Li Jinzhang argued that innovation should come from engaging traditional industries in a structural change made possible by 5G technology.

For the Chinese government, the external economic environment is being guided by a timid growth of international trade and instabilities in the financial and commodity markets, which justifies a new route for the national development plan aiming at "sacrifice speed for the sake of quality" and laying the foundations for a "healthy and long-time sustainable development" (Jinzhang, 2016).

This premise was reinforced in the current context of the post-pandemic economic recovery. In 2019, during the G20 meeting, President Xi Jinping stated that it is necessary to advance structural reforms to achieve high-quality growth through the development of a digital economy, promoting connectivity in the industrial environment. He also pointed out that China should continue to take new cycles of internal demand and innovation as the key drivers of economic development, keeping foreign markets and investments in second place in this context (Embassy of the People's Republic of China In Brazil, 2019).

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6 The Medium- to Long-Term Plan has three main targets: (1) To make China an innovation-oriented society by 2020, (2) To become a world leader in advanced innovation by 2030, and (3) a global technological superpower by 2050, paving the way to be world's most developed country in science and innovation (Aglietta; Bai, 2016).

7 The term *Industry 4.0* was coined at Hannover fair in 2011, referring to the reorganization of global value chains guided by the fourth industrial revolution. For a theoretical review of Industry 4.0, see Schwab (2016).

This extensive set of policies and plans has created the right conditions to push the technological leap toward the development and implementation of fifth-generation mobile telephony technology in Chinese territory. Undoubtedly, 5G will generate productivity improvements throughout the entire economy and governments will be compelled to rethink local policies and federal regulations to support their technological development. Since 5G is in the critical period of standards formation and industrialization, all major countries regard 5G as a high-priority area of development in their national digital strategies. Put differently, this is the time to build competitive positions (Chen; Kang, 2018). As Brake states (2018, p. 9):

Leadership in the so-called “5G race” impacts national competitiveness directly in the equipment and communications services industries, but also indirectly in the economic growth a successful 5G deployment enables. These are distinct, but related considerations. First, consider the indirect benefits: this technology is a platform technology that is envisioned as dramatically impacting the competitiveness and innovation potential of virtually every *downstream* industry that uses it, from manufacturing and transportation to health care and agriculture. In other words, the strength of a country’s 5G infrastructure is going to significantly impact the capacity of enterprises therein to develop innovative products and services, and so ultimately will have a strong impact on overall national economic competitiveness.

Industrial sectors such as transport, automotive, mining, health and agriculture, will be deeply affected by the new digital infrastructure of 5G. Its technological trajectory involves more than just the telecommunications sector but relates vertically to innovative industrial areas such as robotics, unmanned aerial vehicles (UAVs) and drones, artificial intelligence, virtual reality, etc. For Chen and Kang (2018), by creating new formats for the existing industry, 5G triggers a real revolution in the world of labor. While these transformations have already started based on existing 4G networks, they will need 5G to reach their full potential in the years to come (Kostopoulos et al., 2019). Therefore, we are not just referring to the development of 5G, but to a whole technological infrastructure that enables it.

Unlike the situation in US or Brazil, telecommunication infrastructure networks in China are notably a public investment. The Chinese state-run telecommunication operators (China Telecom, China Mobile, and China Unicom) are the main industrial developers of the technical infrastructure necessary for the new technology, and the three work in line with the development planning coordinated both by the national and local governments.<sup>8</sup> These companies were made

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8 In the case of Brazil, mobile telephony (personal mobile service) is a service provided in a private-led regime supervised by the National Telecommunications Agency (Anatel). It is based on the constitutional principles of economic activity, according to the General Telecommunications Law. The supply of services throughout the country depends on the business interest of private providers such as Tim, Vivo, Claro, Oi, Algar, and Sercomtel (Anatel, 2018). A similar process occurs in the USA, where telecom services providers are private companies such as Verizon, AT&T, and T-Mobile, all verified by US Federal Communications Commission (FCC).

