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Geopolitics in the infrastructural ideology of 5G

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Abstract

This paper explores how infrastructural ideologies function as tools in geopolitical struggles for dependence and independence between world powers. Meese et al. (2020) suggest that controversies around 5G stem from infrastructural anxieties best examined in the framework of geopolitics. We build on this work by analysing the emerging infrastructural ideology and sociotechnical imaginaries (Jasanoff and Kim, 2015) of 5G in light of the changing global division of labour. Sociotechnical imaginaries refer to the vision of technologies themselves, while ideologies refer to the totality of social relations, translating the objective reality of material conditions to subjective lived experience (Bory, 2020). The Western imaginaries around 5G infrastructures reflect, deflect, translate and sublimate the infrastructural anxieties tied to the development and deployment of new network paradigms by China as an emerging hegemon. The controversial nature, contradictory content and fragmented presentation of 5G is a necessary part of living through the trauma of lost historical agency on the part of Western superpowers. We engaged in code ethnography (Rosa, 2022) of GSM, internet and 5G technologies, as well as participant observation in the main standard-development organisations of the internet and 5G. Our methodological assumption, taken from world systems theory (Wallerstein, 2004), is that the character and content of imaginaries and their underpinning ideologies creatively translate the position of actors in the global division of labour. This paper contributes to the understanding of the role of media infrastructures in geopolitical power tussles and straddles the fields of materialist media studies, science and technology studies and international relations.

Keywords

communication history, communication research methods, communication theory, electronic culture (internet-based), policy and law, ideology, media theory, sociotechnical, telecommunications policy

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Introduction

Control over global media infrastructure is a key instrument for asserting geopolitical hegemony in the world system (Zajácz, 2019). It is possible to tell the story of the changing global division of labour in terms of structural changes in global media infrastructures. Studies in information policy showed how the telegraph enabled British hegemony even in the final days of the Empire (Carey, 1983); how radio telegraphy became an issue for US ascendancy (again, in Zajácz (2019)); how the Internet facilitated the establishment of the United States as a global superpower (Carr, 2012); how mobile telephony advanced European interests across the world in the past decades (Kammerer, 2010). Other significant work at the intersection between science and technology studies with media and communication studies provides complementary perspectives on the same historical developments, but this time from "from below" (Xavier, 2016). Medina (2014) on Allende's Chile and Peters (2016) on the Soviet Union's attempts at networking are but two prominent examples. It is also notable that very little critical comparable work examines the historical evolution of mobile telecommunication networks outside of Europe and the United States, despite many studies of national or regional domestication (Winseck, 2017). However, there are some excellent exceptions about China (Harwit, 2008; Hong, 2017) and India (Choudhury, 2010; Shah et al., 2022). In this paper we seek to connect the national and regional approaches by offering the concept of infrastructural ideology, a theory of power and contestation in and through global material media infrastructures (Meese et al., 2020).

Contemporary scholarship on media and power is occupied with establishing the connection between the introduction of 5G and the increasing role of China in the global division of labour (Nanni, 2021; Radu & Amon, 2021; Tekir, 2020). Ironically, English language literature on the topic represents a peculiar cross-over between the two strands of historically oriented studies that we have highlighted above: the studies of hegemonic actors, and the studies of emerging and periphery powers. This is because such literature can be read as a testimony of Western subjects reflecting on their own decline – a point that later on we develop further. From our situated perspective in the Netherlands, we contribute to this debate on the geopolitics of 5G based on original research on contemporary developments and secondary analysis of literature on earlier media infrastructures.

A red thread running through this body of scholarship is a fascination with the relationship between material things – such as media technologies – and discursive formations that symbolically constitute those things – such as ideas about them. Authors question how the metaphor of the information superhighway paved the way for the socialisation of the Internet (Bory, 2020), how the theory of cybernetics justified infrastructure developments for establishing the planned economy in Chile (Medina, 2014) *and* for advancing the free market in Silicon Valley (Turner, 2006), or how the ideal of "openness" shaped protocol design and information policy in the era of the early Internet (Russell, 2014). We position our theoretical contribution in this area, by putting forward the notion of infrastructural ideologies. The notion was designed to illuminate the things-ideas nexus, or in conceptual terms, the mediation between digital materialities and sociotechnical imaginaries, especially since the latter over emphasises the discursive over the material (Barad, 2007; Dourish, 2017; ten Oever, 2023).

Ideologies and materialities

Classic theories of ideology frame the concept in relation to hegemony and coercion, institutions and practice. The concept received comparatively little attention in contemporary science and technology studies, despite the Marxist origins of the field (Söderberg, 2017). Our own attempt to

rehabilitate the study of ideology is inspired by cultural political economy (Jessop, 2010; Sau, 2021).

The purpose of hegemony is to reproduce a social order that serves the interest of the hegemon. Hegemony is developed and maintained in two ways: coercion and ideology (Gramsci, 1971). A successful ruling class imposes its ideology through institutions and the subsequent production of subjects, minimising the need to apply coercion. Therefore, a good measure of the performance of a hegemonic project is whether social order is enforced through ideology, or whether the rulers have to rely on coercion.

