Securing the Future of 5G

AI Business eBook Series

Paving the Way to a 5G World

In collaboration with:

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Contents and Introduction

The future depends on fast connectivity - and 5G is the ultimate enabler. From artificial intelligence (AI) and self-driving cars to telemedicine and technologies that create a world that is currently unimaginable - an always-on internet connection will make our lives easier, safer, healthier - and possibly more affordable.

5G promises to introduce speeds of around ten gigabits per second to your phone. That's more than 600 times faster than typical 4G speeds used today, ten times faster than Google Fiber's standard home broadband service, and consumers could download a 4K high-definition movie in just 25 seconds or stream several simultaneously. 5G is not just a linear upgrade of 4G. Instead, it's a fundamental redesign of mobile services to intelligently connect billions of people and things more efficiently and with increased value.

The pandemic proved just how enabling digitalization is. In just days, we shifted entirely to remote working, distance learning and connecting with our loved ones from afar. A crucial catalyst for technological transformation, 5G infrastructures present an unprecedented opportunity to deploy, scale and integrate powerful new systems and machine-to-machine communication. Creating significant economic, social, and environmental value, 5G is much more than just smartphones. Expected to positively impact the economy, jobs and emissions, the scale and intelligence of mobile connectivity will support a whole new category of mission-critical services from smart factories to smart energy grids.

By increasing efficiency and intelligence to more factories, buildings, farms and cities, the movement of people also decreases, along with greenhouse gas emissions per unit output. As the pandemic recedes over the next few years, experts expect 5G deployment to accelerate and expand its potential to empower an ever-growing application economy, creating more jobs, prosperity, value, and reduced emissions.

However, the deployment of 5G networks - and the basis of wireless technology - depends on access to the radio spectrum. As the rate of connected devices and their use increases, resources must be harmonized across borders to allow for the interoperability of infrastructures. Therefore, the extreme value of 5G relies on the majority backing of organizational, Governmental and communication service providers for both investment and adoption of the technology. Without such support, new base station sites and end-to-end connectivity would cease to exist.

In this eBook, brought to you in association with Huawei, we explore the state of play for 5G globally, the security considerations around its widespread adoption, and the technological, economic, and immense strategic implications of the infrastructure's deployment.

Darcy Alexander | Associate Editor | AI Business

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5G & Security: An Evolving Landscape

Assessing Political and Technological Progress Globally

Since the dawn of civilization, there has been competition among nations in pursuit of superior weaponry. The US, with a long history of research, development, and invention, has been the global tech leader for decades. However, since the decision to prioritize technological advancement and the investment of tens of billions of dollars in state funding, China is challenging the status quo. Ultimately, whoever emerges as the leader of widespread 5G implementation will hold cyber power and shape future technological norms for generations to come.

The trade and technological cold war between the US and China has intensified in the race to be first to market. Emerging as one of the most significant turning points in geopolitical tensions in recent times, 5G's unique features and applications mean that the technology will be critical for economic and technological advancement. Ultimately, the country that spearheads development will gain the enviable position of technology leader, resulting in the high likelihood of new networks shaping the competition for 21st-century dominance.

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State of play: the UK

According to Barclays research, the deployment of 5G in the UK could supercharge the economy by GBP 15.7 billion a year by 2025. Proving more advanced in the 5G rollout than its neighboring European countries, the four largest mobile operators - EE, Vodafone, Three UK and O2 - have already launched 5G technologies in many cities throughout the UK and intend to expand into industrial sectors by 2027.

Spearheading implementation, EE was the first operator to use 5G infrastructure in 2019 and has since expanded to 125 towns and cities across the UK. During 2022, the operator plans to introduce a complete 5G core network, enhance device chipset capabilities, and increase the availability of the 5G-ready spectrum. Scheduled for 2023, EE plans to introduce Ultra-Reliable Low Latency Communications (URLLC), network slicing and multi-gigabit-per-second speeds that can enable critical applications such as real-time traffic management and sensor networks to communicate simultaneously and allow fleets of autonomous vehicles to interact.