responsible by the Ministry of Industry and Information Technology to account for network infrastructures and to operate the fixed-line telephone services, mobile telephony, and *internet* services.<sup>9</sup> Its performance is aimed to connect application and software suppliers, equipment and service platforms to end-users. They are also responsible for making concessions to afford the telecommunication equipment supply through auctions dominated mainly by the private-held company Huawei and the state-owned company ZTE.<sup>10</sup>

This compromise has facilitated coordination and mutual understanding among all parties involved, both players being attuned to the State's objectives, despite its market-based orientation. To put it simply: the technological development goals of these companies are intertwined with Chinese medium- and long-term development plans, which is responsible for paving the way for the producers involved. The top-down approach has led to a more uniform version of 5G throughout the country, compared with the U.S., and more consistent speeds (Strumpf, 2021).

The Chinese government has directed the three telecom operators in the country to start testing large-scale 5G networks in dozens of cities, including Beijing, Shanghai, and Shenzhen. China Mobile claims that its tests represent alone the largest 5G test network worldwide. As Woyke (2018) points out, Chinese operators see their job as implementing government policies, whereas most global telecom companies try to balance competitive factors, profitability goals, and R&D's investment with international market demands, naturally investing at a slower pace.

Besides, the exploitation of 5G technology means that operators must invest financial means in two types of content. The first is the investment in basic network infrastructure: in March 2020, when China was already loosening social restrictions of Covid-19 pandemic, both China Unicom and China Telecom announced the acceleration of the building plan of 250.000 5G base stations in the latter half of 2022, contrasting with the 130,000 installed by the three companies during 2019. To compare, in August 2020, the total number of base stations of Brazilian operators was 106,226, according to Anatel official numbers compiled (Eishima, 2020, p. 3).<sup>11</sup>

The second type of investment is applied to exploiting 5G-related application services, designed to drive market demand. These activities focus primarily on tech applications and those related to the exploitation of the vertical industry.<sup>12</sup>

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9 The Ministry of Industry and Information Technology, established in 1998, is responsible for the Chinese information and communication technology industry (Yu et al., 2008). Regarded as a "super ministry", it directly organizes and inspects telecommunications operators. But it also and indirectly controls the entire ICT industry through the establishment of a statute for industry, weaving common standards and related service charges.

10 These two companies obtained 80% of all 5G development program contracts for China, with Swedish Ericsson and Chinese Datang Mobile taking what has been left (Clark, 2021). Huawei and ZTE compete in the same business sectors and geographic areas. The only difference is that the former is private-led and the latter is a state-owned company.

11 A 2018 study showed that since 2015, China has surpassed US's 5G infrastructure by \$24 billion, having built 350,000 new cell antennas, while American companies built just 30,000 in the same period. Recent reports over 5G indicate that its technical specifications were released in December 2017, Chinese providers were fast-paced in deploying their basic infrastructure and indeed anticipate releasing 5G in 2019, ahead of schedule (Gallagher; Devine, 2019).

12 China Telecom and Chinese Central Television, for instance, were successful in Spring Gala on January 31, 2019, the first 5G-based live broadcasting of virtual reality. In addition, China Unicom completed a flight test of a commercial 5G industrial drone on March 31 of 2020 (Jeon et al., 2020).

More recent data show that at the end of April 2021, Chinese telecom operators deployed a total of 819,000 5G base stations on Chinese territory, representing 70% of the world total. Liu Liehong, vice-Minister of the Ministry of Industry and Information Technology, stated that 5G networks cover all prefecture-level cities throughout China. He also reported that the country intends to build another 600,000 5G base stations by the end of 2021, reaching over 739 million 5G subscribers by 2025. The China Academy of Information and Communications Technology (CAICT) stated in early 2022, that the country will “achieve full 5G network coverage in urban and rural areas” by the end of 2025, thereby creating a sturdy foundation for the use of 5G in consumer and industrial sectors.