The product of ideology is cultural hegemony where ideas that legitimise the current mode of production become common sense. Common sense produces a spontaneity in which subjects are convinced that the existing material conditions are both scientifically rational and serve their particular interests. As the work of Caudwell (2017) in the sociology of scientific knowledge, and David Noble (1977) in the history of technology has shown, neither science, nor technology or infrastructures are out of reach of ideology.

Althusser (2014) developed a systematic theory of ideology. Ideology produces subject positions that people in society occupy spontaneously according to their role in the division of labour, where the division of labour is defined by the capitalist mode of production. The production of subject positions is instrumentalised through the institutions such as the school and the church. Subject production takes place through practices such as turning around on the call of the policeman on the street, the moment where a subject occupies the subjugated position of citizen in relation to the state. Foucault's early work on knowledge and power in the context of the prison and the hospital started from such institutionally defined configurations of power relationships that are reproduced in the context of everyday life. His notions have been developed by Žižek (2008), who further emphasises that ideology exerts its power through practical compliance rather than through a purely symbolic order.

However, none of these influential authors made the connection between the materialisation of ideologies and the materialisation of technological objects the centre of their investigations. There is a gap in theoretical elaboration at this point, between infrastructure studies and the study of ideology. While it is broadly established that ideologies work through social practices and materialised in technological objects, it is not clear how ideology, materiality and practices come together in infrastructures that become media environments of everyday life. We propose to fill the gap between infrastructure studies and the study of ideology by elaborating on how ideologies are materialised in infrastructures. The concept of infrastructural ideologies is intended to express the ideological force of infrastructures that they exert on social relations through shaping practices, as well as the role of ideology in building infrastructures.

For this research, we engaged in code ethnography (Rosa, 2022) of GSM, internet and 5G technologies, as well as participant observation in the main standard-development organisations of the internet and 5G. Our methodological assumption – taken from world system theory (Wallerstein, 2004) – is that the character and content of imaginaries and their underpinning ideologies creatively reflect the position of actors in the global division of labour. This paper contributes to the understanding of the role of infrastructures in geopolitical power tussles and straddles the fields of science and technology studies and international relations.

Ideologies in geopolitics

Following Saul Bernard Cohen (2002), we understand the geopolitics of world systems as the dynamic changes in the international system and operational milieu that happen through new

international phenomena as well as recurring and restructuring patterns, often at the moment of convergence between economic and ideological forces.

A synonym of ideology is especially apt for clarifying its role in geopolitics. "Worldview" (*Weltanschauung*) suggests a vision of the world as it is seen by a particular subject from a particular point of view. This point can be located in a space and time relative to other spaces and other times. Therefore, the worldview implies a situated position in a regime of social relations of power. A worldview becomes a genuine ideology once the situated point of view that it presents, and the subject that holds that worldview, are disjoint. When subjects hold the hegemonic worldview, it overcodes their actual position in the system of social relations. It is in this gap between the *actual* position of a subject and the *ideological* position from which that subject experiences the world that power operates. In other words, hegemony is achieved once subjects see the world in terms defined by the hegemon. This is as true worldwide as within particular nation states, or the nuclear family, for that matter.

Cultural hegemony specifically through technology transfer has been investigated at different scales. Regional analyses abound in a collected volume entitled *Hacking Europe* (Alberts & Ruth, 2014a), whose authors investigate how the personal computer as a US industrial and cultural product has been domesticated in different Europe contexts. As Alberts & Ruth (2014b) explains, domestication refers to the ways that people make sense and make use of media in their geographically and historically specific local contexts. See Wagenknecht and Korn (2016) for an overview of domestication literature. In a geopolitical framework, we understand domestication as the problem of producing and projecting an infrastructural ideology from the centre of the world system across geographies structured by the global division of labour. In the penultimate section of this article, we will return to the Western domestication of Chinese media infrastructures such as 5G. On a larger scale, Edwards (1996) shows that computers play a crucial role in the Cold War ideology of the West. For these otherwise very different scholars, the message and meaning of media infrastructures – as much as their operational principles – are explained in reference to the situated positions of their developers and users in the global division of labour.

For world system theorists, economic exploitation on a global scale is mainly justified by ideologies rather than coercive domination by force. Wallerstein himself used the term *geocultures* to understand how patterns of cultural differences legitimise unequal exchange between the core and the periphery of the world system (Wallerstein, 1991). This continues to be true as contemporary world systems analysts observe the changing division of labour where China makes a bid for global hegemony (Li, 2008). Such a bid is accompanied by attempts to articulate geocultures that support the domestication of Chinese technology and ideology (Winter, 2019, 2022). But if hegemons and would-be hegemons like the US or China impose worldviews, how do they do it?

Media infrastructures are especially suitable to project global hegemony through infrastructural ideologies. As much as movies or memes, they are the products of a particular cultural, social, political context. Therefore, they are at once ideological constructs. However, due to the technological outlook of media infrastructures, the mere fact that they are pieces of material culture is often overlooked. While potential subjects may recognise a movie as a cultural product, and, thus far, an ideological construct, they may not do the same for its media of circulation. If ideology veils social relations, technology veils ideology.

Media infrastructures improve upon the ideological prowess of other technologies in that the sending and receiving ends of a communication channel need to be compatible. Interoperability in media infrastructures is a problem solved by the application of standards and protocols (Rossiter, 2016). As Balbi et al. (2016) assert, "networks, objects and ideas need to be standardised in order for them to circulate" (13). Mediated communication as a key concept is often defined transcendentally

by scholars, so that it can later be used to account for power relationships in empirical investigations. The paradigmatic Information Age trilogy (most prominently Castells, 2009) is a case in point. For Castells, media infrastructures are an independent variable for explaining global power structures.