Creating 51,000 jobs, GBP 3.3 billion in GDP and contributing £1.1 billion in paid tax, Huawei has aided in growing the UK economy by 180% in the last four years. Announcing the launch of their first 5G mobile private network at the Cambridge Science Park on February 8, 2021, the global technology leader proudly introduced the 'Accelerator' program. It is aimed at helping to educate the technology community to best utilize the new, high-speed 5G environment and allow them to develop and test 5G applications in areas from mobility as a service to the digitalization of building services, remote surgery, and increased efficiency.

The aim is for the UK to perform as a 5G world leader, with successful deployment to the majority of the country by 2027 with an ambitious target of 15 million premises connected to full fiber by 2025. The long-term spectrum plan includes the exemption of business rates for full-fiber infrastructure investment and the launch of the 'Barrier Busting Task Force' who will collaborate with industry experts and local authorities to help identify and overcome obstacles with fixed and mobile network deployment.

Acting as a new security framework for the UK telecoms sector, the Government has proclaimed that the UK will have "one of the toughest telecoms security regimes in the world." It will be supported by the Telecoms Security Bill and the 5G Diversification Strategy, which will ensure public telecoms providers conduct secure, resilient networks and services whilst appropriately managing and growing supply chains equipped for future trends and threats. Operating on three core strands: one, to support incumbent suppliers; two, attract new suppliers into the market, and three, accelerate the development of open-interface solutions, the Government is committed to advancing the deployment of 5G cost-effectively.

Encouraging the sharing of the site and network infrastructures and supporting industry initiatives that build on current mobile network operator agreements - provided it does not restrict competition. However, in January 2021, officials placed restrictions on designated vendors. By July, sanctions expanded into stricter rules, including the official removal of Huawei from the 5G network by 2027. Consequently, this will cause a delay to the 5G rollout by one year, with customers experiencing patchy 5G coverage in some parts of the country and a longer wait for access to next-generation services.

Huawei has aided in growing the UK economy by 180% in the last four years

Currently, Vodafone, Three and EE all rely on Huawei's kit nationwide. Because of tightened restrictions, the companies now face the headache and financial repercussions of replacing equipment with alternative vendors. As per Huawei's declaration - this will leave customers facing more expensive bills due to the billions of pounds spent to remove and replace equipment. Repercussions also extend to the wider economy if Huawei decides to counter and divert its research and recruitment funds elsewhere - as well as other Chinese companies viewing the UK as a less friendly market. As a result, countries such as China that are not facing restrictions are moving ahead with innovation at incredible speeds and are already witnessing huge global economic gains - for both individual consumers and businesses. In the face of political interference, countries that are allocating resources to removing the equipment are watching their best engineers and developers move to countries that are now well ahead of the 5G curve. The wider consequences are still being discovered.

State of play: the US

Already available with multiple operators in the US, the 5G roll-out began in 2019 with three national carriers. However, even with no limitations or explicit barriers to any licensed wireless provider offering 5G, coverage is still deemed limited. Generally, 5G services integrate with 4G and a hand-off occurs when a customer moves to an area of 5G availability.

To ensure that a range of operators and industrial companies have access to frequencies, increased competition, raise money and avoid unfair collusion or secret arrangements between multiple buyers, the FCC holds several auctions. In operation since 1994, any service provider or entity that qualifies to obtain an FCC license is eligible to participate and bid for the acquisition of spectrum licenses up to 25 per cent. The premise is simple: the highest bidder that meets the eligibility requirements wins.

In 2020, the FCC completed auctions for spectrum in three bands with licenses lasting ten years. On December 8, 2020, auctions began for a spectrum known as the C-Band, with grants lasting 15-years. All licenses purchased are renewable and subject to "renewal expectation" - if they meet specified requirements for build-out and operation.

Although there are no 5G-specific rules - with no expectation to adopt any - navigating the FCC's equipment authorization process is critical to anyone that designs, manufactures, markets, or imports 5G radio frequency devices. Since the US blacklisted Huawei from trading equipment, understanding the rules, and considering them early in the design process will prove crucial to avoiding delays in getting to market and expensive fines if devices do not comply.