Wang Zhiqin, the vice-head of CAICT, stated that the next five years will be a watershed for the development of 5G technology, since China will keep promoting progress in key technologies and continue to build an advanced supply and industrial chain to maintain the country’s leading position in 5G system equipment. In addition, an estimated 1.5 trillion yuan (US\$232.2 billion) worth of investment funded by Chinese telecom operators will be channeled into the 5G network construction by 2025. Further, there is an expected investment of 3.5 trillion yuan in the *upstream* and *downstream* segments of the industrial chain. According to recent data (CAICT, [2021]), so far, 180,000 Chinese industrial enterprises have been connected to the 5G-powered industrial *internet*, which has linked more than 60 million units of industrial equipment.

In terms of the annual mobile data consumption, the 5G annual data traffic in China is forecast to reach 782 exabytes by 2025, representing a share of nearly 60% of the world’s total 5G data consumption (Tomás, 2021). China is both the largest 5G developer and user in the world. In 2020, a total of 5G smartphones in China reached nearly 70% of the total revenue for this segment. 5G mobile phone services for the Chinese population were launched on November 1, 2019, by China Mobile, China Unicom and China Telecom, at the cost of 128.00 CNY per month (equivalent to R\$98.00).

By comparison, by the end of 2020, US had approximately 30 to 40 million 5G mobile subscribers. In a recent interview (Alleven, 2021), an American consultancy dedicated to strategic management in the telecom industry accepted that China is racing ahead in building the infrastructure of 5G networks for industry, highways, and airports, pioneering its development. They state that Chinese ambitions with 5G should not be underestimated: this planned offensive shows the country’s commitment to becoming dominant in global high-tech manufacturing.

China is well-positioned to make this new industry to become a reality. One of the main driving forces behind this building process is that Chinese companies can operate large 5G test banks, control supply chains, developing vertical markets, and access a wide variety of global markets. In technology markets, the “first-mover advantage usually generally leads to a winner-takes-all scenario due to economies of scale” (Hoffmann; Bradshaw; Taylor, 2019). These factors help explain why the 5G network issue has been framed as a zero-sum competition: because it will bring decades of vendor lock-in for critical infrastructure providers. It could also result in walled gardens of devices and services, capture of markets, further reduction in market competition, and the emergence of a Chinese vertical 5G tech monopoly. (Hoffmann; Bradshaw; Taylor, 2019).

The standards development process is crucial for 5G geopolitics. The country that dominates this sector will be leading the way in establishing standards and patents for a global supply chain of emerging technologies. Less than ten years ago, the 4G market was a US-dominated enterprise. The so-called “sharing economy” enabled by the fourth generation of mobile telephony has structured productive chains of immense profitability dominated by U.S. companies such as Uber, Lyft, Airbnb, and other cloud-based services. Apple, Google, Facebook, Amazon, Netflix, and countless others have created new applications and services that are now the founding elements of the new global digital economy.<sup>13</sup>

There is, therefore, a twofold movement: countries are adopting different technological development strategies for 5G (from their respective economic and social formation) while developing globally applicable standards for fifth-generation device and spectrum technologies. For these reasons, the export of Chinese 5G equipment and standards are firmly associated with the Belt and Road Initiative plan, which has been dubbed the New Silk Road. According to Triolo et al. (2020), the New Silk Road initiative ensures that large Chinese technology companies, such as Alibaba, Tencent, Baidu, and Huawei, and the major state-owned telecom operators, enhance their influence in emerging and developing countries, consolidating a set of opportunities for national technology companies to expand their global business footprints, especially on those projects.

The plan consists in integrating the services of Chinese telecom equipment (including ZTE, Huawei, and China Datang Corporation), the service of state-owned operators and e-commerce (Alibaba, JD.com), to project regional connectivity in those countries assisted by the New Silk Road based on the export of digital infrastructures, such as cross-border optical cables and 5G base stations.<sup>14</sup> Through the combination of setting the standards and building the infrastructure, China controls the equipment, the technical assistance, and the ability to shape developing technology (Bartholomew, 2020).<sup>15</sup>

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13 The groundbreaking development of a broad 4G network has enabled new devices equipped with more technologically advanced semiconductors, that can process way more data at a faster pace. As a superior standard, 4G LTE was deployed in other countries with the same American products and applications. 4G indeed boosted US global hegemony in the ecosystem of wireless and *internet* services, which every country in the world has operated for almost a decade (Medin; Louie, 2019).