In order to counterbalance such fatally flawed assumptions, we emphasise that media infrastructures always already operate within the global matrix of power. Geopolitically speaking, communication tends to have a vector that points from centres of power towards the peripheries. Interoperability as a technical requirement for communication, for instance, is by definition an asymmetric relationship where technological transfer from centre to periphery is the basis of unequal exchange. Compatible with what, we ask? Compatible with the central economy that invested most in the development of that technology!

The success of infrastructural ideology can be measured against a bidirectional flow: On the one hand, the flow of information from the centre towards the periphery (ideological projection). On the other hand, a complementary flow of surplus value from the periphery towards the centre (uneven development). The concept of infrastructural ideology explains the connection between these two asymmetric flows, relating informational asymmetry to uneven development. Thus, media infrastructures express worldviews of the core in order to make them productive in peripheral contexts.

Three network paradigms

We reconstruct the conditions that are necessary (but not sufficient) for the production of a new network paradigm: mainly a central position in the world system. We cite three examples of network paradigms, each attached to an infrastructural ideology that legitimises it. These are the ideology of openness that legitimised the paradigm of the Internet produced by the United States; the ideology of mobility that legitimised the paradigm of GSM (mobile phones) produced in European cooperation; and the ideology of smartness that aspirationally legitimises the paradigm of programmable infrastructures such as 5G today.

Thus, the ideology of openness allowed for the Internet to be promoted as the technology that brings freedom, while also being acknowledged as a United States (US) enterprise. A legitimacy exchange (Turner, 2006, pp. 25–26; Bowker, 1993) has taken place between the values associated with the technology itself, and the hegemonic position of the US in the global division of labour. The values and content of the Internet legitimised the US policy of opening markets to neoliberal globalisation, and integrating them under its sphere of influence. In this context, the Internet has been a fundamental material infrastructure for funnelling profits from the semi-peripheries to the core economies.

Later on, with the global adoption of mobile phones ushered in by the European championship of the Global System for Mobile Telecommunication (GSM) protocol suite, even the periphery of the world system could be integrated into the aforementioned funnel. This process was driven by large telecommunication companies based in European countries called the national champions. It took place through dividing the territory into cellular spheres of influence and then defining interoperable interfaces between them. The ideology that legitimised this narrative was about closing the digital divide through mobility (Napoli & Obar, 2013; Wyatt et al., 2005). The infrastructural ideology of GSM justified economic relationships of unequal exchange between the core and the periphery. The resulting pattern of dependencies reproduced colonial geographies.

5G reverses this narrative, tracking the changing global division of labour in the world system. The US now plays the role of the hegemon in decline, with Europe following at its heels. In a bid for the hegemonic position in the world system, China asserts its research prowess in addition to its already recognised industrial capacity. The Chinese strategy for global hegemony is different from

previous US and European imperialisms, though. The Chinese strategy for geopolitical hegemony is an infrastructural imperialism (Rossiter, 2016, pp. 138–84), while previous ones combined cultural imperialism with infrastructure. The infrastructural ideologies associated with the Internet and mobile phones deployed sociotechnical imaginaries strategically, in conjunction with relying on material infrastructural effects. In the case of 5G, the infrastructural ideology of smartness breaks down in the Western context in which we have studied it. The result is infrastructural contestation such as trade sanctions and industrial sabotage, raising the question whether an infrastructural ideology can be successfully performed without relying on significant sociotechnical imaginaries.

The infrastructural ideologies behind the development of the Internet, mobile phones and 5G reflect different strategies for global hegemony on the part of the US, Europe and China, respectively. The associated sociotechnical imaginaries show how it is possible to make sense of these ongoing social conflicts culturally. In the next three subsections, we highlight the structural constraints and historical contingencies around the standardisation of three subsequent network paradigms. We concentrate on the interplay between their digital materiality and the cultural political economic context from which they emerged.

Internet: The open

It is important to remember that despite the legendary proportions to which historical studies elevate the Internet, militaries, airlines and banks all had their specialised global communications infrastructures up and running by the time that the Internet grew to global proportions, not to speak of the landline telephone network that fulfilled similar needs.

The early Internet that emerged from the interdisciplinary research cultures incubated in places like the Radar Laboratory at the MIT reflected and contributed to the newly established hegemonic position of the United States after the Second World War. The US policy of demilitarisation brought military technology and research organisation into the civilian market (cf. Eisenhower's military-industrial-academic complex). The Internet standards that emerged in the decades that followed are fashioned after the diagram of the market. They assume a dumb network with intelligent edges, capitalising on the assumption that a simple system can produce complex results in an emergent way. In cyberculture, openness appears as a virtue of the Internet itself, rather than the ideology of the hegemonic US or the neoliberal market. Thus, the association between freedom and the Internet legitimised US cultural imperialism and neoliberal economic expansion in the second part of the 20th century.

