The People's 5G Laboratory: Critical Perspectives on Media Technologies

Position Paper

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Contents

In this document we lay out the case for the rationale, tradition and methodology informing the positioning of the People's 5G Laboratory. It is published for consultation with our partners and allies in order to shape the future of the project. Therefore, it is possible that the document will be updated in the future, but past versions remain available on the website for reference.

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1. Positioning the People's 5G Laboratory

Figure 1: GNU radio spectrum analyser in Amsterdam sunrise. Photo: Niels ten Oever.

1.a Problem statement

(i.) Telecom networks and the Internet are merging in 5G

The International Telecommunications Union is the only body that sets the official standards for telecommunication networks. They do so by setting the performance and reliability preconditions for the next generation networks, and subsequently a combination of standards is being judged against these preconditions. The ITU did this with the International Mobile Telecommunications for the year 2000 standards (IMT-2000 in short), which acknowledged the CDMA2000 and the UMTS standards, more commonly known as 3G. The ITU-T did this as well with IMT-advanced, which acknowledged the 4G standards. The 4G standars were fundamentally different from previous telecommunications standards because it was fully based on the Internet Protocol. Meaning that telecommunication services, from 4G onwards, would be fully dependent on the the underlying architecture of the Internet. This makes mobile network operators indistinguishable from internet service providers and was an enormous step towards the the merging of telecom networks and the internet.

The development of the 5G, the next generation of telecommunication networks, happens against the ITU-2020 conditions. And unlike in 3G where CDMA2000 as well as UMTS got recognized, only 5G standards as developed by the 3GPP are mostly likely recognized as living up to this generation of standards. Mean-

ing that 5G will be implemented world-wide as the next generation of telecommunication standards.

In 5G there are two architectural moves that are made at the same time. Firstly, functionality is added to the edge networks of operators that is indistinguishable from end-nodes. This adds functionality to the network, which is a breach of the end-to-end principle which thusfar has been the guiding principle of internet design. Secondly, 5G networks are planned to take over functionality from core networks and services and overwriting user preferences, such as in the case of DNS. With this, 5G is note only rehaping the design of mobile networks and internet edge networks, but potentially the architecture of the internet itself.

(ii.) Knowledge about telco networks is still largely captured within corporations

The knowledge and know-how of the reconfiguration of the internet architecture by mobile network operators and mobile equipment vendors happens outside of the public eye and bodies where this is normally undertaken, such as the Internet Engineering Taskforce. Furthermore, knowledge about the functioning of telecommunication networks is scarce because telecommunications hardware has been hard to come by and the code to operate these networks for the longest time has been closed-source. Meaning that the knowledge about these networks, that are now seemingly trying to reshape the whole internet, is gathered with a limited group of conslidated mobile network operators and mobile networking equipment vendors.

(iii.) There are several exemptions: community networks + research networks

There are three exeptions to this this rule. Firstly, there are community networks such as those operated by Rhizomatica (as described above). However, it has to be said that these networks operate with 4G standards, and not 5G standards. Which would thus not address the lack of knowledge within civil society about this networking architecture. Secondly, there are research networks operated by universities. These networks generally serve two roles: network optimization research, and research to support community networks (such as the excellent work that is being done at the University of Washington). Thirdly, there is a new trend of open source 5G network implementations that are not only aimed at network security research, but are aimed at providing cross-vendor standards implementations to be used on concrete production environments. An example of this is the Magma project [https://github.com/magma/magma], which has been financially supported by Facebook. The rise of open source implementations is also driven by initiatives such as the OpenInfraProject, that stimluates interoperability between tne implementations of telecommunication standards of different vendors and implementers.

(iv.) With the increasing open source implementations and modularization of telco networks, there is an opportunity

With the increasing number of open source implementations of telecommunication networks and the modularization of telcommunication networks in many different micro services, these networks become more configurable and more knowable for third paries. One reason for this is that telecommunication equip-

ment vendors want to expand their markets outside of telecommunication operators, and leverage so-called 'verticals,' such as car manufacturers and other companies interested in the 'Internet of Things.' The configurability of telecommunication networks for vertical also provides the opportunity for researchers and other members of civil society to interrogate *how* communication network function and reimagine what they could do.

(v.) Not only how *to operate, but to* understand, adapt *and to* shape *future technologies*

The open source implementations that function on a wide range of telecommunication networking devices does not only allow researchers and civil society to operate networks. They also allow for a deeper understanding of how networks work, adapting them to perceived needs, and shaping the trajectory of the development of future networks.

1.b Social conflicts around 5G infrastructures

The People's 5G Lab *maps cultural interferences in the infrastructural imaginaries around new network paradigms*, with the aim of eventually producing one that strategically intervenes in the social conflicts around the biggest infrastructural investment on the planet since the roll-out of the early Internet. The proposal to build a People's 5G Lab was born from the realisation that

> ***(i.) there is a vacuum of infrastructural imaginaries around new network paradigms;***
>
> ***(ii.) social conflicts around 5G are driven by the question of who can fill this vacuum, yet none of the actors in the controversy are positioned appropriately to do so alone;***
>
> ***(iii.)*** therefore, there is a historical window of opportunity to intervene in the meaning-making around an emerging technology.

The P5L mission is to first map the infrastructural imaginaries in the controversy during the stabilisation phase of the technology, and then propose a critical interpretative framework that aligns the standards, design, implementation and deployment of the technology with societal values. The mapping and production of infrastructural imaginaries takes place on the strategic terrain of the changing media landscape and in the conductive athmosphere of network ideologies.

Aside from promises of abundant connectivity and economic growth (Schneir et al. 2018), the rapid development of network technologies produces anxiety and confusion that is evident in all sectors of society. In civil society – such as conspiracy theories about the health effects of 5G associated with the Covid-19 pandemic (Bruns, Harrington, and Hurcombe 2020); government – such as security concerns about mobile communications infrastructure from Chinese vendors (Kaska, Beckvard, and Minárik 2019); and the private sector (Brake 2018) – such as the potential use cases, adoption and innovation potential of new networks. The friction between technological progress and societal valorisation is variously theorised as a matter of technology adoption, regulatory gap (Buzbee 2003), and productivity returns.

1.c The mission of the People's 5G Laboratory

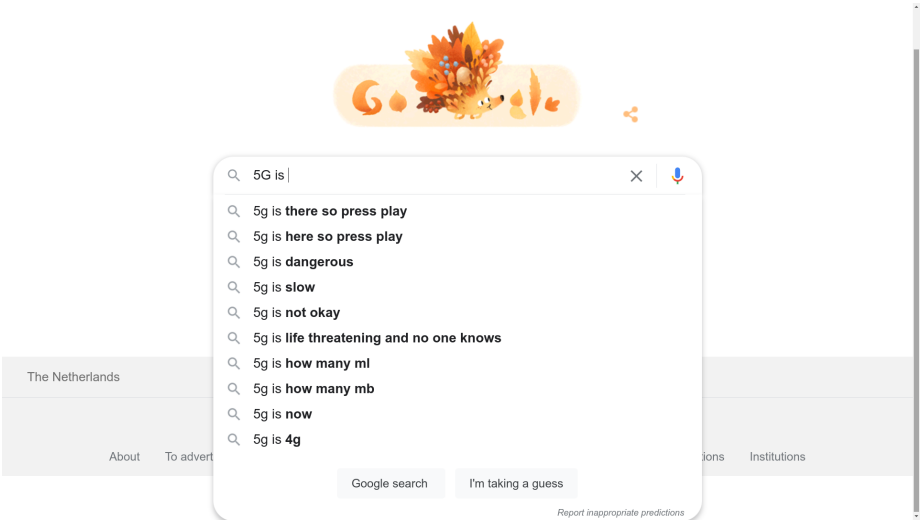

Figure 2: Auto-completions from Google Search Netherlands for "5G is…"

We imagine the People's 5G Lab as an interdisciplinary research hub for *critical knowledge production about new networking paradigms*. The mission of the laboratory would be to democratise access to 5G technologies. In this spirit, the lab would bring together media scholars and technical experts with the other stakeholders who shape 5G networks, including actors from the spheres of civil society, policy making and the telecommunications industry. While many other network laboratories focus on producing technological breakthroughs, the People's 5G Lab would produce critical perspectives on new media technologies.