14 It is common to find theoretical reviews stressing that the New Silk Road has been diverted to railroads, roads, and ports but, in fact, it is strategically planned to construct information connectivity by building cross-border optical cable networks (Tekir, 2020). 5G network technology relies on fiber-optic cabling that enables an increasing flow of data traffic. After the New Silk Road was launched, Chinese 5G networks reached other countries: Myanmar, whose population did not even have access to mobile technology in 2017, made an agreement with Huawei to take 5G technology by 2025. In 2019, Huawei began operating in Serbian, Russian and Cambodian markets to develop 5G infrastructure, establishing partnerships with local mobile companies. Apart from countries with tight restrictions on Huawei’s participation in 5G networks, such as Australia, Brazil, Japan, New Zealand, and the USA, many others have been ambivalent or receptive to Chinese projects.

15 According to a recent survey (Bartholomew, 2020), in April 2019, Chinese companies were involved in 52 5G initiatives in 34 countries. Chinese control of basic technical “laws” and architectural frameworks gives Chinese products, already developed to those standards, a competitive edge, putting Chinese companies in the pole position of providing technical assistance, and allowing new Chinese technologies to be designed to meet those standards.

Finally, the United States, Japan, and South Korea have all made significant strides toward 5G readiness, but none to the same extent as China. Fierce Wireless editor Mike Dano says it's almost certain that China will win the 5G race because of powerful state-owned companies investing money in infrastructure deployment. He cites a series of recent reports that support this conclusion: for example, Deloitte writes that first-adopter countries embracing 5G could sustain more than a decade of competitive advantage (Dano, 2018).

Despite government efforts to develop technology- and capital-intensive industrial sectors, China faces significant obstacles to consolidating its definitive leadership in the 5G sector. It is crystal clear that 5G comprises a complex production chain involving many sectors of the information and communication technology industry. China depends on the supply of *chips* and integrated circuits from foreign companies and cannot be avoiding the world's rigid international division of labor of a few rich 'core' countries that sets all technological standards and paradigms.

Since the 2010s Beijing has sought to make the technological *catch-up* in semiconductors – a basic industry for 5G – aiming at reaching the rate of 70% of self-sufficiency in chips *design* and production by 2025 (Deng & Deng, 2022). As a result, China has suffered strong political opposition from the US, a country that historically holds the hegemony of the sector. As mentioned, the process worsened further in 2017, when former President Donald Trump started a trade war, trying to influence foreign US allies to exclude Chinese companies from global production chains in the semiconductor industry.

Despite China's significant advances toward technological self-reliance, there is a long way off to becoming independent in supplying these key elements to 5G industry.<sup>16</sup> Chinese direct and indirect dependence on US products and technologies, in integrated circuits, has caused a major bottleneck that slows or even blocks Chinese success in other ICT segments, including 5G (Majerowicz, 2020)<sup>17</sup>

In short, it is understood that the race for 5G has just begun, and it will be a marathon and not a sprint. However, the technological trajectories resulting from this process have a direct *linkage* with industry, and this is a matter of concern for the US: if the country lags behind in the implementation of 5G networks, this could potentially undermine its hegemonic position in the global technology market when faced with China.

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16 According to data gathered by Udin (2021) for the year 2020, of the US\$22.7 billion in integrated circuits produced in China, US\$8.3 billion (36.5%) were made by local companies. This represents only 5.9% of the integrated circuits used in the Chinese industry; the remainder was supplied by foreign companies such as TSMC (Taiwan), SK Hynix (South Korea), Samsung (South Korea), Intel (USA), among others.

17 Although developed at the beginning of the twentieth century, Lenin's theory (2021) on economic imperialism is more current than ever: at the current stage of capitalism, the struggle for competition between small and large companies, technically backward and advanced establishments, was replaced by monopolists throttling all those who do not submit to the arbitrariness of the monopolies of core capitalist countries.

