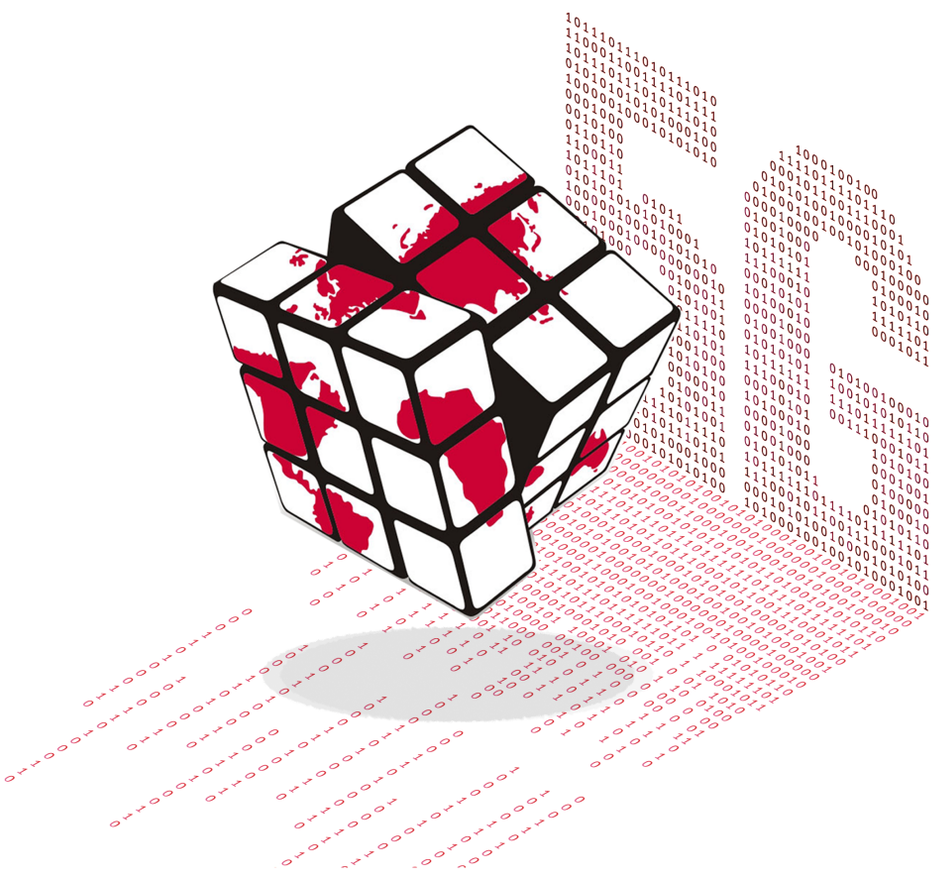
Geopolitics and the Global Race for 5G

CGS Global Focus | May 2019



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The Center for Global Studies (CGS) at the University of Bonn is dedicated to the exploration of power and power shifts in international relations. The series CGS Global Focus investigates selected issues in contemporary global politics.

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CONTENT

EXECUTIVE SUMMARY

DEUTSCH

STRATEGIE

- Nationalstaaten, insbesondere die USA und China, dominieren den globalen Wettlauf um 5G. Die eigentlichen Akteure im 5G-Sektor wie Anbieter und Betreiber werden durch geopolitische Wettbewerbe zwischen den Großmächten beim Aufbau von 5G-Netzen stark eingeschränkt.

- Durch den Fokus auf hohe öffentliche Investitionen, breit angelegte Frequenzen und eine sehr breite Flächendeckung mit einem von der Regierung koordinierten Leitprogramm zeichnet sich die 5G-Strategie Chinas durch eine strategische, auf einem langfristigen Ansatz beruhende Deutlichkeit aus.

- Die Strategie der USA, die auf branchenspezifische Standards und Investitionen, einen schnellen und breiten Ausbau sowie Cybersicherheit abzielt, ist erfolgreich und soll die USA im globalen Wettlauf um 5G auf Platz eins befördern.

- Die europäischen Staaten liegen hinter den 5G-Spitzenreitern zurück, weshalb ihr primäres Ziel im 5G-Rennen nicht der Sieg, sondern ein Status zum Erhalt ihrer Wettbewerbsfähigkeit ist. Dieses Ziel zeigt das strukturelle Dilemma Europas auf: Da die 5G-Strategien in erster Linie auf nationaler Ebene entschieden werden, hat die EU lediglich eine koordinierende Funktion.

GEISTIGES EIGENTUM

- Das Rennen um das Recht des geistigen Eigentums (IPR), insbesondere der Kampf um Standard Essential Patents (SEP), ist die ‚Qualifikationsrunde' des 5G-Rennens. Es bietet eine solide Grundlage für den Wettbewerb um 5G-Standards für den weltweiten Ausbau von 5G-Netzen. Aufgrund des wirtschaftlichen Wertes und der strategischen Bedeutung der 5G-bezogenen SEPs ist ihre Zahl in den letzten Jahren stark gestiegen. Die meisten von ihnen stammen aus China, Europa, Südkorea, den Vereinigten Staaten und Japan.

- Derzeit liegen chinesische Unternehmen im Wettlauf um 5G SEPs knapp in Führung, was dazu führt, dass die chinesische 5G-Technologie praktisch unverzichtbar ist. Wir haben herausgefunden, dass eine Verlagerung von US-amerikanischen, japanischen und europäischen SEP-Inhabern zu chinesischen und koreanischen Inhabern schnell und mit steigender Tendenz stattfindet.

- Insgesamt 25 unabhängige 5G-Patentfirmen aus verschiedenen Ländern nehmen am globalen Wettlauf um 5G-SEP teil. Es gibt vier chinesische Unternehmen (Huawei, ZTE, CATT und Oppo), die 35,51% der gesamten 5G SEPs ausmachen. In Südkorea besitzen drei Unternehmen (Samsung, LG und KT) insgesamt 21,42%. In den USA machen fünf Unternehmen (QUALCOMM, Intel, InterDigital, Apple und Optis) 14,29% aus. Japanische Unternehmen (Sharp, Fujitsu, Sony und NEC) halten 5,3%. Europäische Unternehmen wie Nokia aus Finnland, Ericsson aus Schweden, Innovative Technology aus Großbritannien und Sisvel aus Italien belegen insgesamt 23,1% der 5G-SEPs.

STANDARDS

- Der Prozess der Standardisierung wird zu einem wichtigen Schauplatz für die geopolitischen Aspekte von 5G. Die Normungsgremien 3GPP und ITU fungieren als wichtige politische Arenen im Kampf um die 5G-Normen. Der aktuelle Stand der Normung ist das Ergebnis des Kampfes der Länder und Unternehmen um Macht, Kontrolle und Einfluss in diesen Gremien.

- China ist zu einem wichtigen Akteur in den Normungsgremien geworden, ist aber noch weit davon entfernt, den internationalen 5G-Normungsprozess zu dominieren. Qualcomm, als amerikanischer Technologieriese, hat seit Jahrzehnten die Dominanz bei globalen Telekommunikationsstandards. Huawei zeigt jedoch die Tendenz, Qualcomm zu ersetzen und das Unternehmen mit dem stärksten Einfluss auf die 5G-Standardsetzung zu werden.

- Insgesamt spielen die USA, China und die Europäische Union fast gleichermaßen eine wichtige Rolle im Normungsprozess von 5G. Dieser geopolitische Kampf um 5G-Standards stellt ein multipolares Machtsystem dar. Wir stellen fest, dass es keine transformative Wirkung der geopolitischen Macht einer Nation auf eine 5G-Standardsetzungsmacht gibt. Obwohl der Normungsprozess von einzelnen Unternehmen, Kartellen und vielleicht sogar Ländern manipuliert wird, kommt es, um zu einem 5G-Standard zu werden, auf den technologischen Fortschritt und die Attraktivität für die Mehrheit der Mitglieder von 3GPP und ITU an.

ANBIETER

- Der Markt für Funkzugangsnetze (RAN) wird von dem chinesischen Unternehmen Huawei und den skandinavischen Unternehmen Nokia und Ericsson dominiert, die fast 80% des Marktumsatzes ausmachen.

- Aufgrund des jüngsten Umsatzrückgangs ist der bevorstehende 5G-Ausbau für die Anbieter noch wichtiger, was zu einem verschärften Wettbewerb um Spitzentechnologie, Kooperationen und dominierende modi operandi zwischen den Unternehmen führt.

- Zudem ist nicht klar, ob Huaweis Kampf um Glaubwürdigkeit seinen Konkurrenten Nokia und Ericsson zugutekommen wird oder ob sie negativ beeinflusst werden, da diese mit Forschung, Entwicklung und Produktion auch in China stark involviert sind.

- Darüber hinaus wird Ostasien, mit China im Mittelpunkt, für die Größe der Märkte und das Tempo der Implementierung von 5G entscheidend sein. Die möglichen Gegenmaßnahmen Pekings könnten die Vorteile, die europäische Anbieter nach dem Verbot von Huawei in anderen Regionen erlangen würden, zunichtemachen.

BETREIBER

- Der Übergang zu 5G erfordert Investitionen in Höhe von mehreren Milliarden Dollar durch die Netzbetreiber. Der benötigte Betrag variiert von Region zu Region aufgrund unterschiedlicher Kulturen von staatlichen Unterstützungs- und Lizenzvereinbarungen.

- Betreiberfirmen werden von der Politik in ihrer Absicht, das volle Potenzial von 5G auszuschöpfen, sowohl gedrängt als auch eingeschränkt. Während internationale Geschäftsbeziehungen von grundlegender wirtschaftlicher Bedeutung sind, sind einige von ihnen nationalen Sicherheitsbedenken zum Opfer gefallen. Währenddessen zielen die Politiker*innen im Allgemeinen darauf ab, das nationale Umfeld für den Generationenwechsel zu verbessern.

- Die regionalen Marktgrößen und -konzentrationen sind sehr unterschiedlich. Wir haben herausgefunden, dass die Landschaft der Netzbetreiber am stärksten in der Europäischen Union fragmentiert ist und am wenigsten in China, was für Chinas Wettbewerbsfähigkeit im globalen Wettlauf um 5G förderlich ist.

- Die meisten Betreiber verwenden für ihre Netzwerkinfrastruktur einen Multi-Lieferanten-Ansatz, der praktisch nie transparent gemacht, sondern als Betriebsgeheimnis behandelt wird. Wir haben sogar Hinweise darauf gefunden, dass bestimmte Geschäftsbeziehungen in Unternehmensberichten bewusst im Hinblick auf das politische Klima gestaltet werden.

- Huawei-Technologie wird vermutlich in rund der Hälfte der knapp 75.000 deutschen Basisstationen eingesetzt, davon 13.500 von fast 27.000 Basisstationen allein für die Deutsche Telekom. Eine Basisstation wird mit rund 170.000 Euro zuzüglich Backhaul und Zusatzkosten wie Mieten berechnet. Nach diesen Berechnungen würde ein Austausch aller mit Huawei ausgestatteten deutschen Basisstationen bis zu 6,4 Milliarden Euro kosten, wovon 2,3 Milliarden Euro allein von der Telekom getragen würden.

NARRATIVE

- Wir haben herausgefunden, dass sich ein internationaler Streit um die Gestaltung von Narrativen über die Natur von 5G entwickelt. Fünf verschiedene Narrative können identifiziert werden: (1) Nutzen, Konnektivität und Chancen, (2) Wirtschaftswachstum und Schaffung von Arbeitsplätzen, (3) Cyberbedrohungen und nationale Sicherheit, (4) ein digitales Wettrüsten und (5) eine Frage der Loyalität.

- Während die ersten beiden Narrative weitgehend von Einstimmigkeit zwischen den beteiligten Akteuren geprägt sind, sind die restlichen drei entscheidend von Divergenz und dem Streben nach einem Vorrecht des eigenen Narratives vor allem zwischen den USA und China geprägt.

- In jüngster Zeit haben das dritte und fünfte Narrativ an Bedeutung gewonnen, da insbesondere die USA Huawei und andere chinesische Akteure weiterhin als Bedrohung der nationalen Sicherheit darstellen. Auf dieser Basis wollen die USA ihre Partner und Verbündeten dazu bringen, chinesische Hersteller von ihren Märkten zu verbannen - bisher mit unterschiedlichem Erfolg. 5G ist zu einer Bewährungsprobe für die Loyalität von Verbündeten gegenüber den Vereinigten Staaten geworden.

EXECUTIVE SUMMARY
ENGLISH

STRATEGY

- Nation states, particularly the US and China, are dominating the global race to 5G. The intrinsic actors of 5G such as vendors and operators are strongly restrained by geopolitical competitions between great powers in proceeding the rollout of 5G networks.

- By focusing on high public investments, wide-ranging spectrum deployment and very broad area coverage with a government-coordinated guiding program, China´s 5G strategy is marked by a strategic clarity based on a long-term approach.

- The US succeeds with its strategy aiming for industry-driven standards and investments, fast and broad rollout as well as cyber security, striving for being No. 1 in the global race to 5G.

- The European states lag behind the 5G frontrunners. Instead of winning the race, the EU and its member states are targeting a status that would permit them to remain competitive in the 5G race revealing the structural dilemma of Europe: The 5G strategies are primarily based at the national level, the EU solely has a coordinating role to play.

INTELLECTUAL PROPERTY RIGHTS

- The race for Intellectual Property Right (IPR), particularly the fight for Standard Essential Patents (SEP), is the qualifying round of 5G race. It provides a thorough basis for the competition for 5G standards to be applied for rollout of 5G networks at global level. Owing to the commercial value and strategic significance of the 5G-related SEPs, their number has increased sharply during the last years. Most of them are from China, Europe, South Korea, United States and Japan.

- Currently, Chinese companies are in a narrow lead in the race to 5G SEPs and make Chinese 5G technology in practice indispensable. We found out that a shift from US-American, Japanese and European SEP holders to Chinese and Korean ones are taking place quickly and tending upwards.

- A total of 25 independent 5G patent-owned companies from different countries are participating in the global race for 5G SEP. There are four Chinese companies (Huawei, ZTE, CATT and Oppo) accounting for 35.51%. In South Korea, three companies (Samsung, LG and KT) possess a total of 21.42% (2051). Regarding the US, five companies (QUALCOMM, Intel, InterDigital, Apple and Optis) take up 14.29%. Japanese companies (Sharp, Fujitsu, Sony and NEC) hold 5.3% of the total 5G SEPs. European companies such as Nokia from Finland, Ericsson from Sweden, Innovative Technology from the UK and Sisvel from Italy, occupy 23.1% 5G SEPs in total.

STANDARDS

- The process of standardization is becoming a key locale for the geopolitics of 5G. The standards bodies 3GPP and ITU serve as a major political arena in the fight over the 5G standards. The current status of standardization is the result of the countries' and companies' struggle for power, control and influence in these bodies.

- China has become an important player in the standards bodies, staying, however, far from the ability to dominate the international 5G standards-setting process. Qualcomm, as an American technology giant, has been holding dominance in global telecommunication standards for decades. Huawei, however, has the tendency to replace it to become the company with the strongest influence on 5G standards setting these days.

- Overall, the US, China and the European Union play almost equally an important role in the standards setting process of 5G. This geopolitical battle on 5G standards represents a multipolar power system. We note the fact that a transformative effect of geopolitical power of a nation into 5G standard-setting power does not exist. Although the standard-setting process is manipulated by individual firms, cartels and perhaps even countries, what matters for a solution to become a 5G standard is its technological advance and marketing appeal for the majority of members of 3GPP and ITU.

VENDORS

- The radio access network (RAN) Market is dominated by the Chinese Huawei and the Scandinavian Nokia and Ericsson, who share almost 80% of the market's revenues.

- Due to the recent decline of the revenues, the upcoming 5G rollout is even more essential for the vendors, sparking fiercer competition for cutting edge technology, cooperation and dominating modi operandi among the companies.

- It is also not clear whether Huawei's struggle for credibility will benefit its competitors Nokia and Ericsson, or if they may be affected in a negative way, since they are deeply engaged in China with R&D and productions as well.

- Moreover, East-Asia with China at its core will be crucial for 5G in terms of markets size and the pace of implementation of 5G for the vendors. Beijing's possible counter measures could negate the advantages European vendors would acquire in other regions after a possible Huawei's ban.

OPERATORS

- The transition to 5G requires multi-billion-dollar investments by the network operators. The needed amount varies from region to region due to diverging cultures of government support and licensing arrangements.

- Carriers are both, pushed and detained by politics in their endeavor to realize 5G's full potential. While of vital economic concern, some international business relations have fallen victim to national security concerns, whereas politicians generally aim to enhance the national environment for the generation change.

- Regional market sizes and concentrations vary to a great extent. We found out that the network operators landscape is the most fragmented in the European Union and the least in China conducive to its competitiveness in the global race to 5G.

- Most carriers use a multi-vendor approach for their network infrastructure, which is virtually never made transparent and treated as a company secret. We even found indications that certain business relations are likely to be framed deliberately in company reports with respect to the political climate.

- Huawei technology is used presumably in around half of the roughly 75,000 German base stations making 13,500 out of nearly 27,000 base stations for the Deutsche Telekom alone. One base station is calculated with around €170,000 plus backhaul and additional costs like rents. Based on these calculations, a replacement of all Huawei-equipped German base stations would cost up to €6,4 billion of which €2,3 billion would be carried by the Telekom alone.

NARRATIVES

- We found out an international strife for framing narratives concerning the nature of 5G is unfolding. Five different narratives can be identified: (1) Convenience, Connectivity, and Chances, (2) Economic Growth and Job Creation, (3) Cyber Threats and National Security, (4) A Digital Arms Race, and (5) A Matter of Allegiance.

- While the first two narratives are largely characterized by unanimity between actors involved, the remaining three are crucially shaped by divergence and the strife for a prerogative of narrative between, above all, the United States and China.

- Recently, the third and fifth narratives have gained traction, as the United States in particular continues to frame Huawei and other Chinese actors as threats to national security. On this basis, the U.S. seeks to nudge its partners and allies to ban Chinese manufacturers from their markets – thus far with varying degrees of success. 5G has become a litmus test for the loyalty of allies to the United States.

1. INTRODUCTION

The world is entering an age of global race for next-generation mobile technology (5G). Indeed, the issue of 5G can be considered an instructive expression of the return of geopolitics to international relations. In this sense, to paraphrase Carl von Clausewitz, the much-discussed issue of 5G dominating headlines today represents a continuation of great power competition with other means.

While it has developed itself quickly to one of the most discussed topics in international media and telecommunication branch-special reports over the past three years,[1] the subject 5G has acquired little academic attention in terms of systematic inquiries into geopolitical prospects of the intensifying global race for the new generation of mobile technology.[2] The key question, how geopolitical forces shape the development of next-generation mobile technology (5G), particularly its standard-setting, spectrum allocation, and deployment in key markets and regions, and how these developments, in return, influence balance of power between great powers of the 21st century, remains still unexplored.

This paper attempts to fill this vacancy. It investigates the geopolitical meanings of 5G rollout strategies of big powers, 5G intellectual property rights, standard-setting, equipment vendors' competition, and operators' calculations, as well as divergent narratives from different forces involved in the race to 5G. By doing so, we aim to reveal some new dimensions of international relations in the age of real-time information flows and vast improvements in information and communication technologies.

2. 5G STRATEGY OF CHINA, UNITED STATES AND EUROPEAN POWERS

5G is expected to fundamentally transform mobile communications in the 2020s[3] and thus become a "strategic resource."[4] It will do so through deploying ultra-fast, highly reliable,

1 Best reports in this context are: Clark, Don: What Is 5G? Here's What You Need to Know About the New Cellular Network, in: The New York Times, December 31, 2018, https://www.nytimes.com/2018/12/31/technology/personaltech/5g-what-you-need-to-know.html (Accessed on April 10, 2019); European Commission: 5G for Europe: An Action Plan. COM (2016) 588 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels September 14, 2016, https://ec.europa.eu/digital-single-market/en/news/communication-5g-europe-action-plan-and-accompanying-staff-working-document (Accessed on March 7, 2019).

2 Among the few exceptions seem to be: Lee, Kevin; Lo, Steve: China is poised to win the 5G race. Key steps extending global leadership, Ernst and Young Report, 2018, https://www.ey.com/Publication/vwLUAssets/ey-china-is-poised-to-win-the-5g-race-en/$FILE/ey-china-is-poised-to-win-the-5g-race-en.pdf (Accessed on February 22, 2019).

3 This evolution includes among others new broadband technology, videos without buffering, enabling Virtual Reality, Augmented Reality and the so called Internet of Things, interconnectivity, and facilitates higher frequencies; for a further elaboration of 5G's advances in comparison to its predecessors see: Dhanya, V.A.; Krishnan, Deepika G.; Sunitha, C.: Overview of Fifth Generation Networking, in: International Journal of Computer Trends and Technology (IJCTT), Vol. 43, No. 1, January 2017, pp. 49-54.

4 Stratfor: The US, China and Others Race to Develop 5G Mobile Networks, in: Forbes, April 03, 2018, https://worldview.stratfor.com/article/us-china-and-others-race-develop-5g-mobile-networks (Accessed on February 25, 2019).

scalable, and very low latency connectivity networks.[5] The connection to strategy takes up Andrew D. Bishop's idea of standard power which, according to him, is the method of choice in 21st century geopolitics.[6] This effective form of governments influencing peers[7] instead of exercising hard power makes standard setting the new game in town. 5G standard-setting primarily concerns spectrums, frequencies, implementation plans and area coverage. As catalyst for transitioning Artificial Intelligence (AI), the Internet of Things (IoT) and Augmented Reality (AR) from buzz words to the basis for long-term national economic potential[8] 5G has thus constituted a severe power competition on the international level for which strategy is essential.

Strategists who are responsible for designing 5G infrastructure in different nations have to answer the same questions:" What kind of infrastructure does our 5G strategy target at? What spectrums, frequencies, time tables for implementation and area coverage should it suggest? How can this help to take on worldwide 5G leadership? One of the key points to winning and exercising 5G leadership are the spectrum and frequencies used. As 5G will rely on higher frequencies than were essential for preceding generations, mobile communication will require much more cell sites to guarantee sufficient area coverage.[9] The time tables to implement 5G in test areas as well as its commercial launch will give respective front-running countries a lead. The reason for that is that applications will be developed according to the first-time standards rather than others and it is almost inevitable that the IT sector will learn to rely on them. In order to understand the current 5G race and strategy-making, we need to take a closer look at the major international powers in the arena.

CHINA

China's strategy focuses on high public investments ,[10] a fast rollout of frequencies with its three biggest Mobile Network Operator (MNOs) committing to the 2020 schedule[11] and a vast extension of cell sites as the PRC has built 350.000 of them from 2015 to 2018.[12] Furthermore, the country is building the necessary infrastructure on an unprecedented scale as "China Tower added approximately 460 sites per day, implying that US tower companies and carriers added fewer sites in the last three years [from 2015 to 2018,

5 Cf. Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 7.

6 Cf. Bishop, Andrew D.: Standard Power: The New Geopolitical Battle, in: The National Interest, October 07, 2015, https://nationalinterest.org/feature/standard-power-the-new-geopolitical-battle-14017 (Accessed on February 22, 2019).

7 Cf. Bishop, Andrew D.: Standard Power: The New Geopolitical Battle, in: The National Interest, October 07, 2015, https://nationalinterest.org/feature/standard-power-the-new-geopolitical-battle-14017 (Accessed on February 22, 2019).

8 Cf. Fritz, Jack et al: 5G: The chance to lead for a decade, Deloitte, 2018, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-5g-deployment-imperative.pdf (Accessed on February 21, 2019), p. 1.

9 Cf. Chin, Josh; Krouse, Sarah; Strumpf, Dan: The 5G Race: China and US Battle to Control World's Fastest Wireless Internet, in: The Wall Street Journal, September 09, 2018, https://www.wsj.com/articles/the-5g-race-china-and-u-s-battle-to-control-worlds-fastest-wireless-internet-1536516373 (Accessed on April 10, 2019).

10 Cf. Lee, Kevin; Lo, Steve: China is poised to win the 5G race. Key steps extending global leadership, Ernst and Young Report, 2018, https://www.ey.com/Publication/vwLUAssets/ey-china-is-poised-to-win-the-5g-race-en/$FILE/ey-china-is-poised-to-win-the-5g-race-en.pdf (Accessed on February 22, 2019), p. 7.

11 Cf. Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 17; pp. 19-20 with a focus on figure 3.8.

12 Cf. Fritz, Jack et al: 5G: The chance to lead for a decade, Deloitte, 2018, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-5g-deployment-imperative.pdf (Accessed on February 21, 2019), p. 1.

author's note] than China Tower added in three months."[13] This high amount of towers gives it an competitive advantage, even more so because it corresponds with China's lead in licensing 5G applicable spectrum.[14] While higher frequencies provide better services with regard to pace, latency and reliability, lower frequencies do not require as many sites or towers and thus need a less extensive infrastructure.

In financial terms, the PRC has outspent the US by approximately 24 billion US dollars in wireless communications infrastructure and specified 400 billion US dollars in 5G-related investments in its five-year economic plan.[15] Consequently, a GSMA Intelligence report forecasted that Chinese 5G connections will reach 428 million by 2025.[16] Despite all strategic aspirations, customer prices are likely to be high in the beginning and only fall over time, consequently suggesting a somewhat difficult commercial launch.[17] Based on the size of its domestic market, however, the early commercial launch will give the PRC an advantage in research and development. In addition, it could indicate initial market dominance as well as long-term gains in the domestic telecommunications sector by an early market integration of 5G.

Nation states, particularly the US and China, are dominating the global race to 5G. The intrinsic actors of 5G such as vendors and operators are strongly restrained by geopolitical competitions between great powers.

In contrast to previous generations of mobile communications[18], 5G is therefore placed high on Beijing's agenda as the already performed and planned preparations have demonstrated. This is reflected in the country's Made in China 2025 plan, as the ten priority sectors contain new advanced information technology[19], the 13th Five-Year Plan and other programs[20] as well as in the CTIA's final report, where China scored the highest on its 5G readiness.[21] Accordingly, 5G is crucial to Beijing's technological and innovation strategy and its high readiness underlines the strategic importance that the PRC attributes to it.

UNITED STATES

The US bases its 5G race strategy on the idea that "the nation that leads the world in

13 Fritz, Jack et al: 5G: The chance to lead for a decade, Deloitte, 2018, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-5g-deployment-imperative.pdf (Accessed on February 21, 2019), p. 4.

14 See figures 4.7 and 4.16 by Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), pp. 33, 40.

15 Cf. Fritz, Jack et al: 5G: The chance to lead for a decade, Deloitte, 2018, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-5g-deployment-imperative.pdf (Accessed on February 21, 2019), p. 1.

16 Cf. GSMA Intelligence: 5G in China: Outlook and regional comparisons, 2017, https://www.gsmaintelligence.com/research/?file=67a750f6114580b86045a6a0f9587ea0&download (Accessed on March 05, 2019), p. 4.

17 Cf. GSMA Intelligence: 5G in China: Outlook and regional comparisons, 2017, https://www.gsmaintelligence.com/research/?file=67a750f6114580b86045a6a0f9587ea0&download (Accessed on March 05, 2019), pp. 4-5.

18 Cf. Woyke, Elizabeth: China is racing ahead in 5G. Here's what that means, in: MIT Technology Report, December 18, 2018, https://www.technologyreview.com/s/612617/china-is-racing-ahead-in-5g-heres-what-it-means/ (Accessed on April 18, 2019), p. 3.

19 Cf. Kennedy, Scott: Made in China 2025, Center for Strategic and International Studies, June 01, 2015, https://www.csis.org/analysis/made-china-2025 (Accessed on March 05, 2019).

20 Cf. Lee, Kevin; Lo, Steve: China is poised to win the 5G race. Key steps extending global leadership, Ernst and Young Report, 2018, https://www.ey.com/Publication/vwLUAssets/ey-china-is-poised-to-win-the-5g-race-en/$FILE/ey-china-is-poised-to-win-the-5g-race-en.pdf (Accessed on February 22, 2019), pp. 6-7.

21 Cf. Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 64.

wireless technology wins."[22] Corresponding to this idea and the Federal Communications Commission's (FCC) 5G FAST Plan[23], Washington is currently developing a sustainable spectrum strategy. So far, it relies on advancing policies to promote the extension of flexible spectrums with access for all users, the innovative spirit of its researchers and entrepreneurs as well as spectrum repurposing initiatives.[24] Furthermore, the Presidential memorandum on 5G also focuses on national security measures and improving the global competitiveness.[25] With this approach the US gives the private sector a strong role and prefers industry-driven standards. This view is supported by the four national MNOs conducting early trials as well as having launched 5G commercially in 2018 or early 2019, although the full area coverage will only be completed at a considerably later date.[26] For instance, AT&T announced the launching of its mobile 5G service in a dozen city centers on December 21, 2018.[27]

Moreover, "[t]he FCC has adopted rules to make a large amount of spectrum available for 5G", thus to compensate for the distance lost in the previous stages of the race. Although Fritz et al. assert that US lag behind in their infrastructure-building process and have underspent on the PRC by eight to ten billion US dollars per year[28], they estimate the US to still have an advantage when it comes to its technological and standardization leadership.[29] For instance, the US, with its 715.5 MHz, has currently awarded the second-highest amount in total mobile spectrum after Germany and accordingly leads in the sub-3GHz spectrum.[30] In other frequencies this is, however, a different story as the US currently ranks sixth in the range of 3 to 24 GHz and second in the high-band spectrum above 24 GHz.[31]

The US therefore has a slightly lower readiness than its competitors China and South Korea[32] but continues to benefit from its strong 4G performance. For this reason, putting a much higher emphasis on accelerated extension of spectrum is essential for the US position in the 5G race. This is also reinforced through the private sector's

22 Kratsios, Michael: America Will Win the Global Race to 5G, 2018, https://www.whitehouse.gov/articles/america-will-win-global-race-5g/ (Accessed on February 21, 2019).

23 Cf. Federal Communications Commission: The FCC's 5G FAST Plan, 2018, https://docs.fcc.gov/public/attachments/DOC-354326A1.pdf (Accessed on March 03, 2019).

24 Cf. White House: Presidential Memorandum on Developing a Sustainable Spectrum Strategy for America's Future, October 25, 2018, https://www.whitehouse.gov/presidential-actions/presidential-memorandum-developing-sustainable-spectrum-strategy-americas-future/ (Accessed on April 18, 2019).

25 Cf. White House: Presidential Memorandum on Developing a Sustainable Spectrum Strategy for America's Future, October 25, 2018, https://www.whitehouse.gov/presidential-actions/presidential-memorandum-developing-sustainable-spectrum-strategy-americas-future/ (Accessed on April 18, 2019).

26 Cf. Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 24.

27 Cf. European 5G Observatory: AT&T mobile 5G service launching on the 21st of December, December 19, 2018, https://5gobservatory.eu/att-mobile-5g-service-launching-on-the-21st-of-december/ (Accessed on April 18, 2019).

28 Even with adaptation to different population sizes and wireless subscribers.

29 Cf. Fritz, Jack et al: 5G: The chance to lead for a decade, Deloitte, 2018, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-5g-deployment-imperative.pdf (Accessed on February 21, 2019), p. 5.

30 Cf. figures 4.1 and 4.2 by Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), pp. 27-28.

31 Cf. figure 4.7 by Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 33.

32 Cf. Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 64.

recommendations.[33] Overall, Washington understands 5G's strategic value due to its rewarding experience with 4G leadership and "scores highly on industry-based metrics."[34] But apart from that and starting its commercial launch first[35], the US has so far made fewer spectrum available and will take longer to get broad area coverage than its major competitors.

To a certain extent it has lost its frontrunner status. As a result, agreements on 5G with partners such as Japan, South Korea or the EU, a more cooperative approach and global harmonization efforts could support the US strategy. This is the case because it is questionable if the country can get such a lead that others will automatically have to follow its standards. Hence, the US should not only invest stronger in 5G extension and accelerate this process in cooperation with the private sector, but also abstain from seeing the 5G race as a binary choice between China's and its own approach. Moreover, the US plan for spectrum between 3 and 24 GHz is insufficient, presents the biggest gap to its competitors and needs to be revised.

EUROPEAN UNION

The EU's strategic goal is to stay competitive in the 5G race and the EU's Action Plan suggests that a timely deployment of 5G, a coordinated approach and broad area coverage[36] will be key for this. This coordinated approach was initiated through the European Commission's launch in 2013 of "a Public-Private-Partnership (5G-PPP) backed by 700 million euro of public funding"[37] and the idea that member states' 5G strategies should correspond to the one of the Commission.

Hence, the EU set the course in a quite early stage of 5G's development and compared to China and the US, takes a middle road approach towards preferences on private or public sector reliance. However, the commercial launch within the EU is planned for the end of 2020 and for this reason, China, Japan, South Korea and the US will enjoy a starting advantage. As a result, it is within the realms of possibility that both private and public sector will have to adapt to the standards of others and rely on them. This is something the EU should avoid wherever possible. The harmonization of the frequency bands is another focus of the EU's plan as has so far been done with 700 MHz, 3.5 GHz

33 Cf. 5G Americas: 5G Americas White Paper. 5G Spectrum Vision, February 2019, https://www.ntia.doc.gov/files/ntia/publications/5g_americas_ntia_national_spectrum_strategy_comments.pdf (Accessed on March 06, 2019), p. 37;Cf. Racek, Mark: Comments of Ericsson, 2019, https://www.ntia.doc.gov/files/ntia/publications/ericsson_national_spectrum_strategy_comments.pdf (Accessed on March 05, 2019), p. 6;Cf. Hunter, John; Sharkey, Steve B.; Wieczorek, Christopher: Comments of the T-Mobile USA, 2019, Inc. https://www.ntia.doc.gov/files/ntia/publications/t-mobile_response_to_ntia_request_for_comments.pdf (Accessed on March 06, 2019), p. 8.

34 Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 65.

35 See figure 6.7 by Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 63.

36 Cf. European Commission: 5G for Europe: An Action Plan. COM (2016) 588 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels September 14, 2016, https://ec.europa.eu/digital-single-market/en/news/communication-5g-europe-action-plan-and-accompanying-staff-working-document (Accessed on March 07, 2019), pp. 3-4.