The laboratory would be organised around an *experimental mobile networking setup* (Fig.1). The setup would serve as a research infrastructure optimised to open up digital media for critical investigations. On the one hand, the People's 5G Lab would bridge the gap between the highly theoretical research interest of media scholarship and the complex technical substance of its subject matter. On the other hand, the lab would make telecommunications accessible to stakeholders whose understanding of the social impacts of new network paradigms is limited by the opacity of the infrastructure and the promises of innovation. In essence, the laboratory would be an opportunity for media scholars and other stakeholders to engage with the materiality of digital media and evaluate the claims associated with technological innovation.

The People's 5G Lab would research, map, analyse and produce *infrastructural imaginaries*. People use imaginaries to make sense of technologies, so that such imaginaries become the basis for their practical encounters with technologies in the context of everyday life. The imaginary of the Information Superhighway promoted by Al Gore in the USA helped a generation of Americans to understand the early Internet – in a particular way. As a public good, a utility equally accessible to, and ultimately beneficial for everybody. Furthermore, as a symbol of individual freedom and middle class mobility in a consumer society. The infrastructural imaginary of the Information Superhighway eventually supported

a frame for the Internet worldwide as the harbringer of modernity, contributing to the imperialist goals of the United States. The burning question of the day is what imaginary 5G networks would be associated with, and how this would play into the hegemonic ambitions of China.

In the following pages, we make the case for critical research on 5G infrastructures in the here and now, survey previous work on the democratisation of innovation, and lay down a research programme for bootstrapping the People's 5G Lab.

2. Preliminary analysis of infrastructural imaginaries around 5G

2.a Capital

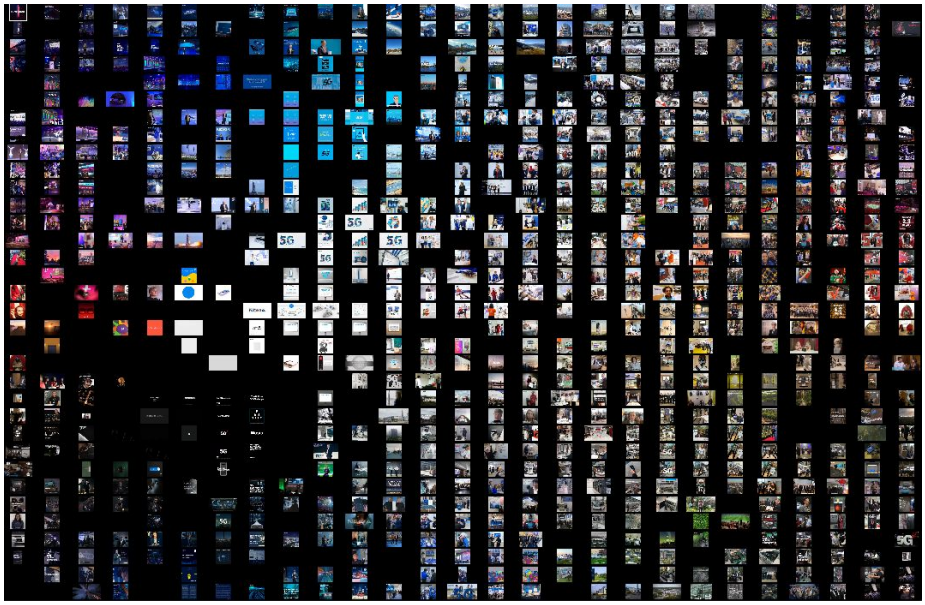

Figure 3: Image wall of 752 representations of 5G from vendor companies' websites: the colour of 5G is blue.

Compared to the double-bind of state representations and the strong imaginary put forward by civil society, vendor companies' marketing image of 5G appears generic and bland. In Oever et al. (2021) we argue that vendors' and network operators discuss 5G in vague terms, failing to create a concrete and meaningful imaginary that people can draw from. While civil society actors mobilise against 5G in the role of citizens, the marketing image of 5G is addressed to the same audiences in the role of consumers.

The marketing image reproduces, with little variation, the well-rehearsed image of the future that we would call *cybernetic modernisation*. Modernisation, since it perpetuates the modern mythology that technological progress and social progress goes hand in hand. Cybernetic, since life changing technologies are depicted as optimalisations of previous generation technologies, where gains are achieved through the intensive and extensive development of media for data processing and data transmission. Activist and scholar Richard Barbrook analyses this image of progress using the example of the 1965 World Exhibition in New York. His main claim is that the imaginary of the future – e.g. the good things that infrastructural modernisation would bring to humanity as a whole – has been invented just after the Second World War through the ideology of cybernetics. In particular, Barbrook pinpoints tickets to the Moon, unmetered electricity and artificial intelligence as the promises associated with cybernetics. We can add that another depiction of the democratised aeronautics of the future

brought about by cybernetics, which has been taken for granted in popular culture, have been flying cars. Contemporary promises of 5G futures include smart networks in smart cities enabling self-driving-cars, low power consumption, and high-bandwith virtual reality content delivery. These appear to be the watered down versions of past promises. Students observe in the above-mentioned study that

> images showing 5G technology are rare and if technology is shown it is also often not clear how this refers to 5G. For example, pictures that depict technology show cars, robots, virtual reality glasses or mobiles, hence, technologies which emphasize 5G as an entertainment or consumer technology, rather than related to public infrastructure. Further, when the images give insights into the functionalities of the 5G technology, there is usually text included in the picture. (Oever et al. 2021)

The inclusion of text on the pictures is yet another proof that publicists fail to communicate visually the promise of 5G networks. The authors of the above report conclude that copmanies "fail to create a meaningful imaginary." Rather than providing detailed information addressing public concerns about deployment, companies promise faster Internet and life changing features in generic terms that might create more suspicion that clearing up doutbts. Therefore, the corporate images generated by the companies that invested in 5G become free-floating signifiers that are easy to present out of context, since they lacked a well defined context in the first place. As mentioned in the previous section, conspiracy theories connect the dots. These dots include the main motifs of both state and capital's depictions of 5G. Therefore, they automatically include, neutralise and repurpose consumer-facing 5G images.

2.b State

Figure 4: Source: Share America, "the U.S. Department of State's platform for communicating American foreign policy worldwide." State Dept. / S. Gemeny Wilkinson / Photo: Shutterstock.

The communication of infrastructural investment by Western nation states in new network paradigms is weighted down by a fundamental contradiction, whereby 5G is presented as a threat and an opportunity at the same time. While the potential economic opportunities and the general prospects of modernisation are being celebrated, the same technology is also held up as a possible security liability and high profile measures are implemented by means of statecraft.

The US-led campaign to ban Huawei equipment from 5G networks over security concerns is bogged down by internal contradictions similar to other historical discourses that accompany the articulation of hegemonic ambitions by world powers. The "War on Terror," which has been initially justified in reference to "weapons of mass destruction" is a case in point. US intelligence failed to make a compelling case, through demonstrated evidence, for the existence of these "weapons of mass destruction," or explain their association with a perceived terrorist threat to the United States of America. Security concerns over Huawei appear more plausible on paper, but it is necessary to make a convincing, evidence based claim for them that goes on the public record. Otherwise, such claims are easily dismissed – just as they are today by the Chinese and Russian media and diplomatic response, or by local dissidents in the Western countries – as mere smokescreens covering the sheer will-to-power of representative democracies. Some credible media scholars such as Meese, Frith, and Wilken (2020) already take up a similar position, discussing the Huawei import restrictions as *economic statecraft*. We discuss these framing of the issue in a subsequent section.