As 5G requires a millimeter wave spectrum to enable the transmission of vast amounts of information in the blink of an eye, the physics does not allow radio propagation to penetrate buildings and other structures, including lower frequency signals traditionally used in other wireless services. As data demands increase and networks become more crowded, carriers must densify their existing networks, and infrastructure will require government cooperation with the private sector. As a result, Congress has changed the law to promote deployment and streamline the review of facilities, including allowing the FCC to engage in rulemakings that tackle regulatory challenges to reduce burdens on the construction of these facilities.

As technology continues to develop and deployment expands, new challenges will arise. In response, the Commission has signaled a willingness to work with industry and local jurisdictions to allow for fast resolution of issues and to ensure transformational technology innovation does not suffer obstruction by red tape and obsolete requirements.

Although numerous security and privacy measures are built into 5G technologies already - including enhanced encryption, increased network virtualization, improved subscriber identity protections, and end-to-end authentication - privacy and data security are front of mind for policymakers across the board. The NIST and the US Department of Defense (DoD) are among many agencies looking at 5G architecture, cybersecurity, and privacy impacts from new 5G use case studies. The findings are then used to develop best practices and models that drive standards of care or impose burdens on the private sector.

Some states, such as California and Oregon, have already adopted laws that impose security mandates on manufacturers and other suppliers in the distribution chain. The mission is clear: companies that wish to embark on 5G technology innovation must understand what they are making, buying and using, and exhibit plans for handling vulnerabilities, managing life cycles and general support.

5G is poised to introduce a whole new ecosystem of innovation, specialized equipment and knowledge to the market that will inevitably confront multiple governmental requirements, FCC regulations and adherence to best practices.

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State of play: China

China's whole-of-government approach in the 5G race has already shown results. Constructing over 700,000 5G base stations and more than 180 million 5G terminal connections, China saw Shenzhen become the first city to achieve full-scale 5G deployment in August 2020, closely followed by Beijing in September 2020. By the end of July 2020, over 88 million users nationally were using 5G technology. 5G has also begun for industrial purposes in sectors from telemedicine and healthcare to mass surveillance and public security, cloud live streaming, manufacturing, transportation, and logistics.

In cooperation with suppliers such as ZTE, Huawei and Ericsson, Chinese providers such as China Telecom, China Mobile and China Unicom have all announced pilot DSS solutions in certain provinces with no national guidance on the implementation. Only four operators - China Mobile, China Unicom, China Telecom, and state-owned broadcaster China Broadcasting Network - have spectrum licenses, with 5G service providers bidding for technology services contracts from the four. There is no public tender process allocating licenses either, as operators are granted directly by the relevant authorities.

In a bid to further improve and build upon China Unicom Beijing's high-quality 5G network, Huawei and the state-owned telecommunications operator joined forces to create the 5G Super Uplink project. In July 2021, the core initiative deployed in multiple high-density areas across more than 1,000 sites presented a vast advancement in network performance in only five days. Results also revealed an improvement of 10 to 40 per cent in the overall uplink rate, with users experiencing a three-fold increase in connectivity at the cell edge.

State of play: Germany

First to the 5G market in July 2019, Vodafone had 60 5G antennas transmitting in more than 20 cities and communities throughout Germany. By November 2020, their antenna structure grew to 3,000-plus, serving 10 million people, which eventually rose to 15 million by the end of the year. Simultaneously in 2020, Vodafone's competitor, Deutsche Telekom, operated over 30,000 5G antennas serving over 40 million customers.

In January 2020, the European Commission and member states of the European Union agreed to a joint EU Toolbox on 5G Security. Recommending and guiding a risk-based approach to cybersecurity based "solely on security grounds", the EU Toolbox does not target any supplier or country. Instead, it advocates objective and proportionate security measures applicable to all, with the intent to harmonize security standards throughout the EU which adhere to an EU-wide certification. To ensure consistency and compliance with basic principles of EU law, the EU published a new cybersecurity directive which - if approved - will implement a stricter, more coordinated framework for member states.