The ideology of openness was also reflected in the US-led international standardisation process that produced the protocol stack through a completely new set of standards bodies such as the Internet Engineering Task Force (IETF) and others (Russell, 2014). The new standards bodies were instruments to articulate rising hegemony through bypassing the old system of standardisation (the International Organization for Standardization) – and the global division of labour at the time. Russell shows that the IETF definition of openness in standardisation came to be seen as both more efficient and more just, thus becoming common sense. For a detailed description and critical discussion of the role of the ideology of openness in the development and standardisation of the internet, see Abbate (1999), Russell (2014), and ten Oever et al. (2021).

The open market, as it has been conceived as an ideal for the best possible allocation of resources, is open exactly in the sense that networks based on the End-to-End principle are open. The open market is an infrastructure that allows for goods and services to be exchanged, without asking who can participate, without monitoring transactions, or without interfering with them. Network operators are only responsible to maintain the same rules over time, and deliver all packets equally.

While the design supposedly unleashes the creativity of participants, it also overcodes (national) borders and (network) boundaries to facilitate the movement of goods and data. The overcoding baked in the protocol has been institutionalised in internet governance, whereby IP addresses are distributed by Regional Internet Registries (RIRs) over continents, rather than sovereign countries.

What the democratic conception of the open network/market hides is that some actors are better positioned and possess more resources for harnessing the advantages of openness, to the point where their participation turns into the exploitation and regulation of the smaller actors that make up the vast majority of the network. This is the mechanism of economic imperialism that the US pursued in the 20th century, most famously under the Clinton administration. Economic imperialism served as a morally superior alternative to the traditional colonialism pursued by European nation states, with its roots going back to the tellingly named Open Door Policy towards China enunciated in 1899 (Russell, 2014, p. 8). Later on in this article we elaborate on the historical irony that the very doctrine of openness that has been developed to harness China by the US now plays on the hand of Chinese hegemony in face of US domination.

The pioneer who colonised the American (Wild) West is the ultimate subject position from which cyberculture has been articulated (Markoff, 2005). This leaves us enterprising, entrepreneurial, free floating subjects, backed up materially by disposable IP addresses dynamically assigned at connection time. Their freedom to roam and their identity decoupled from bodies is a powerful myth that drives adoption well into the 21st century. What non-US subjects spontaneously find online today is overwhelmingly a milieu ruled by US cultural imperialism and economically driven by domestic Silicon Valley companies. Thus, the Internet easily becomes a suction pipe for funnelling profits from around the world to the US (Freuler, 2023) – even though there is no built-in safeguard against competition from emerging economies in Asia either.

It is possible to conceptualise openness as a sociotechnical imaginary in the grand tradition of Science and Technology Studies (Jasanoff & Kim, 2015; Sismondo, 2020). Such a conceptualisation accounts for the success of the imaginary for coordinating development and mobilising adoption. What the alternative framing of infrastructural ideology adds is an explanation of the power relations produced and reproduced in the process. An infrastructural ideology furnishes rational common sense and affective spontaneity in a strategic way to define dominated subject positions and serve hegemonic interests. The Internet does this by tracing the design of the market in its material construction within TCP/IP as much as in its symbolic presentation in cyberculture.

To summarise, in standardising and building the Internet, US state and capital performed and cemented its hegemonic position in the world system, creating a new set of standards bodies, communication protocols and standardisation procedures in the process.

GSM: The mobile

Meanwhile, the old hegemons – Western European nation states – reintegrated into the global division of labour after the Second World War and exploited their entrenched geopolitical position in the world system. This happened partly through the traditional standards bodies such as the International Telecommunication Union (ITU), the development of the GSM protocol suite and the advancement of mobile telephony. The GSM standards reflect the logic of telecommunications companies as national monopolies. In contrast to the dumb networks defined by the End-to-End principle, these are intelligent systems with dumb edges, developed and managed by the operator. For a more detailed overview of the history of the Standardization of telecommunication in Europe, see Hillebrand (2001), Lemstra (2018), and ten Oever and Milan (2022).

Methodological nationalism is baked into the GSM protocol suite. Rather than the pioneer worldview associated with the network paradigm of the Internet, GSM reproduces the worldview of citizenship. Mobile phone networks are operated by one of few companies who preside over their own network covering a certain country – heirs to the national champions that European countries developed in the past as state sanctioned monopolies. Telecommunications companies provide services strongly coupled with providing access to the network. This is in stark contrast to the Internet, where under the End-to-End principle, the network operators and the service providers of the Internet are separated technically to different layers of the protocol suite, different cultures and market segments, with mergers watched over by anti-trust regulators.

The infrastructural ideology of mobility thus veils an important limitation: mobile phone networks are optimised to perform within the territory of a nation state, requiring additional technical arrangements, contractual agreements and user expectations when crossing borders. Cross-border interoperability is the methodological assumption of radio access network designers: each network is built and operated separately across a well-defined geographical perimeter, and the service area is stitched together into a patchwork not unlike the cells constituting those individual networks. The European "roaming" approach maps to the political and economic positions of said designers at the time, in contrast to the US "pioneer" approach baked into the infrastructural ideology of the Internet.

The subject position produced by GSM infrastructure is that of the subscriber, tied to a phone number that is composed of a country code, a network designator and an arbitrary sequence. The subscriber is represented by an International Mobile Subscriber Identity (IMSI) number, stored on a Subscriber Identity Module – colloquially known as a SIM card. In turn, each piece of mobile phone equipment is identified by an International Mobile Equipment Identity (IMEI) number. Both IMSI and IMEI are transmitted by the phone to the network cell in the course of initialising the connection. Therefore, subscriber and device are authenticated on the link layer as a function of the network protocol – an idea foreign to Internet standards!