For now, what we would like to highlight are sactions against against Huawei, as instated by the United States government. These sanctioned were epitomized

in the arrest of the Meng Wanzhou, the CFO of Huawei and the daughter of the founder of Huaeweu, Ren Zhengfei, in Canada on December 1st 2018 (Wen 2020). Whereas Huawei is often portrayed as an example of globalizing China, where the relations between private companies and the state are often opague, what is paid less attention to is that rise of Huawei can be attributed to extremely high prices of American and European telecommunucation equipment due to high prices incurred due to 'technology transer.' This seriously hampered the growth of the Chinese economy which has led to the esablishment and support of Huawei, which is reflected in the meaning of its name 'China can,' which reflects Chinese economic developmental ethos. Thus, the unbalanced international market created by Western committees on export control committees created the competitor they claim has only been able to grow due to Chinese state support (Wen 2020; Hong 2017).

A similar ironic move can be found in countries that increasily realize that the privatization on national telecommunication network in the nineties, has led to the hollowing out of network operators. The companies are often now little more than a billing department, owner of real estate, and a board of directors. Technology is increasingly implemented by equipment manufacturers that not only sell equipment, but also operate it under a Service License Agreement. The Netherlands has this awakening when a national newspaper covered that Huawei had access to all conversations in the largest network of the Netherlands, KPN, because it operated the core network (Modderkolk and Righton 2021). This highlights a tension in the technological imaginary late capitalism where innovation in a knowledge economy, with a limited role for the state, is celebrated as the main economic driver, but where materially it is discovered that the development of new technologies closely intertwined with the actions and attitutes of the state.

2.c Civil society

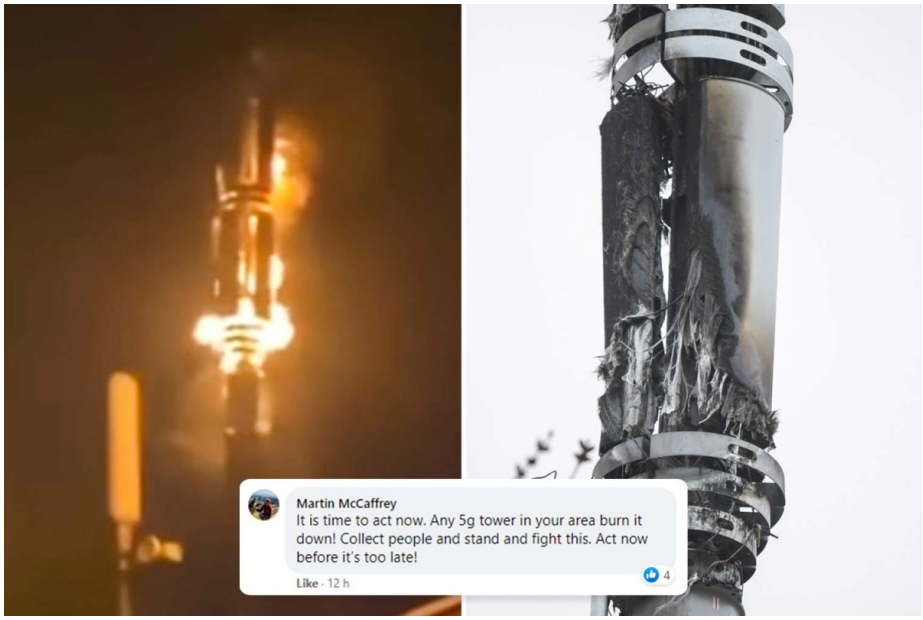

Figure 5: Burning mobile telephone cell tower. Source: The Sun.

Public participation in 5G policy making and roll-out has taken a variety of forms, from arson attacks of antenna masts through demonstrations on the street to court cases challenging policy decision. What is common across these different genres of interventions in information policy is that they follow activist practices. This should not be a surprise, when there are few other institutional channels for public input into information policy pertaining to the design, deployment and governance of 5G networks.

While fringe actors like conspiracy theorists may not hold the legitimacy to speak in the name of civil society as a whole, they have been extremely visible during the pandemic and advanced their agenda in the public sphere during the pandemic. That agenda is continuous with a long tradition of questioning the safety of Electro-Magnetic Frequencies (EMF) from a consumer protection point of view (Gray, Bounegru, and Venturin 2020). The circumstances of the pandemic and the contemporaneous deployment of 5G infrastructures have lent credibility to narratives of institutional capture that are in fact common motifs between the conspiracy theory and consumer protection discourses.

We have studied conspiracy theories linking 5G networks to the COVID-19 pandemic in mainstream and fringe social media platforms (Instagram and Parler) in the course of a Winter School project during the Digital Methods Winter School. We came to the conclusion that conspiracy theorists produces the only genuine instance of an infrastructural imaginary around 5G networks. They have managed to link the technical infrastructure to things that people already know and that can help them to make sense of this new development.

Conspiracy theories link 5G networks to significant historical events (such as

the COVID-19 pandemic itself), known personalities (such as Bill Gates), and absolute categories (such as life and death) that their audiences are already familiar with and feel strongly about. The narrative logic of conspiracy building is about "connecting the dots," which implies that any new piece of information breaching its discoursive perimeter can be readily incorporated into some version of the story. For the same reason, counter-information campaigns might have a limited impact on containing conspiracy theories, since *any* piece of information can be recycled into building blocks for further conspiracy theories.

In the Covid-5G case, Parler as a fringe platform serves as a hivemind of narrative production, inhabited by various conspiracy tribes spinning different versions of the narrative, yet with a high level of consistency in some basic tropes and motives. While the variety of versions ensures that the theory can speak to a wide range of different audiences, overlaps and similarities provide for the possibility of translation for memes, tropes and narrative twists from one version to the other. Furthermore, the folk tale-like characteristics of conspiracy theories ensure that a certain genre can serve as a prolific medium for both participative cultural production and individual self-expression.

As an example, the figure of Bill Gates may appear as a capitalist driven by the profit motive, or directly by bourgoise class consciousness. However, in other versions he may be the personification of the rich jew plotting to end Christian civilisation. In more occult interpretations of the same narrative, Bill Gates is a specimen of an alien reptile race on a mission to wipe out humanity.

Instagram feeds relay these motives towards a more mainstream audience of media consumers. While the format of Instagram posts has a limited capacity to carry the full complexity of actual conspiracy theories and to cultivate the kind of continuous creative reproduction of these narratives that is the characteristic of fringe platforms like Parler, the feed format is perfectly suitable for the effective dissemination of crumb trails leading back to their source. These pieces of information mixed into other popular content such as motivational quotes on fitness celebrity feeds may reach a wider audience.

As we illustrated with the example of Bill Gates, content producers of various persuasion may have disparate motives to make use of these multi-layered codes as quotations in their content curation practices. While someone may not be familiar with the narrative content and the symbolic universe of Disney's Donald Duck movies, they may still recognise the eponymous character from prints on T-shirts and develop a meaningful relationship to the symbol. Rosenblum and Muirhead (2020) discuss such decontextualised symbols as "conspiracy fragments" that contain "conspiracy without theory," meaning that they expose motifs from the overall conspiracy theory as part of popular visual culture.

