WORLDWIDE
ASSET MANAGEMENT

THE NEW TECH WAR AND THE GEOPOLITICS OF 5G

WHITE PAPER

The new Tech War and the geopolitics of 5G

By Thematic Specialist Morten Springborg, C WorldWide Asset Management.

Executive summary

The roll-out of 5G is the most visible battle ground in the new US-China Tech War. Chinese companies have, through very large investments, gained the upper hand and today dominate the standards that will guide the development of future mobile networks globally. Also, China will be deploying advanced 5G services well ahead of most other countries, which is critical, since 5G will be foundational for the 4th Industrial Revolution.

Europe is in a precarious position, as the continent is right in the middle of the crossfire between the US and China. Ordinarily, Europe would go with the US in matters of National Security, but these are not ordinary times, and what happens in the battle for 5G supremacy in Europe could be a precursor to what happens to security alliances going forward.

The US has a significant technology disadvantage in 5G which can only be compared to the disadvantage that China has in semiconductor technologies, where the US dominates. The logical conclusion is that the most likely path going forward is that China and the US will have to negotiate a truce in the technology war, because the price for both countries to pay if the confrontation escalates further will be very high. However, only the smallest possibility of a negative outcome will lead to tech companies across the world being forced to reassess their entire supply chains at the risk of vast expense and disruption. Investors should reassess risk premiums on the shares of tech supply chain companies across the world depending on their exposure to the Chinese value chain.

No other technology transition exemplifies more clearly the rise of China and the beginning tech war between the US and China than the transition to next generation 5G mobile networks. 5G is the technological infrastructure on which the next industrial revolution will be built. Therefore it has also been in the 5G value chain where we have seen "first blood" in the long tech war that will characterize the relationship between the US and China going forward. Over recent months, we have seen initially the ban of US tech sales to the Chinese telecom equipment supplier ZTE (which was quickly overturned by President Trump after personal intervention by President Xi) and later the arrest in Canada of the CFO of Huawei which was followed up by US wide-ranging indictments against the telecoms equipment supplier Huawei, and its CFO. Parallel to this, US authorities have pushed allied countries hard to ban Chinese companies from building 5G networks. It's a high-stakes geopolitical battle, since ZTE and Huawei are global leaders in the development and deployment of 5G and of enormous importance to the technology transition of the Chinese economy as described in the plan "Made in China 2025" – see also our White Paper "Made in China 2025".

What is 5G?

As 5G will be the foundation for future industrial advancement, the decisions taken today about when and how to build 5G networks will have significant consequences, both for how the next phase of the digital revolution unfolds, and, potentially, for the long-term balance of global power.

> **As 5G will be foundational for future industrial advancement, the decisions taken today about when and how to build 5G networks will have significant consequences.**

Much of the focus on 5G has centered on its vastly improved data speeds. Next-generation mobile networks will stream data up to 100 times faster than today's 4G networks. However, unlike previous generations of networks, which were built with consumer voice and data services in mind, the real novelty with 5G is that it will enable high-capacity and ultra-low latency data communications.

The design of 5G networks marks a significant departure from voice centric 2G, 3G, and 4G networks. Unlike its predecessors, 5G is designed from the ground up to handle massive numbers of devices, high-data rates, and applications that require very fast and reliable communications with minimal latency, such as connected and autonomous vehicles, smart cities, robotics and automated manufacturing. To deliver these features, 5G networks are divided into three primary network "segments", as can be seen in Figure 1, each serving a different primary function:

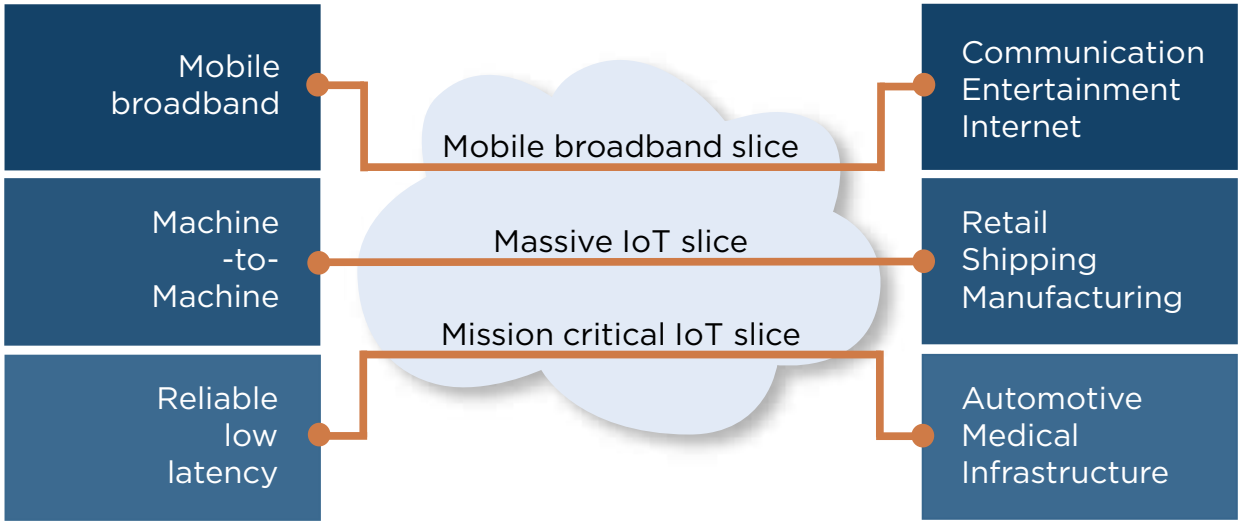
1) Enhanced mobile broadband: This segment of the network, likely to be rolled out first and which will use aspects of existing 4G LTE architecture, will enable much faster data communication. HighSpeedInternet.com compared America's current average speeds and latency on 4G to what they will be with 5G and found that consumers will save 23 hours of loading time—almost one full day—per month while browsing social media, gaming online, streaming music, and downloading TV shows and movies. For example, with 5G, movie downloads will decrease from 7 minutes to just 6 seconds!

2) Ultra-reliable low-latency communications: This segment is designed for applications including autonomous vehicles, which require there to be little or no gaps in communication for mission-critical applications such as road obstacle sensing and command and control. 5G networks are capable of latency rates of under a millisecond in ideal conditions and is estimated to be 60 to 120 times faster than average 4G latencies. For context, there are 1000 milliseconds in each second, and a blink of an eye takes 300 to 400 milliseconds.

3) Massive machine-to-machine communications: This segment is designed to handle billions of new sensors and other "edge" devices that will communicate among themselves and with other parts of the network, also known as the Internet of Things (IoT).

Figure 1

5G network slicing



Source: ITU news as of Jul. 2017

Standalone vs. non-standalone 5G

The path to 5G realization is divided into two phases, non-standalone network and standalone network. First is non-standalone 5G (NSA), which adds enhanced mobile broadband to an existing 4G LTE network. Most western markets as well as China will see NSA roll out starting in 2019-20. Although many carriers will market this as truly revolutionary "5G", this phase will be more evolutionary than revolutionary and will be a relatively minor investment. The second, full or standalone (SA) 5G is more revolutionary as it includes the ultra-reliable low-latency and massive machine-to-machine communications portions, both of which require substantial investments in new infrastructure such as antennas, base stations and fiber optics. Most markets will not see SA roll out before 2025, the exception being China, where the target is to see first deployment in 2020.

> **China is focusing on spectrum that today in the US is reserved for the military, and the US therefore is advocating using different frequencies. How this battle will pan out is unclear, but the risk is that the world will be facing incompatible 5G systems because of different spectrum allocations across geographies.**

While the US initially will focus on residential Fixed Wireless (as an alternative to fiber and WIFI) via 5G NSA, China is going all-in on potentially dominating Stand Alone 5G by launching early and thereby influencing standards as well as showcasing the competencies of Chinese technology and developing relevant new business models for 5G SA. The strategy is a risky one, since all standards have not been determined. Furthermore, there is still disagreement about spectrum allocations and what frequencies should be used for the different stacks of the 5G networks around the world. China is focusing on spectrum that today in the US is reserved for the military, and the US therefore is advocating using different frequencies. How this battle will pan out is unclear, but the risk is that the world will be facing incompatible 5G systems because of different spectrum allocations across geographies.

What patents are telling us about the shift in the geopolitical balance of power

In the litigation-fraught wireless industry, patents are equivalent to both protection (from lawsuits) and profits (from licensing). The process of establishing international standards governing 5G systems and granting patents is nearing completion. The process is overseen by the 3rd Generation Partnership Project (3GPP) and the International Telecommunications Union (ITU).

The standard-setting process is important because it will determine not just how 5G networks are built, but also how money flows between participants in the 5G ecosystem. Companies whose technology becomes the industry standard will receive royalty payments from other ecosystem participants.

Patents in the Telecom Industry are called Standard Essential Patents (SEP). It is difficult to count SEPs since the process is not transparent and because the governing body, ETSI, does not rule what is SEP or non-essential. The ETSI only registers declarations of SEP based on the opinion of the IP provider, which leads to many lawsuits like the highly published lawsuit between Qualcomm and Apple.