37 European Commission: 5G for Europe: An Action Plan. COM (2016) 588 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels September 14, 2016, https://ec.europa.eu/digital-single-market/en/news/communication-5g-europe-action-plan-and-accompanying-staff-working-document (Accessed on March 07, 2019), p. 2.

and 26 GHz.[38] Yet even the 5G Report for the European Parliament states it is unlikely that all member states meet the target to clear and reassign these bands by the end of 2020.[39]

Consequently, the EU needs to commit to more investments and broad area coverage, keep and improve its coordinated approach, further harmonize its spectrum and streamline its implementation plans. With 5G the EU has taken a coordinating role and thus constitutes, at least so far, an action plan but not an actual strategy. Rather it offers a strategy approach which provides a framework for its member states and as a result, 5G strategy in Europe primarily takes place on the national level . For this reason, this segment will look at Germany's, the UK's and France's 5G strategies as Abecassis et al. ranked them in the middle tier of the 5G race with an average readiness and as of April 2018 the highest scoring EU member states.[40] Their considerable economic power and capacities in telecommunications make them the draught horses of the European Union. Another focal point for the EU is cyber security. The EU's Cybersecurity Act takes up a couple of measures to guarantee safety online such as giving ENISA, its Cybersecurity Agency, a permanent mandate. [41] In addition to that, in its Joint Communication EU-China – A strategic outlook the European Commission calls the People's Republic simultaneously "a cooperation partner" and "a systemic rival."[42] This view applies to 5G through Action nine and ten, in which the Commission proposes a common EU approach to the security of 5G networks to protect its critical digital infrastructure as well as the prompt implementation of the framework on screening Foreign Direct Investments (FDIs).[43]

Reflecting upon this, Kleinhans recommends investing "in strategic supply chain reviews" for risk-assessment purposes. Since the importance of cybersecurity will only increase further once 5G's mobile networks are implemented, this is a sensible approach. Nowhere is this clearer than in the question of involving or excluding Huawei in 5G infrastructure. At some point, Berlin, Paris and London will have to decide between the following three options: (i) to continue their current policy of privatizing telecommunication, and consistently, allow the current economic development in the sector to continue, (ii) to collaborate with the US and other Western partners or (iii) to establish an independent European approach.[44]

38 Cf. Electronic Communications Committee: Europe gets closer to the rollout of 5G. EEC Newsletter, August 2018, http://apps.cept.org/eccnews/august-2018/europe_gets_closer_to_the_rollout_of_5g.html (Accessed on March 07, 2019); for a more detailed discussion of spectrum see: 5G Infrastructure Association: 5G Pan-European Trials Roadmap Version 4.0, 2018, https://5g-ppp.eu/wp-content/uploads/2018/11/5GInfraPPP_TrialsWG_Roadmap_Version4.0.pdf (Accessed on March 06, 2019), pp. 7-12.

39 Cf. Blackman, Colin; Forge, Simon: 5G Deployment. State of Play in Europe, USA and Asia, European Parliament, April 2019, http://www.europarl.europa.eu/RegData/etudes/IDAN/2019/631060/IPOL_IDA(2019)631060_EN.pdf (Accessed on May 07, 2019).

40 Cf. Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 8.

41 Cf. European Commission: Cybersecurity Act, 2018, https://ec.europa.eu/commission/news/cybersecurity-act-2018-dec-11_en (Accessed on March 07, 2019).

42 Cf. European Commission: EU-China. A strategic outlook, Joint Communication to the European Parliament, the European Council and the Council, March 12, 2019, https://ec.europa.eu/commission/sites/beta-political/files/communication-eu-china-a-strategic-outlook.pdf (Accessed on March 20, 2019), p. 1.

43 Cf. European Commission: EU-China. A strategic outlook, Joint Communication to the European Parliament, the European Council and the Council, March 12, 2019, https://ec.europa.eu/commission/sites/beta-political/files/communication-eu-china-a-strategic-outlook.pdf (Accessed on March 20, 2019), p. 10.

44 Cf. Voelsen, Daniel: 5G, Huawei und die Sicherheit unserer Kommunikationsnetze. Handlungsoptionen für die deutsche Politik, in: SWP-Aktuell 2019/A, Februar 05, 2019, https://www.swp-berlin.org/fileadmin/contents/products/aktuell/2019A05_job.pdf (Accessed on April 18, 2019), pp. 7-8.

According to Voelsen, the last option would lead to a stronger European role in digitalization and increase cyber security. However, it would also cause much higher costs for businesses and consumers to exclude non-European vendors and delay the network expansion timeline. Plus, Beijing's as well as Washington's reaction might end up in retaliatory measures. Yet Volsen asserts that a homogenous approach of EU member states appears unlikely and hence, he argues that they are more likely to split up over the other two options.[45] Groll and Johnson argue that the reason why the EU finally opted against it and why many of its member states using Huawei equipment in 4G are unlikely to follow the American lead is that "it would be too costly to switch horses in midstream."[46] As has been outlined above, the strategies of France, the UK and Germany will be central to the European strategic approach and therefore, will be investigated below.[47]

GERMANY

The Federal Republic's government aspires to become a leading market ("Leitmarkt") for 5G applications and puts an emphasis on the robustness of its digital infrastructure as well as on broad area coverage.[48] Its 5G strategy includes: (i) accelerating 5G rollout, (ii) providing needs-based frequencies, (iii) facilitating cooperation between telecommunication and application industry, (iv) coordinated and targeted research and (v) early initiation in cities and communities.[49] For this purpose, the government has dedicated €80 million for 5G Research and Development and €100 billion to invest in high-performance broadband such as 5G or fiber.[50]

Berlin started its 5G-Initiative in fall 2016 and aims for full rollout until 2025 which is supposed to cover all major German cities as well as all major traffic routes. In total, this would cover around 30 percent of German network coverage.[51] Moreover, the commercial launch is expected to take place in late 2020. Its frequencies are supposed to accord with those used throughout Europe and furthermore, it supports the harmonized 5G spectrum that were and will be set by the World Radio Communication Conferences

45 Cf. Voelsen, Daniel: 5G, Huawei und die Sicherheit unserer Kommunikationsnetze. Handlungsoptionen für die deutsche Politik, in: SWP-Aktuell 2019/A, Februar 05, 2019, https://www.swp-berlin.org/fileadmin/contents/products/aktuell/2019A05_job.pdf (Accessed on April 18, 2019), p. 8.

46 Groll, Elias; Johnson, Keith: The Improbable Rise of Huawei. How did a private Chinese firm come to dominate the world's most important emerging technology?, in: Foreign Policy, April 3, 2019, https://foreignpolicy.com/2019/04/03/the-improbable-rise-of-huawei-5g-global-network-china/ (Accessed on April 18, 2019).), p. 6.

47 The chapter "Dueling Stories: Narratives in 5G Discourse" of this study discusses this in depth and therefore this question will be further left to the appropriate chapter.

48 Cf. Bundesministerium für Verkehr und digitale Infrastruktur: 5G-Strategie für Deutschland. Eine Offensive für die Entwicklung Deutschlands zum Leitmarkt für 5G-Netze und Anwendungen, 2017, https://www.bmvi.de/SharedDocs/DE/Publikationen/DG/098-dobrindt-5g-strategie.pdf?__blob=publicationFile (Accessed on April 23, 2019), p. 2, 12.

49 This is a summarised translation of its proposed measures: "(1) Netzrollout forcieren; (2) bedarfsgerechte Bereitstellung von Frequenzen; (3) Kooperationsförderung von Telekommunikations- und Anwenderindustrien; (4) koordinierte und gezielte Forschung; (5) frühzeitige Initiierung von 5G in Städten und Kommunen."Cf. Bundesministerium für Verkehr und digitale Infrastruktur: 5G-Strategie für Deutschland. Eine Offensive für die Entwicklung Deutschlands zum Leitmarkt für 5G-Netze und Anwendungen, 2017, https://www.bmvi.de/SharedDocs/DE/Publikationen/DG/098-dobrindt-5g-strategie.pdf?__blob=publicationFile (Accessed on April 23, 2019), p. 13.

50 Cf. Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 58.

51 Cf. Fuest, Klaus et al: Erfolgsfaktor 5G. Innovationen und Vielfalt für die nächste Stufe der Digitalisierung, 2018, https://www.rolandberger.com/de/press/Neuer-Mobilfunkstandard-5G-Schlüsseltechnologie-für-den-StandortDeutschland—.html (Accessed on March 25, 2019), p. 27.

2015 and 2019.[52]

Although they consider Germany to have achieved an early lead for already awarded spectrum for mobile use and approve its 5G spectrum roadmap, Abecassis et al. put the country only in the midfield when it comes to the auctions of spectrum in 3.4-3.8 GHz. Moreover, they noticed that the auctions of higher frequencies were held rather late.[53] In the Federal Republic, a successful auction requires the purchaser to fulfil certain supply requirements on households, railways and the construction of 500 base stations with 50 respectively 100 Mbit/s by 2022.[54] In 2019, the auction on 2GHz and 3.4-3.7 GHz spectrum was held in Mainz, where the four competing Network Operators Drillisch Netz AG, Telefónica Germany GmbH & Co. OHG, Telekom Deutschland GmbH und die Vodafone GmbH had bid over €5.6 billion for those frequencies as was the stand of the 286th round.[55]

Thus, Germany's strategy relies on working within the EU framework and on frequency harmonization with those pursued by the other 5G leaders. Although it is well-positioned in spectrum, Germany's short-term prospects make it appear to not quite be able to keep up with the 5G frontrunners. Moreover, Berlin watches closely what steps these frontrunners will take and is likely having to experience pressure from Beijing and Washington regarding the Huawei case. This might require the government to distance itself from one of the two and could complicate its potential obligation to adapt to the 5G winner in a later stage of this strategic competition. While having reservations about Huawei in critical infrastructure, the German government seems unlikely to entirely side with the US position and exclude Chinese vendors outright.[56]

UNITED KINGDOM

Its government called it the UK's ambition to "be a global leader in 5G"[57] and this emphasizes the role Britain claims for itself in the 5G race. For this purpose, London sees three outcomes as central to the success of its strategy. This includes "accelerating the deployment of 5G networks; maximising the productivity and efficiency benefits to the UK from 5G; and creating new opportunities for UK businesses at home and abroad,

52 Cf. Bundesministerium für Verkehr und digitale Infrastruktur: 5G-Strategie für Deutschland. Eine Offensive für die Entwicklung Deutschlands zum Leitmarkt für 5G-Netze und Anwendungen, 2017, https://www.bmvi.de/SharedDocs/DE/Publikationen/DG/098-dobrindt-5g-strategie.pdf?__blob=publicationFile (Accessed on April 23, 2019), p. 8.

53 Cf. figures 6.8 and B.16 by: Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 64, B24.

54 Cf. Demary, Vera; Rusche, Christian: Zukunftsfaktor 5G. Eine ökonomische Perspektive, IW-Report 45/18, November 16, 2018, https://www.iwkoeln.de/fileadmin/user_upload/Studien/Report/PDF/2018/IW-Report_2018-45_Zukunftsfaktor_5G.pdf (Accessed on April 11, 2019), p. 4.

55 Cf. Bundesnetzagentur: Frequenzauktion 2019 - Frequenzen für 5G, May 07, 2019, https://www.bundesnetzagentur.de/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Frequenzen/OeffentlicheNetze/Mobilfunknetze/mobilfunknetze-node.html (Accessed on May 07, 2019).

56 Cf. Bundesministerium für Verkehr und digitale Infrastruktur: 5G-Strategie für Deutschland. Eine Offensive für die Entwicklung Deutschlands zum Leitmarkt für 5G-Netze und Anwendungen, 2017, https://www.bmvi.de/SharedDocs/DE/Publikationen/DG/098-dobrindt-5g-strategie.pdf?__blob=publicationFile (Accessed on April 23, 2019), p. 12;Cf. Kleinhans, Jan-Peter: 5G vs. National Security. A European Perspective, Stiftung Neue Verantwortung, February 2019, https://www.stiftung-nv.de/sites/default/files/5g_vs._national_security.pdf (Accessed on April 03, 2019), pp. 4, 18;Cf. Tagesschau: Merkel gegen Ausschluss von Huawei, 2019, https://www.tagesschau.de/ausland/huawei-5g-105.html (Accessed on March 27, 2019).

57 Department for Digital, Culture, Media and Sport and HM Treasur: Next Generation Mobile Technologies: A 5G Strategy for the UK, 2017, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/597421/07.03.17_5G_strategy_-_for_publication.pdf (Accessed on March 20, 2019), p. 6.

and encouraging inward investment."[58]

This stresses an output-orientated approach aiming at a fast rollout with vastly increased numbers of transmitters and implies a preference for the private sector. The framework behind Britain's 5G strategy focuses on the following five key points: (i) developing a future-focused spectrum policy, (ii) examining existing regulatory frameworks for its 5G adequacy, (iii) its Future Telecoms Infrastructure Review, (iv) setting up a cross-government barrier busting task force to address specific challenges related to the deployment of telecoms infrastructure, (v) concentrating on the local level's need for 5G deployment.[59] As a result and in accordance with the ones discussed above, the UK's 5G strategy relies on making needs-based spectrum available, a timely and efficient network extension. Additionally, this includes broad area coverage by specifically addressing local needs. In comparison to the US or China, the British strategy takes using existing 4G networks and cooperation with local governments into greater account.

Ofcom has planned auctions for the entire spectrum of frequencies mainly throughout 2018 and 2019.[60] In this respect, the UK has been part of the chasing pack with, for instance, third and fourth places in the various spectrum categories.[61] While the 2.3 GHz and 3.4 GHz bands were already auctioned in April 2018, the 3.6GHz to 3.8GHz bands are the frequencies Ofcom will probably auction next.[62] Moreover, there may be more auctions to come "as Ofcom has identified the 26GHz band (24.25-27.5GHz) as the next priority for global harmonisation, which, along with the 37-43.5 and 66-71GHz bands, and potentially also the 32GHz (31.8 – 33.4GHz) band, it plans to put forward for use at WRC-19 (World Radiocommunications Conference 2019)."[63]The commercial launch in Britain is supposed to take place in 2020 and the full rollout five years later. Accordingly, it is planned that all major city centers and roads as well as many of the country's railways are covered by 2025 at the latest.[64] These dates can be assessed as average forecasts in the 5G race though the front tier starts a year earlier. While 5G coverage is already underway, the UK will still heavily rely on 4G for widespread area coverage in the 2020s.[65] In financial terms, the UK dedicated £740 million to 5G and full fiber and the 2017 budget contained an investment of £160 million in associated infrastructure.[66] To provide a modern and extensive infrastructure for 5G extension Dohler et al. suggest the utilization of public street furniture and fiber sharing as well as clearer and more permissible regulation. Plus, they stress the urgency of skill development regarding 5G.[67]

58 Department for Digital, Culture, Media and Sport and HM Treasur: Next Generation Mobile Technologies: A 5G Strategy for the UK, 2017, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/597421/07.03.17_5G_strategy_-_for_publication.pdf (Accessed on March 20, 2019), p. 8.

59 Cf. Department for Digital, Culture, Media and Sport and HM Treasur: Next Generation Mobile Technologies: A 5G Strategy for the UK, 2017, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/597421/07.03.17_5G_strategy_-_for_publication.pdf (Accessed on March 20, 2019), p. 5.

60 Cf. Ofcom: Enabling 5G in the UK, March 09, 2018, https://www.ofcom.org.uk/__data/assets/pdf_file/0022/111883/enabling-5g-uk.pdf (Accessed on April 24, 2019), pp. 3-4.

61 Cf. figures 4.1, 4.5, 4.7 and 4.16 by Abecassis et al. 2018: 27, 31, 33, 40.

62 Cf. Kavanagh, Sacha: 5G UK auction, January 21, 2019, https://5g.co.uk/guides/5g-uk-auction/ (accessed on May 07, 2019).

63 Kavanagh, Sacha: 5G UK auction, January 21, 2019, https://5g.co.uk/guides/5g-uk-auction/ (accessed on May 07, 2019).

64 Cf. Department for Digital, Culture, Media and Sport and HM Treasur: Next Generation Mobile Technologies: A 5G Strategy for the UK, 2017, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/597421/07.03.17_5G_strategy_-_for_publication.pdf (Accessed on March 20, 2019), Treasury 2017b, pp. 5, 10.

65 Cf. Department for Digital, Culture, Media and Sport and HM Treasury: Next Generation Mobile Technologies: A 5G Strategy for the UK, 2017, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/597421/07.03.17_5G_strategy_-_for_publication.pdf (Accessed on March 20, 2019), p. 14.

66 Cf. Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 58.

67 Cf. Dohler, Mischa; Rosas, Maria Lema; Kleinman, Mark: How government can drive 5G innovation, King's College London, 2018, https://www.kcl.ac.uk/policy-institute/assets/5g-innovation.pdf (Accessed on April 03, 2019), p. 1.

Kleinhans considers certain UK's cyber security measures such as the cooperation of the UK National Cyber Security Center (NCSC) with Huawei as exemplary, while the Center has also "established limitations on how Huawei equipment can be deployed and operated."[68] Among other reasons this was done due to previous experiences with cyber espionage and to increase confidence in the government's handling of such cases. The government commitment and its roadmap stand out, while Abecassis et al. classify the industry commitment and the commercial 5G launch as under-average. Hence, the UK's position in the 5G race is rather based on the government's efforts, while the private sector is falling short of expectations and slows the countries' general performance down. To compete in the 5G race the UK will need to fill this gap by encouraging and achieving stronger industry commitment as well as accelerating the 5G roll-out. Potentially, the UK could end up in an awkward position between China, the US and the EU and thus, will have to carefully balance between them to maintain and maybe extend its position in the 5G race.

FRANCE

The French 5G objectives are (i) to launch several 5G pilot projects in 2018, (ii) to host the world's first 5G applications in industrial sectors, (iii) to allocate 5G frequencies by 2020 and launch the commercial rollout in at least one major city and (iv) to achieve 5G coverage of all major transport routes by 2025.[69] In comparison to the strategies discussed above, this might be a plan led less by ambition and more by feasibility. While the plans for spectrum between 3 and 24 GHz are most advanced, Abecassis et al. call the "[p]lans for other bands […] less developed"[70] as the start of the trials in eleven places in 2018 indicates.[71] This is particularly the case with frequencies above 24 GHz where there had not been spectrum confirmed for assignment to 5G by early 2018.[72] Instead, the auctions on France's 5G telecoms frequencies were announced by Junior Minister Agnes Pannier-Runacher to start in autumn 2019.[73] This is also underscored by France's readiness which is in the lower part of the middle tier.[74]
Although there is no specific government funding, the government invests in improving

68 Kleinhans, Jan-Peter: 5G vs. National Security. A European Perspective, Stiftung Neue Verantwortung, February 2019, https://www.stiftung-nv.de/sites/default/files/5g_vs._national_security.pdf (Accessed on April 03, 2019), p. 13.

69 Cf. Autorité de régulation des communications électroniques et des postes : 5G. An ambitious roadmap for France, July 16, 2018, https://archives.arcep.fr/fileadmin/reprise/dossiers/programme-5G/Roadmap_5G_-_VA.pdf (Accessed on April 23, 2019), p. 6.

70 Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 55.

71 Cf. Jaffal, Tarek; Manero, Carole; Pujol, Frédéric: 5G Observatory Quarterly Report 3. Up to March 2019, http://5gobservatory.eu/wp-content/uploads/2019/04/80082-5G-Observatory-Quarterly-report-3.pdf (Accessed on April 24, 2019), p. 44;Cf. Autorité de régulation des communications électroniques et des postes : 5G. An ambitious roadmap for France, July 16, 2018, https://archives.arcep.fr/fileadmin/reprise/dossiers/programme-5G/Roadmap_5G_-_VA.pdf (Accessed on April 23, 2019), p. 11.

72 Cf. figure 4.16 by Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 40.

73 Cf. Reuters: France's 5G frequencies auction to start in autumn, minister tells Le Figaro, January 31, 2019, https://uk.reuters.com/article/us-france-telecoms/frances-5g-frequencies-auction-to-start-in-autumn-minister-tells-le-figaro-idUKKCN1PP0LL (Accessed on May 07, 2019).

74 Cf. Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 2.

fiber coverage and thus, aims for long-term infrastructure extension.[75] According to the Autorité de régulation des communications électroniques et des postes (arcep), Operators in France have agreed on a commercial launch in 2020. In addition, its Superfast Broadband Scheme to provide high speed connections by 2022 as well as a best practices guide are further instruments to support network expansion.[76] Area coverage is likely to be less extensive than by other competitors because in contrast to the British or German strategy the French counterpart does not specify to cover all major cities by 2025. Instead and as mentioned above, it determines 5G coverage for the major transport routes and to launch commercial deployment of 5G in at least one major city.[77] Thus, the French agenda is more open and less specific. Moreover, trials and the allocation of spectrum show that the country's strategy is closely aligned with the EU's Action Plan and suggests support for a coordinated European approach.[78] In relation to government commitment and its timeline for 5G deployment, France achieves a similar result to Germany or the UK.[79] Apart from industry commitment and accelerated 5G launch, where its performance is inferior, Abecassis et al. thus consider France's 5G efforts as average and accordingly the country scores slightly worse than Germany or the UK.[80]

In terms of spectrum and rollout, France is likely to be a 5G leader in Europe and along with other member states likely to shape the EU's role in this race. For this purpose, the EU and its coordinated approach will play a major role in Paris' strategy. Yet the area coverage within France, especially outside of major cities and away from major traffic routes, appears not to keep up with other competitors from the top and middle tier. As a result, France will have to accomplish a more extensive rollout than is currently planned to compete successfully in the 5G race. Furthermore, Paris will have to accelerate the deployment of high frequencies in accordance with EU specifications and in coordination with its partners. As in all EU countries in this study, the industry commitment is lower than in the US or China and for this reason, is likely to cause a later 5G rollout, thus decreasing their abilities to effectively create standard power in 5G.

COMPARING 5G STRATEGIES

For further clarification, all the strategies discussed in this segment lead to the following chart, in which the positions of those countries on spectrum, rollout and area coverage will be summarized. Moreover, it covers their preferences on either private or public sector commitment as well as their biggest strategic gap and asset.

75 Cf. figure 6.4 by Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 58.

76 Cf. Autorité de régulation des communications électroniques et des postes: 5G. An ambitious roadmap for France, July 16, 2018, https://archives.arcep.fr/fileadmin/reprise/dossiers/programme-5G/Roadmap_5G_-_VA.pdf (Accessed on April 23, 2019), pp. 11-12, 16.

77 Cf. Autorité de régulation des communications électroniques et des postes: 5G. An ambitious roadmap for France, July 16, 2018, https://archives.arcep.fr/fileadmin/reprise/dossiers/programme-5G/Roadmap_5G_-_VA.pdf (Accessed on April 23, 2019), p. 6.

78 Cf. Autorité de régulation des communications électroniques et des postes: 5G. An ambitious roadmap for France, July 16, 2018, https://archives.arcep.fr/fileadmin/reprise/dossiers/programme-5G/Roadmap_5G_-_VA.pdf (Accessed on April 23, 2019), p. 12.

79 Cf. figure 6.7 by Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. 63.

80 Cf. figure B.12 by Abecassis, David; Nickerson, Chris; Stewart, Janette: Global race to 5G – Spectrum and infrastructure plans and priorities. Final Report for CTIA, 2018, https://www.ctia.org/the-wireless-industry/the-race-to-5g (Accessed on February 22, 2019), p. B-18.

This chart reflects the segment above and summarizes their position concerning spectrum, rollout and area coverage. On public or private sector preferences China and the US can be considered the different poles whereas the European powers use mixed approaches. While China's asset is its government dedication and for the US its leadership in 4G, the European powers have less decisive ones: German leadership in sub-3GHz spectrum, Britain's Cyber Security and France's alignment of its strategy with the harmonization efforts of the EU. The biggest gaps in the 5G race consist of China's average timeline, the US lack of available spectrum between 3 and 24 GHz, Germany's as well as Britain's lack of industry commitment and France's absence of specific 5G funding. With all these results compared, it again becomes clear why China is leading the 5G race. This is primarily the case due to its high degree of strategic thinking, as Beijing made 5G a strategic priority, to which the government dedicated itself. By contrast, the US reliance on the private sector currently appears not to lead to the same positive results as the approach did with 4G, where the country accomplished global leadership. Fewer spending, more short-term planning and much more competition have contributed to this development and reverberate an upper intermediate level of strategic thinking. In comparison, the UK and Germany lack the commitment of their telecommunication sectors. Since they plan well without excelling in this, their degree of strategic thinking

5G strategies

	China	USA	Germany	United Kingdom	France
Spectrum Provision	Wide-ranging	Wide-ranging but not in	Upper intermediate	Upper intermediate	Lower intermediate
Roll out	Launch in 2020 and broad coverage by 2025	Launch in 2019 and broad coverage by 2025	Launch in 2020 and broad coverage by 2025	Launch in 2020 and broad coverage by 2025	Launch in 2020 and broad coverage by 2025
Area Coverage	Vast	Upper intermediate	Intermediate	Intermediate	Lower intermediate
Reliance on Public or Private Sector	Public	Private	Mixed	Mixed	Mixed
Biggest Asset	Government dedication	4G Leadership	Lead in sub-3GHz spectrum	Cyber Security	EU Harmonization
Biggest Gap	Launch in 2020	Lack of available spectrum between 3 and 24 GHz	Industry commitment	Industry commitment	No specific funding for 5G
Degree of strategic thinking	High	Upper intermediate	Intermediate	Intermediate	Lower intermediate

Source: CGS 2019 based on the 5G strategies of these countries

can be considered as intermediate. In the three main criteria for 5g strategies, France does a little worse than the other European powers. As this graph and particularly the absence of specific funding for 5G demonstrates, France general performance indicates also a smaller level of strategic thinking.

The race to 5G is often viewed as "an uphill battle".[81] In this regard, the US and China are trying to take the first place, or rather strive for the upper hand in the standard-setting process. Since standardized technologies such as LTE, Wi-Fi, NEC, RFID or Bluetooth will strongly contribute to the upcoming technological revolution of the Internet of Things (IoT),[82] the battle for 5G primarily appears in the development of 5G standards.

Standards rely on technical contributions, containing patented technologies that are known as Standard Essential Patents (SEPs). Before implementing a technology within the wireless standard, companies disclose their own patents to standardization organizations in each country or region as SEPs, which is an important part of the standards development process. The majority of declared SEPs has significant market value and mean lucrative royalty fees which not only stand for strong competitiveness in the communications industry, but also worldwide leadership in the new 5G era.

3. WHO ARE THE 5G IPR LEADERS?
THE IMPORTANCE OF PATENTS

According to the Intellectual Property Right (IPR) Policy of the European Telecommunications Standards Institute (ETSI), IPR can be interpreted as "any intellectual property right conferred by statute law including applications therefor other than trademarks. For the avoidance of doubt rights relating to get-up, confidential information, trade secrets or the like are excluded from the definition of IPR."[83] Actually, 5G IPR is not clearly defined, only some special rights have been excluded.

A total of 25 independent 5G patent-owned companies from different countries are participating in the global race for 5G SEP. There are four Chinese companies accounting for 35.51% of the total 5G SEPs...

Intellectual Property Right (usually a patent) is or may become essential to fulfill a technical standard, as standardization can be crucially influenced by patents stimulating development and research and encouraging the transfer of knowledge.[84] Companies wanting to provide 5G services and technologies must use many patents that conform to these standards. Each company is required to submit IPR declarations to the standardization bodies of each country or region.[85] For example, if a non-European company A sells a product containing the patent of company B in Europe, company A must pay patent fees to company B. The premise is that company B has declared its product in ETSI which mainly standardizes telecommunication technologies. If company B wants to sell its products in the US, it also has to declare the patent in the standardization organization in the US, namely the United States Patent and Trademark Office (USPTO). In order for their patents application to be adopted as SEPs, the owners of these patents will take part in the development of the standard-setting and try to persuade the standardization organization to use their technology concerning these patents as standards, so they can occupy the market by the patent application. While they are asked to declare these patents to the standardization organization in time and obliged to license them on fair,

81 Paez, Danny: Why the US must beat China in the race to 5G internet, in: Inverse, August 21, 2018, https://www.inverse.com/article/48228-why-china-is-winning-the-race-with-the-us-to-5g-internet (Accessed on February 26, 2019).

82 Cf. Pohlmann, Tim; Blind, Knut: Landscaping study on Standard Essential Patents (SEPs), IPlytics GmbH and Technical University of Berlin, 2017, https://www.iplytics.com/wp-content/uploads/2017/04/Pohlmann_IPlytics_2017_EU-report_landscaping-SEPs.pdf (Accessed on April 18, 2019).

83 ETSI: Intellectual Property Rights (IPRs), https://www.etsi.org/intellectual-property-rights (Accessed on February 23, 2019).

84 Cf. European Commission: Industry. Patents and Standards, https://ec.europa.eu/growth/industry/intellectual-property/patents/standards_en (Accessed on March 12, 2019).

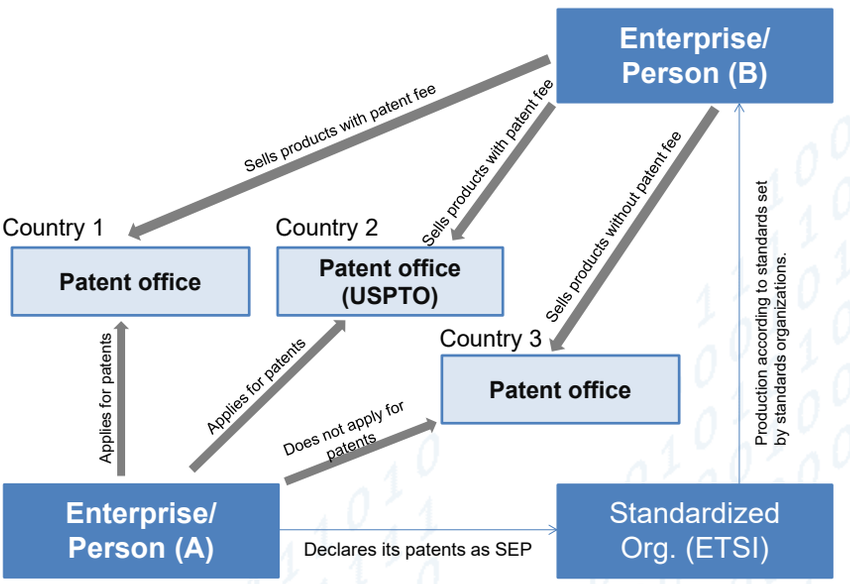
85 Cf. Cyber Creative Institute: Application trend of ETSI standard essential patent (5G-SEP) candidates contributing to realization of 5G and proposal trend of contributions for standards, February 06, 2019.

reasonable, and non-discriminatory (FRAND) terms.[86]

The cellular wireless industry adopts the patent sharing model that can make Intellectual Property (IP) licensing the driving force behind each new generation of cellular technology.[87] Hence, IP holders typically recoup their R&D investment and licenses through SEP royalty income and seek to improve their existing standards for more SEPs, while the companies that lag behind since the previous generations expect to actively take part in the development technologies for standards and contribute to standardization. 3G and 4G patent owners make profit from their licensing programs of mobile technologies in the smartphone industry. After 4G LTE networks had been launched, the US was the first country to make 4G available on a wide scale and thus American firms made great profits by selling the resulting apps globally.[88]

Another typical example is Nokia. Although Microsoft bought Nokia's phone business in a US$7.2 billion bid in 2013, Nokia holds a significant share of essential patents relating to GSM, 3G radio and 4G LTE and therefore Nokia can earn very high margins in IP licensing revenues every year. In mid-2017, Apple paid Nokia around US$2 billion

Process of Corporate Patents and Standarts



Source: CGS 2019

to settle their IP dispute. This example clearly demonstrates that owning patents plays an important role in telecommunication and provides a thorough grounding in setting the standard leading to 5G development and innovation.

This feature – the patent sharing model – determines the high relevance of the declared SEPs, "which is most probably connected to the increasing importance of future

86 Cf. Layne-Farrar, Anne; Padilla, A. Jorge; Schmalensee, Richard: Pricing Patents for licensing in Standard-Setting Organizations: Making Sense of FRAND Commitments, in: Antitrust Law Journal, Vol. 74, No. 3, 2007, p. 671.

87 Cf. McGregor, Jim; Tirias Research: 5G IP leadership – It's too late to determine, in: Forbes, December 01, 2018, https://www.forbes.com/sites/tiriasresearch/2018/12/01/5g-ip-leadership-its-too-early-to-determine/#2ff416b62126 (Accessed on February 27, 2019).

88 Cf. Woyke, Elizabeth: China is racing ahead in 5G. Here's what that means, in: MIT Technology Report, December 18, 2018, https://www.technologyreview.com/s/612617/china-is-racing-ahead-in-5g-heres-what-it-means/ (Accessed on April 18, 2019).

technological solutions that depend on interconnectivity and compatibility of different systems working together (e.g. 4G, 5G, IoT)".[89] It further demonstrates the commercial value of the existing SEPs. With the importance of 5G standards to the global market, many companies are actively participating in the development of the 5G standard in recent years.

Currently, Chinese companies are in a narrow lead in the race to 5G SEPs and make Chinese 5G technology in practice indispensable. We found out that a shift from US-American, Japanese and European SEP holders to Chinese and Korean ones is taking place quickly and tending upwards.

THE 5G PATENT RACE

According to the WIPO, global intellectual property filing activities set new records in 2017 and reached 3.17 million, representing a 5.8% growth compared to the previous year. China remained the main driver of global growth in IP filings and China's shares of global patent filings reached 43.6%. Japan and the US experienced no growth in patent filings.[90] Considering that the 5G technology owns market potential and revolutionary meaning for the world, the participation in the development of the 5G standards by an even broader range of companies is much higher compared to previous generations.[91] The number of 5G-related SEPs has increased sharply. According to analysts of IPlytics[92] in January 2019, the top eleven patent holders of declared 5G SEPs are respectively Huawei (1529), Nokia (1397), Samsung (1296), ZTE (1208), Ericsson (812), QUALLCOMM (787), LG (744), Intel (550), CATT (545), Sharp (468) and Oppo (118).[93] A total of 25 independent 5G patent-owned companies belong to different countries. There are four Chinese companies (Huawei, ZTE, CATT and Oppo) accounting for 35.51%. In South Korea, three companies (Samsung, LG and KT) possess a total of 21.42% (2051). Regarding the US, five companies (QUALCOMM, Intel, InterDigital, Apple and Optis) take up 14.29%. Japanese companies (Sharp, Fujitsu, Sony and NEC) hold 5.3% of the total 5G SEPs. European companies such as Nokia from Finland, Ericsson from Sweden, Innovative Technology from the UK and Sisvel from Italy, occupy 23.1% 5G SEPs in total.