The infrastructural effect of GSM can be seen in how it is used by law enforcement agencies for targeted and mass surveillance. With the combination of regulation requiring the presentation of state-issued identification documents at the point of purchase for SIM cards, and the design of the protocol that segments the geographical territory of the service area into a patchwork of clearly delineated "cells," mobile networks are the perfect media for location tracking and wiretapping.

While surveillance and privacy are hot topics when it comes to the Internet, the same infrastructural effects are common sense in the case of mobile networks, so baked into the protocols that they can hardly be questioned. Advocates for the open Internet mobilise arguments about the nature of the network to advance their agenda. Internet activist John Gilmore is often quoted to the effect that the "Net interprets censorship as damage and routes around it" (Rheingold, 1993, p. 7). Unfortunately, digital rights activists cannot make similar arguments about telecommunications, because a subjugated subject position analogous to citizenship is part and parcel of GSM and its successor standards.

Such differences reflect the cultural assumptions and situated economic, technical and social positions of the original designers. Nonetheless, the technology then becomes a cornerstone of keeping law and order in repressive regimes, turning ideology into coercion. It is worth to remember that the telecommunication companies that operationalise the surveillance and repression of post-colonial populations in the service of nation states today are often owned by the national champions anchored at the old colonialist states in Europe. Thus, telecommunications infrastructures reproduce colonial geographies and power relations.

5G: The smart

Contemporary debates about Chinese media infrastructures tend to focus on the "paternal" (O'Hara & Hall, 2021) or "authoritarian" (MacKinnon, 2011; Taylor, 2022) character of those infrastructures. These claims are regularly extrapolated to argue about the inherent insecurity of Chinese hardware and software, especially when it comes to 5G, which has fuelled an all-out trade war between the US and China, and caught European countries in the middle (ten Oever, 2023). In order to explain the infrastructural ideology of 5G better, it helps to understand China's position in the global division of labour.

China moved from the periphery of the world system to the position of an emerging hegemon within the last half century. The death of Mao Zedong in 1979 led to the re-integration of Chinese economy into the global division of labour in the 1980s. China's aim at this point was first and foremost to keep up with its East Asian neighbours. To catch up, China re-linked parts of the country with the global economy, most notably the special economic zones in coastal cities (Hong, 2017). The leadership allowed foreign direct investment in the 1990s. The country joined the World Trade Organization in 2001, which marked the near completion of its integration into the modern capitalist world system.

While China established links with the global economy, policy makers also concluded that its economy was still largely export based, due to low labour costs and the legalising of foreign direct investment. Parts were often assembled in other East Asian countries, even if China itself was an important source for the supply chain of integrated circuits and telecommunications equipment – bearing large knowledge-transfer fees (Yang et al., 2023). In this sense, China functioned as the world's factory, but the assembly lines were owned by US or European companies, and located in East Asian countries such as Korea, Cambodia or Vietnam.

China was very aware of its trade deficit. Therefore, it started a reorganisation that included the industrialisation of western provinces, concentrating in high tech. Meanwhile, the Western development of 3G and 4G led to vertical integration, which cemented the centrality of telecommunications for China's international competitiveness. One of the approaches to regain competitiveness was the development of its own domestic telecommunication standard (TD-SCDMA), which spurred the development of knowledge about standards and galvanised a research-to-implementation pipeline. Another approach was to hand out state subsidies to national champions such as China Unicom, ZTE and Huawei (Harwit, 2008; Hong, 2017; Wen, 2020). During this period, the US and European countries kept on insisting that China should build its own patent portfolio and engage in international standardisation. This is exactly what China did. In a bid to gain more control over its means of production, and increase its sovereignty, China developed its "cyber power strategy" in 2014. The strategy heralded greater centralisation, culminating in 2016 with the promulgation of the Cybersecurity Law and the publication of a national cybersecurity strategy (Creemers, 2022). This was further entrenched with the "Made in China 2025" manufacturing and industrialisation policy, and the "China Standards 2030" standardisation policy, which gave the final push for China to not just set domestic telecommunication standards, such as it did with TD-SCDMA, but rather shape a global standard, namely, that of 5G.

China's bid for global hegemony once again established the historical conditions for the production of a new network paradigm: 5G. The design of the system brings together an intelligent network with intelligent edges. While in the US, demilitarisation through a transition of technologies to the market sector was a central concern, in Chinese bureaucratic capitalism the military, capital and civil society are supposed to be more closely aligned (Wen, 2020). The 5G protocol stack shows a similar alignment. The articulation of power on a global scale, and in the scope of the

intelligent network and the intelligent edges, is a complex problem, tackled by 5G through algorithmic optimisation. The intelligence of the network automates the translation of policies into specifications and configurations. The 5G standards mainly developed within the 3rd Generation Partnership Project (3GPP) subsume both GSM and Internet standards, just as China attempts to subsume American and European positions in global markets.