However, it is fair to say that in 2G the Chinese firms had zero share of SEP, and that 2G was 90% dominated by Qualcomm, Nortel, Ericsson and Nokia. In 3G the 3 Chinese firms (Huawei, ZTE, Chinese Academy of Telecom also known as Datang) had around 10% of SEP, but patents were still 80% dominated by Qualcomm, Ericsson and Nokia.

4G saw a big shift in IP; Qualcomm took a bigger share because a core part of 4G data packet transmission technology was a Qualcomm invention. The Koreans, mostly Samsung, became the #2 SEP holder. Huawei became #4, ZTE # 7, the Chinese Academy telecom #10. In aggregate, China was #1 with 22% of 4G SEP. On the next page, the 4G LTE patents count as of September 2015 in Figure 2 and the SEP count for 5G as of February 2019 can be seen in Figure 3.

Figure 2

SEP Count for 4G

SEP major patent holders 2015		
Company/organisation	**Patents**	**% of total**
Qualcomm	655	11
Samsung	652	11
Nokia/Nokia Siemens	612	10
Huawei	603	10
InterDigital	418	7
Ericsson	399	7
ZTE	399	7
LG	317	5
Motorola	310	5
Chinese Academy Telecom (Datang)	273	5
NTT	264	4
Sharp	189	3
TI	125	2
Alcatel	62	1
MediaTek	-	0
Total above	5,278	89

Source: CLSA, ETSI patent data base, as of Sep. 2015

Figure 3

SEP Count for 5G

SEP major patent holders 2019		
Company/organisation	**Patents**	**% of total**
Huawei	3,036	35
LG	1,563	18
Samsung	1,528	18
ZTE	1,473	17
Ericsson	465	5
Qualcomm	223	3
InterDigital	186	2
NTT	138	2
NEC	95	1
Total above	8,707	100

Source: CLSA, ETSI patent data base, as of Feb. 2019

It is obvious how influential Chinese companies have become in the development of the next generation of mobile technologies. According to CLSA, Huawei currently owns 35% of the Standard Essential Patents followed by LG, Samsung and ZTE. In total, Chinese entities own more than half of SEPs, followed by Korea at 35%. The US owns less than 5% of SEPs in 5G. Therefore, China's bargaining power has risen a lot since cross-licensing patents will be required for any equipment makers to build 5G networks for any country.

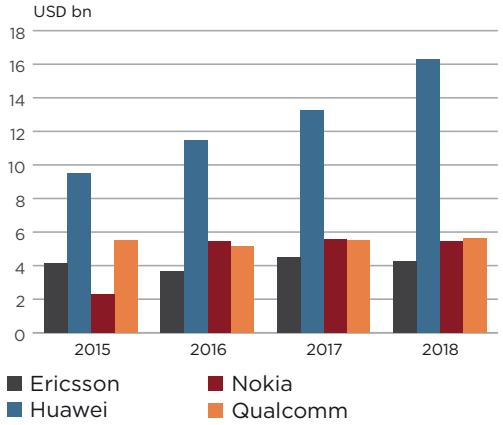
If telecoms dominance is the new battleground, then the US is starting from a quite weak position. Currently, there are only four companies making major telecom infrastructure equipment: Huawei, ZTE, Ericsson, and Nokia. None of them are American. The US used to have major players in Lucent, Motorola and Canada-based Nortel. The first two were folded into Nokia; Nortel went bankrupt.

Cisco and Qualcomm are important companies, but they are focused on different layers of the technology i.e. enterprise networking and chipsets, respectively, and furthermore, have little patent ownership compared to earlier generations of mobile networks.

How have the Chinese companies become so dominant? It has happened simply because the Chinese have outspent everybody else! Huawei employs more people in R&D than anybody and spends 3 times more on R&D than number 2, Qualcomm as shown in Figure 4 and 5 below.

Figure 4

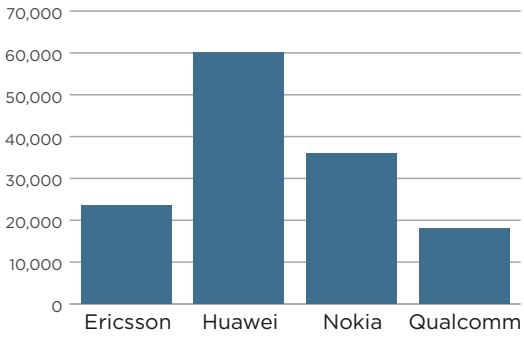
R&D expenditures



Source: CLSA as of Feb. 2019

Figure 5

R&D staff



Source: CLSA as of Feb. 2019

While it is reasonable to argue that the number of self-declared SEPs is not equal to the economic value of the patents that are negotiated when the industry players sit down together and agree on the real value and royalty amounts, there is no doubt that the royalty payments are going to reverse from China and Korea to the US and Europe to the opposite, i.e. from the US and Europe to China and Korea. Welcome to the 21st century.