Whilst German legislation does not foresee the exclusion of specific 5G suppliers, security requirements for everyone are tightening, with specified rules imposed on critical infrastructure. Formulated and defined by the Federal Network Agency, a new security catalog for the operation of telecommunication networks and the IT Security Act 2.0 passed into legislation on May 27, 2021. Although there is the possibility to exclude certain suppliers when all other options are exhausted, the Act currently allows all manufacturers to cooperate with German 5G networks and states that any such exclusion will require hard evidence and objective risk. Adhering to concerns of security risks, providers of publicly accessible services must obtain a comprehensive declaration from the manufacturer or supplier to demonstrate its trustworthiness. In addition, to ensure supplier diversity, manufacturers are also encouraged to be independent of each other and not equally dependent on a third party. According to Annex 2 of the Security Catalog, critical network and system components must obtain at least two different manufacturers for the core, transport, and access networks - unless the operator's own solutions are already in use. Implemented into German National Law, the IT Security Act 2.0 recommends the reference of the EU Toolbox and emphasizes the objective evaluation of manufacturers' risk profiles and insurance of EU law compliance that encourages harmonized certification and cybersecurity measures.

Telecoms companies in Germany charge customers a higher price for 5G than 4G services, and as of November 13, 2020, the government grants local 5G frequencies to over 50 companies upon request. After 52 days and 497 rounds of bidding, applicants paid a total of over EUR 6.5 billion for a combined 420 MHz of spectrum allocated until December 31, 2040. Every candidate had to demonstrate reliability, expertise, and performance to operate a public telecommunications network, as well as describe, in a frequency usage concept, how it intends to ensure efficient, interference-free frequency usage and fulfill coverage obligations.

The aim by the end of 2022 is for at least 98 per cent of households in each federal state to have access to a minimum of 100 Mbit/s, with over 1,000 5G base stations. All motorways (approximately 18,000 km), roads (5,350 km), and railways (carrying over 2,000 passengers per day over 21,000km) aim to have at least 100 Mbit/s and a maximum 10 ms latency. By the end of 2024, the complete federal highways (approx. 32,700km) will have a minimum of 100 Mbit/s. All national and state roads (approx. 80,000 km), seaports and core inland waterway networks (approx. 4,500km) and all other railways (approx. 20,000 km) will all have a minimum of 50 Mbit/s.

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State of play: India

Entering the conversation as late as 2017 via a high-level forum introduced by the government, a 5G roadmap was devised with ambitions for a 2020 roll-out. However, whilst 61 countries worldwide have been quick to adopt and implement 5G technologies and networks already, India is yet to launch. With technology solutions set to change the lives of billions of consumers all eagerly anticipating the upgrade, the debate surrounding foreign telecom equipment reliability and specific 5G India standards have delayed development.

The Telecommunications Standards Development Society India (TSDSI) encourages homegrown telecom equipment manufacturers to participate in trials that include Large Cell, Low Mobility enhancement for broader coverage in rural areas. However, the Cellular Operators Association of India (COAI) disagrees, arguing that 5Gi could lead to interoperability issues, and instead suggests implementing the global 3GPP standard for 5G. The uncertainty over 5G spectrum pricing and allocation has been an area of contention since 2017. The first 5G spectrum auction in India set the base rate at INR 492 crore per unit between 3.3 to 3.6 GHz - making it one of the highest rates in the world, causing Indian telecom operators to push back from the auction and fight for a more reasonable price.

Gear vendors and tech companies have been launching 5G testbeds since 2018, and leading telcos have been confident that their commercial 5G in India launch date would be in September 2021. However, a 2021 parliamentary panel report on the status of 5G in India served as a rude awakening for the Department of Telecom (DoT). Concluding that "sufficient preparatory work has not been undertaken for launching 5G services in India" - thanks to inadequate spectrum availability, excessive spectrum pricing, poor development of test cases, ineffectual back-haul capacity, the limited reach of optical fiber across the nation, and a lack of formal approvals for testing 5G in India.