We see the novelty of 5G in the convergence of computing and networking, a phenomenon captured in the marketing buzzword *smart networks* and the technical term *software-defined networking*. The convergence allows for a range of new applications that go beyond the conventional and popular use cases of mobile phones and even smartphones. These use cases range from drone detection to self-driving cars, extended reality to industrial automation, and replacing consumer-grade broadband and surveillance cameras for crowd control, amongst other things. The range and variety of use cases, as well as the plethora of protocols that cater for them, warrant the designation of a new network paradigm on the order of the Internet and mobile telephony.

At the same time as we emphasise the novelty of 5G, we also note the continuity with both modern Internet protocols, and previous generations of GSM technologies. The confusion between generations and features that is a characteristic of the mobile phone networks discussed in the previous section also applies to smart networks run on 5G. In particular, when today's smartphone users see the 5G sign in the status bar, this likely stands for an early version of 5G protocols, often backed up by 4G hardware (5G NSA, which means "non-standalone"). However, massive investment from telecommunications companies and subsidies from state sources ensure the gradual development and deployment of more advanced 5G standards. Showing the effectiveness of the infrastructural ideologies associated with the technology, it became common sense in information policy that smart networks are a proxy of economic competitiveness in the 21st century.

The International Telecommunications Union's Telecommunications Sector (ITU-T) sets the criteria that proposed radio communication standards would have to meet, including the previous generations of mobile phone protocols, and now 5G. The ITU-T approved the International Mobile Telecommunications-2020 (IMT-2020) for the requirements of 5G networks in 2015, which were published as a recommendation in February 1st, 2021. These requirements and criteria define performance metrics and technical features in abstract terms, such as the speed and latency achieved for network connections and the number of connections to be supported in a service area, etc.

Three standardisation bodies answered the call to develop technology standards that meet these requirements: 3GPP, 3GPP2, WiMAX Forum. The latter two has fallen on the wayside, with the Third Generation Project Partnership (3GPP) industrial consortium, founded in 1998, eventually developing standards under the 5G moniker. 3GPP presided over the development of earlier generations of industrial standards for mobile telecommunications, led by European actors. The China Communications Standards Association (CSSA), founded in 2002, joined the 3GPP in 2004. By 2018, Chinese members signed for 40% of research items related to 5G standardisation, with from the telecommunications vendor Huawei and the national champion phone company China Mobile presenting the first 5G access point on the market in the same year (Shijia and Yang, 2018; Jones, 2018). According to industry analysis, "Huawei submitted the most contributions to 3GPP for 5G by a considerable margin (19,473), followed by Ericsson (15,072)" in 2019, and by 2021 the firm lead in terms of *approved* contributions too (Bruer & Brake, 2021, p. 17; IPlytics, 2019, p. 9; 2021, p. 7).

5G standards pertain to three application areas that have separate requirements. Enhanced Mobile Broadband (eMBB) follows up on previous generations of mobile technologies such as 4G to provide mobile Internet and voice calls for end users. Ultra-Reliable Low-Latency Communications (URLLC) is for mission-critical applications such as remote surgery where the network has to

respond in near real time and its stability should be guaranteed. Massive Machine-Type Communications (mMTC) underpins the Internet of Things, enabling drones, autonomous vehicles and factory automation. 5G networks are imagined, built and configured with a range of specific applications in mind.

Some use cases require dedicated hardware, such as the millimetre wave radio access networks functioning on newly allocated frequencies. Most other use cases are supported through reconfiguring network parameters in real time – which is why we call the new network paradigm *programmable infrastructure*, and which is why the *smart* moniker stuck in the marketing parlance. The same equipment can simultaneously function in several different configurations dedicated to separate connections, using a technique called slicing. There is no theoretical limit to the number and complexity of network slices. Within and across the three broad application areas mentioned above (eMBB, URLLC and mMTC) many more use cases and associated network configurations are designed, experimented and deployed.

Just as in the case of mobile phone standards, 5G development within the 3GPP is organised into releases. Release 15 (2018) focused on eMBB, delivering the first wave of 5G networks that could replicate, improve and replace 4G mobile phone connectivity in consumer markets. Release 16 (2020) added the missing eURLLC and eMTC applications, enabling private 5G networks in factories and campuses to work on unlicensed spectrum. Release 17 (2022) opened up more frequencies, above 52.6 GHz, also delivering satellite connectivity. Release 18 (estimated 2024) is planned to feature mature media codecs for Extended Reality (XR) use cases and introduce machine learning to network design. 6G is forecasted to be introduced in Release 21 around 2027.

Network slices optimised for particular use cases can be products that telecom companies sell or lease to special business partners, the "verticals." For instance, these business partners could be the very platform monopolies who profited most from Internet connectivity and digital mobile networks, by virtue of providing services to end users on the top of the stack, on the application layer. Think Google Ads, Amazon Prime or the Apple Store. As we explained in the previous sections, ever since the End-to-End principle has been baked into the technical, legal, political and ethical aspects of the system, it prevented telecom companies to tax these financial flows running through their networks. What is worse, on a dumb network, telecoms could neither offer their own exclusive services.

Programmable infrastructures change all that and more: network slices dedicated to verticals open a multiverse of business-to-business revenue streams for telecom companies, offering them more economic opportunities – and more infrastructural power in society at large. The new network paradigm of GSM already addressed similar issues of power and profit, including the strong coupling between a smart network and the services provided by the telecom company, namely, voice calls and data uplinks. Yet, mobile in itself proved limited in its innovation potential for telecom companies. With time, phones became glorified computers on flimsy Internet connections, and the platform monopolies from Silicon Valley took over once again. Thus, smart networks allow telecom companies to profit from connectivity like never before – one reason for platform monopolies such as Facebook and Google to venture into the telecom market themselves.