The data shows that Chinese companies are in a leadership position in 5G patents , which means they can obtain big SEP royalties once 5G is widely implemented and used just as Nokia is doing today from his previous 2G, 3G and 4G patents. However, it cannot be directly concluded that China has a leadership position in 5G, since not all patents are of equal value, even if they are focused on the same technologies.[94] It is instead about the features of the SEPs. We can imagine the SEP system as a tree: There are tree trunks, branches and leaves and while all are important parts of the tree, they have different functions and values. Different SEPs have various functions and values. One SEP as a core technology may be a critical part for the 5G specification that seems like a 'tree

89 Pohlmann, Tim; Blind, Knut: Landscaping study on Standard Essential Patents (SEPs), IPlytics GmbH and Technical University of Berlin, 2017, https://www.iplytics.com/wp-content/uploads/2017/04/Pohlmann_IPlytics_2017_EU-report_landscaping-SEPs.pdf (Accessed on April 18, 2019).

90 Cf. WIPO (World intellectual property Organization): World intellectual property Indicators 2018, Geneva 2018, https://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2018.pdf (Accessed on April 18, 2019).

91 Cf. ibid.

92 IPlytics is a Berlin based company that offers an online-based market intelligence tool (IPlytics Platform) to analyze technology trends, market developments and a company's competitive position. The IPlytics Platform provides access to over 80 million worldwide patent documents, 2 million worldwide standard documents and over 200,000 declared standard essential patents (Source: IPlytics website and Pohlmann/Blind, p. 61).

93 Cf. Kampus, Kristo: Who is leading the 5G patent race? Analysis on declared standard essential patents, 3GPP contributions and attendance data, in: IPLytics Report, January 29, 2019, https://www.iplytics.com/de/report-de/who-is-leading-the-5g-patent-race/ (Accessed on February 25, 2019).

94 Cf. McGregor, Jim; Tirias Research: 5G IP leadership – It's too late to determine, in: Forbes, loc. cit.

trunk'. There might be dozens of smaller elements of this core technology.[95] Both serve as one SEP that are not equal in technical and economic values. Therefore, the possibility cannot be excluded that companies may overestimate and thus over-declare the number of essential patents they own. In addition, declarations as standard essential patents are carried out by each company's own judgment. It is very difficult to evaluate whether they are truly mandatory standards.[96] Furthermore, standardization organizations expect many patent applications and will not raise thresholds for SEPs declarations owing to an amount of patent protection fees each year from the companies. Lacking an official review process for SEP declaration, the open disclosure policy in ETSI may generate an

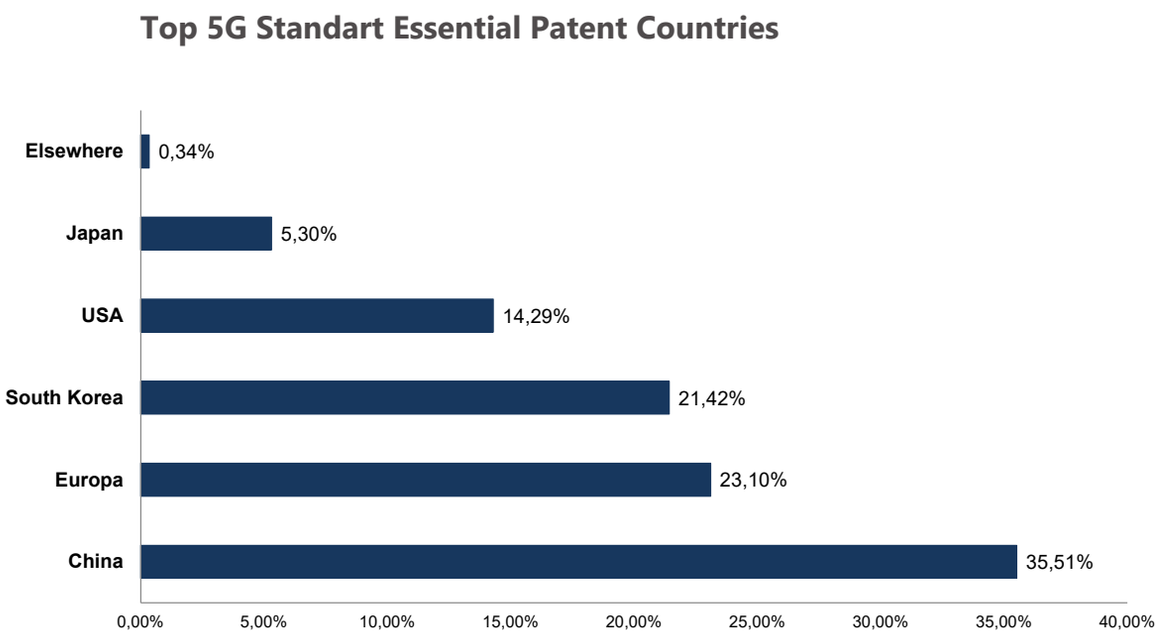


Table source: CGS 2019 based on data from IPlyrics.

over-declaring of SEPs with different qualities.[97]

In order to define the leader in the race to 5G, it is necessary to consider the companies' technical contributions to 5G technology. The IPlyrics platform indicates that Huawei, Ericsson, HiSilicon, Nokia and Qualcomm have made large technical contributions to 5G technology.

The data of both the number of Chinese companies on the list and their contributions to 5G standards reveals a huge advantage for China. Apart from technical contributions, IPlyrics has chosen the attendance of engineers at the standards-setting meetings to measure the current status of the global race to 5G. Patent applications are usually also included in a company's patent portfolio, which is defined as a collection of related patents owned by a single entity. We can imagine a patent portfolio as the entirety of leaves on a trunk or a branch. A cluster of patents makes it more difficult for other companies to bypass the patent portfolio. As a result, a company owning a wide patent portfolio is more likely to get a market monopoly position and more revenue from licensing intellectual property. Besides the monetary benefits, the portfolio holder can obtain the strategic advantages of defending it against rival portfolio holders and encouraging investment. If we take measure of 5G patent portfolios, Qualcomm, Huawei, LG Electronics, Ericsson

95 Cf. ibid.

96 Cf. Cyber Creative Institute: Application trend of ETSI standard essential patent (5G-SEP) candidates contributing to realization of 5G and proposal trend of contributions for standards, loc. cit.

97 Cf. McGregor; Tirias Research: 5G IP leadership – It's too late to determine, loc. cit.

and Samsung own the largest 5G SEP portfolios.[98] Though companies such as Alcatel-Lucent, Sharp, Panasonic, BlackBerry, Apple and InterDigital do not belong to the top 5G standard contributors, they also hold great 5G SEP portfolios.
Table source: IPlyrics.[99]

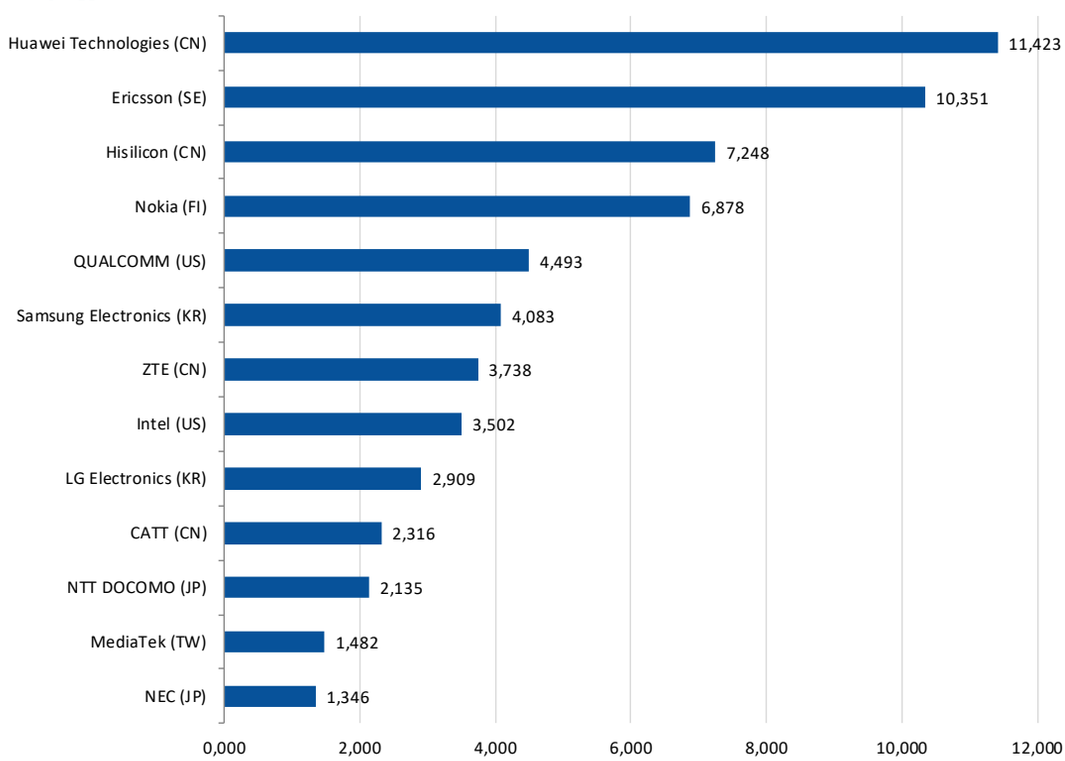
The real number of 5G SEP registrations of a company, the technical contributions of the 5G standard as well as the 5G patent portfolios provide a glimpse of the 5G patent landscape and help us to monitor which company will become the strongest IP owner for 5G SEPs for the upcoming years.[100] Since a common specification of 5G standards can easily interconnect different systems and communication across multiple devices in reality. Patent application is a key step to exploit and develop the market.

Although the SEP and the 5G Standard contributions are not the best way to measure the 5G patent race, they are still the most objective and important indicator to this day. Owning the highest number of SEPs is definitely the key factor in order to establish 5G leadership.

THE LEADER OF 5G STANDARD PATENTS

The IPlytics report on landscaping SEPs 2016 shows the shift of SEP holders. Some

5G Standart Contributions per Company



big European patent holders such as Nokia, Ericsson or Siemens still declare a large amount of SEP families. Meanwhile, many SEPs from US and Asian companies such

98 Cf. Pohlmann, Tim: Industry report – who will be the technology leader for 5G? Part two, in: iam, July 18, 2018, https://www.iam-media.com/who-will-be-technology-leader-5g-part-two (Accessed on March 01, 2019).

99 Cf. Kampus: Who is leading the 5G patent race?, loc. cit., p. 5.

100 Cf. ibid.

as Qualcomm, InterDigital, Samsung, Huawei, Google and LG were filed in Europe.[101] In terms of particular technologies such as GSM, UMTS and LTE, the number of Asian applicants increased in the mid-2000s. Furthermore, the analysis of the age of SEP portfolios owned by companies indicates a shift of rights holders from the US, Japanese and Europe to China, Korea and Taiwan. [102]

The reason why China holds a narrow lead in the race to 5G SEPs is that China attaches great importance to the strategic position of 5G, and the government is vigorously promoting the development of 5G technologies, standards and industries. While European telecommunication companies lack such characteristics, they employ different strategies than companies with 5G SEP. Huawei has invested a large amount of money into research on 5G wireless networks and patenting key technologies, employed many experts from abroad to set technical standards for 5G and teamed up with many companies and universities to make 5G a reality.[103] The traditional patent winner Nokia is also safeguarding a position in the race to 5G and is developing, researching and cooperating with other entities to render 5G communications as fast as possible.[104] Ericsson, another European company, owns expertise in the 5G domains and has already performed several trials by collaborating with domestic vendors. The American company Qualcomm, the most active company in 5G patent filing, focuses on building 5G products. The US Telecom deployed smart policies to provide 5G to US consumers and is building modern infrastructure all over the country. Although European telecommunication companies are on the list of the 5G SEPs owners, they lag behind China that builds infrastructure for the Chinese mobile operators and America that makes "the commercial investments and preparations necessary for 5G deployment".[105] These companies are ready for 5G and hope not only to be 5G technical leaders, but also the leaders in the total race to 5G. In an interview with Inverse, Chunyi Peng, a mobile networks researcher from Purdue University, clarifies the race to 5G Internet. According to Peng, it will not make a big difference if a country occupies the first or second place, but it will make a difference if a country lags behind too much.[106] While 5G is beginning to take shape, China, South Korea, the US and European countries try to keep pace with the pioneers in the race to 5G and are ready to deploy 5G and launch 5G commercial services. In comparison to government sectors, companies usually possess an acute insight into the market and revolutionary technology. Similarly, the promotion of the 5G strategy requires close communication and cooperation between the government and enterprises.

Compared to the technological structure of 2G, 3G and 4G, the technological structure for the next generation of wireless communication technology is changing rapidly with a fierce competition. In this regard, the IP race plays a very important role in the 5G era and the great power competition, which influences the development of the national strategy, serves as a key factor for the development of new markets and as one way to measure innovation as well as leads the implementation of the operator.

101 Cf. Pohlmann, Tim; Blind, Knut: Landscaping study on Standard Essential Patents (SEPs), loc. cit., p. 18.

102 Cf. ibid.: pp. 26-27.

103 Cf. GreyB: 5G Market Research: What are the top players upto?, in: IP Analytics, August 21, 2018, https://www.greyb.com/companies-working-on-5g-technology/ (Accessed on February 29, 2019).

104 Cf. ibid.

105 Ibid.

106 Cf. Paez, Danny: Why the US must beat China in the race to 5G internet, loc. cit.

THE FIGHT OVER 5G STANDARDS

As discussed in the previous section, patents provide sufficient conditions for standardization, because a standard consists of a large number of innovations protected by patents. Technology standards represent a set of rules and regulations to ensure "the interoperability between products" and "the rapid diffusion of technologies" while contributing to industrial innovation and competitiveness.[107]

During the standardization process, the participants forfeit their IP rights when contributing a technology to the standards within formal standard-setting organizations (SSOs). Accordingly, some standards organizations produce open standards that can be accessed by all manufacturers who may need a license from owners of IPR. Thus, standards can be easily controlled by a single firm or a group of firms.[108] Consequently, standards are viewed as Power, or rather "Standard Power" which shapes a new geopolitical battle.[109] It may be argued that leading 5G standards is a key factor to win the global race for 5G.

4. STANDARDS BODIES AND THE STANDARDS SETTING PROCESS OF THE 5G

According to a popular proverb in Chinese business circles "third tier companies make products; second tier companies make technology; first tier companies make standards". This widely spread saying reflects China's prevailing view of technology standards.[110] Especially, owing to the rising speed of technology advancement and product updating, the mobile telecommunications industry heavily relies on standardization. Regarding the increased bandwidth and faster speed of 5G, accompanied with its potential opportunities for economic growth and new jobs, the race for 5G is a competition to extend the influence in the standard-setting process, or rather gain dominance amongst standards bodies such as the 3rd Generation Partnership Project (3GPP) and International Telecommunications Union (ITU).

In the fight over the 5G standards, the 3GPP und ITU serve as a "major political arena".[111] Almost all major players in the telecommunication industry are involved in developing the 5G standard and standards bodies. 3GPP is a key standardization body for global mobile communication systems and consists of seven regional telecommunication associations

107 Cf. European Commission: Industry. Patents and Standards, https://ec.europa.eu/growth/industry/intellectual-property/patents/standards_en (Accessed on March 23, 2019).

108 Cf. Baron, Justus; Gupta, Kirti; Roberts, Brandon: Unpacking 3GPP standards, Working paper, March 24, 2015, https://www.law.northwestern.edu/research-faculty/searlecenter/innovationeconomics/documents/Baron_Gupta_Unpacking_3gpp_Standards.pdf (Accessed on March 25, 2019).

109 Cf. Bishop, Andrew D.: Standard Power: The New Geopolitical Battle, in: The National Interest, October 07, 2015, https://nationalinterest.org/feature/standard-power-the-new-geopolitical-battle-14017 (Accessed on February 22, 2019).

110 Cf. Brake, Doug: Economic Competitiveness and National Security Dynamics in the Race for 5G between the United States and China, in: ITIF (Information Technology and Innovation Foundation), August 2018, p. 14.

111 Lee, Edison; Chau, Timothy: Telecom Services. The Geopolitics of 5G and IoT, Jefferies Franchise Note, September 14, 2017, https://www.jefferies.com/CMSFiles/Jefferies.com/files/Insights/TelecomServ.pdf (Accessed on April 03, 2019), p. 1.

(ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC)[112] as primary members and a variety of other organizations as associate members. Aside from these regional standards bodies, which are called Organizational Partners, the industry alliances, which are called Market Representative Partners, take also part in the 3GPP. Meanwhile, individual operators and equipment manufacturers, as members of those regional standards bodies and/or industry alliances, are essential to develop new cellular technology in the 3GPP.[113]

There are three Technical Specification Groups (TSGs) in 3GPP: Radio access networks (RANs), Services and Systems Aspects (SA), and Core Network and Terminals (CT)[114], which include 16 Project Co-ordination Groups (PCG)[115]. All members in 3GPP possess diverse interests and preferences and take efforts to influence the decisions concerning technical specifications for cellular technology. If no consensus on a specification is reached, the chairman of each project group plays a significant role in the control, coordination and supervision of technical specification.[116] As a result, some countries increasingly focus on leadership positions in 3GPP in order to increase their influence.

After the members of 3GPP have developed and agreed on the technical specifications for cellular technology, 3GPP will submit the results on behalf of its regional standards bodies to the ITU for approval as a global standard.[117] ITU is the specialized United Nations Agency for ICT (Information and Communications Technology) services and technologies promotion, collaboration and standardization and takes over the technology standard development and coordination. It was founded in 1865 to facilitate international connectivity in communications networks in 193 countries, over 800 private-sector entities and academic institutions.[118] If one's product or service requires any kind of international buy-in, one needs to take part in the standardization discussions in ITU'S Telecommunication Standardization Sector (ITU-T).[119] Similar to 3GPP, ITU uses the consensus building approach holding conferences and meetings to develop technical specifications. Therefore, different interest groups in the telecommunication industry, representing their own products standards, continually strive for approval of their preferred specifications in ITU.

The process of standardization is becoming a key locale for the geopolitics of 5G. The standard bodies 3GPP and ITU serve as a major political arena in the fight over the 5G standards. The current status of standardization is the result of the countries' and companies' struggle for power in these bodies.

The companies from countries actively involved in the development of 5G standards attempt to possess or control key resources, markets and directions of development in the field of cellular technology. An effective approach is to possess leadership positions at the standards bodies such as 3GPP und ITU. Companies that receive government support gain a competitive advantage over their competitors in the competition for 5G standards.

For instance, the growing influence of CCSA in 3GPP is closely related to the increasing policy and financial support from the Chinese government. Some companies try to

112 ARIB: Association of Radio Industries and Businesses; ATIS: Alliance for Telecommunications Industry Solutions; CCSA: China Communications Standards Association; ETSI: European Telecommunications Standards Institute; TSDSI: Telecommunications Standards Development Society; TTA: Telecommunications Technology Association; TTC: Telecommunication Technology Committee.

113 Cf. Lee, Edison; Chau, Timothy: Telecom Services. The Geopolitics of 5G and IoT, Jefferies Franchise Note, September 14, 2017, https://www.jefferies.com/CMSFiles/Jefferies.com/files/Insights/TelecomServ.pdf (Accessed on April 03, 2019), p. 40.

114 Cf. 3GPP: About 3GPP, https://www.3gpp.org/about-3gpp (Accessed on March 24, 2019).

115 Cf. 3GPP: Specifications Groups Home, https://www.3gpp.org/specifications-groups/specifications-groups (Accessed on March 24, 2019).

116 Cf. Lee, Edison; Chau, Timothy: Telecom Services. The Geopolitics of 5G and IoT, Jefferies Franchise Note, September 14, 2017, https://www.jefferies.com/CMSFiles/Jefferies.com/files/Insights/TelecomServ.pdf (Accessed on April 03, 2019), p. 41.

117 Cf. ibid.: p. 40.

118 Cf. ITU: About International Telecommunication Union (ITU), https://www.itu.int/en/about/Pages/default.aspx (Accessed on March 25, 2019).

119 Cf. ITU: What does ITU do?, https://www.itu.int/en/about/Pages/whatwedo.aspx (Accessed on March 25, 2019).

manipulate these multiple standards bodies to promote their agendas and dictate their favorite future design of 5G or even 6G, which is beneficial to their domestic companies. Besides, leadership positions at the standards bodies do not only strengthen the companies' or country's international political power but also help to achieve own national interests. Therefore, the process of standardization is becoming a key locale for the geopolitics of 5G. The fight over 5G standards in the standards bodies will be discussed thoroughly in the forthcoming section.

THE COMPETITION FOR 5G STANDARDS

Standardization of 5G started in early 2016. A first step of was the 3GPP Release 15, 5G specifications. The 5G NR specifications for non-standalone (NSA) operations were released in December 2017 which means successful competition is an essential step in 5G standardization. So far, there are three versions in the Release 15: R15 NR NSA, R15 NR SA, and R15 late drop. The completion of SA specifications complements the NSA specifications. A final – the R15 late drop – version of 5G specifications is under development and will be completed three months later than originally scheduled, by March 2019.

The timeline of 5G Standardization directly influences its commercialization. Although the three-month delay may not impact the first 5G deployments, it can reduce the difference in deployment between pioneer and following companies. Some insiders predict that the leading enterprises such as Huawei will lose its leading advantages in 5G due to the delay. By that time, more and more manufacturers will gain more time to develop and deploy 5G. This is why the delay is beneficial for manufacturers such as Apple, which announced to release its 5G mobile phone up until 2020.

The current status of standardization is the result of the countries' and companies' struggle for power, control and influence in 3GPP and ITU. Qualcomm, as an American technology giant , has been holding dominance in global telecommunication standards for decades. In the early days, Qualcomm successfully brought its products, technologies and standards on the Chinese market.[120] However, Huawei has gradually taken the place of Qualcomm as the strongest influence developing the 5G standards setting these days.

China has become an important player in the standard bodies, staying, however, far from the ability to dominate the international 5G standard-setting process. Qualcomm, as an American technology giant, has been holding dominance in global telecommunication standards for decades...

For almost a decade, Huawei has been championing an alternative coding method for 5G data transmission named "polar codes", that is considered a direct challenge to the US-developed coding method "LDPC"(low-density parity check).[121] Qualcomm, Samsung, Nokia and Intel as well as a number of smaller American firms backed LDPC. The 3GPP body decided on the polar coding as the enhanced mobile broadband control channel coding methodology for the 5G New Radio specification.[122] Seen from this angle, Huawei can be viewed as the core contributor to 5G technology.

Recently, Huawei continuously invests in research and development (R&D) and

120 Cf. Ma, Joy Dantong: From Windfalls to Pitfalls: Qualcomm's China Conundrum, in: Macro Polo, November 14, 2018, https://macropolo.org/about/ (Accessed on April 02, 2019).

121 Cf. Sin, Ben: The Key for Huawei, and China, in 5G race is a Turkish Professor, in: Forbes, July 27, 2018, https://www.forbes.com/sites/bensin/2018/07/27/the-key-for-huawei-and-china-in-5g-race-against-the-u-s-is-a-turkish-professor/ (Accessed on April 03, 2019).

122 Cf. Brake, Doug: Economic Competitiveness and National Security Dynamics in the Race for 5G between the United States and China, in: ITIF (Information Technology and Innovation Foundation), August 2018, p. 16.

filed the largest number of patent applications. This lays the foundation for Huawei's key contribution to the 5G NR specification. In addition, some Chinese companies gain huge subsidies and receive support from their government. In February 2013, China's Ministry of Industry and Information Technology (MIIT), National Development and Reform Commission and Ministry of Science and Technology jointly established China's IMT-2020 (5G) promotion group.[123] Its members aim to support the Chinese industry in the standards setting process. Both contribute to China's growing influence in the geopolitical landscape of the 5G standard. Moreover, Chinese firms and the government actively participate in the 3GPP and ITU to strengthen their influence in these bodies. At the 83rd Plenary meetings of 3GPP, held in Shenzhen, the leadership was elected for the next 2 years.

As shown in the given table, Chinese companies, such as Huawei, CATT and China Mobile are distributed in three Technical Specification Groups. That means that Chinese companies own the globalized supply chains of telecommunications infrastructure. In comparison, the US companies do not hold a dominant position anymore. In the election

3GPP Plenary Leadership for the next 2 years

Group	Position	Name	Company	Country
CT	Chairmanship	Lionel Morand	Orange	FR
	Vice Chairmanship	Behrouz Aghili	InterDigital	US
		Ming Ai	CATT	CN
		Johannes Achter	Deutsche Telekom	DE
RAN	Chairmanship	Balazs Bertenyi	Nokia	FI
	Vice Chairmanship	Satoshi Nagata	NTT DOCOMO	JP
		Xiaodong Xu	China Mobile	CN
		Stephen Hayes	Ericsson	SE
SA	Chairmanship	Gerog Mayer	Huawei	CN
	Vice Chairmanship	Yusuke Nakano	KDDI	JP
		LaeYoung Kim	LG Electronics	KR
		Gregory Schumacher	Sprint	US

Table source: CGS 2019 based on data from 3GPP.

for the position of a Chairman of SA, Georg Mayer from Huawei beat Eddy Hall from Qualcomm. During the election process, the voters mainly evaluated the technology and capabilities of the companies behind the candidates and considered them as significant for their vote.

The election result for the three Technical Specification Groups – CT, RAN and SA in 3GPP – in March 2019 partly reflects the influence of different telecommunication companies for the next 2 years. In consideration of the timing for the normative 5G work, Rel-16, that will be completed by March 2020, the new leadership personnel will play an important role in the 5G standard-setting.

In this context, the ITU is currently led by Houlin Zhao, who is the first Chinese official as the ITU's Secretary-General. He was elected at the 2014 ITU Plenipotentiary Conference and re-elected ITU Secretary-General at the 20th Plenipotentiary Conference in Dubai in November 2018. Since the work of 3GPP and ITU is based on the principle of consensus building, the rising presence and leadership in the standards organizations can certainly influence the decision making of the technical specifications. Furthermore, the impact of

123 Cf. Kania, Elsa: China's play for global 5G dominance—standards and the 'Digital Silk Road', Center for Advanced China Research, June 27, 2018, https://www.aspistrategist.org.au/chinas-play-for-global-5g-dominance-standards-and-the-digital-silk-road/ (Accessed on April 05, 2019).

the chairman on decisions concerning the specifications cannot be ignored. Nevertheless, the most prominent actors are the companies trying to protect their respective regional standards bodies and their government.

The competition for setting 5G standards and next generation technologies is heating up already existing tensions between China and the US. The arrest of the chief financial officer of Huawei in December 2018 can be attributed to result from the competition in 5G standards.[124] As its core, this is a battle over the future of international telecommunication standards and market leadership. China is already changing "from a market that passively accepted Western companies' standards to a contender in the global technological race"[125]. As a response, America seems to focus firstly on blocking China, especially its top company Huawei. Indeed, the fight for standards is a long-lasting geopolitical game, with the US-China "tech cold war"[126] at the center.

European countries are also unwilling to lag behind and attempt to keep up with the US and China. Ericsson has developed the industry's first global portfolio of 5G NR radios and contributed to the 5G standards. 5G standards are identified by the European Commission as one of the five priority areas under the Digitizing European Industry initiative. The EU aims to influence the technological definition of future communications systems (5G and beyond) and consequently the standards through its advanced research.[127]

Overall, the US, China and the European Union play almost equally an important role in the standard-setting process of 5G. This geopolitical battle on 5G standards represents a multipolar power system...

Overall, US, China and the European Union play an important role in the standards setting process of 5G and in promoting the 5G and its standards. This geopolitical battle represents a multipolar power system. Although China has become one of the important players in the standards bodies and reached the forefront in the fight over 5G standards, it does not mean that Chinese standards will be adopted by other countries automatically. 5G standards are international standards. It is difficult to measure the weight of (some of) the companies involved in the discussion and voting process. Although the standard-setting process is manipulated by individual firms, cartels and perhaps even countries, "more than any other factor, what determines whether a standard will attain dominance is how open and attractive it is to users."[128] Being a part of 5G Standards merely provides a thorough basis in the whole 5G race.

WHO DOMINATES THE GLOBAL 5G MARKET?

When it comes to the radio access network (RAN) vendors, there are multiple active

124 Cf. Daily Sabah: Competition for 5G standards pressures Huawei, Daily Sabah Tech, December 15, 2018, https://www.dailysabah.com/technology/2018/12/15/competition-for-5g-standards-pressures-huawei (Accessed on April 02, 2019).

125 Ma, Joy Dantong: From Windfalls to Pitfalls: Qualcomm's China Conundrum, in: Macro Polo, November 14, 2018, https://macropolo.org/about/ (Accessed on April 02, 2019).

126 Eurasia Group White Paper: The Geopolitics of 5G, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on April 03, 2019), p. 18.

127 Cf. European Commission: 5G Research & Standards, April 02, 2019, https://ec.europa.eu/digital-single-market/en/research-standards (Accessed on April 03, 2019).

128 Bishop, Andrew D.: Standard Power: The New Geopolitical Battle, in: The National Interest, October 07, 2015, https://nationalinterest.org/feature/standard-power-the-new-geopolitical-battle-14017 (Accessed on February 22, 2019).

players on the US$32 billion[129] (2017) market[130] that are traditionally engaged in a highly competitive environment, even more so with 5G-technology coming up. Nonetheless, three of particular scale in terms of technological advances and especially market share today are Huawei (30.1 percent), Ericsson (26.4) and Nokia (22.2). This trio dominates the market with a combined lion's share of almost 80% (2017).[131] Even those giants, however, recently had troubles to keep the revenues at a steady level due to the rather negative trend on the RAN-Market.

THE BIG THREE

The mobile infrastructure market for RAN and core equipment has been slowly shrinking in the past three years, going down 14 percent in 2017 alone.[132] On the market for software solutions and services, more stable in terms of demands, a decline could be observed, though at a moderate scale of 1% in the same year. This trend could be observed globally. "Despite relative stability in North America and slight pickup in Japan, mobile infrastructure revenue declined in 2017 in all regions, and even more so in China," according to Stephane Teral from mobile infrastructure and carrier economics research at IHS Markit.[133] Also on the software market, where Nokia, Ericsson and Huawei are also major players (although with ca. 8% share each, followed by Amdocs (5.5%), NEC (4.1%) and Oracle (3.5%)), the revenues declined in 2017, while Ericsson's decline was larger than that of its opponents.[134]

Consequentially, the big three players had to make some concessions to this negative development. Especially Nokia, once Finland's champion with an all-time sales record of US$70.6 billion in 2007 was going through tough times losing more than 40% of its revenues in only five years and forcing the company to sale its handset business. Therefore the sales sank to US$17.5 billion and went up again only after the acquisition of Alcatel-Lucent to €23.6 billion in 2016.[135] Hence it is not surprising that Nokia announced plans for further job cuts across all departments and cost savings of ca. US$800 million. Although in a not as troubled condition as Nokia, Ericsson also felt the pressure and cut a total of 18,000 jobs in 2018 in order to keep the losses at bay.[136] Ericsson's revenues in hardware felt from US$43.3 in 2016 to US$37 billion in 2017.[137]

5 .

The radio access network (RAN) Market is dominated by the Chinese Huawei and the Scandinavian Nokia and Ericsson, who share almost 80% of the market´s revenues.

129 Combined with software and services market the value rises to US$69 billion –Cf. Cooperson, Dana: Huawei overtakes Ericsson to lead the USD69 billion telecoms software market in 2017, in: Analysys Mason, November 20, 2018, http://www.analysysmason.com/Research/Content/Comments/market-share-comment-rma09 (Accessed on April 18, 2019).

130 Cf. Schoolar, Daryl: RAN Vendor Market Update: 2018 - Market dominance of the big three RAN vendors remains for now, OVUM TMT intelligence, 2018, p. 2.

131 Cf. ibid.

132 Cf. Téral, Stéphane: Global mobile infrastructure market down 14 percent from a year ago, in: IHS Markit, March 13, 2018, https://technology.ihs.com/600864/global-mobile-infrastructure-market-down-14-percent-from-a-year-ago (Accessed on April 18, 2019).

133 Cf. Bannerman, Natalie: Ericsson, Nokia lose infrastructure market share while Huawei continues to grow, in: Capacity, March 15, 2018, https://www.capacitymedia.com/articles/3794074/Ericsson-Nokia-lose-infrastructure-market-share-while-Huawei-continues-to-grow (Accessed on April 18, 2019).

134 Cf. Cooperson, Dana: Huawei overtakes Ericsson to lead the USD69 billion telecoms software market in 2017, in: Analysys Mason, November 20, 2018, http://www.analysysmason.com/Research/Content/Comments/market-share-comment-rma09 (Accessed on April 18, 2019).

135 Cf. Ojo, Bolaji: Is 5G the Key to Nokia's Redemption?, in: EPSNews, February 07, 2019, https://epsnews.com/2019/02/07/5g-key-nokia-redemption/ (Accessed on April 18, 2019).

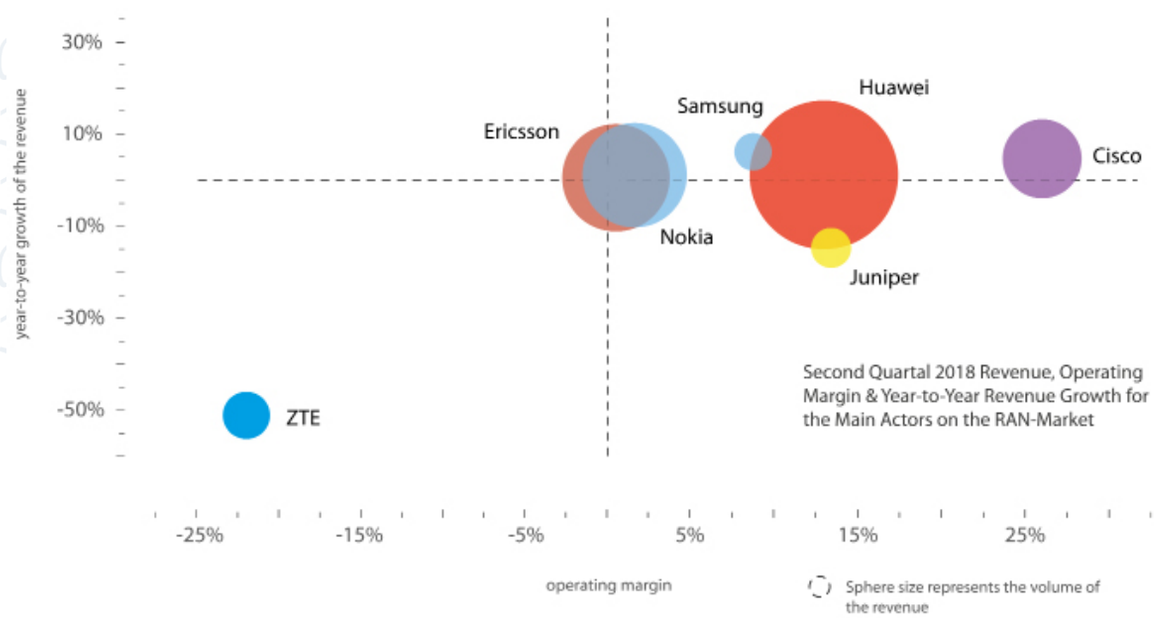
136 Cf. Slattery, April: With 18,000 Job Cuts, Ericsson Trims Losses, in: Computer Business Review, April 20, 2018, https://www.cbronline.com/news/18000-job-losses-ericsson-trims-losses (Accessed on Mai 7, 2019).