Thus, we have established that there is a division of labour between mainstream and fringe platforms, corresponding to production and distribution of narratives. A similar *conspiracy pipeline* have been documented before about the manufacture and spread of QAnon themed conspiracy theories (Tuters 2020). Of course, it is not only researchers who reflect on the mechanisms of the propaganda machine. Some actors strategically instrumentalise such cultural dynamics, perhaps improving on the celebrated *tactical media* approaches in the early Internet era.

"Red pilling" (in reference to the 1999 Matrix movie) is the native name for a radicalisation process through gradual immersion in conspiracy theory themed content, especially within the alt-right. However, conspiracy theories may also be farmed as a means of pychological operations or — as we discuss later on – a form of economic statecraft exercise by nation states or their mercenaries. Russia-sponspored troll farms and Chinese corporate marketing operations have both been documented to have been instrumental in the amplification, canalisation and weaponisation of conspiracy theory content and communities across social media platforms (Graphika Team 2021).

On the whole, the coherence and consistency, as well as the versatility and volatility of conspiracy theories around 5G networks stand in stark constrast with the schizophrenic messaging of the state departments and the bland marketing image cultivated by telecommunications companies. Neither state, nor corporate narratives in our survey could frame the technical infrastructure in a meaningful way that connects to everyday experiences of urban life in the centre economies. Consequently, officials and salesmen are bound to fall back on and iterate over the faded memory of the Internet as a staple of (post-)modernisation.

We have mentioned above that in some decisive moments in early Internet history, Al Gore appeared as the public face of state-sponsored investiment in information infrastructures, and helped people to make sense of the Internet by comparing it to the lifetime achievement of his father, the Interstate highway system that many American citizens knew and loved, and which ultimately stood for the idea of freedom in road movies within popular culture. We have seen that conspiracy theories can likewise associate 5G networks with prominent personalities like Bill Gates, world events such as the pandemic, and existential questions such as life and death. The stories that states and corporations can tell in order to win over the hearts and minds of people are pale in comparison, which results in lukewarm public support for the greatest global investment in basic communication infrastructure so far in the 21st century.

2.d Geopolitical context

Figure 6: Stock illustration from a leading Chinese 5G vendor, depicting the circulation of capital between America and Europe. Source: Huawei Technology Insights..

Meese, Frith, and Wilken (2020) suggest that controversies around 5G stem from infrastructural anxieties best examined in the framework of geopolitics. World powers seek to increase others' dependence on their material infrastructures and simultaneously advance their technological sovereignty. Infrastructural imaginaries are mobilised by world powers in this context in order to provide legitimation and justification for their hegemonic ambitions.

We build on this work to analyze the emerging infrastructural imaginary of 5G in light of the changing global division of labor since the Second World War. We argue that the Western imaginaries around 5G infrastructures reflect, deflect, translate and sublimate the infrastructural anxieties tied to the development and deployment of new network paradigms. Their controversial nature, contradictory content, and fragmented presentation is a necessary part of living through the trauma of lost historical agency on the part of Western superpowers.

In order to understand the significance of infrastructural imaginaries around 5G networks, we need to look back briefly at the geopolitical conditions that allowed for the Internet to be promoted as the technology that brings freedom, while also being acknowledged world wide as a United States (US) enterprise. Such legitimacy exchange between the values associated with the technology and the hegemonic position of the US in the global division of labor legitimized US cultural and infrastructural imperialism that "opened the markets" for ne-

oliberal globalisation. In this context, the Internet have been a fundamental material infrastructure for funneling profits to the core economy from the half peripheries, and eventually — through the inflection of GSM from the periphery of the global World System. Inversely ideological association between freedom and the Internet, (which veiled the real material conditions of US economic expansion through neoliberal economic statecraft), allowed to position China in the narrative as the underdeveloped ("developing"), authoritarian, industrial capitalist nation state — the convenient antithesis of not only the US, but the supposedly value-neutral infrastructural development of the Internet itself.

5G then, reverses this narrative, indicating the changing global division of labor in the World System, where the US now plays the role of the hegemon in decline, and China asserts its research prowess in addition to its already recognized industrial capacity. The network ideologies behind the development of the early Internet on the one hand, and the new network paradigms on the other hand, reflect the particular configuration (diagram) of state, capital and civil society in the US and China respectively. The associated infrastructural imaginaries (detailed in the previous section, 1.b) show how it is possible to make sense of these ongoing social conflicts culturally.

A hegemonic geopolitical position in the global division of labour is a necessary – though surely not sufficient — condition for the production of a new network paradigm. 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 associated diagram of power shows the logic of de-militarization, bringing military technology and research organization into the civilian market sphere (cf. Eisenhower's military-industrial-academic complex). Fashioned after the diagram of the market, Internet standards assume a dumb network with intelligent edges, capitalizing on the assumption that a simple system can produce complex results in an emergent way. Its ideology of freedom legitimized US cultural and technological imperialism in the second part of the 20th century, where freedom often appeared as the ideology of the Internet itself, veiling its US origins. The ideology of freedom was also reflected in the US-led international standardization process that produced the protocol stack through a completely new set of standards bodies such as the IETF and others. The latter were an instrument to articulate rising hegemony through bypassing the old system of standardization — and global division of labor.

Meanwhile, the old hegemon — Western European nation states — restored and exploited their entrenched geopolitical position in the world system, and the traditional standards bodies such as the ISO, through the development of the GSM and the advancement of mobile telephony. The GSM standards reflect the logic of telecommunications companies as national monopolies. These are intelligent systems with dumb edges, managed by the operator.

The rising geopolitical hegemony of China once again established the historical conditions for the production of a new network paradigm: 5G. The diagrammatic design of the system brings together an intelligent network with intelligent edges. While in the US demilitarization through a transition of technologies to the market sector was a central concern, in Chinese bureaucratic capitalism the logic of the military, capital and civil society are more consistent. The technical

design of the 5G protocol stack reflects their material conditions of emergence in a strong bureaucratic state economy organized on a large scale. The articulation of power on a global scale and both in the scope of the intelligent network and the intelligent edges, is only possible through algorithmic power and optimization, which automatizes the translation of policies into specifications and configurations. The 5G standards mainly developed within 3GPP subsume both GSM and Internet standards, just as China subsumes its hegemonic position in the global division of labor.

3. Previous work on laboratory approaches to media critique

3.a Institutional critique and the democratisation of innovation

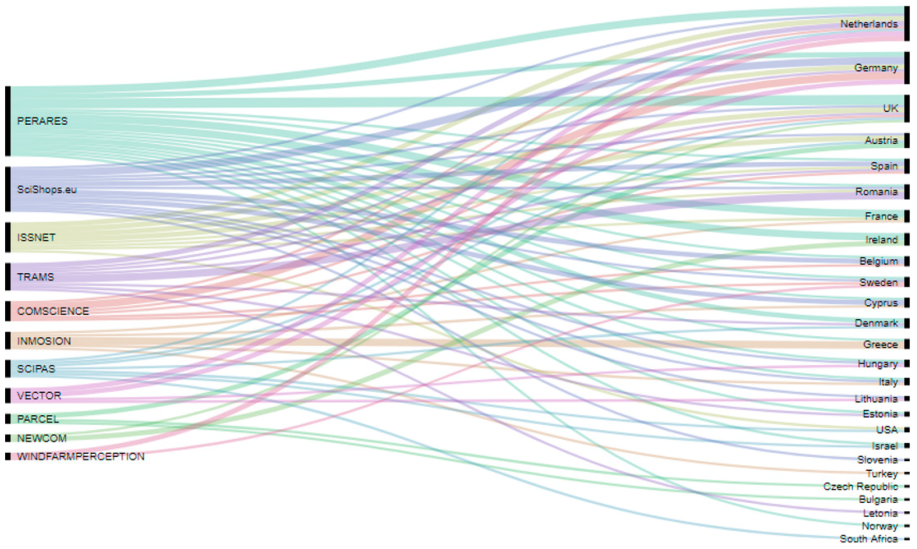

Figure 7: Cooperation among countries participating in science shop projects. Source: De Filippo et al. (2018)

We situate the People's 5G Lab in a long tradition of democratising innovation. Within the wider straing of democratising innovation, there have been many previous initiatives that sought to combine material engagement with public participation in order to produce critical perspectives on technology. In this section, we present three notable cases and the lessons learned from those experiences.