The programmable infrastructure corresponds to a particular infrastructural ideology. Subject positions defined by 5G protocols are categorised according to what are the use cases and who are the users. The network will facilitate the use case on the basis of the closely coordinated cooperation between the telecom company's equipment, the verticals' business logic, the real time analysis of network conditions, and feedback from user input. Departing from the ideal of "Connecting People" (Nokia), which has been arguably the most successful slogan for a telecom company, for 5G networks, people are but one type of users. Broadly speaking, eMMB targets individual consumers,

URRLLC targets state-sponsored mission-critical organisations, and mMTC targets fixed capital. Thus, the slogan might be translated as "Connecting Society," where the ontological divisions between entities run along the distinctions between the roles and needs assigned to civil society, the state and capital. As in the case of European political geography and the GSM protocol stack, we can see this as an assumption of Chinese policy making about the design of the infrastructure.

While such an analysis is certainly schematic, the point is to highlight the contrast between the dumb network of the Internet and the programmable infrastructures of 5G. In the former, the whole point of "permissionless innovation" at the edges is that the infrastructure presents itself as a general-purpose logistical media for moving digital information around. Users are welcome to throw whatever they invent at it, unbeknownst to the underlying telecommunication infrastructure, its operator and even regulators. Then, the market decides what sticks. The downside of the approach is that innovation is restricted to the edges, and even there, users cannot enrol the cooperation of the network in facilitating their inventions. Within the smart paradigm, the telecommunication network is always already a teleological infrastructure: users declare their identity, purpose and destination before the session is opened for them. This is one interpretation of the engineering principle of "intent-driven management" in 5G networks (planned for Release 18).

Geographically speaking, we saw that the US Internet have been conceived as a smooth, open space, extending seamlessly across borders and ideology that veiled economic imperialism, while (ironically) mobility in European-designed GSM networks happens within and across the striated spaces of national borders served by separate telecom companies. With 5 G, the underlying spatial strategy is not about decoupling topology from topography, or relying on the political geography of the deployment territory. The spatial objective of 5G protocol development and 5G network deployment – articulated in the marketing imaginary with exceptional lucidity – is programming, which in the conceptual language of political geography is called *ruling* a territory. Such programming depends on positioning, which refers to the awareness of the radio access network of the spatial position of the end-user device. Release 16 already supported positioning across all application areas, but by Release 17, positioning should work to a decimetre precision, or more even in the case of smartphones. What programming as an infrastructural ideology delivers is optimisation, and what it hides is who is doing the programming, or, in other words, who is in control.

The architectural imaginaries of subsequent network paradigms speak to the same sensibilities. The global village and the electronic frontier are cosmic ideals bereft of geographical considerations. The imaginary puts a spotlight on the topological. On the contrary, GSM facilitates mobility and emphasises presence in geographical space, placing humans in architectural contexts in advertisements. Finally, 5G networks are promoted through diagrammatic depictions of isometric urban spaces shot through with blue rays (Gabrys, 2022). Thus, it is in this "phygital" (Ibid.) imaginary of the smart city where communications becomes control, bringing together the digital and physical, which has been previously imagined as opposites.

Since ruling a territory is now a feature of the protocol, Chinese ascendancy can be predicated on infrastructural effects, rather than open markets or colonial heritage. The specific case of 5G should be understood in the context of a wider strategy of power through infrastructure. The Belt & Road Initiative, connecting Asia to Europe for the transportation of goods, provides such a context. Both can be analysed as programmable infrastructures of logistical media, mediating territories. Yet, the Infrastructural Revolution in China is pursued without a corresponding Cultural Revolution, as much in logistics as in telecommunications. Internet users worldwide had to be Americanised in order to integrate into a dependent position in the global division of labour relative to the US (at least learn the language), but for contemporary telecommunications consumers, it might be enough to

rely on mobile phones Made in China, served by 5G networks Invented in China (Goldsmith & Wu, 2008, p. 102).

Theoretically speaking, the Chinese proposition is then that of Žižek's: ideology is a question of practice rather than belief, of circumstances rather than convictions, so that material conditions can produce spontaneous cooperation without a symbolic order of justification, legitimation and rationalisation. We showed in this section that such a spontaneity for cooperation towards a common purpose shared by all actors is assumed in the design of 5G protocols. However, the Western response of trade sanctions and conspiracy theories calls into question whether a media without meaning – a hegemonic infrastructural ideology without a hegemonic sociotechnical imaginary – could be infused into the world system.

The Western domestication of 5G

We investigated Western geocultures of 5G in order to see how Chinese infrastructural ideologies are domesticated in the core economies. The study aimed to compare how English speaking publics, governments and corporations imagine 5G networks. Of the three, only the public succeeded in producing a fully fledged sociotechnical imaginary (ten Oever et al., 2021).