137 Cf. Bannerman, Natalie: Ericsson, Nokia lose infrastructure market share while Huawei continues to grow, in: Capacity, March 15, 2018, https://www.capacitymedia.com/articles/3794074/Ericsson-Nokia-lose-infrastructure-market-share-while-Huawei-continues-to-grow (Accessed on April 18, 2019).

At the first glance, this picture looks different if it comes to the now biggest player on the market. China's Huawei took over the pole position as RAN-vendor from Ericsson in 2016 and has been further consolidating this position since. Despite being cut off from the US-market – the second largest globally – Huawei was able to show a solid growth of 18% in the first half of 2018. And despite the networking business lagging behind the consumer and enterprise division outside of China,[138] Huawei was the only RAN-vendor to gain shares on the market in 2017.

In view of the recent overall decline, the upcoming 5G technology is essential to the vendors, due to the end of large LTE rollouts, but especially due to the drop of the rapid pullback in spending on 2G and 3G technology.[139] By 2018 the revenues of the major vendors had already been improved by the operators that made early investments in 5G networks, especially in the US.[140] Although this technology will not be widely in use until 2022, Ericsson predicts around 54 million 5G-smartphone users worldwide by then and more than 550 million only two years later.[141] The communication analyst

Main Players on the RAN-Market



Second Quartal 2018 Revenue, Operating Margin & Year-to-Year Revenue Growth for the Main Actors on the RAN-Market

Source: CGS 2019 based on TBR and Company Data

Dell'Oro Group estimates 5G base station sells to overtake LTE (4G) base station by 2022.[142] A similar development can be observed on the Evolved Packet Core (EPC) market, a technology essential for LTE (4G) and 5G standards. Here, while Nokia is even further behind Huawei and Ericsson (both gathering over 60% of the also lately declining market) the promise of a growth over the next one or two years is tied to the

138 Cf. Culpan, Tim: All's Quiet on Huawei's Western Front, in: The Washington Post, December 12, 2018, https://www.washingtonpost.com/business/alls-quiet-on-huaweis-western-front/2018/12/11/ef3f935e-fd1a-11e8-a17e-162b712e8fc2_story.html?utm_term=.c65909ec6ac1 (Accessed on April 18, 2019).

139 Cf. Schoolar, Daryl: RAN Vendor Market Update: 2018 - Market dominance of the big three RAN vendors remains for now, OVUM TMT intelligence, 2018, p. 4.

140 Cf. Soper, Michael: Telecom vendor revenues trend upward as operators pull forward 5G investment, in: TBR Technology Business Research, March 10, 2018, https://tbri.com/special-reports/telecom-market-recap-2q18/ (Accessed on April 18, 2019).

141 Cf. Richter, Felix: Global 5G Adoption to Take Off in 2021, in: Statista, December 04, 2018, https://www.statista.com/chart/9604/5g-subscription-forecast/ (Accessed on April 18, 2019).

142 Cf. Dano, Mike: Apple, Nokia, others worry over manufacturing operations in China, in: Fierce Wireless, December 12, 2018, https://www.fiercewireless.com/wireless/apple-nokia-others-worry-over-manufacturing-operations-china (Accessed on April 18, 2019).

early stages of the migration to 5G.[143]

Estimates show that within five years about 1 billion people will be 5G-enabled[144] and within a decade the 5G market will surpass US$1.2 trillion while almost 80% of 5G related spending will be used for hardware and network transformations.[145] Due to 5G using previously underutilized bands in the 3.5GHz range and above 6GHz, as well as existing bands (e.g. 700MHz) it is expected to show a long investment cycle[146], which promises a brighter future for the vendors able to seize valuable market shares.

Consequently, the competitive battle among the vendors is about to take a new stage, with companies trying to showcase their now growing portfolios in the most favorable way in order to win contract with carriers. Contracts worth billions of dollars have already been signed or announced, but they are just the beginning of a lot more to come.[147] The companies hope, by competing aggressively for old and new clients among the carriers in this early stage, to build confidence in their products and eventually "to tip the balance of power"[148].

Due to the recent decline of the revenues, the upcoming 5G rollout is even more essential for the vendors, sparking fiercer competition for cutting edge technology, cooperation and dominating modi operandi among the companies.

As of now, the companies are at the forefront of the technical development, although with competitive advantages in different fields. In terms of combined global reach and range of portfolio, Nokia is to date leading in the field. According to Nokia's CEO Rajeev Suri, the company's end-to-end portfolio is the chief advantage in responding to the sooner-than-expected acceleration of 5G demand.[149] This is especially the case since the acquisition of Alcatel-Lucent in 2016.

Acquiring the former French company provided Nokia a broad range of products in radio, core, optical and digital technologies. Ericsson, although with bigger market shares, lacks such an in-house portfolio. On the other hand, Ericsson's strength lies in its expertise in RAN-Networks. Its cutting-edge Radio System is already responsible for 84% of all its RAN sales and the Swedish company was able to make some major deals, e.g. to replace Nokia as a supplier to Deutsche Telekom in Germany.[150] This is also not at least due to Ericsson aggressive price policies. The Swedes seem to be more price-competitive, since they were able to outbid Huawei on its home market in China by 25%.[151]

As for Huawei, it has an even wider range of services and hardware to offer. As stated by the president of Huawei's 5G product line, Yang Chaobin, his company has the only "true" end-to-end portfolio, where all its components – from the core network to the

143 Cf. Tan, Allan: Dell'Oro: 5G deployments spur EPC growth in 2Q 2018, in: Telecomasia.net, September 14, 2018, https://www.telecomasia.net/content/delloro-5g-deployments-spur-epc-growth-2q-2018 (Accessed on April 18, 2019).

144 Cf. Kim, Sam; Kim, Sohee: 5G Is Making Its Global Debut at Olympics, and It's Wicked Fast, in: Bloomberg, February 12, 2018, https://www.bloomberg.com/news/articles/2018-02-12/5g-is-here-super-speed-makes-worldwide-debut-at-winter-olympics (Accessed on April 18, 2019).

145 Cf. Newman, Daniel: These 4 companies will be the big early winners from the $326 billion push to 5G, in: MarketWatch, March 12, 2018, https://www.marketwatch.com/story/these-4-companies-will-be-the-big-early-winners-from-the-326-billion-push-to-5g-2018-03-07 (Accessed on April 18, 2019).

146 Cf. Schoolar: RAN Vendor Market Update: 2018 - Market dominance of the big three RAN vendors remains for now, loc. cit.

147 Cf. Sherrington, Simon: Who Will Be the Also-RANs in the 5G Market?, in: Light Reading, April 10, 2018, https://www.lightreading.com/mobile/fronthaul-c-ran/who-will-be-the-also-rans-in-the-5g-market/a/d-id/746584 (Accessed on April 18, 2019).

148 Gabriel, Caroline: Nokia and Ericsson pin hopes on 5G to catch up with Huawei, in: Rethink Research, August 10, 2018, https://rethinkresearch.biz/articles/nokia-and-ericsson-pin-hopes-on-5g-to-catch-up-with-huawei-2/ (Accessed on April 18, 2019).

149 Cf. Tanner, John C.: 5G vendors compete on end-to-end – but is that what cellcos want?, in: Disruptive Asia, March 02, 2018, https://disruptive.asia/5g-vendors-compete-end-end-cellcos-want/ (Accessed on April 18, 2019).

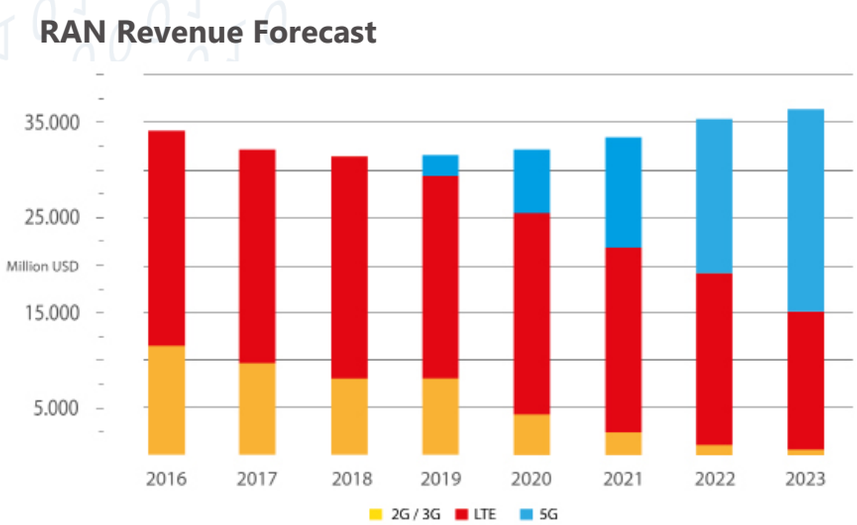
150 Cf. Morris, Iain: Ericsson vs. Nokia: Who's Ahead in 5G Right Now?, in: Light Reading, January 08, 2018, https://www.lightreading.com/mobile/5g/ericsson-vs-nokia-whos-ahead-in-5g-right-now/d/d-id/745048 (Accessed on April 18, 2019).

151 Cf. Zhu, Davy: Ericsson Is Surprisingly Cheapest Vendor in Huawei's China, in: Yahoo News/ Bloomberg, February 14, 2019, https://news.yahoo.com/huawei-apos-china-ericsson-surprisingly-040804387.html (Accessed on April 18, 2019).

device itself – are produced by the vendor.[152] Overall, the three have the widest portfolio of products, combined with the best service and global reach, which makes it hard for carriers to build networks without contracting at least one of them.

In order to keep or even to expand the said advantages the companies are forced to boost their investments in R&D. The new 5G related technologies are of a much higher complexity and require a new approach from the vendors. The enormous "softwarization" of all aspects of 5G networks in particular may open up opportunities for new, yet smaller players and innovative start-ups.[153] It comes as no surprise that this outlook made the now dominant companies step up their research and development efforts. Here Huawei is in front with a clear lead. In 2017 the Chinese company has been outspending its rivals with about US$14 billion, while Nokia spent ca. 5.6 and Ericsson 4.4 billion. Investing such an amount of resources Huawei even topped Microsoft and Apple.[154]

However, the number of patents alone does not decide the competition. For example, Ericsson announced an "end-to-end" submission, a patent combining the research of 130 company's inventors. It promises to include an entire technological infrastructure needed



Source: Schoolar, Daryl: RAN Vendor Market Update: 2018

to build a complete 5G network.[155] Furthermore, the companies strive in an attempt to gather more expertise and to set a foot on important markets and already are investing and founding new researching facilities, e.g. Ericsson in Texas[156], which will be focused on 5G. Another example is Nokia, which started a new R&D center in Bangalore. This is already the fourth facility of this kind besides two in Europe and one in China.[157]

152 Cf. Tanner, John C.: 5G vendors compete on end-to-end – but is that what cellcos want?, in: Disruptive Asia, March 02, 2018, https://disruptive.asia/5g-vendors-compete-end-end-cellcos-want/ (Accessed on April 18, 2019).

153 Cf. Kinney, Sean: 5G opens the door to new players in telecom vendor space, report says, in: RCRWireless News, September 25, 2017, https://www.rcrwireless.com/20170925/5g/5g-opens-door-new-players-telecom-vendor-space-report-says (Accessed on April 18, 2019).

154 Cf. Toh, Michelle: America's fight with Huawei is messing with the world's 5G plans, in: CNN Business, February 14, 2019, https://edition.cnn.com/2019/02/14/tech/huawei-nokia-ericsson-5g/index.html (Accessed on April 18, 2019).

155 Cf. Townsend, Will: Ericsson vs. Huawei: Who's Winning The 5G Race?, in: Forbes, December 04, 2017, https://www.forbes.com/sites/moorinsights/2017/12/04/ericsson-vs-huawei-whos-winning-the-5g-race/#7543d51f8aa5 (Accessed on April 18, 2019).

156 Cf. ibid.

157 Cf. Singh, Vipin; Tanwer, Neha: 5G Market Research: What are the top players up to?, in: Greyb Services, 2018, https://www.greyb.com/companies-working-on-5g-technology/#Huawei-Technologies-Co-Ltd-China (Accessed on April 18, 2019).

INTEROPERABILITY OF 5G COMPONENTS

Alongside with the in-house R&D activities the companies are looking for cooperation with universities and public entities. To name some examples - Ericsson is cooperating with the Fraunhofer Institute for Production Technology on industrial 5G applications.[158] Meanwhile Huawei and the Carleton University (Canada) announced plans for Huawei's Canada Research Centre to extend the research partnership for 5G.[159] Huawei also coopted with the University Politecnica de Madrid, signing an agreement for the creation of HUAWEI-UPM5G Chair in Business, the first chair for 5G technologies in Spain with the aim to promote top talent in Spain.[160] Nokia is part of a joint research program at the University of Bristol, where the Finnish side is providing 5G network solutions and radio access points and the University is contributing the research expertise.[161]
Following the need to close gaps in their own portfolio, to enable interoperability between different components and to find solutions for new challenges, even more in-depth partnerships and short-term multiple cooperation's can be observed between the vendors and other companies and carriers.

Most of the partnerships are not of an exclusive character however with vendors and carriers cooperating often on case-by-case basis, e.g. Qualcomm and Nokia were testing 5G-Networks ahead of the commercial deployment[162], also to improve its interoperability. For the same reason, Nokia, Cisco, Huawei, Ericsson, Dell, HP and some major carriers where cooperating in order to test-syncing their 5G equipment.[163]
The latter facet - interoperability - is of high importance, since due to commercial or political reasons there is no guarantee a carrier will prefer an end-to-end approach and choose a network completely dependent on a single company. Hence, the emphasis on the "end-to-end" portfolio may not be that attractive to carriers, who prefer "…best-of-breed multivendor solutions – especially at a time when the ICT industry has been moving steadily away from proprietary hardware and software to open-source solutions."[164] Even now, considering open standards, it is possible for carriers to combine one vendor's RAN with another producer's transporting technology. This new approach may open up a path to a "multi-vendor RAN"[165].

In that light the OpenRAN (ORAN) Alliance could play a special role for the future of the RAN-Market. This cross-industry alliance with such members as Deutsche Telekom, AT&T, Verizon, Nokia, Ericsson, Cisco, Samsung etc. was founded in 2018 and is now pushing for changes to make the networks more open and to allow operators to use

158 Cf. Chau, Fiona: Ericsson, Fraunhofer Institute demo industrial 5G for jet engine, in: TelecomAsia, May 08, 2018, https://www.telecomasia.net/content/ericsson-fraunhofer-institute-demo-industrial-5g-jet-engine (Accessed on April 18, 2019).

159 Cf. Carleton University: Carleton University and Huawei Canada Research Centre Extend Successful 5G Research Partnership Program, December 01, 2017, https://research.carleton.ca/2017/carleton-university-huawei-canada-research-centre-extend-successful-5g-research-partnership-program/ (Accessed on April 18, 2019).

160 Cf. Xinhua: Huawei, Spanish university sign agreement to promote 5G technology, April 25, 2018, http://www.xinhuanet.com/english/2018-05/25/c_137204238.htm (Accessed on April 18, 2019).

161 Cf. Fadilpašić, Sead: BT and Nokia carry out further UK 5G tests, in: ITProPortal, November 27, 2017, https://www.itproportal.com/news/the-university-of-bristol-bt-and-nokia-testing-5g-in-bristol/ (Accessed on April 18, 2019).

162 Cf. Digit NewsDesk: Qualcomm, Nokia successfully complete 5G test calls ahead of 2019 commercial deployment, in: Digit, December 05, 2018, https://www.digit.in/telecom/qualcomm-nokia-successfully-complete-5g-test-calls-ahead-of-commercial-deployments-next-year-45056.html (Accessed on April 18, 2019).

163 Cf. Reichert, Corinne: 5G mobile edge tests completed by global tech giants, in: ZD Net, October 31, 2018, https://www.zdnet.com/article/5g-mobile-edge-tests-completed-by-global-tech-giants/ (Accessed on April 18, 2019).

164 Tanner, John C.: 5G vendors compete on end-to-end – but is that what cellcos want?, in: Disruptive Asia, March 02, 2018, https://disruptive.asia/5g-vendors-compete-end-end-cellcos-want/ (Accessed on April 18, 2019).

165 Morris, Iain: Ericsson vs. Nokia: Who's Ahead in 5G Right Now?, in: Light Reading, January 08, 2018, https://www.lightreading.com/mobile/5g/ericsson-vs-nokia-whos-ahead-in-5g-right-now/d/d-id/745048 (Accessed on April 18, 2019).

multi-vendor RAN's. It is seen as a challenge to the traditional business model of the vendors. The reason why companies like Nokia or, at a later point, Ericsson are entering the alliance seems to be the high demands from the industry and the most major carriers behind it. Ericsson's entry especially was of importance, Huawei now being the only major RAN-vendor outside the movement.[166]

Although Huawei declares itself devoted to "…the principle of open innovation and collaboration to facilitate the development of the telecoms industry"[167], this may put the company under further pressure. Its sheer size makes the company a target of competitors, NGO's, and politics. With an annual revenue of over US$90 billion it is in the same weight category as Microsoft and Alphabet. Huawei is employing a workforce of over 180,000 worldwide.[168] As Huawei grows further and widens its product portfolio into new realms, it becomes the competitor of those companies it was once client of. If it comes to chipsets and modems for mobile communications, Huawei started as a major customer of Qualcomm. Now the Chinese company is building its own chipsets.[169] HiSilicon, Huawei's chipset-branch, established in 2004, plays a part in its success and expanded the range of the processors significantly by now, extending from flagship products to middle range.[170] The company could also decide to compete directly with Qualcomm or Intel in the future.[171]

However, as the counter-pressure also extends beyond the US border, Huawei finds itself subject to "incredibly unfair treatment", according to Chairman Guo Ping.[172] Accordingly, the company seeks to boost its lobbying efforts[173]. After establishing its presence in Brussels in 2009, the Chinese company became one of the most active players with an annual budget of €2.2 million and eight lobbyists with access to the European parliament. [174] The stakes are high: although, by forecasts, the European market for 5G will neither be the biggest nor the fastest growing globally by 2022, it is still vital for Huawei since it was cut off from the biggest market – the USA. Hence the company is trying hard to clear up all doubts about its reliability and established a center for cybersecurity not only in Bonn, but also directly in Brussels.[175]

Still, Huawei's dominance in size, price-competition and technological progress, already established or looming on the horizon, as well as its background as a Chinese champion,

166 Cf. ibid.

167 Lucas, Erwan: European telecoms' dilemma: Huawei or the highway?, in: Phys.org, February 03, 2019, https://phys.org/news/2019-02-european-telecoms-dilemma-huawei-highway.html#jCp (Accessed on April 18, 2019).

168 Cf. Ting-Fang, Cheng; Li, Lauly: 'Huawei freeze' chills global supply chain - Tight web of partnerships makes Chinese equipment tough to replace, in: Nikke Asian Review, December 08, 2018, https://asia.nikkei.com/Economy/Trade-war/Huawei-freeze-chills-global-supply-chain (Accessed on April 18, 2019).

169 Cf. Nellis, Stephen: Samsung, Huawei supply majority of own modem chips, Qualcomm says, in: Reuters, January 05, 2019, https://www.reuters.com/article/us-qualcomm-tech/samsung-huawei-supply-majority-of-own-modem-chips-qualcomm-says-idUSKCN1OZ00F (Accessed on April 18, 2019).

170 Cf. Triggs, Robert: HiSilicon: What you need to know about Huawei's chip design unit, in: Android Authority, April 12, 2018, https://www.androidauthority.com/huawei-hisilicon-852231/ (Accessed on April 18, 2019).

171 Cf. Shrout, Brian: US tech dominance is under threat from this one Chinese company, Market Watch, April 16, 2018, https://www.marketwatch.com/story/us-tech-dominance-is-under-threat-from-this-one-chinese-company-2018-04-16 (Accessed on April 18, 2019).

172 Cf. Lucas, Erwan: Calls for Huawei boycott get mixed response in Europe, in: Phys.org, January 13, 2019, https://phys.org/news/2019-01-huawei-boycott-response-europe.html#jCp (Accessed on April 18, 2019).

173 Cf. Emmott, Robin: In Brussels, China learns 'eurospeak' to seek influence, in: Reuters, April 01, 2014, https://www.reuters.com/article/us-eu-china/in-brussels-china-learns-eurospeak-to-seek-influence-idUSBREA3009V20140401 (Accessed on April 18, 2019).

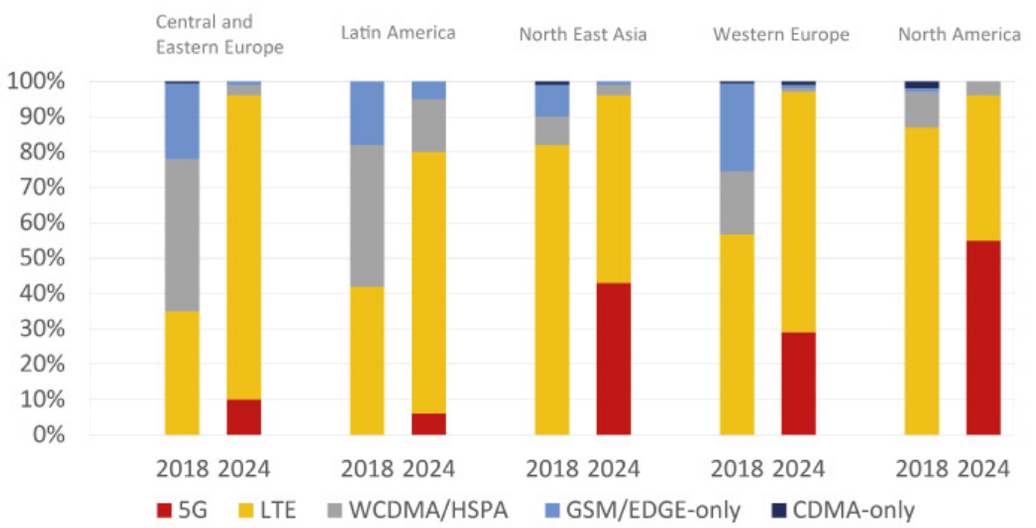
174 2018 Nokia spend about €800.000 and Ericsson €1.2 million in the same period.

175 Cf. Hera-Adamowicz, Jakub: Huawei Transparency and Cybersecurity Centre in Brussels, in: Huawei Brussels, May 25, 2018, https://huawei-brussels-office.prezly.com/huawei-transparency-and-cybersecurity-center-in-brussels# (Accessed on April 18, 2019).

are further mobilizing opposition. A remarkable example for the Chinese company's influence on the workings of the market even without being a part of a deal can be seen in the failed attempt of then Singapore-based Broadcom to buy San Diego-based Qualcomm in a US$117 billion deal. Qualcomm is already dominating the US$15.5 billion market for 4G modem chips with a 59.6% share[176] and the System-on-Chip (SoC) market with 42% in 2017[177] in front of Huawei, Intel, Samsung or Apple. Qualcomm also owns about 15% of 5G relevant patents[178] and is "…driving the 5G ecosystem forward with over 18 global carriers and over 20 handset and mobile hotspot OEMs and working with carrier equipment manufacturers Ericsson, Nokia, Samsung Electronics, Huawei Technologies, DT Mobile, and ZTE."[179]

Broadcom, on the other side, while also being one of the world's largest providers of chipsets, concentrates mainly on lower market segments without any strong position in the 5G sector.[180] It is not known for extensive R&D either.

Mobile Subscriptions by Region and Technology



Source: Jejdling, Frederik: Ericsson Mobility Report November 2018, p. 12

Despite no direct connection between Broadcom and any Chinese representative are known, the move was blocked by an executive order of President Donald Trump after the Committee on Foreign Investment in the US had expressed concern and even before the companies had formally agreed on the deal, which is rather unusual.[181] "In a frank statement, the Deputy Assistant Secretary of the US Treasury Department Aimen Mir made it clear: "Reduction in Qualcomm's long-term technological competitiveness and

176 Cf. Nellis, Stephen: Samsung, Huawei supply majority of own modem chips, Qualcomm says, in: Reuters, January 05, 2019, https://www.reuters.com/article/us-qualcomm-tech/samsung-huawei-supply-majority-of-own-modem-chips-qualcomm-says-idUSKCN1OZ00F (Accessed on April 18, 2019).

177 Cf.. Srivastava, Shobhit: Qualcomm Leads Smartphone SoC Market; Fueled From Adoption By Fast Growing Chinese Brands, Counterpoint Research, December 30, 2017, https://www.counterpointresearch.com/qualcomm-leads-smartphone-soc-market-fueled-adoption-fast-growing-chinese-brands/ (Accessed on April 18, 2019).

178 Cf. Bloomberg: Mr Tan Goes To Washington: How the Broadcom-Qualcomm deal unravelled, in: The Business Times, March 16, 2018, https://www.businesstimes.com.sg/technology/mr-tan-goes-to-washington-how-the-broadcom-qualcomm-deal-unravelled (Accessed on April 18, 2019).

179 Moorhead, Patrick: Qualcomm Reinforces Its Global Mobile 5G Orchestrator Role At 4G-5G Summit, in: Forbes, October 23, 2018, https://www.forbes.com/sites/patrickmoorhead/2018/10/23/qualcomm-reinforces-its-global-5g-orchestrator-role-at-4g-5g-summit/#2463f1ce2731 (Accessed on April 18, 2019).

180 Cf. Meyer, Dan: Broadcom's Chip Portfolio Is Top Heavy, as Are Its Headlines, in: SDxCentral, September 20, 2018, https://www.sdxcentral.com/articles/news/broadcoms-chip-portfolio-is-top-heavy-as-are-its-headlines/2018/09/ (Accessed on April 18, 2019).

181 Cf. Cheng, Roger: Why Trump blocked Qualcomm-Broadcom: It's all about 5G, in: CNET, March 14, 2018, https://www.cnet.com/news/why-trump-blocked-qualcomm-broadcom-its-all-about-5g/ (Accessed on April 18, 2019).

influence in standard setting would leave an opening for China to expand its influence on the 5G standard-setting process".[182] "China would likely compete robustly to fill any void left by Qualcomm as a result of this hostile takeover. Given the well-known US national security concerns about Huawei and other Chinese telecommunications companies, a shift to Chinese dominance in 5G would have substantial negative national security consequences for the United States."[183]

While Qualcomm was able to draw an advantage from Huawei's shadow in this case, it is still not clear what the consequences for other vendors will be, should Huawei receive further bans from foreign markets. The question is whether Nokia and Ericsson will at all be able to fill the void created by a possible complete exclusion of Huawei from e.g. the European market. This is on the one hand a problem of available capacities, on the other hand one of the technological status quo. According to communication analyst Ian Morris, who interviewed a representative of one of Huawei's major carrier customers under the condition of anonymity, the European vendors do not have the resources for a swap-out. "They don't have the product portfolio, they don't have the stock, they don't have the resources. They cannot replace Huawei."[184] Also in terms of technology Nokia and Ericsson are behind their Chinese competitor. As indicated by several European telcos, Huawei is approximately one year ahead in terms of the quality of its 5G products.[185] Also the quality of support provided by Huawei to the carriers is much higher. Even though Huawei is more expensive than its competitors today, it is not spurring that the prospect to substitute the company is met with skepticism by the European carriers.

It is also not clear whether Huawei's struggle for credibility will benefit its competitors Nokia and Ericsson, or if they may be affected in a negative way, since they are deeply engaged in China with R&D and productions as well.

Nevertheless, Nokia and Ericsson reject the doubts about their capabilities and quality. Both companies see themselves on the same stage of technological development and point out that they are already deploying 5G equipment. Whilst the companies' executives also see Europe moving much slower in comparison with other markets, they see "…the lack of spectrum, high spectrum fees and heavy regulation"[186] as the main reason. It is still unclear if the two companies can build up their capacities fast enough.

This may be being one reason for Nokia's and Ericsson's reluctance to comment on the (possible) bans of the Chinese giant and the consequent chances for themselves, the other reason is the fear of Beijing's possible reaction. Not only did Nokia and Ericsson already make heavy investments on the Chinese market and were able to win some billions worth contracts with carriers there[187], the Chinese market is also of big importance to the non-Chinese vendors, due to its estimated advances in the realm of

182 Horwitz, Josh: US fears China winning on 5G if Broadcom gets to take over Qualcomm, in: Quartz, March 07, 2018, https://qz.com/1223483/broadcom-a-company-trump-called-really-great-faces-a-national-security-investigation/ (Accessed on April 18, 2019).

183 Shields, Todd; Sebenius, Alyza: Huawei's Clout Is So Strong It's Helping Shape Global 5G Rules, in: Bloomberg, February 01, 2019, https://www.bloomberg.com/news/articles/2019-02-01/huawei-s-clout-is-so-strong-it-s-helping-shape-global-5g-rules (Accessed on April 18, 2019).

184 Morris, Iain: Huawei Muscle Puts Ericsson, Nokia on 5G Back Foot in Europe – Sources, in: Light Reading, February 14, 2019, https://www.lightreading.com/mobile/5g/huawei-muscle-puts-ericsson-nokia-on-5g-back-foot-in-europe---sources/d/d-id/749474 (Accessed on April 18, 2019).

185 Cf. Trefis Team: Why Nokia Remains Muted About Prospects Despite Huawei's Mounting Woes, in: Forbes, February 01, 2019, https://www.forbes.com/sites/greatspeculations/2019/02/01/why-nokia-remains-muted-about-prospects-despite-huaweis-mounting-woes/#6992c210d613 (Accessed on April 18, 2019).

186 Seal, Thomas; Nicola, Stefan: Huawei crackdown exposes Europe as laggard in global 5G race, in: BNN Bloomberg, February 18, 2019, https://www.bnnbloomberg.ca/huawei-crackdown-exposes-europe-as-laggard-in-global-5g-race-1.1215734 (Accessed on April 18, 2019).

187 Cf. Groll, Elias: Who Benefits From the US Crackdown on Huawei? Rival companies could get a boost—or face a backlash from China, in: Foreign Policy, January 31, 2019, https://foreignpolicy.com/2019/01/31/who-benefits-from-the-u-s-crackdown-on-huawei/ (Accessed on April 18, 2019).

industrial internet, according to Ericsson's CEO Ekholm.[188] The size and technological aspirations of China's market are of great importance now and in the near future, as the RAN-Market is expected to show the highest grow rates in the Asian-Pacific Region[189], of which China itself is likely to be the biggest driver.[190] The Chinese government may undermine the efforts of western companies to enter the market as an answer to Western politics.[191]

Another concern for the European vendors are in-house production and research facilities located in China. Most Western equipment manufacturers have production or assembling sited in China, usually as joint ventures with Chinese companies. This is also true for Nokia and Ericsson.[192] As Jeremy Mitchel, Huawei Australia and New Zealand's director of corporate and public affairs put it: "You might be able to take Huawei out of the equation, but you can't take China out of it […]. Chinese made equipment, from all major suppliers, is an integral part of the global telecommunication supply chain. Ericsson's factory in China is half owned by the Chinese government. Nokia has a factory there, too."[193] Indeed, both companies have a long history of conducting business in China and are deeply engaged in the country.

Nokia opened its first office in Beijing in 1985 and has widened its presence in China ever since, establishing several dozens of branches, R&D facilities and four manufacturing sites in Suzhou, Dongguan, Fujian and Beijing with a personnel of more than 4500 by 2005.[194] As a result of the crisis sparked by the decline of the mobile phone business, the company was forced to restructure, closing several facilities or selling them. By now the manufacturing plant in Suzhou, next to Shanghai, is one of Nokia's four facilities (along with sites in Finland and India).[195] Apart from this plant, Nokia is also involved in the Nokia Shanghai Bell Co. Ltd. This is a joint venture of Nokia (as a majority shareholder) and China Huaxin, a state-owned industrial development company. The merger was a final step in the acquisition of former French Alcatel-Lucent in 2016.[196] The fusion into the Nokia Bell with its 15 sub-divisions[197] gave and additional rise to Nokia's presence in China, as around 16% of its overall personnel is now operating there, making it the biggest contingent along with India (16%) and before USA (12%).[198] Consequently, Nokia's CEO Suri commented on the deal: The "[…] agreement demonstrates Nokia's

188 Cf. Yang, Yang: China will be the first place for industrial internet to take off: Ericsson CEO, in: China Daily, Mai 29, 2018, http://www.chinadaily.com.cn/a/201806/29/WS5b35cd8ca3103349141dfc3e.html (Accessed on April 18, 2019).

189 Cf. MarketsandMarkets: Radio Access Network Market by Communication Infrastructure (Small Cell, Macro Cell, RAN Equipment, DAS), Connectivity Technology (2G, 3G, 4G/LTE, 5G), Deployment Location (Urban, Rural, Residential, Retail Stores), and Geography - Global Forecast to 2023, in: Market Research Report, April, 2018, https://www.marketsandmarkets.com/Market-Reports/radio-access-network-market-259656260.html (Accessed on April 18, 2019).

190 Cf. Trefis Team: Why Nokia Remains Muted About Prospects Despite Huawei's Mounting Woes, in: Forbes, February 01, 2019, https://www.forbes.com/sites/greatspeculations/2019/02/01/why-nokia-remains-muted-about-prospects-despite-huaweis-mounting-woes/#6992c210d613 (Accessed on April 18, 2019).

191 Cf. Groll, Elias: Who Benefits From the U.S. Crackdown on Huawei? Rival companies could get a boost—or face a backlash from China, in: Foreign Policy, January 31, 2019, https://foreignpolicy.com/2019/01/31/who-benefits-from-the-u-s-crackdown-on-huawei/ (Accessed on April 18, 2019).

192 Cf. Sawall, Achim: Ericsson und Nokia sehen Huawei-Ausschluss in USA mit Sorge, in: Golem.de, February 12, 2019, https://www.golem.de/news/5g-ericsson-und-nokia-sehen-huawei-ausschluss-in-usa-mit-sorge-1902-139347.html (Accessed on April 18, 2019).