The movement for *participatory design*, the *science shops# and the* consensus conferences# had all been initiatied as interventions into innovation processes where emerging technologies influence the balance of power between workers and citizens on the one hand, and the state and capital on the other hand. These three initiatives have all been rooted in an institutional setting, similar to the our idea to embed the People's 5G Lab in a university setting. At the same time, representatives of all three initatives articulated a critique of the existing institutions, in order to open them up for experimental engagement with innovation processes and participation by extra-institutional actors in the social shaping of technology.

First, the *Collective Resource Approach* was a joint Swedish-led Scandinavian initiative of academics, activists and trade unions networks to involve workers in the design and management of technologies, especially around the digitalisation of work processes (Ehn 1988; Pelle and Kyng 1989). The emblematic intervention happened in the context of a printing press, where workers have

been consulted on the proposed design and management of novel digital printers in anticipation of changes that would be introduced in the labour process through its automation. A key point raised by the advocates of the Collective Resource Approach was that future users should be treated as stakeholders already in the early stage of the design and innovation process, when they still have a chance to shape the technology. Otherwise, workers would face machines as solid social facts, a *fait accompli*, when the technology already stabilised. In the latter case, the social impact of technological innovation would appear as an inevitable price to pay for progress and modernisation.

In relation to the historical experience of the Collective Resource Approach, the People's 5G Lab can be seen as an urgent response to the rapid development and deployment of 5G networks worldwide, a process that leaves little opportunity for consultation with the future users of the infrastructure, or the customers of the services that are going to be provided. The People's 5G Lab would provide a place of connection and intervention where the design of the telecommunication infrastructure can be investigated, experienced, debated and contested by both the critical experts and the future users, e.g. those who would be otherwise left out of the innovation process until the stabilisation of the technology. The common point is that participation should go beyond a managerial attitude to the technology and extend to the design aspect early on in the process.

Second, *consensus conferences* were established in Denmark during the 1980s. They have brought together a panel of citizens with academic experts and industry leaders within the methdological framework of a technology evaluation exercise overseen by state institutions. The outcomes of the exercise was a report authored by the citizens who participated in the panel, similarly to the way that the jury informs the judge during a trial. The report would have to be taken into account by policy makers, shaping the investment in technological innovation and the regulation of emerging technologies. The advocacy for consensus conferences built on the lessons learned from the opposition to nuclear power, but in this case the concern was around the public acceptance of GMO crops. Consensus conferences formalised citizen participation in technology policy (Einsiedel, Jelsøe, and Breck 2001). They were legitimised by the recognition of lay expertise; that a democratic society should recognise the situated knowledge of citizens, who would be the ones most affected by technological progress, a progress often subsidised by taxpayer money.

The People's 5G Lab draws on the institution of consensus conferences as an interface between concerned citizens, policy makers and industry leaders. While the laboratory itself would never be in a position to establish a consensus conference, it could make valuable contributions to the methodologies and argumentations that recognise lay expertise and the voice of citizens in technology policy. Crucially, the People's 5G Lab could combine the lessons learned about material engagement and participatory design from the Collective Research Approach in order to improve and strengthen the recognition of users' situated knowledges in technology evaluation and the policy making that draws on it. A relevant development in this regard is that a version of the consensus conference have been set up recently by the Belgian state for the technology evaluation of 5G infrastructures (Lyons 2021) in response to growing demands from concerned citizens.

Third, *science shops* started here in the Netherlands in the 1970s with a mission to provide trade unions and other civil society organisations with their "own interface with science and technology" (144-145) through translating their needs to "external demand" (137) towards the academia (Leydesdorff and Besselaar 1987). At this point in time, social conflicts around technology have been often articulated as labour conflicts. In case workers choose the institutional path for addressing their grievances, the conflict was mediated through negotiations between the trade unions and the business management. While state sanctions lent some protection to the negotiating position of labour unions, not all sides had access to the same resources in order to substantiate their arguments. In particular, the management drew on so-called time and motion studies conducted by management consultants and other "independent" experts. These were presented as objective measures of the proper pace and execution of routine work processes. The founders of science shops envisioned to create a counterbalance by taking up cases from unions and working on research projects with postgraduate students and Phd candidates that would help workers to back up their arguments with scientific research that would stand the comparison with the studies commissioned by the management.

Likewise, the academics from the People's 5G Lab could work with graduate students and Phd candidates from the university on exploring research questions that have been raised by civil society actors. As many authors in science studies (Dyer-Witheford 1999; Wark 2004; Berardi, Jacquemet, and Vitali 2009, etc.), most famously David Noble (1984) have observed, the introduction of automation into the factory setting was actually a significant factor in the decline of union power over the last decades. It appears that the concerns of science shop activists have been justified, even if their efforts to prevent the balance of power tilting further towards the management had been thwarted. One consequence of this development is that today fewer such institutional pathways and legal safeguards exists for the mediation of social conflicts around technology. That is true even if previous concerns over automation and digitalisation have only intensified since union power waned. A case in point is the spread of conspiracy theories and the sabotage of cell towers mentioned in section 1. above. Therefore, the People's 5G Lab would have to find inventive means and methods to address and articulate citizens' concerns around the development and deployment of the next generation telecommunications infrastructures.

The People's 5G Lab would draw on these diverse traditions in the democratisation of technology. All in all, the common thread between these initiatives was that they sought to democratise science and technology through funneling some input of lay expertise directly into research, development and policy making within the relevant institutions. Opening up the innovation process for public participation in experimental settings enabled the co-production of critical perspectives on technology that would not have been articulated otherwise. At the same time, retrospective evaluations testify (Kraft and Bansler 1994; Scheufele 2010; Leydesdorff and Besselaar 1987) that the level of contestation that these initiatives have brought against the incumbent power relations and innovation regimes was rather limited. The eventual positioning of the People's 5G Lab would take into account the limitations of these past efforts as well as the advances in critical perspectives on technology that participative design methodologies, consensus conferences, and science shops are known for

today. Finally, inspiration drawn from these rich historical experiences would be brought together by the conceptual framework of infrastructural imaginaries and the thematic focus on 5G networks.

3.b Hacker methodologies in humanities and social science research

Figure 8: Blue box designed and built by Steve Wozniak and sold by Steve Jobs before they founded Apple. Displayed at the Powerhouse Museum, from the collection of the Computer History Museum. Source: Wikipedia

The aforementioned experiments in the 1970s and 1980s tried to empower workers to participate in the design of their tools. However, it seems that an even more materialist approach was in order. Grassroots engagements with technology and innovation came to define the next cycle of experiments with critical approaches to technology. These experience coalesced around the figure of the hacker. The figure of the hacker is defined by an outsider position, operating independently of the institutions and the wage relation. This is even true where the university came to be a surface of emergence for hacker culture, as in the case of the MIT AI lab in the 1970s. Hackers at MIT who pioneered early operating system design and digital networking protocols acquired a no less subversive profile than their counterparts in the Homebrew Computer Club or the phone phreaking scene (Levy 1984). The participants of the Homebrew Computer Club built personal computers, organising informally as an alternative to established research and development pipelines. Meanwhile, phone phreakers explored the telephone network. Their activities were not simply an alternative to established institutions. Their hacks, pranks and rhetorics employed in zines and text files were articulated in opposition to the phone company and the technology policies of the time (Lapsley and Wozniak 2013). It has been only after the fact, based on their perceived impact, that the approaches of hackers working inside and outside of the university started to be systematically incorporated into research methodologies.