Although a tumultuous journey for India so far, the 5G mission is fervently gathering pace. As of May 2021, the DoT has reportedly allocated spectrum for a six-month 5G in India trial to telcos, with preference given to homegrown OEMs across multiple locations. The 5G India auction should take place at the latest in 2022, with only a dozen firms granted permission to participate in the trials. Notably, however, Chinese firms have been excluded. However, according to Delhi, the suspension does not result in the banning of Chinese companies that currently supply a significant amount of equipment to India's mobile providers.

The boycott of Huawei and ZTE in India's six-month 5G trials signaled a tightening of security measures intended to alienate Chinese companies. However, this decision has the potential to cause unfavorable consequences to India's economy. A report from Oxford Economics revealed that by blocking Huawei from rolling out its sophisticated 5G technology, India will lose USD 64 billion in GDP in the top eight technology markets by 2023. However, Huawei remains hopeful of playing a significant role in India and considers a strategic market in its long-term plans. CEO David Li explained that the "long-term commitment for India is not just words. [It is] a legacy of 20 years of putting India first with our world-class technology, service, [and] innovations, backed by a clean track record."

However, according to the government and DoT's findings, the necessary large-scale network infrastructure for the 5G launch is still inadequate. Over the next six to nine months, an accelerated rate of fiberization is planned and will connect rural India to 5G services. As per the National Broadband Mission, around 2 million km of optical fiber covering 70 per cent of the nation's towers are scheduled for installation country-wide by 2024.

The anticipation of 5G in India has been building for years. Many manufacturers have already launched the latest 5G smartphones in the country, with more planned. With an estimated number of 5G devices growing to 31 million units and the average price of entry-level 5G devices reduced by almost 40% in the last six months, it's no wonder the appetite for connectivity opportunities is so significant. Once implemented, 5G solutions can support up to one million connected devices per sq. km, compared to just 2000 per sq. km. under 4G LTE.

> *Sufficient preparatory work has not been undertaken for launching 5G services in India*

Taking Huawei out of the network does not improve security

Interview with Jeremy Thompson, Executive Vice President & CSO Huawei Western Europe

"Huawei went from being warmly welcomed by the David Cameron government (arguably the golden age of the UK-China relationship where the UK was proactively seeking cooperation and business with China) to the situation we are in today. The US elected Trump and China selected Xi Jinping - two leaders effectively running in opposite directions," says Thompson. "China has strengthened in the last few years, which has caused countries to react differently. Having been the technology leader of the world over the past three decades, America appears to feel threatened by China's impending race-to-5G victory - a title effectively won by simply outspending America. China has the skills, capital and a massive home market that has neutralized America's advantage. As a result, America has adopted an aggressive systematic campaign to undermine Huawei during a time of rapid growth. Huawei has rapidly evolved into a leader of the 5G market and now provides most of the global 5G infrastructure. Unfortunately, the lobbying tactics seem to have prevailed, especially in the UK - perhaps due to post-Brexit pressures to seek trade deals."

In reaction to the contention around Huawei and security, what is Huawei doing to prove that its 5G equipment is safe and secure?

"There are three phases to making sure 5G equipment is safe and secure. The first is during the product and design phase. As 5G is in its fifth generation, we have an opportunity to learn from previous generations and build standards from multiple areas, including all equipment manufacturers, operators and other businesses that have vested interests. By being both active and proactive in security standards development, Huawei can ensure security by design. The second phase is to build products in a continuously secure way: by focusing on the programming standards, configuration management, lifecycle management, software and hardware design and manufacturing. The third phase is to work with operators globally to identify and protect vulnerabilities and attack vectors. Due to the extra scrutiny Huawei receives, we have introduced a series of transparency centers where we demonstrate the security of our products. Located in Brussels, the UK, Italy, and China, we are dedicated to best serving our customers by allowing them to deep dive into our products and look at the code. We also proudly support the standardized security valuation scheme developed by the GSMA - which ensures that mobile networks define and maintain accreditations to network security. Arguably, 5G is the most secure generation of telecommunications, especially due to its high attack sophistication."