Nation-states continue to be the main actors in geopolitics, although their goals and methods change according to the restructuring of the international conjuncture (Santos, 2002). Network data and flows cannot be contained or controlled but influenced. Thus, governments and firms gain hegemony by building and cultivating technological dependencies. Because we are dealing with a technological frontier, all 5G-tech holders conjugate their market advantages with those pioneering the establishment of necessary infrastructure. Not by chance, there is a US-China technological “decoupling” over the dominance of digital geopolitics that feeds a growing tension.

## Concluding remarks

China did not participate in the establishment of 2G standards but developed a 3G standard for its own national territory only, and had modest participation in 4G (TD-LTE) international establishment. Now, 5G’s unique and global standard-setting, gives the Asian country a pole position as an innovative agent in the mobile telecommunication sector, since this fifth-generation technology needs a completely new setup to offer its low data latency, massive connections among several devices, and exponentially higher speeds than previous ones.

This time China was able to partake in all phases of technological development, from R&D to the creation of brand-new innovative infrastructures and *design*. It is the first time that the country has broken its dependence on American, Japanese, and European standards of mobile telephony, becoming an example to be followed. 5G is the basis on which untold innovative technological trajectories shall be unveiled, and it is just doable to truly encompass all digital societies. More than simply a new technological paradigm offering greater quality and innovative possibilities, 5G networks could potentially become the digital nervous system of contemporary societies.

In keeping with the 14th Five-Year Plan, China is resolute to intensify its aggressive strategies to become a leading digital economy by adopting 5G, deepening its IoT, *big data*, and *cloud computing* engagement in all possible industrial sectors along with the building of the international New Silk Road to position itself as a global standard-setter in the digital space. As China is ranked first among the countries with the most *internet users*, it is expected that the government’s new economic strategy – aiming at focusing on domestic consumption – will keep technical progress in the telecommunications sector flowing, as its super-large population of 1.4 billion is progressively enhancing its per-capita income.

In addition, China is still attractive to foreign investors, both due to the size of its population and consumer diversity. Another determinant element to consider is the good conditions of energy, transport, and communication infrastructure, which constantly receive state-led investments that guarantee its maintenance, expansion, and modernization. China has a political insertion in several trade and political blocs and geographical proximity to its main FDI partners (Hong Kong, Singapore, South Korea, Japan, and Taiwan).

On the other hand, the ideologically aligned governments of the US want to protect their markets and industries against the access of Chinese-origin 5G. The results of American pressure worldwide are heterogeneous: Germany, for instance, has refused to ban Huawei equipment. US ideological allies, such as Boris Johnson's United Kingdom, Jair Bolsonaro's Brazil, and Scott Morrison's Australia, accepted all the US agreements for 5G, ruling out any cooperation with China in the telecommunications sector. In addition, all four Japanese operators decided to ban Huawei or ZTE equipment, blocking them from building 5G networks, and Tokyo effectively prohibited any official contracts with China. The premise demonstrates a lack of competitiveness of Western telecom equipment suppliers against Chinese producers such as Huawei and ZTE, which offer products at a lower cost than competitors such as Ericsson and Nokia.

Geopolitical disputes over 5G imply rebuilding the international division of labor. A technological decoupling among nations, molded by US-China rivalry, is expected in the years to come. This decoupling is already disrupting the technology supply chains, which can generate a long-term untenable situation worldwide, since these global production chains are deeply intertwined.

In light of these considerations, we can expect 5G to be only the first chapter in an increasingly heated technological competition between China and the rest of the world. The US fear is that China will keep its initial edge in developing emerging technologies that rely on 5G networks, as it recognizes the fact that China is aiming to establish, defend, or expand its geographical and sectoral spheres of influence. Therefore, the coming years will be deeply marked by the global dispute in the rollout of 5G, and the stakes on China's cutting-edge technological development could not be higher.

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**Section editor:**

**Ricardo Mendes Antas Junior**

**Received:** Feb 15, 2022  
**Approved:** May 16, 2022

PRESTES, E. G.