Therefore, we are not the first scholars to propose methodologies inspired by hacker practices. In this section we look at three main sources that we draw on for the methodological positioning of the People's 5G lab: critical making, parallel operation and rebuilding. We close the section with a run-down of some

other proposals in the area which we found inspiring.

Critical making draws on practices developed in hacklabs (Maxigas 2012), hackerspaces (Bre and Astera 2008), makerspaces (Davies 2017) and other types of shared machine shops (Troxler and Maxigas 2014). The incredible proliferation of this type of spaces proved that tinkering with technology can bring people with various backgrounds – such as in art, technology or activism – together around common concerns and visions. Some types of shared machine shops, such as FabLabs and incubators, have been themselves integrated into institutions such as universities, municipal establishments and corporate headquarters (see the special issue of the Journal of Peer Production on the topic, introduced by Braybrooke and Smith 2018).

Matt Ratto has been organising workshops under the critical making moniker since 2008, popularising the approach within academia and related fields and writing up its methodological tenets (2011). Critical making is a research method based on material engagement with theoretical problems, comprised of prototyping exercises and experiments with micro-electronics that help participants to approach theory development from a materialist angle. It is rooted in the tenets of constructionist pedagogy (Papert 1980; Papert and George 1998; Knorr-Cetina 2000), which "emphasizes the importance of actively making things" (Ratto 2011, 254). Ultimately, critical making workshops make concepts more approachable, bring them closer to the body, drawing on the lived experience of participants in order to "make new connections between the lived space of the body and the conceptual space of scholarly knowledge" [Ibid.].

As we emphasised in the opening sections of this paper, the People's 5G Laboratory is an answer to the inaccessibility of 5G networks and the lack of opportunties for democratic participation in the standardisation, regulation and deployment of the next generation mobile infrastructure. Critical making is an excellent methodology for addressing these needs, since it allows participants with diverse backgrounds to engage in the conceptual exploration of the problem through material engagement with the technology. While Ratto and other critical makers use micro-electronics to model theoretical frameworks, our contribution to the tradition and practice of critical making is that we stage interventions into the very object of study that our conceptual framework (of infrastructural imaginaries) refers to. Hence, the material component of the workshop acquires a more immediate significance to participants, while it continues to be an aid for conceptual engagement with social conflicts.

Reverse engineering is a classic technique in the repertoire of hacking as an engineering culture. Reverse engineers take media objects apart in order to understand them. It is often necessary to take a black box approach to reverse engineering media objects when documentation and schematics are not available. The black box approach is based on inspecting the input and the output of the system and reasoning about its operation and performance based on those observed results. Jailbreaking is a particular genre of reverse engineering, when hackers develop tools to run after market operating sytems on mobile phones, game consoles and other computational devices that are only supposed to run the proprietary software approved by the manufacturer. Major controversies incited by jailbreaking and reverse engineering has been the breaking of the CSS copy protection system on DVD disks (Eschenfelder, Howard, and Desai

2005), the jailbreaking of the Sony Playstation (Marshall and Da Rimini 2015) and the iPhone (Magaudda 2010). These generated heated public debates about intellectual property and consumer protection.

As already mentioned in the first part of this paper, Goguey (2019) explicitly formulated his methodological approach as a response to the apocryphal character of mobile phone networks, e.g. the circulated rumours and unconfired reports about IMSI catchers on social and news media. The increasing complexity, the wide variety of novel applications, and the speed of the deployment of 5G networks exasperates the problems identified by Goguey in connection with previous generation mobile telephony. Goguey decided to rebuild the IMSI catcher through an iterative process during which he worked with three successive prototypes of the device, exploring various approaches to the problem and various possibilities for the surveillance of mobile phone networks with the mystical IMSI catcher. The research outcames have been a methodological paper and an exhibition based on the material and conceptual results thematising privacy issues with mobile phones.

The experimental network setup at the People's 5G Laboratory can be seen as a gesture comparable to Goguey's response to public concern about mobile surveillance. Rebuilding 5G networks and developing prototypes of them is a good – and sometimes the only – way to test and thematise the claims made by the various actors in the controversy. Reverse engineering allows us to move beyond studying representations circulating within the circuits of media and study the materiality of media in observable details. Observability arose as a key methodological and political concern in recent media scholarship on social media platforms, algorithmic effects and information policy [Rieder+Hofman2020]. It is a fortunate development that open source implementations supported by major industry players exist for the software stack behind 5G networks, so that – given the appropriate off-the-shelf equipment – it is possible to build prototypes of these information infrastructures that privilege observability as a key property of the system. Such prototypes can be also instrumental for discovering, demonstrating and exploring social issues with this new technological development in a public setting, as well as conducting a human rights impact assessment that takes into account how power works through telecommunication protocols and information infrastructures.

Parallel operation has been a staple of hacker culture since the beginning, when phreakers built their own model telephone networks from discarded industrial equipment and members of the Homebrew Computer Club built their own personal computers from scratch around the new microchips that became available on the market. Grassroots activists and non-governmental organisations have been running autonomous servers that provide services such as web hosting, email accounts and mailing list for vulnerable demographics who have reasons not to trust commercial service providers (Beritelli 2017; Milan 2009). The political potentials of community wireless networks have received sustained attention in media studies over the years (Oost, Verhaegh, and Oudshoorn 2009; Powell 2008; Slager 2019), often seen in relation to the earlier cycle of struggles around community and pirate radios (Dunbar-Hester 2014).

Wagenknecht and Korn (2016) analyse a case of parallel operation of mobile phone networks by hackers connected to the renowned Chaos Computer Club

in Germany, especially as it has advanced over the years in the context of the Club's annual meeting, the Chaos Communication Congress. They see the parallel operation of mobile networks as *subversive infrastructuring*, opening up the norms and practices that define and govern users' relations to mobile telecommunications. Operating their own network and providing service to actual users during the conference puts hackers in the shoes of the telecommunications corporations. This lateral perspective allows a critical view on the technology that is very different – and more materially grounded – than most academic studies based on other methods of data collection and analysis.

The theoretical perspective of parallel operation as subversive infrastructuring and the practical example that Wagenknecht and Korn (2016) documents is directly relevant to the efforts behind the People's 5G Lab, since we also aim to develop critical perspectives on mobile telephony infrastructures through material engagement with them. The experience of the Chaos Computer Club proves that material engagement with the technology is worth the effort, since it puts us into an epistemologically privileged position where we can understand critical issues from the inside. It is exactly this epistemological, experimental aspect of the CCC experience that we would like to develop in the framework of the People's 5G Lab. To be clear, then, there would be no attempt to provide mobile telephone services to end users outside of an experimental, workshop-like setting, exactly because that would require years of collective effort. Our more experimental and academic take on parallel operation would complement existing efforts. We situate the experimental network setup in the context of other relevant examples of the parallel operation of mobile telecommunications infrastructures in the next section.

Instead of replicating efforts or reinventing the wheel, we draw on existing efforts and past experiences in order to determine a research direction best suited to the research problem, e.g. the epistemological uncertainty and the political strife around 5G networks in the current historical moment. Therefore, it is necessary to introduce a new term for our own approach to research methodologies based on material engagement: the *dissection*. The idea of dissection as a research method refers to public experiments conducted by physicians in early modernity in order to demonstrate the medical, but also philosophical, epistemological and ontological issues pertaining to the workings of the human body and its place in the universe. Such experiment have been most famously conducted in the operating theatre of the Waag, a guild house on the Nieuwmarkt square in Amsterdam. These experiments have been effective as interventions in the debates of the times about religious, scientific and philosophical doctrine, and dramatised both the findings of cutting edge science and the – sometimes disturbing – questions such science brought forward. They did so by gathering diverse publics around material engagement with their research objects. This is why we look back at these public experiments as an adequate source for naming our methodological approach dissection.