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Other than public networking, what use cases are there for 5G equipment, and what other avenues are you exploring?

"The second generation of wireless was all about voice and text, and how to achieve better quality. The third generation was effectively a stepping stone where many of the same features improved without significant change. The fourth generation focused on consumer apps. This time, the fifth generation centralizes on connected devices. In reality, 5G is unnecessary for a good app experience. Whilst it provides faster speeds and better latency, its most valuable function lies in the unit price being substantially less than 4G with less power consumption. Once full-scale rollout occurs, the economies of scale enable consumers to double their bandwidth to insatiable amounts every 18 months. Over the last ten years, the number of devices a consumer owns has dramatically increased from connected printers and speakers to smartphones, smart fridges, connected cars and wearable devices. The environment will evolve from being predominantly business-centric to consumer-centric, then business-to-business. Our fridges already connect to the supermarket, and our cars to the manufacturers, for example."

How does Huawei networking equipment enable emerging technologies and use cases like AI, IoT, digital twins and VR?

"Looking at the broader sense of deployment, 5G is set to infiltrate most industries and manufacturing and will reengineer dozens of businesses and activities. Previously, a plant would have multiple sensors to regulate temperatures and productivity. Now, the entire logistics and assembly line is automated. 5G enables real-time updates from lorry driver ETAs, logistics of containers, cargo ship deliveries and offloading times, which notifies the production line. The ecosystem is constantly evolving, and everyone involved is experimenting, leaving an opportunity for any country to take the lead."

With so many connected devices, how does the average consumer ensure their privacy?

"It's difficult to encourage consumers to pay for security. In response, the UK government developed a set of laws to ensure a minimum standard of protection across all devices. By focusing on the Internet of Things, several basic hygiene factors were identified - which then caused the whole industry to adapt and build products to a predefined security level. Without the minimum level of security, devices could be left vulnerable to botnet attacks which essentially weaponizes devices to attack institutions. It's within everyone's best interest to ensure a high level of security. GDPR was also introduced regionally across Europe and has since been deployed worldwide, including in China - a Chinese version. The reality is that average consumers - for the most part - are ill-informed and unaware of the impact and value of their data, often citing that they have 'nothing to hide'. This means that governments and businesses must protect themselves, and their customers, by implementing standardized procedures that serve the best interest of all parties."

Will customer privacy and security be impacted or even suffer by ripping out and changing the infrastructure?

"It will impact the economics as extra resources are required to remove the equipment and reinstall it, which takes away from the timeline of building new base stations. Fortunately, it's not a privacy or security issue. The former CEO of NCSC of GCHQ, Ciaran Martin, has said, "taking Huawei out of the UK network does not improve security - but it is economically very expensive."

The environment will evolve from being predominantly business-centric to consumer-centric, then business-to-business

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Who's liable in assuring 5G security?

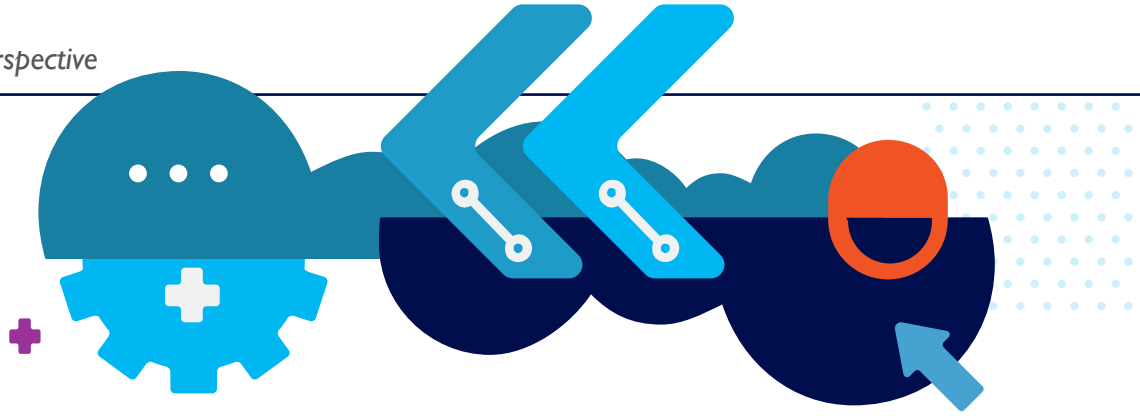
Interview with Ronald Hendrikx, partner and co-head of Bird & Bird's international Technology & Communications sector group