The infrastructural ideology of programmability – backed up by the sociotechnical imaginary of smart – is an excellent business proposition, a mediocre policy proposal, and a lukewarm public relations act. Correspondingly, 5G in the Western world received enormous investment from the private sector, ample government subsidies, but also trade sanctions, and fierce opposition from civil society. The sociotechnical imaginary of smartness remains a puzzle even for industry analysts and sales copywriters, who pay lip service to the smart city paradigm, but largely rely on the "deployment imperative" (Brake, 2018; Deloitte, 2018) to justify investment and adoption.

The conspiracy theories spread on social media are the only meaningful interpretations of 5G, connecting the technology to known personalities (like Bill Gates), political categories (such as democratic sovereignty) and the contemporary historical moment (of the global pandemic). The hard versions cast Bill Gates in the role of an evil genius employing mind control for world domination, with optional anticapitalist, antisemitic or alien abduction overtones. His caste aims to take over the world by injecting chips into the veins of citizens in the disguise of vaccination drives, while lockdowns serve as a cover for installing the corresponding antennas on the roofs of their houses. The soft versions are based on health concerns around radiation in electro-magnetic frequencies (EMF) allocated to 5G radio access networks, building on a long-standing genre of anti-EMF activism (Gray et al., 2020). The latter have been acknowledged by international organisations such as the WHO, EU bodies, the Belgian government, etc. The former have been persecuted after a wave of arson attacks against mobile phone antenna masts.

Both question the sovereign right of governments and corporations to coercively impose new technologies on the unwilling populations of electoral democracies, be those radio access networks that operate on novel spectrum, or biological preparations that provide immunity to novel infections. Whatever the details of these arguments, the kernel of truth within is that there is little to none public discourse, debate or consultation about the frequency auctions, the standardisation process, or the street-level deployment of radio technologies for smart networks. In our terms, the introduction of another network paradigm into Western social life seems to be imposed through coercion rather than ideology.

We conclude that neither governments, nor corporations could supply a consistent sociotechnical imaginary for 5G for Western subjects. The smart cities or self-driving cars of today fail to entertain the kind of collective fascination that once lent the global village or the information superhighway

the rhetorical force to justify the introduction of the Internet as a new network paradigm. The infrastructural ideology of a programmable infrastructure offers optimised urban spaces and intent-driven subject positions, but cannot command the desire of Western subjects to inhabit them or identify with them. How such fragmented imaginaries can be interpreted is solely as tragic attempts of the Western imagination to come to terms with the changing role of Western economies in the global division of labour. In Jameson's terms (1981), these variously paranoid or schizophrenic narratives reflect the existential fear that China's bid for global hegemony exerts on the political unconscious. Notwithstanding the floundering of Western interpretations of the emerging technology, it is a fascinating question whether Chinese capital may impose a hegemonic infrastructural ideology without the symbolic justification of a popular sociotechnical imaginary.

Conclusion

We show the historical conditions necessary for the production of a new network paradigm: mainly a central position in the global division of labour. Within that structural constraint, we found variety in how geopolitical hegemony and media infrastructures are related. In the case of the Internet and the US, the new network paradigm marked the peak of US ascendancy to a hegemonic position in the world system. In the case of GSM and Europe, the new network paradigm corresponded with the re-integration of European countries into the global division of labour as allies of the US. In the case of 5G and China, the new network paradigm constitutes a challenge to the geopolitical order and a bid for the hegemonic position, which resulted in geopolitical contestation as witnessed in trade sanctions.

We theorised that sociotechnical imaginaries are necessary, but not sufficient for understanding the role of media infrastructures in geopolitical power struggles. Sociotechnical imaginaries account for the meaningful coordination of collective action, but cannot, in themselves, explain how power operates to produce a social order. Infrastructural ideologies do more than sociotechnical imaginaries, namely, establish hegemony through the strategic deployment of a common sense that makes the social order both morally justified and epistemologically rational. They shape social practice through arranging material conditions, offering subjugated subject positions that are spontaneously occupied. In short, they exert power by serving a particular purpose and a partial interest, but thriving to make them appear self-evident and universal. The role of sociotechnical imaginaries is in the justification of the infrastructural ideology. Because the network reconfiguration that is accompanied with 5G is met with coercion on the infrastructural level (through trade sanctions by the US and European counties), and since it is not accompanied by a sociotechnical imaginary (such as was the case with the internet and the electronic super highway), it is met with contestation such as the burning of telecommunications masts in Europe.

We mobilised the analytical framework of infrastructural ideology in a schematic historical reconstruction. Throughout, we analysed how the infrastructural ideology of each network paradigm is baked into the digital materiality of the protocol stack, paying particular attention to the way that sociotechnical imaginaries are strategically arranged to result in a diagram of power relationships. Openness, mobility and smartness have been deployed to promote the hegemony of the US, Europe and China, respectively. We surveyed Western perceptions of 5G networks, concluding that the infrastructural ideology of 5G networks is not common sense just yet, and offering a theoretical puzzle whether sociotechnical imaginaries are the only way to make it so.

The contribution is an outline of a research programme at the intersection of materialist media studies, science and technology studies, and international relations for understanding media infrastructures as material culture in the context of power struggles on the basis of political economy.

More research is needed on how media organises space, time and power historically and geographically. The relevance of the investigation to the contemporary historical moment is that the sociotechnical imaginary of 5G networks is widely contested and their infrastructural ideology poorly understood, leading to social conflicts that warrant an intervention from critical scholarship.

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