In this section, we reviewed existing scholarly efforts to enrich academic research methods by drawing on hacker practices and other lateral approaches to producing critical perspectives on technology. We could have looked at numerous other examples, including but not limited to code ethnography (Rosa 2019), infrastructure walks and interventionist methodologies such as the teardown

(Eriksson et al. 2019), or manifestoes such as that about critical engineering (Oliver, Savičić, and Vasiliev 2011). We are greatly inspired by all these works, but it should be sufficient to consider the three examples mentioned here – critical making, rebuilding and parallel operation – to make our case that hacker methodologies are worthy to consider for scholarly investigations based on material engagement, and to clarify our own distinctive approach to that problem.

3.c Current experiments with mobile networks

Having considered academic methodologies and perspectives on research methods drawing on material engagement, in this section we situate the experimental network setup of the People's 5G Laboratory in a context closer to the research object: the parallel operation of specifically mobile phone networks. We argue that the proposed experimental network setup complements existing efforts, builds on them and opens up new perspectives and research directions. Our claims to this effect are also based on initial consultation with some of the participants involved in the projects mentioned below.

Rhizomatica is a community mobile telephone network built by civil society and social movement actors in the Oaxaca district of Mexico. This is an area of hills and mountains inhabited by indigenous peoples. Due to geographical and economic reasons, commercial network providers refuse to consider the service area a viable market. In this sense, the case of Rhizomatica is a classic case of market failure in infrastructure deployment and technological modernisation. However, the experience of building a community network goes beyond connecting an underserviced area or providing access to marginal social groups. In fact, activists of Rhizomatica highlight major structural issues with 3G, 4G and 5G mobile networks, including critical insights rooted in the social, political and technical analysis of telecommunications. This is proven by the outreach activities that are part and parcel of building the actual network, and also by the national and international level campainging and lobbying efforts that support the existence and development of the Rhizomatica project. Activists onboard members of the local communities into the everyday use, maintanence and operation of the network, while a prerequisite of the legal viability of the project has been the success of a national campaign to change the national policy about frequency allocation.

Bravo (2017) has discussed the Rhizomatica experience in the context of *technological sovereignty*, the idea that communities of users should be able to determine for themselves what are the appropriate technologies for them to make use of in the context of their everyday lives, as well as how such technology is produced, in heed of the power relationships put in place by local infrastructure provision and international supply chains. In their review of discourses around technological sovereignty, Couture and Toupin (2019) note that such discourses are articulated from an anti-hegemonic position, and advocate for the self-determination of some subject, be that a nation, a people, a community or the individual. The main claim is that a deliberative choice of available technologies is part and parcel for the struggle for freedom.

The mission of the People's 5G Laboratory resonates with the work of Rhizomatica and the discourse of technological sovereignty. The idea is to help audiences to evaluate the costs and benefits of a technology in the context of the social, political and economic issues that it opens up. As we continue to insist, however, the experimental network setup would be geared towards producing epistemological insights through practical experiences with the technology, rather than providing network access to marginalised groups. We believe that such an effort is complementary to the mission of community networks, and contributes to their development by providing critical insights into emerging technologies,

Figure 9: Transparency Grenade: network intervention device, exploit enactor. Photo: Khoung Bismuth. Source: Julian Oliver

particularly in the area of mobile phone networks.

OSMOCOM is another example of people taking mobile infrastructures in their own hands, but this time in a quite different context than in the case of Rhizomatica. The acronym refers to a free software project driven by hackers in the wider circles of the Chaos Computer Club. The OSMOCOM developers and the fruit of their labour have been a central component of the field experiments with mobile networks described by Wagenknecht and Korn (2016), that we have referred to earlier. The OSMOCOM project publishes a free software implementation of mobile phone protocols, lowering the barrier of entry for network operation and providing essential documentation that allows actors outside of the telecommunications industry to grasp how these networks work. Rhizomatica and other community networks – as well as academic research laboratories – routinely rely on the OSMOCOM software and the related tools in their work.

We saw that Wagenknecht and Korn (2016) discussed the efforts around OSMOCOM as a case of transgressive infrastructuring. The OSMOCOM work reconfigures what is technically possible, and therefore, what is socially achievable, providing essential practical value and invariably delivering critical insights into the mobile procotols and their operation. However, it is besides the point of the project to follow up and investigate such critical insights, as much as it is out of scope for OSMOCOM to publicise and organise critical debates around problematic aspects. Outreach efforts by OSMOCOM are largely restricted to yearly progress reports at the aforementioned annual Chaos Congress and a persistent presence of their developers and infrastructures in that same context. The People's 5G Laboratory would make use of OSMOCOM tools and follow up on issues discovered by the developers, investigating and contextualising the technological options regarding their social, political and theoretical significance.

Apart from community networks and software projects, there is a third area outside of the media studies where critical insights into mobile networks based on material engagement are routinely produced: the media arts. A range of artists, including Julian Oliver (Parikka 2013), Dennis de Bel and Roel Roscam Abbing (Dieter 2015), as well as artist organisations such as Constant VZW (Huybrechts 2011) are exploring playful ways to put technologies and publics into contact with each other in provocative ways. The red thread running through these otherwise quite different artistic productions is that they actually "work" in the technical sense of the word, performing in practice what they also showcase in a way that is both perceptible to the senses and susceptible to public debate. In this sense, they make the invisible visible and contextualise it as a matter of concern for everybody.

Julian Oliver proposed to treat these artistic approaches under the rubrick of *network as material*, arguing that likeminded artists work with computer and communication networks with the same virtuosity with which master sculptors approach the granite stone, for instance. As much as Rodin would highlight and explore certain aspects of the volume and the void in his sculptures which also open up to interpretation central social and philosophical issues of his time, some contemporary artists work with digital networks. The Chicago Picasso generated public debate about the role of artworks in the public space, the values

that the citizens of the city stand for, crime rates and property speculation. Oliver's works such as the Transparency Grenade raise questions about the privacy of digital communications and the unequal power relationships put in place by increasing technological complexity, as well as the perception of media and truth by audiences.

Dissections, public demonstrations, and experimental network setups at the People's 5G Laboratory would draw inspiration from media art, but bring these concerns to bear on theoretical debates in media studies and deliberative forms of public engagement. Conceptual issues are certainly a priority over aesthetic presentation in scholarly investigations, yet the question of form has also haunted research in the Humanities and Social Sciences since long. While the People's 5G Laboratory would sometimes produce workshops, demonstrations or installations, these would be contextualised and elaborated in formal academic outputs.

In this section we have showcased work with mobile phone networks outside the commercial, industrial circuits that opens up digital communication infrastructures for critical perspectives. Community networks, software projects and media art each approach this question in distinctive ways. We hope to position the People's 5G Laboratory in a way that complements and connnects these efforts, filling a space of academic research with public relevance that exploits the potentials of material engagement with the research object.