Twenty years ago, everyone was looking at liberalising markets by ensuring competition for connectivity. Now, technology is innovating so fast that governments are racing to keep pace with all the opportunities that connectivity creates, with security and data protection concerns high on the agenda. Previously, telcos were at the heart of all connectivity regulation. Today, everyone who uses connectivity in their products or services must exercise caution when embracing connectivity and the resulting data they are sharing. A much wider group of connectivity providers must now consider how their customers will use their products, what dangers they may be susceptible to and how best to protect their users in a hyper-connected world.

What are the biggest concerns and challenges lawyers face regarding 5G and its capabilities?

"5G is a real game-changer," says Hendrikx. "Not only is the technology very exciting in itself, but it is a real enabler, a catalyst for other tech revolutions to happen. We've moved from looking purely at tech from a patent, IP, and security standpoint to what wider issues are raised by 5G-enabled services. We now have to explore what companies intend to do with the technology they are creating - and how people will embrace 5G - as it's not just about playing better, quicker games on our mobiles. The opportunity for the industrial application of 5G will bring a level of speed, intensity, and data we've never seen before. Entire sectors will be transformed by connectivity which raises difficult questions of liability."

"The biggest challenge we are currently facing is a challenge of mindset. When incorporating 5G into our products and services, we must now consider the entire value chain, including third parties, and not just the product itself. From a legal perspective, 5G raises interesting issues - some we were already dealing with; about the equipment itself, how to protect IP in it, how safe it is and how it has been tested. We now have to also ask ourselves what services the products enable and the value chain it creates. Assigning fault and responsibility is becoming increasingly more complex, too, as there are more players to consider in this connected world - and that's without considering the risks associated with data concerns. Everyone wants access to the data that connectivity helps create and transport. Everyone wants to learn from that data, but consumers, individuals and citizens want to feel that their data is handled in a robust and safe way. Those who embed connectivity in their products have to think about what connectivity means. As people are creating networks in their own homes, cars or at work when synching multiple devices, for example, providers must think of their responsibility in respect of the data that is being shared. The challenge for these providers is to change their mindset, become better educated about the opportunities and the dangers of hyperconnectivity and take responsibility for the security of their products, their customers and data. And this now applies throughout a more complex value chain, from designing safe products to ensuring the whole network of connected products is safe and secure."



Which industry will be most affected legally by 5G technology?

"Every sector is trying to identify how they will utilize 5G and how it will change their industry. Who will be most affected? It could be any industry. It could be consumer-focused industries because they have to keep up with consumer demand for innovation and speed, ease of access and use as well as virtualisation that 5G is famous for. Or it could be those at the other end of the spectrum where investments run in longer cycles - the key facilitators of our modern-day life in transport and energy. All businesses must consider the opportunities offered by hyperconnectivity as well understanding the risks of what could go wrong and how secure their supply chain is in case of connectivity disruption. Each sector has different challenges, from the network of connected devices itself, the services created for it, and winning over the people using it. I can see all industries struggling with different issues and concerns in the wake of 5G adoption."

Given the need to ensure devices and infrastructure is 5G compatible, how concerning is corporate espionage and theft of IP, and what structures have been put in place to protect liability and intellectual property?