193 Philipson, Graeme: The China supply chain and 5G, in: InnovationsAus.com, July 26, 2018, https://www.innovationaus.com/2018/07/The-China-supply-chain-and-5g (Accessed on April 18, 2019).

194 Cf. Kaiming, Liu; Xin, Deng: Day and Night at the Factory - Working conditions of temporary workers in the factories of Nokia and its suppliers in southern China, Institute of Contemporary Observation, 2015.

195 Cf. Nokia: Manufacturing, September 15, 2016, https://www.nokia.com/about-us/news/media-library/manufacturing/ (Accessed on April 18, 2019).

196 Cf. Bushell-Embling, Dylan: Nokia formally launches Nokia Shanghai Bell JV, in: Telecomasia.com, July 04, 2017, https://www.telecomasia.net/content/nokia-formally-launches-nokia-shanghai-bell-jv (Accessed on April 18, 2019).

197 Cf. Nokia-Bell: 公司简介, Nokia-Bell, https://www.nokia-sbell.com/staticpage/index?page=CompanySurvey (Accessed on April 18, 2019).

198 Cf. Nokia: Nokia People & Planet Report 2017, May 21, 2018.

deep commitment to China. Together with China Huaxin, Nokia will be in an excellent position to support strategic initiatives of the Chinese government such as "Internet Plus" and provide a strong link between Europe and China".[199]
Ericsson has even deeper historical roots in China. The Swedish company's first presence in Shanghai goes back to the 1890s and was interrupted by the revolution and closing of the People's Republic to western business until 1985. After establishing a local company for the second time in 1994, China became Ericsson's largest client with respect to booking only three years later.[200]

Today Ericsson's largest of several joint ventures in China is the Nanjing Ericsson Panda Communication – founded in 1992 with the state-owned Panda Electronics Group Company Ltd. Since its founding it has grown to become Ericsson's largest production and supply center,[201] essential for its global supply network and providing hardware modern communication solutions to more than 100 countries.[202] This manufacturing site is also right at the front of Ericsson's modernization initiative for the new generation of smart manufacturing technologies serving to increase the operational ability and efficiency, which additionally underlines its importance for the company's strategy.[203]
Clearly, the supply chains of both European vendors are deeply involved in China, which makes their products potentially vulnerable to interferences by the Chinese government, especially as the production does not exclusively take place at the central manufacturers, but is also outsourced to highly specialized sub-tier suppliers. It is the assembling and testing of the final products that are largely done in-house.
"In general, Ericsson has alternative supply sources and seeks to avoid single source supply situations" – according to the company's annual report.[204] This outsourcing and splitting up of the production sites makes it harder for the vendors to keep everything under tight control. As stated by Lillian Ablon from RAND Corporation, it is already a difficult task to manage supply chain security regarding the conventional threats; it becomes even harder if the chain is a target of an intelligence operation: "…getting visibility to lower-tier and sub-tier suppliers, and determining which suppliers pose the most risk. Gaining full visibility into every supplier at each sub-tier is a herculean task".[205]
The possibility of manipulation of components being produced at or transported from sub-tier suppliers has already been pointed out and proven by several academic papers

199 Cf. Tung, Liam: Nokia strikes China joint venture for 'swift approval' of Alcatel-Lucent merger - Nokia hopes to win the approval of China's regulators with a new joint venture with Chinese investment firm Huaxin, in: ZDNet.com, August 28, 2015, https://www.zdnet.com/article/nokia-strikes-china-joint-venture-for-swift-approval-of-alcatel-lucent-merger/ (Accessed on April 18, 2019).

200 Cf. Telefonaktiebolaget LM Ericsson and Centre for Business History: History – China, Ericsson, https://www.ericsson.com/en/about-us/history/places/asia/china (Accessed on April 18, 2019).

201 Cf. Ericsson: Ericsson inaugurates new R&D facilities in Nanjing, September 20, 2012, https://www.ericsson.com/en/press-releases/2012/9/ericsson-inaugurates-new-rd-facilities-in-nanjing (Accessed on April 18, 2019).

202 Cf. Liu, Zheng: Ericsson preserves competitiveness on 5G development in China, in: China Daily, February 23, 2016, http://www.chinadaily.com.cn/business/tech/2016-02/23/content_23608976.htm (Accessed on April 18, 2019).

203 Cf. GSMA: Industrual Iot Case study - Ericsson smart Factory, September 07, 2018, https://www.gsma.com/iot/ericsson-smart-industrial-factory/ (Accessed on April 18, 2019).

204 Cf. Ericsson: Ericsson Annual Report 2017, Ericsson, 2018, https://www.ericsson.com/assets/local/investors/documents/2017/ericsson-annual-report-2017-en.pdf (Accessed on April 23, 2019).

205 Koebler, Jason; Cox, Joseph: The Worst Hack in Science Fiction Has Allegedly Already Happened in Real Life, in: Motherboard, October 04, 2018, https://motherboard.vice.com/en_us/article/gye8w4/chinese-supply-chain-hack-apple-bloomberg (Accessed on April 18, 2019).

and security research[206], but also by the documents leaked by Edward Snowden, showing NSA implanting surveillance capabilities in commercial hardware.[207] It is this risk which was ironically indicated by the chief security officer for Huawei in the US, Andy Purdy: "China—or another country with good hacking skills—could target the supply".[208]
However, there is a substantial difference between subverting a supply chain and subverting the design of the hardware in order to produce built-in vulnerabilities. The latter, once achieved, poses the bigger risk and hence uncertainty for the customers. Infiltrating the hardware during the production in such a way that any altered or added parts do not impair the product but also look generic requires deep knowledge of the piece of hard- or software in question. "So China-based factories introduce some risk, but it is not as great as China-based and China-designed."[209]

Still, it should not be neglected that the two European vendors do not only have production facilities, but also main R&D facilities in China. For Ericsson, with some 5000 employees working in several research and development facilities in Beijing, Shanghai, Guangzhou, Nanjing, Chengdu and Shenzhen, China became the largest innovation base for the company.[210] With the need to relocate the design closer to the manufacturing sites, the company increased the investment in R&D there.[211] For example, Ericsson launched a new 11,700sq m research site in Nanjing in 2012.[212] With the additional acquisition of companies located in China, the Swedes also expand on facilities and homegrown experts in the country.[213]
As for the Finnish rival Nokia, it is also heavily relying on its R&D capabilities at the Nokia Shanghai Bell which is an integral part of its global operations. The Shanghai Bell Labs is ranked as a top 10 enterprise center in China and is an integral part of the company's further development of IP Routing and 5G technologies, as it engages in such areas as Wireless access and fixed access technology, advanced multiple antenna technologies, device to device communication, Cloud RAN etc.[214] Nokia's pioneering research project – Future X network – is also one of the Bell Labs main projects.[215]

206 A recent highly reported example was the "Big Hack" report by Businessweek in 2018, as an illustration of one possible scenario. The report indicated a major infiltration of the motherboard production of US-American Super Micro Computer, one of the largest motherboard vendors by Chinese-made microchips, thus providing a backdoor to Amazon, Apple and several other big companies' servers. Although this was strongly denied by the concerned firms, it is still not clear whether the report's findings are true or not. –Cf. Robertson, Jordan; Riley, Michael: The Big Hack: How China Used a Tiny Chip to Infiltrate US Companies, in: Bloomberg Businessweek, October 04, 2018, https://www.bloomberg.com/news/features/2018-10-04/the-big-hack-how-china-used-a-tiny-chip-to-infiltrate-america-s-top-companies (Accessed on April 18, 2019).

207 Cf. Simonite, Tom: US Lawyers Don't Buy Huawei's Argument on Chinese Hacking, in: Wired April 03, 2019, https://www.wired.com/story/us-lawyers-dont-buy-huaweis-argument-chinese-hacking/ (Accessed on April 18, 2019).

208 Ibid.

209 Fernando, Gavin: Can the Australia-China relationship survive a Huawei ban?, in: News.com.au, August 14, 2018, https://www.news.com.au/technology/online/security/can-the-australiachina-relationship-survive-a-huawei-ban/news-story/ab43488a903c11bc5f5ec5c45d17bd69 (Accessed on April 18, 2019).

210 Cf. Liu, Zheng: Ericsson preserves competitiveness on 5G development in China, in: China Daily, February 23, 2016, http://www.chinadaily.com.cn/business/tech/2016-02/23/content_23608976.htm (Accessed on April 18, 2019).

211 Cf. PowerPulse.net: Ericsson Opens New Design Center in China, February 09, 2004, https://powerpulse.net/apc-presents-new-apc-scm-r-digital-controller/ (Accessed on April 18, 2019).

212 Cf. Ericsson: Ericsson inaugurates new R&D facilities in Nanjing, September 20, 2012, https://www.ericsson.com/en/press-releases/2012/9/ericsson-inaugurates-new-rd-facilities-in-nanjing (Accessed on April 18, 2019).

213 Cf. Bushell-Embling, Dylan: Ericsson buys China's Sunrise Technology, in: Telecomasia.com, March 17, 2015, https://www.telecomasia.net/content/ericsson-buys-chinas-sunrise-technology (Accessed on April 18, 2019).

214 Cf. Nokia Bell Labs: Shanghai – China, https://www.bell-labs.com/connect/global-locations/shanghai-china/ (Accessed on April 18, 2019).

215 Cf. IT-Times: Nokia: Was hinter dem neuen Joint Venture Shanghai Bell mit China Huaxin steckt, Mai 18, 2017, https://www.it-times.de/news/nokia-was-hinter-dem-neuen-joint-venture-shanghai-bell-mit-china-huaxin-steckt-124094/ (Accessed on April 18, 2019).

NATURE OF GLOBAL SUPPLY CHAINS

Certainly, locating manufacturing and R&D sites in China does not make Nokia and Ericsson Chinese companies. They are, however, fully embedded in Chinese society and its company structure and culture. By Chinese law it is eligible for Chinese Communistic Party to set up a party commission in every sized enterprise with possibilities to exercise influences on strategic decisions of the company. This is particularly the case for joint ventures between Chinese authorities and foreign investors where the party acts as shareholders on behalf of the Government units.

This has obviously led to the impression that the Chinese party has extended its pressure on foreign companies which are traditionally obliged to operate in joint venture structures with local firms - a structure that can be a gateway for pressure from Beijing. This impression has intensified sharply since President Xi Jinping entered office in 2013. Reports about executives of Western firms who were urged by their Chinese partners to involve internal party committees[216] in decisions of strategic dimension increased[217] against the background that Xi launched a massive campaign to reinforce the "leading role" of the CCP in China.

East-Asia with China at its core will be crucial for 5G in terms of its markets size and the pace of implementation of 5G for the vendors. Beijing's possible counter measures could negate the advantages European vendors would acquire in other regions after a possible Huawei's ban.

It is interesting to see that newly growing claims of the CCP to power in Chinese enterprises were perceived by foreign observers as "political infiltration". "Infiltration", remarked James Zimmerman, a Beijing based lawyer with connections to multinational corporations, "by party operatives into the executive circle of foreign-invested enterprises is not extensively apparent at this time but things are certainly going in that direction"[218]

Zimmerman´s observation is correct, but not new. The board of Ericsson's Chinese facilities, for example, is cast with several directors who also hold positions in the Communist Party[219] - they are charged by the party to represent the interests of the government as shareholder. In Nokia's case, the Nanjing Panda company, for instance, has an executive director who is also the party committee secretary of the company and served as general manager of Military Communication Department of Panda Electronic Group Ltd.[220] Furthermore, the share of Chinese employees among the top tiers of the companies has also been growing over time.[221]

Moreover, one can assume that the vendors already see the danger of being compromised while also being the target of US tariffs on China-made equipment, as some of them start to relocate the production out of China,[222] e.g. Nokia addressed the efforts to reduce the risk by short-term outsourcing of some manufacturing from China to APAC and

216 It is required by law to establish a party organization at the joint venture with a participation of a foreign company inside of China.

217 Cf. Stevenson, Alexandra: China's Communists Rewrite the Rules for Foreign Businesses, in: The New York Times, April 13, 2018, https://www.nytimes.com/2018/04/13/business/china-communist-party-foreign-businesses.html (Accessed on April 18, 2019).

218 Ibid.

219 Cf. Backer, Richard: Top 5G suppliers linked to China's Communist Party, in: The Sydney Morning Herold, August 13, 2018, https://www.smh.com.au/business/companies/top-5g-suppliers-linked-to-china-s-communist-party-20180812-p4zwzt.html (Accessed on April 18, 2019).

220 Cf. Panda: Directors, Nanjing Panda Electronics Company Limited, http://www.panda.cn/index_352.aspx (Accessed on April 18, 2019).

221 Cf. Fey, Carl E. et al.: Does One Shoe Fit Everyone? A Comparison of Human Resource Management in Russia, China, and Finland, in: Organizational Dynamics, Vol. 33, No. 1, 2004, pp. 79–97.

222 Cf. Dano, Mike: Vendors' sigh of relief: Dell'Oro predicts growth in infrastructure market for 1st time in 7 years, in: Fierce Wireless, January 30, 2018, https://www.fiercewireless.com/wireless/vendors-sigh-relief-dell-oro-predicts-growth-infrastructure-market-for-1st-time-7-years (Accessed on April 18, 2019).

increasing capacities in other facilities.[223] However, Huawei too is asking its suppliers to relocate part of the production to China due to possible access restrictions to US technology, in order to reduce the risks.[224]

In this complicated situation Samsung, the Korean champion, may benefit the most. The company seeks to considerably expand its own RAN-business. Although it is only making first steps into this market, Samsung is well equipped with know-how, money and personnel as the world's leading smartphone and advanced chipsets manufacturer. Furthermore, Samsung has a very strong presence in key markets like the US, India and Japan. The company is already relocating managers and other staff to its network-divisions, but is also looking to win up to 1500 new experts and new contracts with carriers[225] and announced in 2018 to invest more than US$22 billion in the next three years, also in 5G technologies,[226] while it already boasted the biggest increase in RAN-market shares in 2017 and its revenues grew by 15% against an overall market decrease.[227]

However, Samsung and other vendors are worried about the uncertainties the late political developments brought up. As Börje Ekholm puts it: "What it has created is an uncertainty among our customers. Uncertainty is never good for investments."[228] The industry has significant troubles to make projections, plans and hence investments. "Over the past year, the impact of international political risks on the global tech industry has been unprecedented. It is the greatest that I can recall", stated the chairman of iPhone assembler Petragon, Tung Tzu-hsien.[229] According to some estimates, the disturbances may worsen with a kind of snowball effect on other suppliers in Asia, which heavily rely on Huawei and other Chinese manufacturers.[230]

NETWORK OPERATORS UNDER GEOPOLITICAL PRESSURES

This section takes a closer look at the profile, preferences, and concerns of network operators in order to enhance mutual understanding between the economic, political and

223 Seeking Alpha: Nokia Oyj (NOK) Q3 2018 Results - Earnings Call Transcript, October 25, 2018, https://seekingalpha.com/article/4214421-nokia-oyj-nok-q3-2018-results-earnings-call-transcript?part=single (Accessed on April 18, 2019).

224 Cf. Li, Lauly et al: Huawei tells suppliers to move production to China as US ban looms - Company calls on partners to relocate operations to avoid tech wall, in: Nikkei Asian Review, January 30, 2019, https://asia.nikkei.com/Economy/Trade-war/Huawei-tells-suppliers-to-move-production-to-China-as-US-ban-looms (Accessed on April 18, 2019).

225 Cf. Austrian Press Agentur: Samsung will von Huawei-Problemen profitieren, in: Der Standard, February 18, 2019, https://derstandard.at/2000098181447/Samsung-will-von-Huawei-Problemen-profitieren (Accessed on April 18, 2019).

226 Cf. Tan, Allan: Dell'Oro: 5G deployments spur EPC growth in 2Q 2018, in: Telecomasia.net, September 14, 2018, https://www.telecomasia.net/content/delloro-5g-deployments-spur-epc-growth-2q-2018 (Accessed on April 18, 2019).

227 Cf. Schoolar, Daryl: RAN Vendor Market Update: 2018 - Market dominance of the big three RAN vendors remains for now, OVUM TMT intelligence, 2018, p. 5.

228 Groll, Elias: Who Benefits From the US Crackdown on Huawei? Rival companies could get a boost—or face a backlash from China, in: Foreign Policy, January 31, 2019, https://foreignpolicy.com/2019/01/31/who-benefits-from-the-u-s-crackdown-on-huawei/ (Accessed on April 18, 2019).

229 Cf. Li, Lauly; Ting-Fang, Cheng; Liu, Coco: Huawei tells suppliers to move production to China as US ban looms - Company calls on partners to relocate operations to avoid tech wall, in: Nikkei Asian Review, January 30, 2019, https://asia.nikkei.com/Economy/Trade-war/Huawei-tells-suppliers-to-move-production-to-China-as-US-ban-looms (Accessed on April 18, 2019).

230 Cf. ibid.

societal communities. For a start, it needs to be noted that network operators are, above all, economic actors interested in profit maximization. Geopolitical issues are of concern whenever they are likely to curb the best possible revenue. Therefore, network operators are acquainted with the current debates in politics and society as they might affect their entrepreneurial options. Existing laws and future regulations, security risks or concerns, and regional promotion plans are political realms of which network operators are not only aware, but which they even try to shape in their favor by active lobbying, publicity work or technical expertise.

6.

Still, all those activities are carried out under constant economic pressure as existing players aim to gain a competitive advantage or new competitors access the market. In the globalization era, foreign competition has also increased, though the market is characterized by enormous infrastructural investment and growing capacity demands that the operator need to serve.[231] Due to rapid technical progress, an infrastructure overhaul has become even more pressing. A new telecommunication generation is introduced almost every decade[232] promising a competitive edge to the first provider on a regional and even global scale. Immense financial expenditures needed for a comprehensive provision of the service and rapidly falling prices for mobile data curbing the operators' revenues are the other side of the coin needing to be considered for understanding the carriers' attitudes towards 5G.[233]

5G-DEBATE RESHAPES CHANNELS OF INFLUENCE AND COOPERATION

The telecommunications market is a hybrid complex regulated by international standards, national legislations, local conditions and of course user demands. Although the operators are primarily economic actors, they are by far not politically incurious or impotent. Carriers are interested in keeping the costs low and check ways to monetize their investment.[234] Their major political interest is thus to shape a favorable environment for their commercial endeavors which requires them to take an active seat at negotiation tables, if possible.

The international standards, as we have discussed in section three of this report, are also influenced by the network operators. Taking a closer look at the 3GPP, for instance, the network operators' interests are represented by the Organizational Partners as well as the Market Representation Partners. Elaborating on this case, the major US carrier AT&T works with 3GPP both as an Organizational Partner through its membership in the Alliance for Telecommunications Industry Solutions (ATIS) and as a Market Representation Partner through 5G Americas.

Representation, however, does not mean direct decision making power as the 3GPP states that Market Representation Partners do "not have the capability and authority to define, publish and

231 Cf. O-RAN Alliance: O-RAN: Towards an Open and Smart RAN. White Paper, October 2018, https://static1.squarespace.com/static/5ad774cce74940d7115044b0/t/5bc79b371905f4197055e8c6/1539808057078/O-RAN+WP+FInal+181017.pdf (Accessed on February 21, 2019), p. 6.

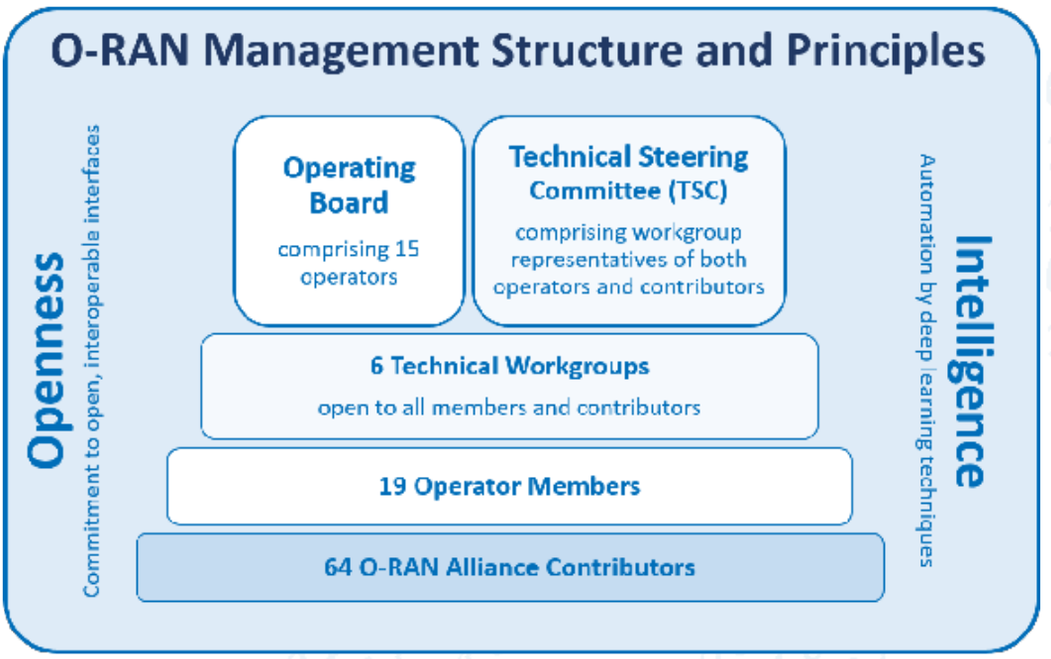
232 Cf. Dhanya, V.A.; Krishnan, Deepika G.; Sunitha, C.: Overview of Fifth Generation Networking, in: International Journal of Computer Trends and Technology (IJCTT), Vol. 43, No. 1, January 2017, p. 50.

233 Cf. Littman, Dan et al.: 5G: The chance to lead for a decade, Deloitte 2018, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-5g-deployment-imperative.pdf (Accessed on April 03, 2019).

234 Cf. ibid.: p. 6.

set standards within the 3GPP scope, nationally or regionally"[235]. That being said, their influence should also not be underrated as Market Representation Partners indeed have "the ability to offer market advice to 3GPP"[236] – in other words to lobby for their agenda.[237] This is particularly important for 5G , the rollout of which is assessed as one of the most expensive technology ventures so far. Moreover, its introduction is influenced like no previous network generation by political and national security concerns, though varying in different national settings.

On the bright side, the next generation of networks will broaden the industrial deployment and offers innovative options, hence offering a plethora of new business opportunities and customers for the operators.[238] Although this adds to the economic pressure to gain the first-mover advantage and prestige in 5G, it lays ground for a joint vision for 5G realization. In times of limited revenue growth due to ongoing market saturation of mobile subscriptions, new commercial options and cost-effective 5G development are vital to the survival of the operators. Based on this, the operators forged an industry alliance called O-RAN for the accomplishment of these goals, to pool intelligence and develop open interfaces to enhance interoperability and reduce costs.[239] German, Chinese, French, Japanese, US-American and carriers of other nationalities teamed up as operator members raising the hopes for global cooperative solutions while also pointing to their necessities.



Source: CGS 2019 based on o-ran.org

Cross-border collaboration between the operators and vendors is also common in the telecommunications industry. For example, under the aegis of O-RAN, contributors like Fujitsu, Intel, Qualcomm, Samsung, Ericsson, Nokia or ZTE established close ties with the multinational operators.[240] Taking a look at the O-RAN management structure, it

235 3GPP: Partners, 3GPP. A global Initiative, http://www.3gpp.org/about-3gpp/partners (Accessed on April 23, 2019).

236 Ibid.

237 Cf. Triolo, P.; Allison, K: Eurasia Group White Paper: The Geopolitics of 5G, in: Eurasia group politics first, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on February 20, 2019), p. 9.

238 Cf. ibid.: p. 5.

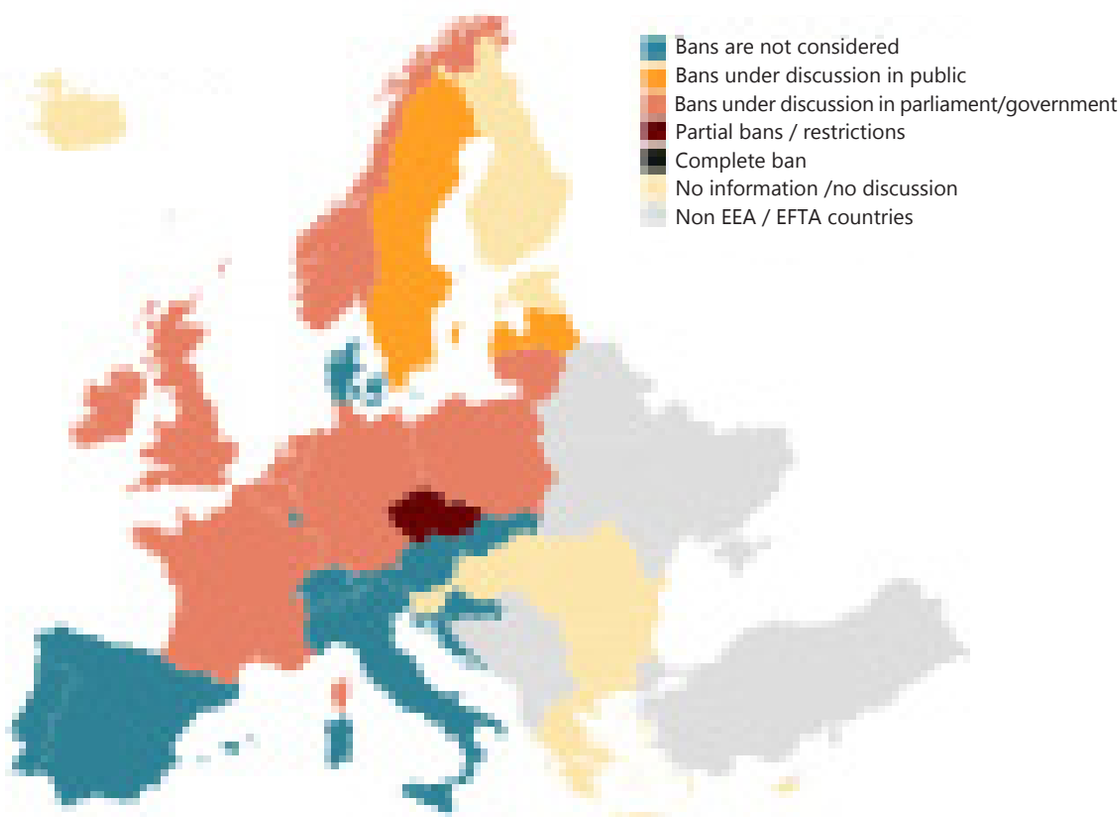
239 Cf. O-RAN Alliance: O-RAN: Towards an Open and Smart RAN. White Paper, October 2018, https://static1.squarespace.com/static/5ad774cce74940d7115044b0/t/5bc79b371905f4197055e8c6/1539808057078/O-RAN+WP+FInal+181017.pdf (Accessed on February 21, 2019), pp. 6-7.

240 O-RAN: Membership, O-RAN Alliance 2019, https://www.o-ran.org/membership (Accessed February 21, 2019).

becomes clear that the operators retain their decisive influence, whereas contributors such as the vendors are more involved in the technical realization. Nevertheless, with 19 operator members and 64 alliance contributors as of April 2019, O-RAN demonstrates a highly international, multi-actor approach committed to shared principles. Thus, while the political communities are quarreling about the growing trade confrontation between the USA and China, the mobile industry strengthened cross-regional cooperation towards commercialization based on common interests and obstacles leveraged by the 3GPP standardization work.[241]

Yet the picture is not as rosy as it seems: Some business relations have already fallen victim to the political sword of national security concerns which underscores the unwelcomed uncertainty geopolitics entail. In order to achieve faster 5G deployment, AT&T, for instance, fostered ties with China Mobile, Deutsche Telekom, Huawei,

Discussion of Huawei Bans in EEA and EFTA Countries



Source: CGS 2019

Ericsson, Samsung and other telecommunication leaders as announced in August 2016.[242] Over the years, however, the US government has increased political pressures to bar Chinese firms from the telecommunications market and particularly from gaining foothold in US 5G networks – fears of espionage and even kill-switch opportunities are

241 Cf. SoftBank Corp: Mobile industry works together to deliver complete 5G system standard on time, SoftBank, June 14, 2018, https://www.softbank.jp/en/corp/set/data/group/sbm/news/press/2018/20180614_02/pdf/20180614_02.pdf (Accessed on February 21, 2019).

242 Cf. AT&T: AT&T Teams Up with Global Technology Leaders for Faster 5G Deployment, August 17, 2016, https://about.att.com/story/faster_5g_deployment.html (Accessed on February 21, 2019).

covered by the term "national security concerns" in political statements.[243]

This contributed among other things to AT&T and Verizon stopping the sale of Huawei phones in 2018.[244] Australia was the first in line to officially ban Chinese manufacturers like Huawei from equipping its 5G networks thus limiting its carriers options on behalf of political concerns. Other countries' officials, too, call for an inspection of trade and equipment regulations, but have not yet come to a final solution.[245] Uncertainty is, however, detrimental for the business, so some companies are preempting political decision-making by openly committing themselves to not use Chinese equipment. John Legere, T-Mobile US CEO, said in an official testimony that the carrier will not use Huawei or ZTE network equipment.[246] The heightened political and trade confrontation between the US and China therefore has direct implications for the technological choices of carriers and their cross-border cooperation, limit global competition and may entail unforeseeable consequences. Despite the market distortion caused by politics, gloomy pictures like a "de-globalization of global technology supply chains"[247] are painted. Although the fall-outs of this confrontation vary from country to country, it illustrates that the network operators are already involuntarily dragged onto the geopolitical stage.

Most carriers use a multi-vendor approach for their network infrastructure, which is virtually never made transparent and treated as a company secret. We even found indications that certain business relations are likely to be framed deliberately in company reports with respect to the political climate.

BUSINESS TIES UNDER CROSSFIRE

Despite any gloomy picture, tracking the supply chains in telecommunications is indeed a tricky task for outsiders. It even seems that some business ties have become a taboo for certain carriers, for instance, in its financial report of 2018, the Deutsche Telekom does with no word mention business relations to Huawei, though audit activities with Chinese equipment vendors are said to be a key area.[248] In contrast to this, its previous report of 2017 presents how the two telco companies have collaborated to enhance the "Internet of Things" for the international engineering and service company KONE.[249]
Although the Telekom cooperatively trialed Huawei 5G technology in Berlin in 2018[250], by name, only the 5G trials in Hamburg in cooperation with Nokia were presented in the financial report of that year.[251] It is also interesting to note that only Chinese suppliers have been named as a potential risk for dependencies in the report which was not the case in the year before.[252] This may be a sign of purposeful framing the business relations

243 Cf. Triolo, P.; Allison, K: Eurasia Group White Paper: The Geopolitics of 5G, in: Eurasia group politics first, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on February 20, 2019), p.17.

244 Cf. Sanger, David E. et al: In 5G Race With China, US Pushes Allies to Fight Huawei, in: The New York Times, January 26, 2019, https://www.nytimes.com/2019/01/26/us/politics/huawei-china-us-5g-technology.html (Accessed on February 22, 2019).

245 Cf. Triolo, P.; Allison, K: Eurasia Group White Paper: The Geopolitics of 5G, in: Eurasia group politics first, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on February 20, 2019), p.15-16.

246 Cf. Shields, T.; Bloomberg: T-Mobile CEO to Congress: We Won't Use Huawei Equipment After Sprint Acquisition, Fortune, February 13, 2019, http://fortune.com/2019/02/12/t-mobile-congress-testimony-huawei-equipment-sprint-acquisition/ (Accessed on February 22, 2019).

247 Triolo, P.; Allison, K: Eurasia Group White Paper: The Geopolitics of 5G, in: Eurasia group politics first, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on February 20, 2019), p. 18.

248 Deutsche Telekom AG. (2019). Deutsche Telekom: Das Geschäftsjahr 2018. Bonn, p. 88.

249 Deutsche Telekom AG. (2018). Deutsche Telekom: Das Geschäftsjahr 2017. Bonn, p. 29.

250 vom Hofe, Klaus: 5G tests out of the bus, Telekom, August 29, 2018 https://www.telekom.com/en/company/details/5g-tests-out-of-the-bus-537456 (Accessed on March 13, 2019).

251 Deutsche Telekom AG. (2018). Deutsche Telekom: Das Geschäftsjahr 2017. Bonn, p. 28.

252 Deutsche Telekom AG. (2018). Deutsche Telekom: Das Geschäftsjahr 2017. Bonn, p. 122.

according to political debates as many countries are either discussing or adopting a ban of Chinese vendors. In Germany, the Federal Network Agency has published additional safety requirement for telecommunication networks in March 2019 before the parliament had decided on definite legal measures. In these requirements, the Agency forbids "monocultures" in equipment supplies, obliges regular security inspections and allows only "trustworthy" meaning authorized vendors.[253] The actual impact of these measures and potential costs are hard to gauge. Referring to the exemplary case, the Telekom alone has a global network of more than 20,000 suppliers from over 80 countries[254] which makes it virtually impossible for public authorities to check all of them.

In reality, usually all network carriers install the technologies of different vendors and do not fully depend on one single supplier. Besides, Huawei is said to be the only supplier to equip all of the currently three national German mobile operators.[255] Even in the US, where the telco "industry has generally avoided Huawei under government pressure"[256], some operators warn about prohibitive measures and high replacement costs for already installed equipment. The Rural Wireless Association (RWA), a trade association for small-size rural wireless carriers, reports that an estimated one fourth of its members uses equipment from Chinese suppliers. Estimated replacement costs differ from carrier to carrier – Pine Belt Wireless in Alabama expects US$7 to US$13 million in direct costs, Sagebrush Cellular in Montana around US$57 million.[257]

Huawei technology is used presumably in around half of the roughly 75,000 German base stations making 13,500 out of nearly 27,000 base stations for the Deutsche Telekom alone...

In the unlikely scenario that German network operators would have to remove already existing gear, the costs would be billions of euros.[258] While there are no exact numbers, it is reported that Huawei technology is used in around half of the roughly 75,000 German base stations; that would be around 13,500 out of nearly 27,000 base stations for the Deutsche Telekom alone.[259] One base station is calculated with around €170,000 plus backhaul and additional costs like rents, though these costs may significantly vary depending on the individual circumstances.[260] Based on these numbers, a replacement of all Huawei-equipped German base stations would cost up to €6.4 billion of which €2.3 billion would be carried by the Telekom alone. If in such an event no reimbursement funds are offered – as proposed by the RWA[261] – the carriers might pass on these costs to the consumers meaning higher prices for communication services.