4. Research agenda

4.a Methodological premises

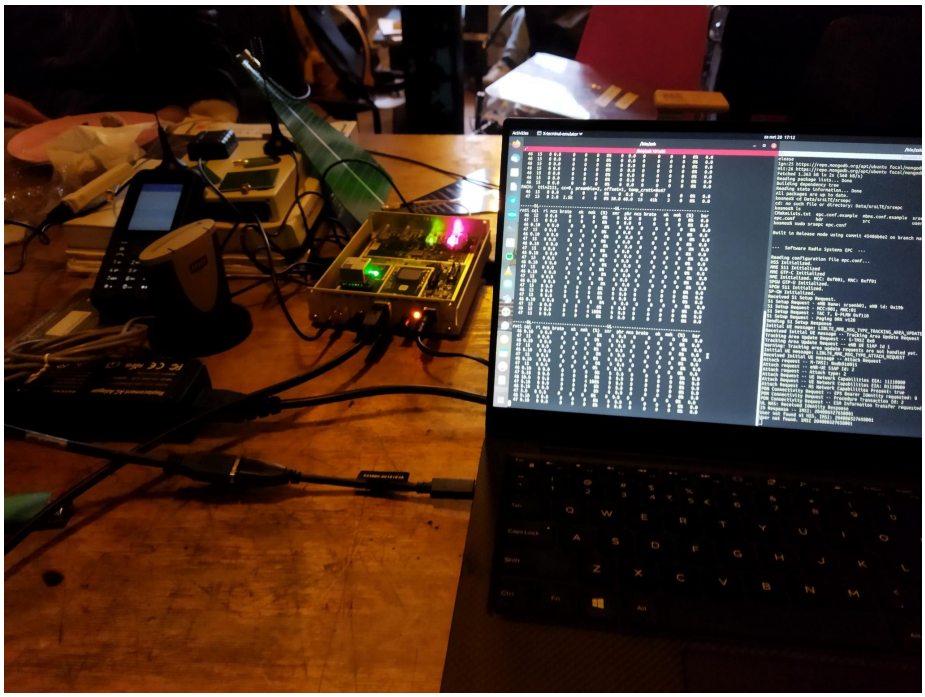

Figure 10: A first prototype of the experimental network setup. Author: Niels ten Oever.

Building on previous work outlined in section 3, the People's 5G Lab will combine material engagement with 5G networks with the public engagement with these experimental networks.

The 'parallel operation' of open source 5G standards implementations yields first-hand experience of 5G design, hardware, and software that could be understood as *code ethnography* (Rosa 2019). Working through the technical complexities (configuring modular microservices and directing beamforming antennas, etc.) yields a thorough understanding of the capabilities of 5G technology. However, focused technical work is rarely done in isolation. Working through these problems is a collective effort that is equivalent with immersion in the communities of developers, operators, and manufacturers who deliberate deployment details. Therefore, the actual labour of network building doubles as a field work experience.

In the deployment of the experimental 5G network setup we will explicitly focus on the new possibility in relation to 'edge computing,' because these are advertised as the most significant changes since previous network evolutions, and might alter the architecture of communication networks.

The research expliclity does not stop here. Understanding 5G networks through rebuilding is merely the beginning of an iterative process of reaching out to dif-

ferent publics about the function of telecommunication networks. Experimental deployment builds an understanding of the workings and plasticity of networks, but also allows for the interrogation and reimagination of those same networks. This move in not merely about making the networks more public in the sense of making them more visible, but also making them more public in the sense that citizens and end-users of these networks are provided with knowledge and opportunities to engage with the design of these technologies.

The dialogue between publics and technologies will happen on a socio-technical and theorical level, which the lab aims to bridge using creative and interactive formats such as art works, workshops, and installations that disclose the the workings of network configurations to a variety of publics, or even reflect the needs of different publics towards network designers.

4.b Research problems

Initial research already shows concrete areas for engagement for the critical investigation of 5G networks. We highlight some of these areas in this section in order to present some of the concrete issues that the People's 5G Laboratory could engage with and explore in future research. These are largely based on technical and theoretical groundwork for the development of human rights impacts assessment methodologies for new network paradigms.

The development and implementation of 5G is likely to lead to the deployment of heterogeneous networks. This is strengthened by the increasing complexity of 5G networks that introduce many new functionalities. The new technological materiality, the combination of standards, functionality, deployment, and practices, that these functionalities produce might have a significant impact on the human rights of its users and therefore deserve consideration in the development, standardization, production, deployment, and maintenance of communication networks. Aside from the direct impact of 5G standards and networks, 5G will not be implemented in isolation but is likely to bring about new paradigms in computing and hardware that are leveraged by 5G, such as IoT, smart cities, and programmable infrastructures. Therefore, these technologies should also be part of a human rights impact assessment, since their deployment is entangled with the deployment of 5G.

4.c Increase in private data

The deployment of 5G networks, including a finer grid of antennae with the roll-out of higher frequencies, will lead to a network with lower latency and more precision through technologies such as beam-forming. This leads to more granular information about the location of users and devices. This subsequently can be used to build profiles of users and their devices. This level of geolocation data might bring about a whole different set of concerns than the more crude geolocation data of previous generation networks and devices of which the impact on user privacy and connected rights might not have been exhaustively analyzed. This concern is strengthened through the leveraging of concepts such as Information Centric Networking in combination with the facilitation of many more sensors and devices that produce user information. Finally, the deployment of remotely programmable e-sims (embedded SIMs) might further disenfranchise users.

4.d Transparency and configurability of networks

The previously mentioned expected emergence of heterogeneous networks presents a challenge for end-users in the sense that the network becomes more configurable for telecommunication providers and less knowable by the end-user. It should be considered how it will be communicated to the user whether their DNS settings will be overwritten, when they make use of edge-computing services offered by the edge-network, or rather through an end-to-end encrypted connection with another end-host. Aside from communicating infrastructural configurations to end-users, it could also be considered whether and how users can set their preferences for the usage of the network, and communicate back to the users whether (and potentially how) these preferences are respected. This

has a direct impact on the right to self-determination, freedom of expression and information, right to privacy, right to association, and the right to science.

4.e Law enforcement and surveillance

With standardized access for Law Enforcement Agencies (LEA) in nearly every layer of the 5G stack (Access and Mobility Management Function, Session Management Function, User Plane Function, Control Plane Function, Unified Data Management, and the SMS Function) oversight becomes more complex. The level of potential access by LEA should be documented, as well as the procedures that are needed to actualize these levels of access. Subsequently, access by LEA should be logged, attributable, proportional, and limited. At any time this information should be ready for inspection by the relevant oversight bodies, such as courts and regulatory agencies, and after a predetermined period also by end-users. Such a system should be an inherent part of the standardized LEA access stack to ensure this impact on users' right is necessary and proportionate and subject to due diligence.

4.f Network induced economic realities

Spectrum scarcity and large infrastructure investments needed to deploy new 5G networks are likely to (further) increase market consolidation. This reduces the possibility of end-users and smaller organizations to deploy their own networks. This newly introduced power imbalance could be balanced in several ways. One way this could be done through deploying more transparent systems, providing code and specifications of hardware and software under open source licenses, and enabling (groups of) end-users to set their own network preferences.

4.g Due diligence, compliance, and regulation

Through the roll-out of new hardware computing paradigms of Software Defined Networking and Network Function Virtualization are mainstreamed. Such software-defined networks can potentially be more easily configured and optimized for different needs. However, such dynamically configurable networks bring about challenges for policy compliance. Therefore, new configurations should be documented in a manner that both considers the impact, and that are in turn available for relevant authorities and impacted parties. This might happen through document YAML files, or other manners of network documentation. Such documentation should take into account notions of algorithmic transparency, end-user privacy (also vis-a-vis third-party network service providers), non-discrimination, and self-determination.

5. Conclusion

Figure 11: One author promoting the People's 5G Laboratory. Photo: Maxigas.

The People's 5G Laboratory is relevant and necessary in order to address the burning questions of the day: to uncover the invisible backbone of the information society. We set out to explore, along with different publics, how 5G networks shape society, and how they could be reimagined and reshaped to reflect societal norms and values. By uncovering what is normally invisible, either because of the nature of radio waves, the underground life of cables, or the bland conference centers where standards get negotiated, we challenge audiences, industry, and researchers to co-design an infrastructural imaginary.¶

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