5G showcases China as a Global Technology Leader today

Much is being said in western media these days on the coming demise of Huawei due to claims that the company is the extended arm of the Chinese state and therefore fundamentally untrustworthy as an infrastructure supplier. Several countries have already banned the use of Chinese equipment in the buildout of 5G, and the pressure on European countries to join the ban is growing. Europe is the region outside China where Huawei over recent years has been most successful in growing its market position, which is estimated to be around 40% in 4G.

The roadmap to 5G chosen in Europe has been first to implement 5G NSA. This is, as mentioned earlier, an overlay to existing 4G networks. If the existing network is a Huawei network, compatibility issues make it very difficult to use other equipment than Huawei in 5G. Therefore, Huawei has a very strong market position in 5G in markets where it has been responsible for the 4G networks.

Obviously, at the end of the day, National Security trumps everything, and countries could decide to stop using Huawei, and rip out old Huawei 4G components and use other suppliers. This will, however, be a very difficult and expensive decision to make, given the fact that China today is a very important (and growing) trading partner for most European countries. Also, the broader trends in US-European relations are going in reverse these days, given the current US administration's very aggressive posture on national defense and trade, security in the Middle East and little apparent respect for the political construct of Europe. So, while it would have been unimaginable 10-15 years ago to see alliance partners in Europe go against the national interests of the US, today the situation is not so clear cut.

Furthermore, the Chinese companies led by Huawei are almost the standard-setting companies in 5G with more than 50% share of SEPs. It is very difficult to imagine the buildout of 5G without the active support of Huawei and other Chinese companies. If western countries insist on keeping Chinese technology out of their networks, it will as a minimum mean significant delay to the roll-out of 5G, which will only expand the lead that China has in 5G compared to all other countries.

> **How have the Chinese companies become so dominant? It has happened simply because the Chinese have outspent everybody else!**

The US has a significant technology disadvantage in 5G which can only be compared to the disadvantage that China has in semiconductor technologies, where the US dominates – see also our White Paper "Made in China 2025". The logical conclusion from this is that the most likely path going forward is that China and the US will have to negotiate a truce in the technology war, because the price for both countries to pay, if the confrontation escalates further, will be very high.

Investment implications

The rise of Chinese dominance in 5G is an example of the general rise of Chinese tech capabilities. China is now driving the technological development within telecoms and is taking significant market share from previous market leaders. The old incumbents might get a breath of air from widespread banning of Chinese equipment in western markets. However, most countries outside the US security alliance will likely vote with their wallet and go Chinese, and also get the early lead, since Chinese companies will be able to launch ahead of competition due to the significant experience lead they will derive from early deployment in the world's largest telecoms market, China.

Risks across the technology value chain globally have clearly risen recently. The US has the upper hand in the US-Chinese tech war due to control of most leading-edge semiconductor technology and software. If controls like the ones threatened on ZTE were to be imposed on US sales to Huawei, they would severely damage, and could even cripple, the Chinese company's business. Of Huawei's 92 core suppliers, 33 are US corporations, including chipmakers Intel, Qualcomm, and Micron, and software companies Microsoft and Oracle. If Washington now prohibits these companies from selling to Huawei, the Chinese telecoms giant will struggle to survive. We do not believe this is a likely outcome since it would be coming close to declaring war on the economic rise of China and therefore have very serious geopolitical implications. However, only the smallest possibility of this outcome will lead to tech companies across the world being forced to reassess their entire supply chains at the risk of vast expense and disruption.

> **The rise of Chinese dominance in 5G is an example of the general rise of Chinese tech capabilities. China is now driving the technological development within telecoms and is taking significant market share from previous market leaders.**

So far, the impact of the US-China cold war on financial markets has been driven almost entirely by investors' shifting perceptions of the risk of trade tariffs. Risk premiums have not yet reflected the full risk of other possible US actions, including export controls. This omission suggests investors should reassess risk premiums on the shares of tech supply chain companies across the world depending on their exposure to the China value chain. US companies with large China exposures are at risk, while "neutral" countries tech companies could potentially gain from dislocation of tech supply chains. Finally, one should not underestimate the Chinese drive and resolution to reduce the country's dependency on US technology through accelerated R&D investments in leading-edge semiconductor technologies in the years ahead. China will not always stay a laggard in this space.

C WORLDWIDE ASSET MANAGEMENT FONDSMAEGLERSELSKAB A/S

Dampfaergevej 26 · DK-2100 Copenhagen

Tel: +45 35 46 35 00 · Fax: +45 35 46 36 00 · VAT 78 42 05 10

cworldwide.com

Q1 2019