On a global scale, 5G has triggered unprecedented debates about telecommunication

253 Bundesnetzagentur: Bundesnetzagentur veröffentlicht Eckpunkte zusätzlicher Sicherheitsanforderungen für Telekommunikationsnetzwerke, March 7, 2019.

254 Deutsche Telekom AG. (2018). Deutsche Telekom: Das Geschäftsjahr 2017. Bonn, p. 87.

255 Sawall, Achim: 5G: Telekom hält Spionagevorwürfe gegen Huawei für unbegründet, Golem, December 04, 2018a, https://www.golem.de/news/5g-telekom-haelt-spionagevorwuerfe-gegen-huawei-fuer-unbegruendet-1812-138049.html (Accessed on March 13, 2019).

256 Bloomberg: Huawei Crackdown Exposes Europe as Laggard in Global 5G Race, February 20, 2019, https://www.supplychainbrain.com/articles/29425-huawei-crackdown-exposes-europe-as-laggard-in-global-5g-race (Accessed on March 13, 2019).

257 Dano, Mike: Apple, Nokia, others worry over manufacturing operations in China, in: Fierce Wireless, December 12, 2018, https://www.fiercewireless.com/wireless/apple-nokia-others-worry-over-manufacturing-operations-china (Accessed on April 18, 2019).

258 Cf. Bloomberg: Huawei Crackdown Exposes Europe as Laggard in Global 5G Race, February 20, 2019, https://www.supplychainbrain.com/articles/29425-huawei-crackdown-exposes-europe-as-laggard-in-global-5g-race (Accessed on March 13, 2019).

259 Cf. Dohmen, F. et al: Superschnell, Superteuer: Der verpatzte Start des neuen 5G-Standards, in: Der Spiegel 11/2019, March 03, 2019, https://magazin.spiegel.de/SP/2019/11/162787661/index.html (Accessed on March 13, 2019).

260 Cf. Sawall, Achim: Bundesregierung: Was eine Mobilfunkanlage kostet, Golem, March 11, 2018b, https://www.golem.de/news/bundesregierung-was-eine-mobilfunkanlage-kostet-1811-137497.html (Accessed on March 13, 2019).

261 Cf. Dano, Mike: Apple, Nokia, others worry over manufacturing operations in China, in: Fierce Wireless, December 12, 2018, https://www.fiercewireless.com/wireless/apple-nokia-others-worry-over-manufacturing-operations-china (Accessed on April 18, 2019).

business ties. Some of the biggest telecommunication players have already barred the Chinese vendors as mentioned in the previous section. Japan's four carriers have themselves decided against Huawei and ZTE 5G-equipment, in South Korea two out of three mobile carriers (with exemption of LG Uplus) will not use Huawei supplies, in the US the Chinese suppliers have officially been shut out of the 5G infrastructure, whereas the European picture looks as fragmented as usual in this industry.[262]

Consequences of these decisions are reportedly already felt by Ericsson that is struggling to meet demand in North America.[263] On a global scale, Huawei has already delivered more than 40,000 5G-base stations as of February 2019 based on contracts with around 30 operators, 18 of them based in Europe.[264] Replacement costs are therefore not the only consequence to be considered by the network contractors, but also the mere possibility that the other vendors like Ericsson or Nokia may not compensate a swap-out.
Observers fear that these suppliers neither have the human nor the product resources to cope with such a demand without seriously delaying the 5G rollout.[265] Still, time is more than a valuable commodity for the operators on the highly competitive telecommunications market which underlines the multiple aspects of the political crossfire on the 5G issue. This also sheds some light on reasons for the public framing or even covering of some business relations and global supply chains of certain telecommunication enterprises.

CARRIERS PUSHED AND DETAINED BY POLITICS

For politics, 5G has evolved to a litmus test of innovation capacities, becoming frontrunner in future technologies and production processes. Consequently, carriers have become a lever for politics to realize this vision. As the previous sections have indicated, the network providers are at the same time pushed and limited by the political sphere.
Carriers based in the European Union need to consider the national level as well as the European framework which defines the rules of competition, sets goals for network development and enables funding. They are for example subject to the EU competition rules on antitrust, state aid and mergers. The European Commission may impose fines in case of competition infringement or prohibit mergers as it was the case in 2016 of the proposed acquisition of O2 UK by Hutchison.[266]
A prominent example of EU ruling was the "roam like at home" decision that took effect in mid-2017. Network operators now needed to accept that European mobile users from all member states may occasionally use their networks charging the domestic rate.[267] The operators had to face the end of extra roaming revenues, whereas permanent free-of-charge roaming remained off the table – also underlining the political heft of the telco industry.

262 Cf. Horikoshi, I.; Kawakami, T.: Telecom's 5G revolution triggers shakeup in base station market, in: Nikkei Asian Review, December 25, 2018, https://asia.nikkei.com/Business/Technology/Telecom-s-5G-revolution-triggers-shakeup-in-base-station-market (Accessed on March 13, 2019).

263 Cf. Morris, Iain: Huawei Muscle Puts Ericsson, Nokia on 5G Back Foot in Europe – Sources, in: Light Reading, February 14, 2019, https://www.lightreading.com/mobile/5g/huawei-muscle-puts-ericsson-nokia-on-5g-back-foot-in-europe---sources/d/d-id/749474 (Accessed on April 18, 2019).

264 Cf. Planken, Max: Huawei hat bereits 40.000 5G Sender ausgeliefert, Maxwireless, February 20, 2019, https://maxwireless.de/2019/huawei-hat-40000-5g-sender-ausgeliefert/ (Accessed on March 13, 2019).

265 Cf. Morris, Iain: Huawei Muscle Puts Ericsson, Nokia on 5G Back Foot in Europe – Sources, in: Light Reading, February 14, 2019, https://www.lightreading.com/mobile/5g/huawei-muscle-puts-ericsson-nokia-on-5g-back-foot-in-europe---sources/d/d-id/749474 (Accessed on April 18, 2019).

266 Cf. European Commission: Competition. Telecommunications Overview, January 11, 2018, http://ec.europa.eu/competition/sectors/telecommunications/overview_en.html (Accessed on February 25, 2019).

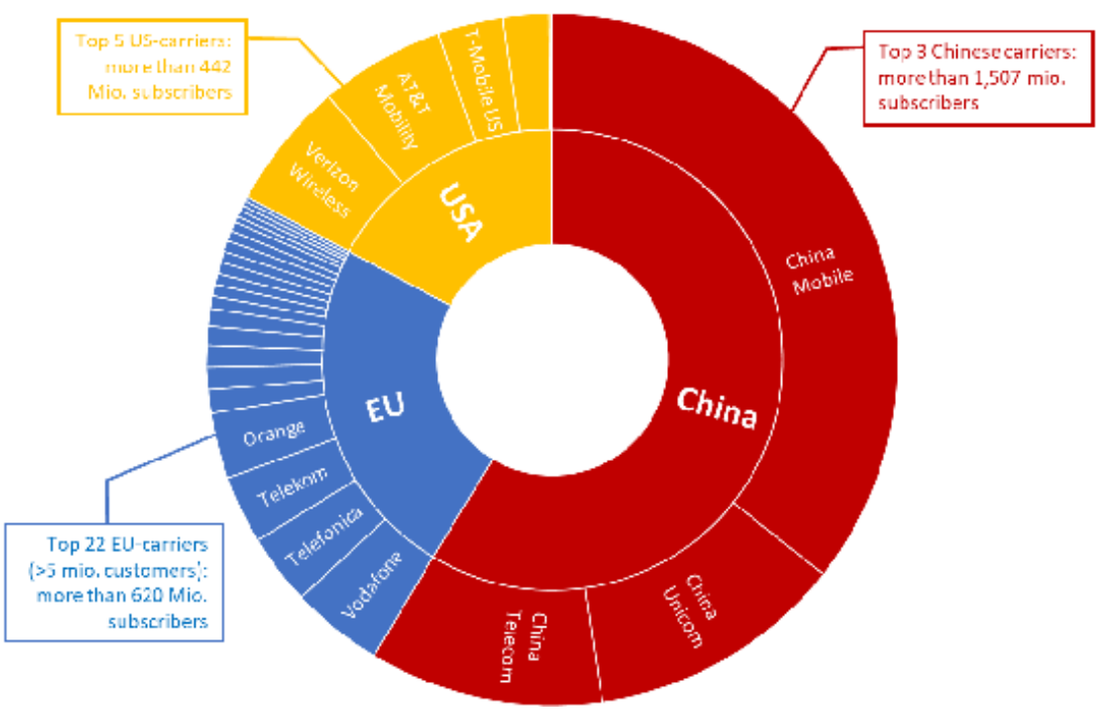
267 European Union: Roaming in the EU. Roam like at home, January 24, 2019, https://europa.eu/youreurope/citizens/consumers/internet-telecoms/mobile-roaming-costs/index_en.htm (Accessed on February 25, 2019).

Nevertheless, the telecommunications market remains a hybrid system of European and national level regulations and obligations as visible in the planned introduction of 5G. Already in September 2016, the European Union set the target to cover all urban areas and all major terrestrial transport paths with uninterrupted 5G by 2025.[268]

The roadmap was specified in its Action Plan "5G for Europe" to ensure a "timely and coordinated deployment of 5G networks in Europe".[269] The Commission aims at tackling the major risk of lacking coordination, promising upcoming pan-European efforts which means new obligations and policy-opportunities for network operators. By targeting a commercial large scale introduction by the end of 2020 and pushing for harmonized 5G spectrum allocations, the EU aims at accelerating the 5G rollout and supporting its future competitiveness which also brings additional sources of public funding.[270]

While this is an ambitious plan, national conditions vary widely in terms of already

The Largest Regional Mobile Network Operators by Subscribers



Source: CGS 2019 based on Company Rerports

existent fiber infrastructure, public funding schemes or 5G spectrum auctions for network operators. In some countries, the carriers need to fulfill certain coverage requirements in rural and oftentimes unprofitable areas. In Germany, coverage requirements have even

268 Cf. European Court of Auditors (ECA): Special Report No 12: Broadband in the EU Member States: despite progress, not all the europe 2020 targets will be met, Luxembourg 2018, https://www.eca.europa.eu/Lists/ECADocuments/SR18_12/SR_BROADBAND_EN.pdf (Accessed on February 25, 2019), p. 3-14.

269 Cf. European Commission: 5G for Europe: An Action Plan. COM (2016) 588 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels September 14, 2016, https://ec.europa.eu/digital-single-market/en/news/communication-5g-europe-action-plan-and-accompanying-staff-working-document (Accessed on March 07, 2019), p. 3.

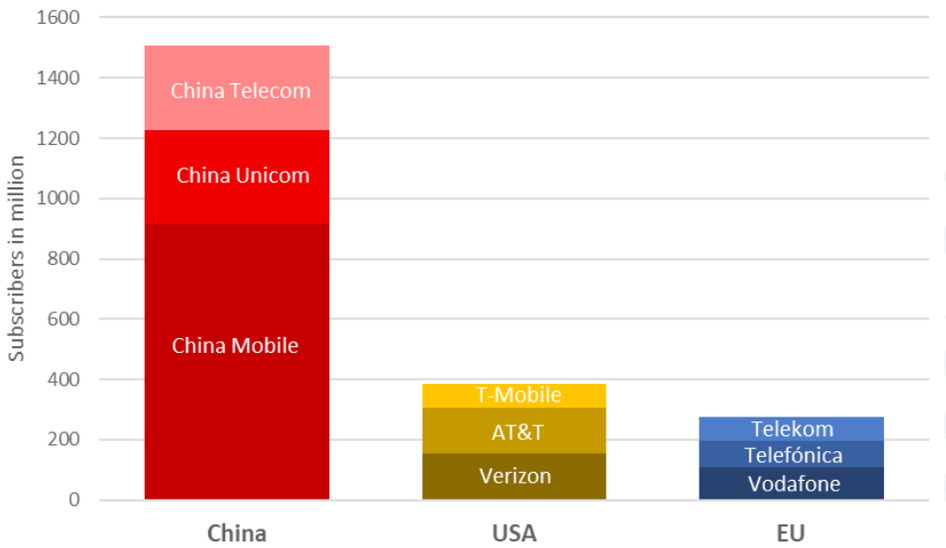
270 Cf. European Commission: 5G for Europe: An Action Plan. COM (2016) 588 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels September 14, 2016, https://ec.europa.eu/digital-single-market/en/news/communication-5g-europe-action-plan-and-accompanying-staff-working-document (Accessed on March 07, 2019), p. 3-4, 10

been set for carriers to participate in the spectrum auction.[271] Despite public funds, most of the investments for example for broadband are provided by private operators and the funding gap for the targeted rural areas not properly addressed in most EU member states.[272]

As divergent as the national telecommunication conditions in Europe are the profiles of network operators. US-American operators are generally privatized, Chinese carriers are state-owned, but European carriers are very mixed in their ownership structure with governments oftentimes being shareholder in the companies. This might also contribute to diverging expectations in terms of funding and cross-border competition that translates into the complex picture in Europe. The differences are huge and current assessments for the broadband backbone of 5G are that most of the EU countries will likely miss the 2020 target of providing 50% or more of European households with ultrafast connections of more than 100 Mbps.[273]

The figures illustrate the highly fragmented mobile network operators market in the European Union. Data for these figures are already merged, thus subsidiary companies are assigned to their owner and only the 22 operators with more than 5 million subscribers are

The Top 3 Regional Network Operators



Source: CGS 2019 based on Company Rerports

presented. Consequently, the multi-actor nature of the EU market becomes obvious. In contrast to this, the US and Chinese markets are more concentrated. Therefore, the top three regional network operators count more customers in the United States of America and China. However, the difference in market concentration between the US and the EU is rather small compared to that of China.

While there is hardly any reliable data on the Chinese broadband state, the carriers are subject to an enormous governmental push to move to standalone 5G. In contrast to the

271 Cf. NERA Economic Consulting: Telecommunications Infrastructure International Comparison. A Report for the Department of Digital, Culture, Media and Sports, March 30, 2018, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727891/FTIR_Annex_B-_NERA_Telecommunications_Infrastructure_International_Comparison.pdf (Accessed on March 13, 2019), p. 71.

272 Cf. European Court of Auditors (ECA): Special Report No 12: Broadband in the EU Member States: despite progress, not all the europe 2020 targets will be met, Luxembourg 2018, https://www.eca.europa.eu/Lists/ECADocuments/SR18_12/SR_BROADBAND_EN.pdf. (Accessed on February 25, 2019), p. 34

273 Cf. European Court of Auditors (ECA): Special Report No 12: Broadband in the EU Member States: despite progress, not all the europe 2020 targets will be met, Luxembourg 2018, https://www.eca.europa.eu/Lists/ECADocuments/SR18_12/SR_BROADBAND_EN.pdf. (Accessed on February 25, 2019), p. 21.

EU or the United States, China is keeping its operators on the short leash of "managed competition"[274]. The state owns the carriers and the state directs the carriers. This is for example visible in the management of mergers. Media sources such as Reuters and Bloomberg[275] said a merger of China Unicom and China Telecom was explored by Chinese officials in 2018 for the sake of reducing 5G infrastructure costs.[276]

For the Chinese carriers state-ownership means both an advantage and a disadvantage on the global telecommunications market. To illustrate, in 2018, the Trump administration blocked access to China Mobile, the largest Chinese carrier. It declared that the company posed a potential security risk due to the state's holdings.[277] The current debate on 5G concentrates on globally selling Chinese vendors because network operators usually have a national reach. In this regard, one misses the potential edge that these carriers might gain by successfully applying 5G technology for the masses on an early or even on the first stage and their promotion by Belt and Road infrastructure investments.[278] While the latter particularly applies to the vendors, carriers might also gain market entrance to third countries if their home companies lack the technical expertise or financial endowments. Although Europeans and US-Americans are engaged in development politics around the globe, neither offer a comparable infrastructure campaign.

Regional market sizes and concentrations vary to a great extent. We can see that the network operators' landscape is the most fragmented in the European Union and the least in China. This entails and fosters divergent interests as well as regulatory needs for 5G, of which the political sphere needs to be aware.

As the Chinese government has declared 5G development a strategic priority, e.g. in its "Made in China" 2025 Initiative, domestic carriers can rely on strong government support in terms of funding and global advertising for their agenda and Chinese standards.[279] The goal for China is to lead in 5G instead of catching up with the "West" – the political push of this long-term strategy is visible in all aspects of 5G development, be it standard-setting, manufacturing or stand-alone deployment of 5G at scale.[280] With this support, China Mobile was already able to conduct 5G trials in 2016 and plans to launch 5G services by late 2019 – one year earlier than originally planned.[281]

In contrast to US or European carriers, the Chinese did not have to spend billions on 5G spectrum allocation auctions. The Chinese frequency bands are allocated by assignment, not by auction. Some observers view this as a major advantage for Chinese carriers as no dead money is spent for licensing instead of research and development or infrastructure.[282] Beijing's top-down approach to foster 5G development thus currently

274 Cf.Triolo, P.; Allison, K: Eurasia Group White Paper: The Geopolitics of 5G, in: Eurasia group politics first, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on February 20, 2019), p. 13.

275 Cf. Reuters: China explores merger of carriers China Unicom, China Telecom: Bloomberg, Reuters Technology News, September 4, 2018, https://www.reuters.com/article/us-china-telecoms-merger/china-explores-merger-of-carriers-china-unicom-china-telecom-bloomberg-idUSKCN1LK0VQ (Accessed on March 13, 2019).

276 Cf. Triolo, P.; Allison, K: Eurasia Group White Paper: The Geopolitics of 5G, in: Eurasia group politics first, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on February 20, 2019),p. 13.

277 Cf. Goh, B.; Jiang, S.: Trump moves to block China Mobile's US entry on security concerns, Reuters Business News, July 03, 2018, https://www.reuters.com/article/us-usa-china-china-mobile-idUSKBN1JT02M (Accessed on February 25, 2019).

278 Cf. Triolo, P.; Allison, K: Eurasia Group White Paper: The Geopolitics of 5G, in: Eurasia group politics first, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on February 20, 2019), p. 13.

279 Cf. Pujol, Frédéric et al: 5G Observatory Quarterly Report 2. Up to December 2018, IDATE DigiWorld. European Commission, January 2019, http://5gobservatory.eu/wp-content/uploads/2019/01/80082-5G-Observatory-Quarterly-report-2-V2.pdf (Accessed on February 25, 2019), pp. 16-17.

280 Cf. Brake, Doug: Economic Competitiveness and National Security Dynamics in the Race for 5G between the United States and China, in: ITIF (Information Technology and Innovation Foundation), August 2018, p. 12-14.

281 Cf. Pujol, Frédéric et al: 5G Observatory Quarterly Report 2. Up to December 2018, IDATE DigiWorld. European Commission, January 2019, http://5gobservatory.eu/wp-content/uploads/2019/01/80082-5G-Observatory-Quarterly-report-2-V2.pdf (Accessed on February 25, 2019), pp. 16-17.

282 Cf. Woyke, Elizabeth: China is racing ahead in 5G. Here's what that means, in: MIT Technology Report, December 18, 2018, https://www.technologyreview.com/s/612617/china-is-racing-ahead-in-5g-heres-what-it-means/ (Accessed on April 18, 2019).

seems to turn out well and China is even found to have outspent the US by US$24 billion in 5G infrastructure from 2015-2018.[283] However, it is Verizon which first launches a commercial 5G service on October 1st, 2018 in four US-cities, thus winning a "world's first"-prestige point for the United States.[284]

In the United States, 5G development and deployment is mainly industry-driven. This is oftentimes assessed as the country's main competitive advantage to spur innovation but also leads to varying approaches on 5G and aggressive timelines owing to commercial pressures. As stated above, the private telecommunication providers have to face the uncertainty of politics restricting certain sources of equipment, whereas they have to put up capital for 5G frequency bands and drive technical and infrastructural deployment.[285] Yet the market-driven approach of the United States has pushed the carriers to spur 5G introduction. Although the carriers are still far from a comprehensive rollout (partly because 5G compatible smartphones are only just emerging), AT&T already launched the first commercial standard-based mobile 5G network in December 2018 underlining the great pressure of showing early successes. The political influence is furthermore visible in the commercial ties of the US telco providers as the 5G Observatory report does not state any partnership of the US operators such as Verizon or AT&T with Chinese vendors.[286] The expected executive order to ban Chinese-origin equipment in telecommunications networks due to security concerns seems to have already adjusted the operator's behavior before its official release.
A cost-efficient rollout is, however, of central concern for US carriers. Accenture, for instance, estimates that the telecom operators will have to invest US$275 billion on 5G infrastructure, of which US$93 billion have to be spent on construction alone. This might in turn boost their revenue and may more generally increase the annual US GDP by US$500 billion and create up to 3 million new jobs.[287] The early deployment of 5G infrastructure and 5G-ready smartphones promises market share gains, increased revenues and thus possible returns of their investments.

Beyond that, first-mover and leadership advantages add to the economic gains as it is estimated that the US leadership in the fourth telecommunications generation has added up to US$100 billion to the US economy.[288] Having said that, the "value that will be captured by carriers is uncertain"[289], as Deloitte points out. As the United States apply a market-led approach to 5G, carriers are much more sensitive to the costs and

283 Cf. Gallagher, Jill C.; DeVine, Michael E. (Congressional Research Service): Fifth-Generation (5G) Telecommunications Technologies: Issues for Congress, January 30, 2019, https://crsreports.congress.gov/product/pdf/R/R45485 (Accessed on April 10, 2019), p. 10-11.

284 Cf. Pujol, Frédéric et al: 5G Observatory Quarterly Report 2. Up to December 2018, IDATE DigiWorld. European Commission, January 2019, http://5gobservatory.eu/wp-content/uploads/2019/01/80082-5G-Observatory-Quarterly-report-2-V2.pdf (Accessed on February 25, 2019), p. 13.

285 Cf. Gallagher, Jill C.; DeVine, Michael E. (Congressional Research Service): Fifth-Generation (5G) Telecommunications Technologies: Issues for Congress, January 30, 2019, https://crsreports.congress.gov/product/pdf/R/R45485 (Accessed on April 10, 2019), pp. 10-11.

286 Cf. Pujol, Frédéric et al: 5G Observatory Quarterly Report 2. Up to December 2018, IDATE DigiWorld. European Commission, January 2019, http://5gobservatory.eu/wp-content/uploads/2019/01/80082-5G-Observatory-Quarterly-report-2-V2.pdf (Accessed on February 25, 2019), pp. 13-15.

287 Cf. Al Amine, M.; Mathias, K.; Dyer, T.: Smart Cities: How 5G can help municipalities become vibrant smart cities, in: Accenture Strategy, January 12, 2017, https://www.accenture.com/t20170222T202102__w__/us-en/_acnmedia/PDF-43/Accenture-5G-Municipalities-Become-Smart-Cities.pdf (Accessed on February 26, 2019), p. 3.

288 Gallagher, Jill C.; DeVine, Michael E. (Congressional Research Service): Fifth-Generation (5G) Telecommunications Technologies: Issues for Congress, January 30, 2019, https://crsreports.congress.gov/product/pdf/R/R45485 (Accessed on April 10, 2019), p. 8.

289 Littman, Dan et al.: 5G: The chance to lead for a decade, Deloitte 2018, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-5g-deployment-imperative.pdf (Accessed on April 03, 2019), p. 6.

potential payout. Consequently, not all areas or industries might gain access to the new telecommunications generation in the US by reason of low profitability or local resistance to the placement of 5G infrastructure.[290]

Yet Deloitte warns US policymakers to take a tight grip on the development of 5G. In their view, over-regulation, subsidizing or nationalizing the 5G industry could possibly disrupt the market dynamics that created the US LTE leadership. Instead they propose a twofold approach to stimulate 5G development and investments: a light-touch policy framework and a smarter bureaucratic process to infrastructure permissions. The former should encourage negotiated contracts between the carriers and the Internet-reliant industry in order to strengthen investment payouts and profitability in both landscapes. The latter recommendation addresses the problem of lengthy approval processes and bureaucratic obstacles for building infrastructure. A national communications infrastructure database is proposed to increase transparency and stimulate best-practices learning.[291] In the broader context of this carrier analysis, these proposals might also be noteworthy for other countries. The European Union for example is already experienced in creating pan-European databases with Eurostat as its institutional frontrunner.

CARRIERS ARE KEY TO 5G

Despite diverging assessments of probable returns for the carriers, their differing profiles and national ecosystems, the general tenor in almost every study remains that being first matters – a belief that also the industry and politics share. This emphasizes the key role for network operators in the global race to 5G and the associated pressure. Reviewing their interests, profiles, and environments helps to understand the complexity of 5G, commercial pressures, and to explore cooperation opportunities and policy frameworks. Network operators of all types are usually the ones who are responsible for giving birth to the application of the technology by providing and managing the actual infrastructure. It is important to note that despite a general hype for 5G, it must be profitable for the carriers to invest in this technology and policymakers provide the framework to provide or deny them certain business opportunities. Even though assessments on the current state of the "5G marathon" vary, it seems a close neck-and-neck race between the two major powers United States and China in the deployment of 5G. Europe with its multi-layered regulation system but highly fragmented market is usually viewed as lagging behind, whereas Japan and South Korea are estimated to be the closest followers of the two giants.[292]

At the same time, operators are confronted with a myriad of practical, economic and political issues that may decelerate the politically envisaged swift and comprehensive 5G rollout. Beyond the already presented aspects, carriers of all nationalities still need to gain experience in the new 5G frequency ranges. Some of them also have to face lengthy and costly spectrum auctions plus governmental coverage requirements. Despite their economic capacities, carriers are dependent on municipal, regional, national and even

290 Gallagher, Jill C.; DeVine, Michael E. (Congressional Research Service): Fifth-Generation (5G) Telecommunications Technologies: Issues for Congress, January 30, 2019, https://crsreports.congress.gov/product/pdf/R/R45485 (Accessed on April 10, 2019), p. 11.

291 Littman, Dan et al.: 5G: The chance to lead for a decade, Deloitte 2018, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-5g-deployment-imperative.pdf (Accessed on April 03, 2019), p. 9.

292 Brake, Doug: Economic Competitiveness and National Security Dynamics in the Race for 5G between the United States and China, in: ITIF (Information Technology and Innovation Foundation), August 2018, p. 19.

trans-national governing entities that need to provide them with feasible policies and bureaucratic processes.

The denser 5G networks require the operators to promote these partnerships and enhance ties with formerly less weighty industries such as automobile or health companies.[293] For the carriers, 5G is a new chance to expand or gain network leadership, while financing and network sharing remain central issues of uncertainty according to the McKinsey 5G Survey 2018.[294] As the network operators are essential key players for 5G, mutual understanding between them, politics and society needs to be fostered which requires a more inclusive dialogue about the dangers, opportunities, geopolitics, economic and practical issues of this new technology.

7. COMPETING 5G NARRATIVES

While previously having focused on rather technical, albeit highly crucial, components within the context of this competition (i.e., intellectual property rights, strategies, standards, suppliers, and operators), the following section examines different and frequently dueling narratives within the larger 5G discourse. This section, accordingly, pays tribute to the importance of narratives and discourse in international relations, topics that have recently gained immense momentum in the discipline of International Relations and its diverse branches.[295] In this sense, it is narratives, or the telling of stories, which crucially shape or even construct the political today.

In an age of real-time information flows and vast improvements in information and communication technologies, this dimension of international politics may, according to some observers, even outdo more traditional power politics of military conquest or domination. According to John Arquilla and David Ronfeldt, for instance, international politics in the 21st century may no longer hinge on "whose military or economy wins," but rather "about whose story wins."[296] Reminiscent of these observations, Joseph S. Nye likewise asserts that "in the information age, success is not merely the result of whose army wins, but also whose story wins."[297] However, succeeding in international strife in this particular dimension does not merely provide opportunities for victory in

293 Cave, Chris: 5G: Six Top Concerns For Network Operators, ECN (Electronic Component News), Mai 1, 2017, https://www.ecnmag.com/article/2017/05/5g-six-top-concerns-network-operators (Accessed on February 19, 2019).

294 Grijpink, Ferry et al: Cutting through the 5G hype: Survey shows telcos' nuanced views, McKinsey&Company, February 2019, https://www.mckinsey.com/industries/telecommunications/our-insights/cutting-through-the-5g-hype-survey-shows-telcos-nuanced-views (Accessed on February 20, 2019).

295 Cf. Roberts, Geoffrey: History, theory and the narrative turn in IR. Review of International Studies, October 10, 2006, Vol. 32, No. 4, pp. 703-714; Antoniades, Andreas; Miskimmon, Alister; O'Loughlin, Ben: Great Power Politics and Strategic Narratives, in: Working Paper No. 7, March 2010, Centre for Global Political Economy, University of Sussex, https://www.sussex.ac.uk/webteam/gateway/file.php?name=cgpe-wp07-antoniades-miskimmon-oloughlin.pdf&site=359 (Accessed on April 24, 2019); Miskimmon, Alister; O'Loughlin, Ben; Roselle, Laura: Strategic Narratives: Communication Power and the New World Order, 2013; Arnold, Annika: Introduction: Why Narratives Matter in Climate Change Communication, in: Climate Change and Storytelling. Palgrave Studies in Environmental Sociology and Policy. Palgrave Macmillan, Cham, pp. 1-6.

296 Arquilla, John; Ronfeldt, David: The Emergence of Noopolitik: Toward an American Information Strategy, Santa Monica, Cal., RAND Corporation, 1999, p. 53.

297 Nye Jr., Joseph S.: The Future of Soft Power in US Foreign Policy, in: Parmar, Inderjeet; Cox, Michael (eds.): Soft Power and US Foreign Policy: Theoretical, Historical and Contemporary Perspectives, 2010, p. 8.

yet another area of great power competition per se. Rather, depending on which narrative on a given topic ultimately prevails, public perceptions as well as political decisions may starkly differ and the triumph of one narrative over another may therefore yield considerable political consequences.

In the international strife for framing narratives concerning the nature of 5G, five different narratives can be identified: (1) Convenience, Connectivity, and Chances, (2) Economic Growth and Job Creation....

In the particular case of the global row about 5G technology, five distinct narratives can analytically be distinguished: (1) Convenience, Connectivity, and Chances, (2) Economic Growth and Job Creation, (3) Cyber Threats and National Security, (4) A Digital Arms Race, and (5) A Matter of Allegiance. While sometimes interconnected, an analytical distinction along these five narratives, to be elaborated upon the following, entails immense advantages for a penetration of a highly complex issue. At the same time, it provides crucial insights to the global competition for the prerogative of interpretation with respect to 5G technology that is currently underway.

NARRATIVE 1: CONVENIENCE, CONNECTIVITY, AND CHANCES

A crucial feature of the rollout of 5G technology relates to the topics of increased (customer) convenience, global connectivity and anticipated chances brought about by the most recent development (or, according to some, revolution) in mobile technology. In fact, practitioners, analysts, and politicians around the world frequently share such assessments and regularly outdo each other in their statements in this particular regard. Hans Vestberg, CEO of Verizon, for example, stated, "We are strong believers that 5G [will have] a very transformative effect on many things in our society. Consumer, media, entertainment…whole industries."[298] Eric Xu, chairman of the competing company Huawei, agreed, "As we face the future, we know deep down that the birth of 5G standards represents a new beginning."[299] Besides these voices from leading players in the 5G industry, a recent report by Deloitte declared no less enthusiastically that "5G technology introduction marks the beginning of a new era in connectivity that will impact almost every element of daily life. [...] With this array of capabilities, 5G technology will influence everything we do. Instead of just connecting people to people through their smartphones, 5G connects an unlimited number of things to other things, which can communicate all day, every day."[300] Besides huge advances expected for private customers, including opportunities for almost-instant video downloads, online gaming, or shopping,[301] 5G has been hailed as a breakthrough for the much-discussed Internet of Things (IoT).[302] Additionally, on a societal level, a recent study by McKinsey identified, drawing on surveys of telecom industry managers in Japan, advantages in

298 Chin, Josh; Krouse, Sarah; Strumpf, Dan: The 5G Race: China and U.S. Battle to Control World's Fastest Wireless Internet, The Wall Street Journal, September 9, 2018, https://www.wsj.com/articles/the-5g-race-china-and-u-s-battle-to-control-worlds-fastest-wireless-internet-1536516373 (Accessed on April 10, 2019).

299 Ibid.

300 Littman, Dan et al.: 5G: The chance to lead for a decade, Deloitte 2018, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-5g-deployment-imperative.pdf (Accessed on April 3, 2019), p. 2.

301 Cf. Clark, Don: What Is 5G? Here's What You Need to Know About the New Cellular Network, The New York Times, December 31, 2018, https://www.nytimes.com/2018/12/31/technology/personaltech/5g-what-you-need-to-know.html (Accessed on April 10, 2019).

302 Cf. Woyke, Elizabeth: China is racing ahead in 5G. Here's what that means, MIT Technology Report, December 18, 2018, https://www.technologyreview.com/s/612617/china-is-racing-ahead-in-5g-heres-what-it-means/ (Accessed on April 18, 2019).

such diverse areas as autonomous driving, healthcare, education, disaster alerts, or home broadband.[303] Another area frequently cited as a huge beneficiary from 5G technology concerns "smart cities". One analyst, accordingly, stressed the improvements 5G technology may bring for traffic management in Chinese cities,[304] while Chris Lane, analyst for Sanford C. Bernstein in Hong Kong, even argued, "This will be almost more important than electricity. Everything will be connected, and the central nervous system of these smart cities will be your 5G network."[305] For China in particular, a recent study by Ernest & Young has found,

> "5G opens up new possibilities for a multitude of life-transforming applications – from 3D video to immersive media, autonomous vehicles and the enablement of smart cities, thanks to the ultra-high data rates, enhanced capacity and reduced latency. It is also the key to unlock other technologies such as artificial intelligence (AI), robotics and the Internet of Things (IoT), therefore providing tremendous potential in China that could not be underestimated."[306]

At the same time, concerns about "public safety, aesthetics, and construction coordination" brought about by the infrastructural necessities involving a 5G rollout are voiced as well.[307]

Turning towards the political arena, laudatory narratives are widely shared around the world. Australian Minister for Communications and the Arts, Mitch Fifield, for example, emphasized in August 2018, "The Government is committed to the timely rollout of 5G networks in Australia. 5G will drive substantial economic and social benefits across the economy, through new technologies which will be used in autonomous vehicles, smart cities, and advanced agriculture."[308] A US Presidential Memorandum, issued by the White House on October 25, 2018, even stated,

> "The growth in the availability of mobile wireless broadband connectivity over the past decade has reshaped the American experience — the way Americans work, learn, shop, run businesses, transport their families and goods across the Nation, farm, conduct financial transactions, consume entertainment, deliver and receive public safety services, and interact with one another. In the growing digital economy, wireless technologies expand opportunities to increase economic output of rural communities and connect them with urban markets, and offer safety benefits that save lives, prevent injuries, and reduce the cost of

303 Cf. Andonian, André; Karlsson, Axel; Nonaka, Kenji: Japan at a crossroads – The 4G to 5G (r)evolution, McKinsey & Company Research report, January 2018, https://www.mckinsey.com/~/media/McKinsey/Industries/Telecommunications/Our%20Insights/Japan%20at%20a%20crossroads%20The%204G%20to%205G%20revolution/Japan-at-a-crossroads-The-4G-to-5G-revolution-final-web.ashx (Accessed on March 20, 2019), pp. 19-21.

304 Cf. Woyke, Elizabeth: China is racing ahead in 5G. Here's what that means, MIT Technology Report, December 18, 2018, https://www.technologyreview.com/s/612617/china-is-racing-ahead-in-5g-heres-what-it-means/ (Accessed on April 18, 2019).

305 Sanger, David E.; Barnes, Julian E.; Zhong, Raymond; Santora, Marc: In 5G Race With China, US Pushes Allies to Fight Huawei, The New York Times, January 26, 2019, https://www.nytimes.com/2019/01/26/us/politics/huawei-china-us-5g-technology.html (Accessed on April 18, 2019).

306 Lo, Steve; Lee, Kevin: China is poised to win the 5G race. Key steps extending global leadership, EY, 2018, https://www.ey.com/Publication/vwLUAssets/ey-china-is-poised-to-win-the-5g-race-en/$FILE/ey-china-is-poised-to-win-the-5g-race-en.pdf (Accessed on April 3, 2019), p. 4.

307 Cf. Littman, Dan et al.: 5G: The chance to lead for a decade, Deloitte, 2018, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-5g-deployment-imperative.pdf (Accessed on April 3, 2019), p. 9.

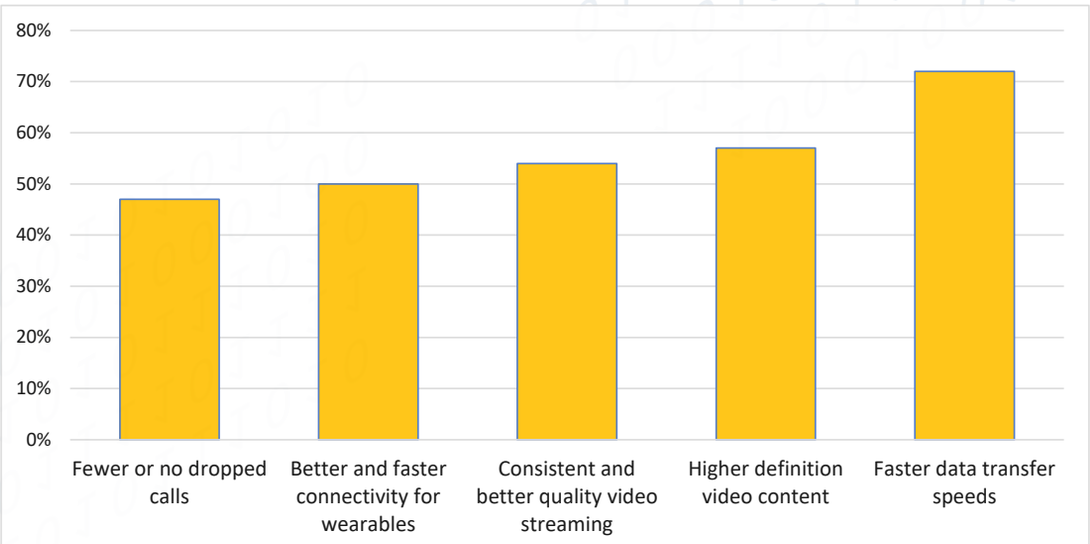
308 Fifield, Mitch; Morrison, Scott: Government Provides 5G Security Guidance To Australian Carriers, August 23, 2018, https://www.minister.communications.gov.au/minister/mitch-fifield/news/government-provides-5g-security-guidance-australian-carriers (Accessed on March 27, 2019).

transportation incidents."[309]

And most recently, in his opening remarks at the Prague 5G Security Conference held on May 2-3, 2019, Czech Prime Minster Andrej Babiš agreed,

> "Transportation, energy, agriculture, manufacturing, health, defense and other sectors will be significantly enhanced and altered through this next generation network. High-speed technology is expected to bring about a true digital evolution, stimulating economic growth, innovation and well-being. The change

The 5G Benefits Consumers Are Monst Excited For



Source: Verizon Media 5G Advertiser and Consumer Insights Study, November 2018.

> will be bigger than the introduction of mobile phones."[310]

In sum, concerning this first narrative of convenience, connectivity, and chances, while some cautionary statements can be found as well, an overwhelmingly positive estimate of the benefits of 5G technology for customers is shared among practitioners, observers, and politicians around the world.

NARRATIVE 2: ECONOMIC GROWTH AND JOB CREATION

Besides the expected benefits for private customers and every-day life, a second prevailing narrative which frequently can be found concerns the significance of 5G for economic growth and job creation. In fact, experts and policy-makers alike regularly mention this dimension in the global competition for 5G technology. 5G, in this sense, has even been "predicted to be the next key driver of economic growth in the much-

309 White House: Presidential Memorandum on Developing a Sustainable Spectrum Strategy for America's Future, October 25, 2018, https://www.whitehouse.gov/presidential-actions/presidential-memorandum-developing-sustainable-spectrum-strategy-americas-future/ (Accessed on April 18, 2019).

310 Andrej Babiš: Opening Remarks by Prime Minister Andrej Babiš at the Prague 5G Security Conference held at the Czernin Palace, May 2, 2019, https://www.vlada.cz/en/clenove-vlady/premier/speeches/pm-babis-by-protecting-the-5g-network--we-will-be-protecting-the-very-fabric-of-our-societies--our-ability-to-thrive--even-to-exist-173339/ (Accessed on May- 8, 2019).

touted Fourth Industrial Revolution."[311]

5G, therefore, has been identified by one recent Deloitte study as a crucial location factor for cities around the world seeking to attract both private residents as well as commercial enterprises.[312] With regard to respective patents in the context of 5G alone, estimates amount to billions of dollars for respective companies.[313] According to one estimate, the global economic potential of 5G amounts to as much as $12 trillion by 2035.[314] Leading the way in 5G technology, therefore, represents a crucial, perhaps even the crucial factor for economies around the world in years to come. According to Roger Entner, founder of telecommunication consultancy firm Recon Analytics, "[L]eading the world in wireless brings significant economic benefits, as the US has seen with its 4G leadership. These are the serious stakes that face American policymakers in the escalating global race to 5G."[315] In fact, for the United States alone, "some expect the benefits to top $3.5 trillion, support 22 million jobs, and contribute the equivalent of the entire economy of India to real American global GDP" – resulting in a bi-party consensus on the overwhelming economic significance of this technology in an otherwise heavily polarized political climate.[316] In a recent statement, the Deputy US Chief Technology Officer, Michael Kratsios, hence asserted, "America's future will have connected homes and farms, autonomous vehicles, drones, and smart cities and communities. The Nation's wireless networks must be ready to support the foundation of America's future growth and prosperity."[317]

In Japan, according to the same McKinsey survey cited above, the automotive and robotics industries are ranked among the major beneficiaries.[318] The same holds true in particular for Germany. According to Christian Rusche, Economist for Industrial Organization and Competition at the German Economic Institute (IW), as well as other analysts, the industrial sector, even more than the private sector, will likewise be the main profiteer of 5G technology and its capacity for high-speed and high-capacity

311 Tham, Jansen: Why 5G Is the Next Front of US-China Competition, The Diplomat December 13, 2018, https://thediplomat.com/2018/12/why-5g-is-the-next-front-of-us-china-competition/ (Accessed on April 18, 2019).

312 Cf. Littman, Dan et al.: 5G: The chance to lead for a decade, Deloitte 2018, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-5g-deployment-imperative.pdf (Accessed on April 3, 2019), p. 10.

313 Cf. Chin, Josh; Krouse, Sarah; Strumpf, Dan: The 5G Race: China and US Battle to Control World's Fastest Wireless Internet, The Wall Street Journal, September 9, 2018, https://www.wsj.com/articles/the-5g-race-china-and-u-s-battle-to-control-worlds-fastest-wireless-internet-1536516373 (Accessed on April 10, 2019).

314 Cf. Mehlman, Bruce: Why the 5G race matters, The Hill, December 10, 2018, https://thehill.com/blogs/congress-blog/technology/420509-why-the-5g-race-matters (Accessed on April 2, 2019).

315 Cole, Justin; Smith, Natalie; Entner, Roger: China Holds Narrow Lead in Global Race to 5G, Report Finds, April 16, 2018, https://www.ctia.org/news/china-holds-narrow-lead-in-global-race-to-5g-report-finds (Accessed on April 11, 2019).

316 Cf. Mehlman, Bruce: Why the 5G race matters, The Hill, December 10, 2018, https://thehill.com/blogs/congress-blog/technology/420509-why-the-5g-race-matters (Accessed on April 2, 2019).

317 Kratsios, Michael: America Will Win the Global Race to 5G, October 25, 2018, https://www.whitehouse.gov/articles/america-will-win-global-race-5g/ (Accessed on April 3, 2019).

318 Cf. Andonian, André; Karlsson, Axel; Nonaka, Kenji: Japan at a crossroads – The 4G to 5G (r)evolution, McKinsey & Company Research report January 2018, https://www.mckinsey.com/~/media/McKinsey/Industries/Telecommunications/Our%20Insights/Japan%20at%20a%20crossroads%20The%204G%20to%205G%20revolution/Japan-at-a-crossroads-The-4G-to-5G-revolution-final-web.ashx (Accessed on March 20, 2019), p. 18.

interconnectedness.[319] Widely-shared within the German political landscape, emphasis has in this regard for long been put on improved network coverage as a crucial factor for Germany as a major hub of industry and innovation.

Commitments to that effect can hence be found in the 2018 coalition agreement of the governing coalition[320] as well as in recent statements of Federal Minister of Economy Peter Altmaier (CDU), former Federal Minister of Transport and Digital Infrastructure Alexander Dobrindt (CSU), as well as Leader of the Social Democratic Party Andrea Nahles.[321] Interestingly, the particular importance of 5G for the highly-advanced industry hub Germany is notably shared by Huawei, as expressed by Dennis Zuo, new head of Huawei Germany, in a February 2019 interview with the Handelsblatt.[322] For China itself, 5G is identified, as one observer put it, "as crucial to the country's tech sector and economy. After years of making copycat products, Chinese tech companies want to become the next Apple or Microsoft – innovative global giants worth nearly a trillion dollars."[323] With estimates forecasting the creation of more than 8 million jobs by 2030, 5G technology accordingly occupies important places in the Communist Party of China's 13th Five-Year-Plan adopted in 2016 and the "Made in China 2025" plan issued the prior year.[324]

In total, as with respect to the first narrative discussed, narratives regarding the global as well as domestic economic growth and job creation attributed to the advance of 5G technology in years to come are overwhelmingly positive and widely-shared among different actors in the 5G discourse.

NARRATIVE 3: CYBER THREATS AND NATIONAL SECURITY

The narrative most frequently and vehemently evoked in the context of 5G technology

319 Cf. Rusche, Christian: Einführung von 5G. Gute Klagegründe, IW Köln, January 2, 2019, https://www.iwkoeln.de/presse/iw-nachrichten/beitrag/christian-rusche-gute-klagegruende.html (Accessed on April 2, 2019); Demary, Vera; Rusche, Christian: Zukunftsfaktor 5G. Eine ökonomische Perspektive, IW-Report 45/18, November 16, 2018, https://www.iwkoeln.de/fileadmin/user_upload/Studien/Report/PDF/2018/IW-Report_2018-45_Zukunftsfaktor_5G.pdf (Accessed on April 11, 2019), pp. 5-6; Delhaes, Daniel: Beim 5G-Standard geht es um mehr als politische Zockerei, Handelsblatt, November 26, 2018, https://www.handelsblatt.com/meinung/kommentare/kommentar-beim-5g-standard-geht-es-um-mehr-als-politische-zockerei/23679028.html (Accessed on April 12, 2019); Delhaes, Daniel; Scheuer, Stephan: Drei Etablierte, ein Angreifer – Wie die 5G-Auktion die Telekombranche verändern wird, Handelsblatt, January 25, 2019, https://www.handelsblatt.com/unternehmen/it-medien/mobilfunk-drei-etablierte-ein-angreifer-wie-die-5g-auktion-die-telekombranche-veraendern-wird/23906260.html (Accessed on April 12, 2019).

320 Cf. Coalition Treaty 2018 (CDU, CSU and SPD), 19th legislative period, https://www.cdu.de/system/tdf/media/dokumente/koalitionsvertrag_2018.pdf?file=1 (Accessed on April 10, 2019), p. 38.

321 Cf. Heise Online/dpa: 5G und Funklöcher: Altmaier droht Netzbetreibern mit staatlichen Konsequenzen, January 3, 2019, https://www.heise.de/newsticker/meldung/5G-und-Funkloecher-Altmaier-droht-Netzbetreibern-mit-staatlichen-Konsequenzen-4263782.html (Accessed on April 8, 2019).

322 Cf. Rexer, Andrea; Scheuer, Stephan: „Kaum ein Land der Welt ist so dringend auf 5G angewiesen wie Deutschland", Handelsblatt, February 19, 2019, https://www.handelsblatt.com/unternehmen/it-medien/huawei-deutschlandchef-im-interview-kaum-ein-land-der-welt-ist-so-dringend-auf-5g-angewiesen-wie-deutschland/24008016.html (Accessed on April 3, 2019).

323 Woyke, Elizabeth: China is racing ahead in 5G. Here's what that means, MIT Technology Report, December 18, 2018, https://www.technologyreview.com/s/612617/china-is-racing-ahead-in-5g-heres-what-it-means/ (Accessed on April 18, 2019).

324 Cf. Woyke, Elizabeth: China is racing ahead in 5G. Here's what that means, MIT Technology Report, December 18, 2018, https://www.technologyreview.com/s/612617/china-is-racing-ahead-in-5g-heres-what-it-means/ (Accessed on April 18, 2019); Eurasia Group White Paper: The Geopolitics of 5G, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on April 3, 2019), p. 12; Lo, Steve; Lee, Kevin: China is poised to win the 5G race. Key steps extending global leadership, EY 2018, https://www.ey.com/Publication/vwLUAssets/ey-china-is-poised-to-win-the-5g-race-en/$FILE/ey-china-is-poised-to-win-the-5g-race-en.pdf (Accessed on April 3, 2019), p. 7.

arguably revolves around issues of cyber threats and national security. In a way, issues of security ipso facto follow on the very heels of the technological advancements brought about by 5G. As the Eurasia Group has noted in a 2018 study,

> "As the number of connected devices and the amount of data explode, a greater share of total global economic output will come to rely on global data networks. The vulnerability of companies, industries, cities, and even entire countries to disruptive cyberattacks or network outages will grow accordingly, giving malicious cyber actors new leverage and incentives to conduct ransomware attacks and increasing economic vulnerability to destructive – or even merely disruptive – cyberattacks."[325]

The Japan Times likewise aptly stated, "The treasure chest of data for hackers is getting much, much bigger."[326]

During the May 2019 Prague 5G Security Conference, while also emphasizing the monumental benefits to be expected from the deployment of 5G, Czech Prime Minister Andrej Babiš even admonished, "Today, we already protect our networks from espionage, cyber-crime or intrusion of industrial control systems. This will change with 5G. By protecting the 5G network, we will be protecting the very fabric of our societies, our ability to thrive, even to exist."[327]

In this context, at least two (albeit interconnected) dimensions can be distinguished: On the one hand, the tapping of information of private users and/or industries using 5G technologies poses a serious threat resulting in possible privacy breaches or the stealing of sensitive (industrial or military) information. On the other hand, and perhaps even more consequential, a partial or outright shutdown of 5G networks may result in a total collapse of whole industries or communication networks.

In this context, the prevailing discourse crucially revolves around the question of possible threats to national security originating from China and its engagement in 5G technology. Consequently, as German analyst Jan-Peter Kleinhans has aptly written, "[R]ecently the debate has been dominated by one single question: Does the deployment of 5G equipment from Chinese manufacturers pose a risk to our national security?"[328]

In this regard, the United States has played the key role in globally shaping this, the third 5G narrative by consistently tying the sensitive topic of national security to the 5G discourse. While occasionally also highlighting opportunities for improved domestic defensibility of critical infrastructure and communications networks springing from 5G technology,[329] the US identification of Chinese firms Huawei and ZTE "as potential national security threats" hence crucially set the tone.[330] Besides the United States, fellow members of the "Five Eyes" (i.e., Australia, Canada, New Zeeland, and the

325 Eurasia Group White Paper: The Geopolitics of 5G, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on April 3, 2019), p. 8.

326 The Japan Times (AFP-JIJI): 5G: A costly revolution not without risks, December 16, 2018, https://www.japantimes.co.jp/news/2018/12/16/business/tech/5g-costly-revolution-not-without-risks/#.XHfIsi2X-i4 (Accessed on April 5, 2019).

327 Andrej Babiš: Opening Remarks by Prime Minister Andrej Babiš at the Prague 5G Security Conference held at the Czernin Palace, May 2 2019, https://www.vlada.cz/en/clenove-vlady/premier/speeches/pm-babis-by-protecting-the-5g-network--we-will-be-protecting-the-very-fabric-of-our-societies--our-ability-to-thrive--even-to-exist-173339/ (Accessed on May 8, 2019).

328 Kleinhans, Jan-Peter: 5G vs. National Security. A European Perspective, Stiftung Neue Verantwortung, February 2019, https://www.stiftung-nv.de/sites/default/files/5g_vs._national_security.pdf (Accessed on April 3, 2019), p. 3.

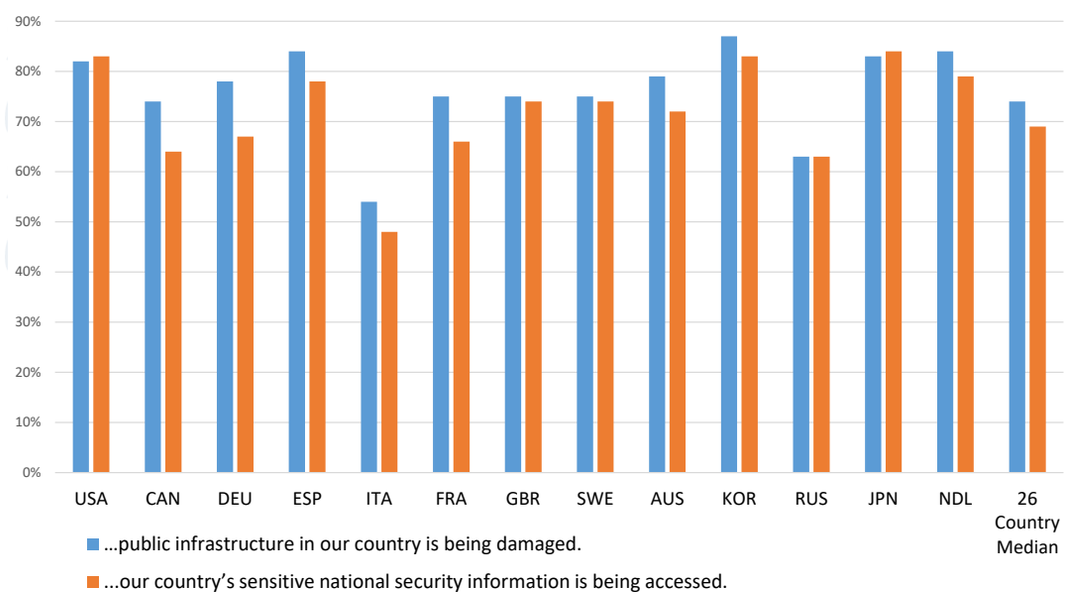
329 Cf. Kratsios, Michael: America Will Win the Global Race to 5G, October 25, 2018, https://www.whitehouse.gov/articles/america-will-win-global-race-5g/ (Accessed on April 3, 2019).

330 Cf. Tham, Jansen: Why 5G Is the Next Front of US-China Competition, The Diplomat December 13, 2018, https://thediplomat.com/2018/12/why-5g-is-the-next-front-of-us-china-competition/ (Accessed on April 18, 2019).

United Kingdom) have gradually joined in this narrative.[331]

In fact, Huawei and ZTE have been named threats to US national security as early as 2012.[332] The US Intelligence Committee hence stated in its 2012 report, "Based on available classified and unclassified information, Huawei and ZTE cannot be trusted to be free of foreign state influence and thus pose a security threat to the United States."[333] More recently, in the wake of the larger confrontation with China over trade disputes under the Trump administration, these sentiments even led to plans for "a 'nationalized' 5G network to counter a host of concerns surrounding China's rising influence in the global communications supply chain."[334] After the pertaining US National Security Council document had been leaked, however, corresponding plans were almost universally rejected in the United States.[335] Instead, leading voices, including Ajit Pai, Chair of the Federal Communications Commission, argued in favor of greater reliance on the forces of free markets and the benefits of competition in the 5G industry instead of bans.[336] At the same time, analysts including Nathan Freitas, founder and director

Percentages of those polled considering it "very likely"/"somewhat likely" that...



Source: CGS 2019 based on Pew Research Center, January 2019, "International Publics Brace for Cyberattacks on Elections, Infrastructure, National Security", p.8.

331 Cf. Voelsen, Daniel: 5G, Huawei und die Sicherheit unserer Kommunikationsnetze. Handlungsoptionen für die deutsche Politik, in: SWP-Aktuell 2019/A, Februar 5, 2019, https://www.swp-berlin.org/fileadmin/contents/products/aktuell/2019A05_job.pdf (Accessed on April 18, 2019).

332 Cf. Chin, Josh; Krouse, Sarah; Strumpf, Dan: The 5G Race: China and US Battle to Control World's Fastest Wireless Internet, The Wall Street Journal, September 9, 2018, https://www.wsj.com/articles/the-5g-race-china-and-u-s-battle-to-control-worlds-fastest-wireless-internet-1536516373 (Accessed on April 10, 2019); Becker, Matthias: Huawei und der 5G-Ausbau. Zwischen Handelspolitik und Cybersicherheit, Deutschlandfunk, February 26, 2019, https://www.deutschlandfunk.de/huawei-und-der-5g-ausbau-zwischen-handelspolitik-und.724.de.html?dram:article_id=442148 (Accessed on March 17, 2019).

333 Brake, Doug: Economic Competitiveness and National Security Dynamics in the Race for 5G between the United States and China, August 2018, ITIF (Information Technology and Innovation Foundation), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3142229 (Accessed on April 4, 2019), p. 28.

334 Ibid., p. 20.

335 Cf. ibid.; Shepardson, David: Trump team idea to nationalize 5G network to counter China is rejected, Reuters, January 29, 2018, https://www.reuters.com/article/us-usa-trump-5g-fcc/trump-team-idea-to-nationalize-5g-network-to-counter-china-is-rejected-idUSKBN1FI1T2 (Accessed on April 18, 2019).

336 Cf. Finley, Klint; Newman, Lily Hay: Proposal for federal wireless network shows fear of China, Wired Business, January 29, 2018, https://www.wired.com/story/proposal-for-federal-wireless-network-shows-fear-of-china/ (Accessed on March 27, 2019).

of the global collective The Guardian Project, have openly doubted whether a national network would in fact carry the guarantee of greater security.[337]

However, national security concerns and fears of Chinese interception of data or even cutoffs continue to dominate the political debate within the United States, which ultimately led to a de facto ban of respective technologies in August 2018.[338] A major concern in this regard, as frequently evoked by US policy-makers, continues to be the alleged close ties of Chinese companies to the government and the Communist Party of China. Senator Marco Rubio (R-Fla.), for example, argued on the Senate floor on May 23, 2018, at the very height of the debate in the United States,

> "The imbalance I am talking about is one where [China] dominates aerospace, where it is the nation that controls satellites and satellite communication, where it is the nation that controls 5G. We are headed toward autonomous vehicles. Autonomous vehicles will depend on 5G technology. China will dominate the world in 5G, and we will depend on it. So we are going to build a fleet of autonomous trucks and autonomous cars, and none of them will work if the Chinese decided to shut it down because they will dominate that field. That is the imbalance I am talking about."[339]

More recently, illustrating both the persistency as well as the bipartisan character of this narrative, Senate Minority Leader Chuck Schumer (D-N.Y.) declared in a Senate address on January 29, 2019, building on earlier statements of comparable content,[340]

> "China has been flouting international sanction laws and, even worse, stealing IP and know-how for the last decade. State-connected telecom giants like Huawei are an example of how China operates. They are not the exception. They are the rule in China. When China wants to supplant US dominance in an emerging industry, it acts rapaciously. It steals. Our law enforcement needs to be especially vigilant with Chinese telecom companies such as Huawei and CTE [sic], which intend to displace US communications networks with their own 5G networks because those could give China access to all kinds of sensitive information. US authorities should be prosecuting Huawei's criminal violations to the fullest extent of the law. I give the administration credit for having this suit go forward, but my message to President Trump now is this: Don't back down. While the Trump administration has shown signs of being tougher on China than either the Bush or Obama administration – which I commend them – President Trump has also tried the conciliatory approach, particularly at the moment when the administration is engaged in negotiations with the Chinese."[341]

With respect to major US allies, corresponding observations can be made. In the wake of the US decision to ban Chinese equipment, Australia, New Zealand, as well as Japan

337 Cf. ibid.; Eurasia Group White Paper: The Geopolitics of 5G, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on April 3, 2019), p. 17.

338 Cf. Kastrenakes, Jacob: Trump signs bill banning government use of Huawei and ZTE tech, The Verge, August 13, 2018, https://www.theverge.com/2018/8/13/17686310/huawei-zte-us-government-contractor-ban-trump (Accessed on April 3, 2019).

339 Rubio, Marco: Congressional Record – Senate, Vol. 164, No. 85, May 23, 2018, https://www.congress.gov/crec/2018/05/23/CREC-2018-05-23-pt1-PgS2846-3.pdf (Accessed on April 18, 2019), S2852.

340 Cf. Shumer, Chuck: Congressional Record – Senate, Vol. 164, No. 44, March 13, 2018, https://www.congress.gov/crec/2018/03/13/CREC-2018-03-13-pt1-PgS1646-3.pdf (Accessed on April 18, 2019), S1648.

341 Shumer, Chuck: Congressional Record – Senate, Vol. 165, No. 18, January 29, 2019, https://www.congress.gov/116/crec/2019/01/29/CREC-2019-01-29-pt1-PgS725-7.pdf (Accessed on April 18, 2019), S726.

effectively followed suit in the course of 2018.[342] Prime Minister Shinzo Abe hence argued during a December 2018 news conference, while cautious not to single out any country or company, "In order to secure cybersecurity, we are aware that it is extremely important to make sure we would not procure equipment with functions of malicious intention."[343]

Then-Acting Minister of Home Affairs Scott Morrison (who now serves as Australia's 30th Prime Minster) likewise declared in the joint statement cited above, "The Government's Telecommunications Sector Security Reforms, which commence on September 18, [2018,] place obligations on telecommunications companies to protect Australian networks from unauthorised interference or access that might prejudice our national security."[344] In the United Kingdom, comparable developments can be observed as the director of the Government Communications Headquarters, Jeremy Fleming, specifically warned against threats springing from Chinese equipment in 5G technology.[345] Most recently, the Prague Proposals, published in the wake of the May 2019 Prague 5G Security Conference, also addressed the issue, while again not calling out any particular country by name,

> "The overall risk of influence on a supplier by a third country should be taken into account, notably in relation to its model of governance, the absence of cooperation agreements on security, or similar arrangements, such as adequacy decisions, as regards data protection, or whether this country is a party to multilateral, international or bilateral agreements on cybersecurity, the fight against cybercrime, or data protection."[346]

Turning towards Germany, the discourse on 5G technology was initially dominated by concerns of network coverage rather than security issues.[347] According to a 2018 study of the Eurasia Group, therefore, "German officials are being careful in characterizing the potential threat to national security"[348] and the Bundesamt für Sicherheit in der Informationstechnik (BSI) accordingly affirmed in late 2018 that it had no hard evidence of Chinese spying activities.[349] Rather than endorsing a ban of Chinese equipment, therefore, Arne Schönbohm, head of the BSI, advocated a "preventive approach" of checking equipment with regards to possible backdoors.[350]

342 Cf. Satake, Minoru: Japan's 4 carriers to shun Chinese 5G tech, Nikkei Asian Review, December 10, 2018, https://asia.nikkei.com/Business/Companies/Japan-s-4-carriers-to-shun-Chinese-5G-tech (Accessed on April 18, 2019).

343 Denyer, Simon: Japan effectively bans China's Huawei and ZTE from government contracts, joining US, The Washington Post, December 10, 2018, https://www.washingtonpost.com/world/asia_pacific/japan-effectively-bans-chinas-huawei-zte-from-government-contracts-joining-us/2018/12/10/748fe98a-fc69-11e8-ba87-8c7facdf6739_story.html?utm_term=.20c6e520dcb5 (Accessed on April 12, 2019).

344 Fifield, Mitch; Morrison, Scott: Government Provides 5G Security Guidance To Australian Carriers, August 23, 2018, https://www.minister.communications.gov.au/minister/mitch-fifield/news/government-provides-5g-security-guidance-australian-carriers (Accessed on March 27, 2019).

345 Cf. Eurasia Group White Paper: The Geopolitics of 5G, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on April 3, 2019), p.16.

346 Prague 5G Security Conference: The Prague Proposals: The Chairman Statement on Cyber Security of Communication Networks in a Globally Digitalized World, Prague, May 5, 2019, https://www.vlada.cz/assets/media-centrum/aktualne/PRG_proposals_SP_1.pdf (Accessed on May 8, 2019), p. 3.

347 Cf. Benner, Thorsten: 5G-Netz. Kontrolle ist besser, Zeit Online, December 6, 2018, https://www.zeit.de/politik/ausland/2018-12/5g-netz-mobilfunk-huawei-deutschland-china-telekom-sicherheit/komplettansicht (Accessed on March 19, 2019).

348 Eurasia Group White Paper: The Geopolitics of 5G, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on April 3, 2019), pp.16-17.

349 Cf. Voelsen, Daniel: 5G, Huawei und die Sicherheit unserer Kommunikationsnetze. Handlungsoptionen für die deutsche Politik, in: SWP-Aktuell 2019/A, Februar 5, 2019, https://www.swp-berlin.org/fileadmin/contents/products/aktuell/2019A05_job.pdf (Accessed on April 18, 2019), p. 2.

350 Cf. Benner, Thorsten: 5G-Netz. Kontrolle ist besser, Zeit Online, December 6, 2018, https://www.zeit.de/politik/ausland/2018-12/5g-netz-mobilfunk-huawei-deutschland-china-telekom-sicherheit/komplettansicht (Accessed on March 19, 2019).

More recently, however, the German narrative in this regard more and more tilted towards national security matters, as expressed by the statements by Christian Rusche from the IW in early 2019[351] as well as increased discussion of the issue in think tank publications, including the Stiftung Wissenschaft und Politik.[352] Consequently, Dennis Zuo, in the interview with the Handelsblatt cited above, found himself compelled to distract respective fears, insisting on Huawei's autonomy from the Chinese government.[353] In fact, the national security narrative in 5G has increasingly permeated the political arena as well, with Chancellor Angela Merkel voicing her concerns regarding the possible violations of intellectual property rights in February 2019.[354]

Norbert Röttgen (CDU), Chair of the Foreign Committee of the German Bundestag, outright declared the matter of Huawei an issue of national security and hence demanded parliamentary debate of the topic.[355] At the same time, experts have become increasingly critical as to the possibilities of effectively monitoring Huawei equipment regarding possible threats, including the former president of the Federal Intelligence Service Gerhard Schindler.[356] In fact, the issue meanwhile has gained momentum across party lines in Germany as well, as SPD spokesman on foreign affairs Nils Schmidt raised the issue,[357] as did different members of opposition parties.[358]
A major point of criticism in this regard, already referred to above, is the close connection between Huawei and the Chinese government, expressed for example by Anna Holzmann from the Mercator Institute for China Studies (MERICS)[359] as well as

351 Cf. Scheuer, Stephan: Ökonom Christian Rusche: „Huawei ist dem Zugriff chinesischer Sicherheitsbehörden ausgesetzt", Handelsblatt, January 22, 2019, https://www.handelsblatt.com/unternehmen/it-medien/oekonom-christian-rusche-huawei-ist-dem-zugriff-chinesischer-sicherheitsbehoerden-ausgesetzt/23895450.html (Accessed on April 2019).

352 Cf. Voelsen, Daniel: 5G, Huawei und die Sicherheit unserer Kommunikationsnetze. Handlungsoptionen für die deutsche Politik, in: SWP-Aktuell 2019/A, Februar 5, 2019, https://www.swp-berlin.org/fileadmin/contents/products/aktuell/2019A05_job.pdf (Accessed on April 18, 2019), p. 3.

353 Cf. Rexer, Andrea; Scheuer, Stephan: „Kaum ein Land der Welt ist so dringend auf 5G angewiesen wie Deutschland", Handelsblatt, February 19, 2019, https://www.handelsblatt.com/unternehmen/it-medien/huawei-deutschlandchef-im-interview-kaum-ein-land-der-welt-ist-so-dringend-auf-5g-angewiesen-wie-deutschland/24008016.html (Accessed on April 3, 2019).

354 Cf. Handelsblatt: Deutschland verschiebt wohl die Entscheidung zu Huawei, February 19, 2019, https://www.handelsblatt.com/politik/deutschland/5g-ausbau-deutschland-verschiebt-wohl-die-entscheidung-zu-huawei/24013366.html (Accessed on April 10, 2019); Handelsblatt: Merkel nennt Bedingungen für Huawei-Beteiligung am 5G-Ausbau, February 5, 2019, https://www.handelsblatt.com/politik/deutschland/mobilfunknetz-merkel-nennt-bedingungen-fuer-huawei-beteiligung-am-5g-ausbau/23949250.html?ticket=ST-1489552-TKG3HCCvm4gU29zk3Q0K-ap6 (Accessed on March 25, 2019); Riley, Charles: Germany says Huawei must provide assurances on data, CNN Business, February 5, 2019, https://edition.cnn.com/2019/02/05/tech/huawei-germany-angela-merkel/index.html (Accessed on April 18, 2019).

355 Cf. Decker, Markus: 5G-Debatte: Norbert Röttgen will Huawei draußen halten, Dresdner Neueste Nachrichten, February 19, 2019, http://www.dnn.de/Nachrichten/Politik/5G-Debatte-Norbert-Roettgen-will-Huawei-draussen-halten (Accessed on April 9, 2019).

356 Cf. Decker, Markus: 5G-Debatte: Norbert Röttgen will Huawei draußen halten, Dresdner Neueste Nachrichten, February 19, 2019, http://www.dnn.de/Nachrichten/Politik/5G-Debatte-Norbert-Roettgen-will-Huawei-draussen-halten (Accessed on April 9, 2019); Benner, Thorsten: 5G-Netz. Kontrolle ist besser, Zeit Online, December 6, 2018, https://www.zeit.de/politik/ausland/2018-12/5g-netz-mobilfunk-huawei-deutschland-china-telekom-sicherheit/komplettansicht (Accessed on March 19, 2019).

357 Cf. Reuters Staff: Politiker von CDU und SPD gegen Huawei-Beteiligung am 5G-Ausbau, Reuters, February 18, 2019, https://de.reuters.com/article/deutschland-mobilfunk-huawei-idDEKCN1Q70DN (Accessed on April 5, 2019).

358 Cf. Stoltenberg, Helmut: Streit um Digitalpolitik, Das Parlament, February 18, 2019, https://www.das-parlament.de/2019/8/innenpolitik/593952-593952 (Accessed on April 18, 2019); Becker, Matthias: Huawei und der 5G-Ausbau. Zwischen Handelspolitik und Cybersicherheit, Deutschlandfunk, February 26, 2019, https://www.deutschlandfunk.de/huawei-und-der-5g-ausbau-zwischen-handelspolitik-und.724.de.html?dram:article_id=442148 (Accessed on March 17, 2019).

359 Cf. Preker, Alexander; Schultz, Stefan: Chinesische IT-Firma Huawei. Weltkonzern von Gnaden der KP, Spiegel Online, December 6, 2018, http://www.spiegel.de/wirtschaft/unternehmen/huawei-so-tickt-der-umstrittene-chinesische-it-konzern-a-1242305.html (Accessed on April 2, 2019); Voigt, Benedikt: Das Netz der KP China, Der Tagesspiegel, January 17, 2019, https://www.tagesspiegel.de/politik/telekommunkationsunternehmen-huawei-das-netz-der-kp-china/23880504.html (Accessed on April 18, 2019); Sanger, David E.; Barnes, Julian E.; Zhong, Raymond; Santora, Marc: In 5G Race With China, US Pushes Allies to Fight Huawei, The New York Times, January 26, 2019, https://www.nytimes.com/2019/01/26/us/politics/huawei-china-us-5g-technology.html (Accessed on April 18, 2019).

Jan-Peter Kleinhans.[360] German journalist Benedikt Voigt in this regard even asserted that relying on 5G technology by Huawei amounts to having the Communist Party of China itself furnishing the network – and strongly spoke against it in an era of increasing systemic competition.[361]

In this sense, the debate on the trustworthiness of Huawei and other Chinese companies as in fact turned into a debate on wither or not the Chinese government itself can be trusted.[362] Keenly aware of this dominating narrative in many Western countries, leading Huawei representatives and spokesmen increasingly endeavor to present the issue of 5G technology as a purely technical rather than a (national) security issue[363] – or even seek to downplay the significance of 5G at large.[364] At the same time, Huawei executives continuously reject US narratives regarding alleged security risks. Guo Ping, in a keynote at the March 2019 Mobile World Congress in Barcelona thus declared, "The US security accusation on our 5G has no evidence – nothing."[365] In addition, and underlining such efforts, Huawei recently published an open letter in the pages of The Wall Street Journal proclaiming, "Don't believe everything you hear."[366] These developments strikingly illustrate the battle for narrative supremacy currently raging on matters of 5G technology.

NARRATIVE 4: A DIGITAL ARMS RACE

Despite the prevalence of the first three narratives discussed above, the roll out of 5G technologies around the world touches upon much more than questions regarding customer convenience, economic growth, or even security matters. In a very real sense, it can thus be considered as the present-day manifestation for the age-old strife for (national) leadership. It has in this regard rightly been noted that the global introduction of 5G "is often portrayed as a technological race between countries, political systems and companies."[367] One observer even likened it to the space race between the United States and the Soviet Union during the heights of the Cold War.[368]

In fact, this perception is shared not least in the United States as the Trump "administration

360 Cf. Becker, Matthias: Huawei und der 5G-Ausbau. Zwischen Handelspolitik und Cybersicherheit, Deutschlandfunk, February 26, 2019, https://www.deutschlandfunk.de/huawei-und-der-5g-ausbau-zwischen-handelspolitik-und.724.de.html?dram:article_id=442148 (Accessed on March 17, 2019).

361 Cf. Voigt, Benedikt: Das Netz der KP China, Der Tagesspiegel, January 17, 2019, https://www.tagesspiegel.de/politik/telekommunkationsunternehmen-huawei-das-netz-der-kp-china/23880504.html (Accessed on April 18, 2019).

362 Cf. Kleinhans, Jan-Peter: 5G vs. National Security. A European Perspective, Stiftung Neue Verantwortung, February 2019, https://www.stiftung-nv.de/sites/default/files/5g_vs._national_security.pdf (Accessed on April 3, 2019), p. 10.

363 Cf. Rexer, Andrea; Scheuer, Stephan: „Kaum ein Land der Welt ist so dringend auf 5G angewiesen wie Deutschland", in: Handelsblatt, February 19, 2019, https://www.handelsblatt.com/unternehmen/it-medien/huawei-deutschlandchef-im-interview-kaum-ein-land-der-welt-ist-so-dringend-auf-5g-angewiesen-wie-deutschland/24008016.html (Accessed on April 3, 2019); Brake, Doug: Economic Competitiveness and National Security Dynamics in the Race for 5G between the United States and China, ITIF (Information Technology and Innovation Foundation), August 2018, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3142229 (Accessed on April 4, 2019), p. 23; Becker, Matthias: Huawei und der 5G-Ausbau. Zwischen Handelspolitik und Cybersicherheit, Deutschlandfunk, February 26, 2019, https://www.deutschlandfunk.de/huawei-und-der-5g-ausbau-zwischen-handelspolitik-und.724.de.html?dram:article_id=442148 (Accessed on March 17, 2019).

364 Cf. Chin, Josh; Krouse, Sarah; Strumpf, Dan: The 5G Race: China and US Battle to Control World's Fastest Wireless Internet, in: The Wall Street Journal, September 9, 2018, https://www.wsj.com/articles/the-5g-race-china-and-u-s-battle-to-control-worlds-fastest-wireless-internet-1536516373 (Accessed on April 10, 2019).

365 Nakashima, Ellen; Fung, Brian: US allies differ on difficulty of containing Huawei security threat, in: The Washington Post, March 6, 2019, https://www.washingtonpost.com/technology/2019/03/06/us-allies-are-skeptical-trump-administrations-huawei-argument/?utm_term=.82e9382ff46b (Accessed on April 18, 2019).

366 BBC: Huawei's full-page WSJ advert: 'Don't believe everything you hear', March 1, 2019, https://www.bbc.com/news/business-47411180 (Accessed on March 17, 2019).

367 Kleinhans, Jan-Peter: 5G vs. National Security. A European Perspective, Stiftung Neue Verantwortung, February 2019, https://www.stiftung-nv.de/sites/default/files/5g_vs._national_security.pdf (Accessed on April 3, 2019), p. 3; emphasis added.

368 Cf. Mehlman, Bruce: Why the 5G race matters, in: The Hill, December 10, 2018, https://thehill.com/blogs/congress-blog/technology/420509-why-the-5g-race-matters (Accessed on April 2, 2019).

contends that the world is engaged in a new arms race – one that involves technology, rather than conventional weaponry, but poses just as much danger to America's national security."[369] No single issue in this race has been attributed with greater significance as 5G and wireless technologies. As the Deputy US Chief Technology Officer and Deputy Assistant to the President at the White House Office of Science and Technology Policy, Michael Kratsios, unequivocally put it, "In the information age, the nation that leads the world in wireless technology wins."[370]

Particularly in the zero-sum mentality of the Trump administration,[371] 5G in particular has therefore become a major field of competition between the United States and China.[372] In fact, the US-Chinese foot race in 5G exhibits remarkable parallels to the United States' Cold War struggle with the Soviet Union, right down to the alleged missile gap. As observers stress the current backlog in US 5G technology towards China and other major competitors,[373] policymakers thus strive to frame the issue accordingly. Senator Michael Bennet (D-Col.) hence declared on January 14, 2019, "If we are not careful – if we are not careful – they are going to deploy 5G a lot more quickly than we will. That is what the rest of the world is doing while we are shut down."[374] Not without reason, therefore, has 5G become a recurrent issue for the 115th US Congress, which measures meanwhile including the introduction of four bills addressing matters of cyber security as well several Congressional hearings on the "Race to 5G".[375]

Actually, according to a host of practitioners and observers, these much-stated fears of Chinese supremacy in 5G do not seem to be too far-fetched. Especially after missing out on previous generations in wireless technologies, Chinese policymakers are hence keen on leading the way in 5G and in order to do so have launched massive governmental efforts to do so.[376] In the wake of such efforts, a slogan frequently evoked runs, "In 2G we followed; in 3G we caught up; in 4G we ran head to head; in 5G we will lead."[377] Besides the technological and economic benefits referred to above, the issue of national pride hence looms large in 5G narratives.[378] Such observations have led one analyst, Jeff Kagan, questioning the economic advantages for the United States of actually leading in 5G to even remark, "I don't think it's ever been more than a battle over the ego over

369 Sanger, David E. et al: In 5G Race With China, US Pushes Allies to Fight Huawei, in: The New York Times, January 26, 2019, https://www.nytimes.com/2019/01/26/us/politics/huawei-china-us-5g-technology.html (Accessed on February 22, 2019).

370 Kratsios, Michael: America Will Win the Global Race to 5G, 2018, https://www.whitehouse.gov/articles/america-will-win-global-race-5g/ (Accessed on February 21, 2019).

371 Cf. Sanger, David E. et al: In 5G Race With China, US Pushes Allies to Fight Huawei, in: The New York Times, January 26, 2019, https://www.nytimes.com/2019/01/26/us/politics/huawei-china-us-5g-technology.html (Accessed on February 22, 2019).

372 Cf. Tham, Jansen: Why 5G Is the Next Front of US-China Competition, in: The Diplomat, December 13, 2018, https://thediplomat.com/2018/12/why-5g-is-the-next-front-of-us-china-competition/ (Accessed on February 22, 2019).

373 Cf. Chin, Josh; Krouse, Sarah; Strumpf, Dan: The 5G Race: China and US Battle to Control World's Fastest Wireless Internet, in: The Wall Street Journal, September 9, 2018, https://www.wsj.com/articles/the-5g-race-china-and-u-s-battle-to-control-worlds-fastest-wireless-internet-1536516373 (Accessed on April 10, 2019).

374 Bennett, Michael: Congressional Record – Senate, Vol. 165, No. 7, January 14, 2019: https://www.congress.gov/116/crec/2019/01/14/CREC-2019-01- 14-pt1-PgS182-7.pdf (Accessed on April 4, 2019), S183.

375 Cf. Gallagher, Jill C.; DeVine, Michael E. (Congressional Research Service): Fifth-Generation (5G) Telecommunications Technologies: Issues for Congress, January 30, 2019, https://crsreports.congress.gov/product/pdf/R/R45485 (Accessed on April 10, 2019), pp. 30-32.

376 Cf. Eurasia Group White Paper: The Geopolitics of 5G, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on April 3, 2019), p. 12; Lo, Steve; Lee, Kevin: China is poised to win the 5G race. Key steps extending global leadership, EY 2018, https://www.ey.com/Publication/vwLUAssets/ey-china-is-poised-to-win-the-5g-race-en/$FILE/ey-china-is-poised-to-win-the-5g-race-en.pdf (Accessed on April 3, 2019), p. 6.

377 Lee, Edison; Chau, Timothy: Telecom Services The Geopolitics of 5G and IoT, Jefferies Franchise Note, September 14, 2017, https://www.jefferies.com/CMSFiles/Jefferies.com/files/Insights/TelecomServ.pdf (Accessed on April 3, 2019), p. 7.

378 Cf. Woyke, Elizabeth: China is racing ahead in 5G. Here's what that means, in: MIT Technology Report, December 18, 2018, https://www.technologyreview.com/s/612617/china-is-racing-ahead-in-5g-heres-what-it-means/ (Accessed on April 18, 2019).

which country is first."[379]

In view of such sentiments, the matter of China seeking to lead the way in setting standards in 5G technology as well as in other infrastructure has rightly been identified as a major tool of national power today.[380] In fact, the 5G race is not just one about the hard power of military advantages in an increasingly connected world or economic opportunities in the next industrial revolution. It also crucially entails a soft power dimensions concerning the attraction of certain political systems and organizing principles over others – a dimension increasingly highlighted within the 5G narrative.

NARRATIVE 5: A MATTER OF ALLEGIANCE

Finally, and intimately tied to both the third and fourth dimension referred to above, a fifth dimension within the 5G narrative can be distinguished: 5G technology has become as much as a litmus test for the standpoint and reliability of different countries today – especially vis a vis China and the United States.[381] 5G technology, therefore, has become a matter of allegiance far exceeding the immediate issue. The Eurasia Group in this regard predicted in 2018:

> "A bifurcated 5G ecosystem would force third countries – and developing markets in particular – to make some tough choices. Many countries more sensitive to cost will probably opt to go with Chinese equipment. While they are likely to come under pressure from the US and allies to avoid dependence on China for 5G over time, China's lower-cost and equal or higher-performance offering is likely to maintain serious appeal, particularly if bundled with other enticements as part of the Belt and Road or similar infrastructure initiatives."[382]

Along with dimension (3) Cyber Threats and and National Security, dimension (5) A Matter of Allegiance has gained traction, as the United States in particular continues to frame Huawei and other Chinese actors as threats to national security.

On the one hand, observers have agreed that third countries – in Asia as well as Europe – will ultimately have to show their colors.[383] On the other hand, especially the United States has become increasingly eager to bring its closest partners into line on the issue over the course of the last twelve months.[384] Thus, "American officials have tried to pressure, scold and, increasingly, threaten other nations that are considering using Huawei in building fifth-generation, or 5G, wireless networks."[385]

Vice President Mike Pence, for example, unambiguously declared during the Munich Security Conference in February 2019,

379 Finley, Klint: Does it matter if China beats the US to build a 5G Network?, in: Wired Business, June 6, 2018, https://www.wired.com/story/does-it-matter-if-china-beats-the-us-to-build-a-5g-network/ (Accessed on March 27, 2019).

380 Cf. Voelsen, Daniel: 5G, Huawei und die Sicherheit unserer Kommunikationsnetze. Handlungsoptionen für die deutsche Politik, in: SWP-Aktuell 2019/A, February 5, 2019, https://www.swp-berlin.org/fileadmin/contents/products/aktuell/2019A05_job.pdf (Accessed on April 18, 2019), p. 6.

381 Cf. Tham, Jansen: Why 5G Is the Next Front of US-China Competition, in: The Diplomat, December 13, 2018, https://thediplomat.com/2018/12/why-5g-is-the-next-front-of-us-china-competition/ (Accessed on February 22, 2019).

382 Eurasia Group White Paper: The Geopolitics of 5G, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on April 3, 2019), pp. 18-19.

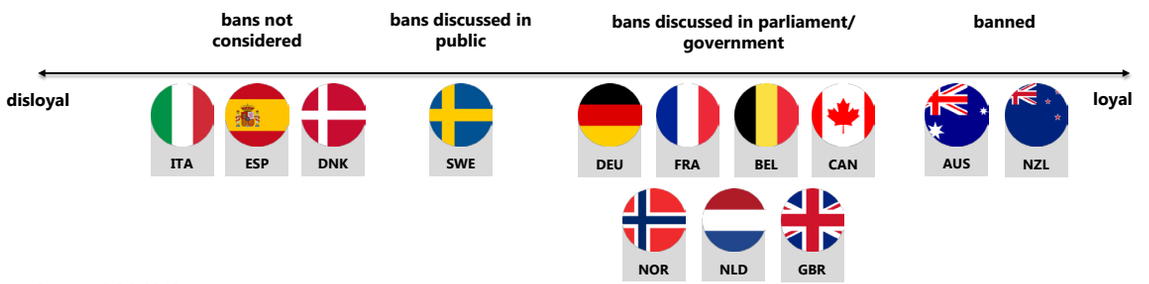
383 Cf. Tham, Jansen: Why 5G Is the Next Front of US-China Competition, in: The Diplomat, December 13, 2018, https://the-diplomat.com/2018/12/why-5g-is-the-next-front-of-us-china-competition/ (Accessed on February 22, 2019); Sanger, David E. et al: In 5G Race With China, US Pushes Allies to Fight Huawei, in: The New York Times, January 26, 2019, https://www.nytimes.com/2019/01/26/us/politics/huawei-china-us-5g-technology.html (Accessed on February 22, 2019).

384 Cf. Becker, Matthias: Huawei und der 5G-Ausbau. Zwischen Handelspolitik und Cybersicherheit, Deutschlandfunk, February 26, 2019, https://www.deutschlandfunk.de/huawei-und-der-5g-ausbau-zwischen-handelspolitik-und.724.de.html?dram:article_id=442148 (Accessed on March 17, 2019).

385 Barnes, Julian E.; Satariano, Adam: US Campaign to Ban Huawei Overseas Stumbles as Allies Resist, in: New York Times, March 17, 2019, https://www.nytimes.com/2019/03/17/us/politics/huawei-ban.html (Accessed on March 17, 2019).

> "We've also made it clear that we will not stand idly by while NATO Allies purchase weapons from our adversaries. We cannot ensure the defense of the West if our allies grow dependent on the East. The United States has also been

"14 Eyes"-Countries' Loyality to the United States Regarding Huawei Bans



Source: CGS 2019

> very clear with our security partners on the threat posed by Huawei and other Chinese telecom companies, as Chinese law requires them to provide Beijing's vast security apparatus with access to any data that touches their network or equipment. We must protect our critical telecom infrastructure, and America is calling on all our security partners to be vigilant and to reject any enterprise that would compromise the integrity of our communications technology or our national security systems."[386]

US lawmakers followed suit in early April, when Senators Tom Cotton (R-Ark.) and John Cornyn (R-Tex.) declared in a statement published in The Washington Post, "For Europe's sake and for the transatlantic alliance, our allies must keep Huawei as far from their 5G networks as possible. Adopting Chinese 5G technology will force the United States to reevaluate long-standing intelligence and military partnerships to protect our security interests."[387] The fact that six former high-ranking US military officials likewise published a statement cautioning against the use Chinese equipment in 5G technology underscores the prevalence of this narrative within the United States.[388]

Increasingly, US officials have not least repeatedly stressed possible consequences stemming from noncompliance with the US agenda. With regard to Poland's position on whether or not to ban Huawei, for example, "Trump officials suggested that future deployments of American troops — including the prospect of a permanent base labeled 'Fort Trump' — could hinge on Poland's decision."[389] Secretary of State Mike Pompeo, thus, explicitly questioned the future of troop deployments as well as the sharing of crucial intelligence with those countries using Huawei equipment, including the United

386 Pence, Mike: Remarks by Vice President Pence at the 2019 Munich Security Conference | Munich, Germany, https://www.whitehouse.gov/briefings-statements/remarks-vice-president-pence-2019-munich-security-conference-munich-germany/ (Accessed on April 2, 2019).

387 Cotton, Tom; Cornyn, John: Keep the Chinese government away from 5G technology, in: The Washington Post, April 1, 2019, https://www.washingtonpost.com/opinions/keep-the-chinese-government-away-from-5g-technology/2019/04/01/ba7a30ac-54b3-11e9-9136-f8e636f1f6df_story.html (Accessed on April 10, 2019).

388 Cf. Nakashima, Ellen: Current, former Pentagon leaders sound alarm on Chinese technology in 5G networks, in: The Washington Post, April 3, 2019, https://www.washingtonpost.com/world/national-security/current-former-pentagon-leaders-sound-alarm-on-chinese-technology-in-5g-networks/2019/04/02/d74f2bfe-54ab-11e9-9136-f8e636f1f6df_story.html (Accessed on April 5, 2019).

389 Sanger, David E. et al: In 5G Race With China, US Pushes Allies to Fight Huawei, in: The New York Times, January 26, 2019, https://www.nytimes.com/2019/01/26/us/politics/huawei-china-us-5g-technology.html (Accessed on February 22, 2019).

States' closest partners.[390]

As already argued above, US warnings have not fallen on deaf ears among several of its allies – including Australia and New Zealand – who have shared US concerns and already joined in banning Chinese manufactures.[391] With respect to some key European partners, however, the United States initiative has largely proven ineffective, at least to date. The United Kingdom, despite a recent report cautioning against the integrity of Huawei equipment, for example, has thus far refrained from banning the company and rather champions a review approach of respective source code.[392]

Regarding Germany, highly critical voices concerning the US position can be heard after US delegations have repeatedly been seeking to convince Berlin decision makers in the matter of Huawei, at least since early 2018.[393] Recently appointed Federal Commissioner for Data Protection and Freedom of Information, Ulrich Kelber, for example, sharply reproached US efforts in this regard by recollecting backdoors in US-originating hardware disclosed in the wake of the Snowden revelations.[394] Similar cautions were recently voiced by German cryptograph and mathematician Rüdiger Weis.[395] German analyst Jan-Peter Kleinhans likewise contended, "Much of the current debate is driven under the assumption that only the deployment of Chinese network equipment bears risks for national security, which is naive."[396] Also asking whether US counterparts can be trusted over Chinese competitors, Thorsten Benner, co-founder and director of Berlin-based think tank Global Public Policy Institute, emphasized the cost benefits for German network operators rather than advocating a ban of Chinese manufactures based on security concerns.[397] Christian Rusche from the IW, to offer a further example, likewise stressed

Demonstrating the highly political nature of 5G, the US seeks to nudge its partners and allies to ban Chinese manufacturers from their markets – thus far with varying degrees of success.

390 Cf. Becker, Matthias: Huawei und der 5G-Ausbau. Zwischen Handelspolitik und Cybersicherheit, Deutschlandfunk, February 26, 2019, https://www.deutschlandfunk.de/huawei-und-der-5g-ausbau-zwischen-handelspolitik-und.724.de.html?dram:article_id=442148 (Accessed on March 17, 2019); Barnes, Julian E.; Satariano, Adam: US Campaign to Ban Huawei Overseas Stumbles as Allies Resist, in: New York Times, March 17, 2019, https://www.nytimes.com/2019/03/17/us/politics/huawei-ban.html (Accessed on March 17, 2019); Garver, Rob: Failed Efforts to Warn Allies Away from Huawei 5G Technology Could Backfire on US, VOA News, March 26, 2019, https://www.voanews.com/a/failed-efforts-to-warn-allies-away-from-huawei-5g-technology-could-backfire-on-us/4849182.html (Accessed on April 9, 2019).

391 Cf. Tham, Jansen: Why 5G Is the Next Front of US-China Competition, in: The Diplomat, December 13, 2018, https://thediplomat.com/2018/12/why-5g-is-the-next-front-of-us-china-competition/ (Accessed on February 22, 2019); Eurasia Group White Paper: The Geopolitics of 5G, November 15, 2018, https://www.eurasiagroup.net/siteFiles/Media/files/1811-14%205G%20special%20report%20public(1).pdf (Accessed on April 3, 2019), p. 6; Chin, Josh; Krouse, Sarah; Strumpf, Dan: The 5G Race: China and US Battle to Control World's Fastest Wireless Internet, in: The Wall Street Journal, September 9, 2018, https://www.wsj.com/articles/the-5g-race-china-and-u-s-battle-to-control-worlds-fastest-wireless-internet-1536516373 (Accessed on April 10, 2019).

392 Cf. Satariano, Adam: Huawei Security 'Defects' Are Found by British Authorities, in: The New York Times, March 28, 2019, https://www.nytimes.com/2019/03/28/technology/huawei-security-british-report.html (Accessed on April 18, 2019); Nakashima, Ellen; Fung, Brian: US allies differ on difficulty of containing Huawei security threat, in: The Washington Post, March 6, 2019, https://www.washingtonpost.com/technology/2019/03/06/us-allies-are-skeptical-trump-administrations-huawei-argument/?utm_term=.82e9382ff46b (Accessed on April 18, 2019).

393 Cf. Sanger, David E. et al: In 5G Race With China, US Pushes Allies to Fight Huawei, in: The New York Times, January 26, 2019, https://www.nytimes.com/2019/01/26/us/politics/huawei-china-us-5g-technology.html (Accessed on February 22, 2019); Becker, Matthias: Huawei und der 5G-Ausbau. Zwischen Handelspolitik und Cybersicherheit, Deutschlandfunk, February 26, 2019, https://www.deutschlandfunk.de/huawei-und-der-5g-ausbau-zwischen-handelspolitik-und.724.de.html?dram:article_id=442148 (Accessed on March 17, 2019).

394 Cf. Handelsblatt: Deutschland verschiebt wohl die Entscheidung zu Huawei, February 19, 2019, https://www.handelsblatt.com/politik/deutschland/5g-ausbau-deutschland-verschiebt-wohl-die-entscheidung-zu-huawei/24013366.html (Accessed on April 10, 2019); Handelsblatt: Merkel nennt Bedingungen für Huawei-Beteiligung am 5G-Ausbau, February 5, 2019, https://www.handelsblatt.com/politik/deutschland/mobilfunknetz-merkel-nennt-bedingungen-fuer-huawei-beteiligung-am-5g-ausbau/23949250.html?ticket=ST-1489552-TKG3HCCvm4gU29zk3Q0K-ap6 (Accessed on March 25, 2019).

395 Cf. Becker, Matthias: Huawei und der 5G-Ausbau. Zwischen Handelspolitik und Cybersicherheit, Deutschlandfunk, February 26, 2019, https://www.deutschlandfunk.de/huawei-und-der-5g-ausbau-zwischen-handelspolitik-und.724.de.html?dram:article_id=442148 (Accessed on March 17, 2019).

396 Kleinhans, Jan-Peter: 5G vs. National Security. A European Perspective, Stiftung Neue Verantwortung, February 2019, https://www.stiftung-nv.de/sites/default/files/5g_vs._national_security.pdf (Accessed on April 3, 2019), p. 13.

397 Cf. Benner, Thorsten: 5G-Netz. Kontrolle ist besser, in: Zeit Online, December 6, 2018, https://www.zeit.de/politik/ausland/2018-12/5g-netz-mobilfunk-huawei-deutschland-china-telekom-sicherheit/komplettansicht (Accessed on March 19, 2019).

the advantages of competition for German operators as well as customers.[398]
In view of such statements, it came as no surprise that Berlin, like London, has finally decided against an outright ban of Huawei equipment but rather argues in favor of review mechanisms.[399] Additionally, Chancellor Angela Merkel has sought a "no-spying deal" with China.[400] In fact, Merkel, rebuffing US officials, including the American Ambassador to Berlin, Richard Grenell, has bluntly declared that German officials are "defining our standards for ourselves"[401]. Concurrently, in a March 2019 recommendation, the European Commission likewise came out against an outright ban of Huawei and advocated security reviews instead.[402]
Most recently, however, a growing awareness of the alliance dimension of the issue as well as the need for a joint approach can be detected. Czech Prime Minister Andrej Babiš thus declared in his opening remarks at the Prague 5G Security Conference, which was attended by 32 countries and four global mobile network operators, on May 2, 2019,

> "For us, it is paramount to find solutions fitting the EU and NATO. We are fully committed to address cyber security concerns related to the 5G, in line, with the recent recommendation by the European Commission. But our discussion has to be wider. 5G is a global undertaking, and I am glad to welcome global partners of the EU and NATO and all our dear colleagues and friends from other countries participating in this conference."[403]

In sum, the United States has actively sought to dominate the international narrative by emphasizing the Chinese threats to national security, insisting on the banning of respective equipment among US allies, and stressing the negative consequences defiance might yield for respective partners. While successful among some of its allies, others, including the United Kingdom and Germany, have – at least until now – not bought into this narrative, as the decision to refuse an outright ban of Chinese equipment indicates. Instead, key partners favor a different approach in reviewing rather than excluding Chinese equipment built in their communication infrastructure, thus seeking to mitigate potential security risks and at the same time drawing on the advantages coming along with increased diversification among manufacturers. In light of these developments, the issues of 5G technology in general and the handling of Chinese manufacturers such as Huawei in particular have become crucial topics of alliance politics – and they manifest

398 Cf. Scheuer, Stephan: Ökonom Christian Rusche: „Huawei ist dem Zugriff chinesischer Sicherheitsbehörden ausgesetzt", in: Handelsblatt, January 22, 2019, https://www.handelsblatt.com/unternehmen/it-medien/oekonom-christian-rusche-huawei-ist-dem-zugriff-chinesischer-sicherheitsbehoerden-ausgesetzt/23895450.html (Accessed on April 2019).

399 Cf. Barnes, Julian E.; Satariano, Adam: US Campaign to Ban Huawei Overseas Stumbles as Allies Resist, in: New York Times, March 17, 2019, https://www.nytimes.com/2019/03/17/us/politics/huawei-ban.html (Accessed on March 17, 2019); Nakashima, Ellen; Fung, Brian: US allies differ on difficulty of containing Huawei security threat, in: The Washington Post, March 6, 2019, https://www.washingtonpost.com/technology/2019/03/06/us-allies-are-skeptical-trump-administrations-huawei-argument/?utm_term=.82e9382ff46b (Accessed on April 18, 2019).

400 Cf. Reuters: China explores merger of carriers China Unicom, China Telecom: Bloomberg, Reuters Technology News, September 4, 2018, https://www.reuters.com/article/us-china-telecoms-merger/china-explores-merger-of-carriers-china-unicom-china-telecom-bloomberg-idUSKCN1LK0VQ (Accessed on March 13, 2019).

401 Barnes, Julian E.; Satariano, Adam: US Campaign to Ban Huawei Overseas Stumbles as Allies Resist, in: New York Times, March 17, 2019, https://www.nytimes.com/2019/03/17/us/politics/huawei-ban.html (Accessed on March 17, 2019).

402 Cf. Satariano, Adam: Huawei Security 'Defects' Are Found by British Authorities, in: The New York Times, March 28, 2019, https://www.nytimes.com/2019/03/28/technology/huawei-security-british-report.html (Accessed on April 18, 2019); Marks, Joseph: The Cybersecurity 202: US and Europe's divergent attitudes on Huawei could damage alliance, officials warn, in: The Washington Post, March 27, 2019, https://www.washingtonpost.com/news/powerpost/paloma/the-cybersecurity-202/2019/03/27/the-cybersecurity-202-u-s-and-europe-s-divergent-attitudes-on-huawei-could-damage-alliance-officials-warn/5c9ad7801b326b0f7f38f27b/?utm_term=.07b656c569a1 (Accessed on April 3, 2019).

403 Andrej Babiš: Opening Remarks by Prime Minister Andrej Babiš at the Prague 5G Security Conference held at the Czernin Palace, May 2, 2019, https://www.vlada.cz/en/clenove-vlady/premier/speeches/pm-babis-by-protecting-the-5g-network--we-will-be-protecting-the-very-fabric-of-our-societies--our-ability-to-thrive--even-to-exist-173339/ (Accessed on May 8, 2019).

stark differences between partners on both sides of the Atlantic. In fact, as in other areas, a certain "disconnect between the Americans and Europeans"[404] can at present indeed be attested over this particular matter – something that policymakers in Washington should not least consider a shot across the bow for the state of US soft power today.

THE POWER OF STORY

The identification of five different dimensions distinguishable within the larger 5G narrative allows for an analytical segmentation of one of the dominant issues in international relations today. While the first two narratives – (1) Convenience, Connectivity, and Chances as well as (2) Economic Growth and Job Creation – are widely shared across different actor groups and countries, the remaining three narratives harbor considerable potential for conflict and confrontation. Therefore, crucially depending on which narrative will ultimately prevail, political ramifications in this latest dimension of great power competition will likewise differ considerably. With respect to the narrative dimensions of (3) Cyber Threats and National Security, (4) A Digital Arms Race, and (5) A Matter of Allegiance, it is in particular the confrontation between the United States and China that permeates discourses. Recently, the third and fifth narrative in particular have dramatically gained traction, as they are frequently and vehemently employed by US decision makers. Given prevailing discrepancies in technological capabilities and power positions, third countries may individually be compelled to take sides in the end. If European countries, for example, should not be prepared to do so, a joint 5G strategy might unlock great potential and allow them, rather than being a pawn in the hands of the powerful, to have a strong say in this New Great Game in geopolitics today.

Narrative 5: A Matter of Allegiance is gaining powerful momentum in shaping the larger 5G narrative.

CONCLUSION

This study has addressed a subject that has become one of the hottest commodities in the international strategic discourse over the last months: How geopolitical forces shape the development of next-generation mobile technology (5G), and how these developments, in return, influence the future of international relations, demonstrating exemplarily the rapid increase of the weight of key technologies in the power competition between nations, especially between China and the United States of America.

The takeover of the White House in Washington by President Donald Trump on January 20, 2017, accelerated the ending process of the engagement policy with China, a process which was already introduced by his predecessor President Barack Obama. It took, however, the Trump administration only several months to change the fundament of the US policy towards China pursued by all US governments since President Jimmy Carter who established diplomatic relations with Beijing in 1979. There is no doubt

404 Nakashima, Ellen; Fung, Brian: US allies differ on difficulty of containing Huawei security threat, in: The Washington Post, March 6, 2019, https://www.washingtonpost.com/technology/2019/03/06/us-allies-are-skeptical-trump-administrations-huawei-argument/?utm_term=.82e9382ff46b (Accessed on April 18, 2019).

that the United States is just on the way "from engagement to rivalry" closing the "door on engagement as the primary mode of US-Chinese relations."[405] 5G is, indeed, only one of the theatres where a new period of strategic competition between Beijing and Washington breaks out.

8.

However, the future of the global race for 5G remains open. The US and China are certainly key players in the race, but neither of them has the guaranty to realize its own ambition to become the No. 1 in 5G. Against this background, it is crucial for European states to unify their own 5G strategies that thus far are primarily based on the national level. The EU and its member states need more courage, craft and commitment to position Europe as a strategically autonomous and technologically independent 5G player in the world making the continent a 5G player on a par with China and the United States.

405 Mattis, Peter: From Engagement to Rivalry Tools to Compete with China, in: Texas National Security Review, Vol. 1, Issue 4 (August 2018), pp. 81-94 (pp. 81-82).

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