"Governments need to figure out what sort of security issues they may face across equipment, networks, services and consumer edge devices. A few years ago, network equipment was at the heart of government concerns. Now, their focus spans the entire value chain. Whole industries have to work with the NIS directive, for example, to understand how to address security issues in critical infrastructures and potential vulnerabilities in IT and connectivity. The debate has transformed from who should take security seriously - to a broader recognition that everyone must build security by design, ensure supply chains are secure and should implement strategies for when something goes wrong. We already have regulations like NIS and GDPR that ensure security is built-in, breaches are reported, incidents are prevented, and threaten fines if these regulations are not followed.

The basic building blocks for protection of IP are also there - and have been for a while; we've got patents, trade secrets, copyrights, trademarks. Many battles have already been fought over ownership and licenses for the network technology. There is now the additional dilemma of figuring out how to attach the many new, 5G-enabled peripheral devices to the network safely, developing the most secure interfaces and how to connect and integrate the available 5G software securely. For 5G connectivity to be successful networks will want to create ecosystems of relationships - because the more people buy and use devices at the edge, the busier the network gets, the more data it creates - and that's the aim: to generate as much traffic as possible to the network. Stakeholders now have to both protect their IP and find ways to share and open up their networks - but do they understand what that means and the possible consequences - can they control it? Do the users on edge devices understand why they're connecting, what it means and how services are being performed? It's no longer just about ownership. It's also about the open nature of the 5G eco-system, helped by it being more software enabled. That's where security comes in again – across the ecosystem. Regulators enforce correct device settings for example, and not assume consumers will take responsibility. Getting the settings right on the edge devices, in some retail settings, or automotive, is critical because if it goes wrong, it goes really wrong."

Does 5G connectivity cause increased concerns regarding protection and cybersecurity?

"Working in this area as a lawyer is very interesting. It constantly begs the question: what haven't we thought of? Often the answer begins with, what is the customer journey? Then we need to decipher what is being sold, and who is dependent on that. Sometimes we focus on the service provider, other times it's the telco or even the equipment manufacturer. The law has evolved into a broad range of rules that guide all these stakeholders and people are beginning to realise that they must change their mindset and take note of the new regulatory plans and laws set for introduction these coming years. I predict that Europe will attempt to create a vibrant data and connectivity environment where people will take greater responsibility for security.

5G and the underlying technology is still evolving with business cases for the use of 5G being developed across all industries. Governments have to perform a balancing act by creating a system that sets clear principles, for example ensuring the protection of personal data, without interfering with innovation and new technologies. These general structures are now starting to emerge with a strong focus on security and data - but we must be careful not to get too specific for fear of missing or hindering new developments."

Applying the economic handbrake on 5G innovation, deployment, and development

Interview with Jeremy Thompson, Executive Vice President & CSO Huawei Western Europe

Huawei made a virtue of working with best of breed suppliers globally and opted primarily to invest in US suppliers as they provide some of the best technology worldwide. However, since the imposed sanctions, Huawei has been forced into finding alternative suppliers. "In some cases, it's relatively straightforward. In others, it's more problematic," says Thompson. As a result, Huawei has altered their resources and are looking to build parts themselves - inadvertently causing the company to become more creative and self-sufficient. "It's most certainly been an unwelcome disruption to the supply chain, but alternative suppliers will - and have already been found." A new spirit inside the company has also emerged aptly named 'The Second Start Up Phase,' where the company is finding several business opportunities that may have previously been overlooked in the portfolio or not focused on in the past. "We are now seeing exciting endeavors in wider industries that demonstrate good growth opportunities, including the automotive sector and renewable energy, which we are supporting with storage devices and products for the sustainable energy market. The sanctions have incited a profound impact on the company, but it has been a great opportunity to revolutionize the portfolio and gain traction in new industries that will propel the way we live our lives substantially."

What is Huawei's 5-year vision for 5G technology? And have your plans changed since the imposed sanctions?

"The ideal vision over the next five years is to connect billions of additional devices that have a multitude of different applications - including industries from manufacturing to health and the creation of smart cities. Each application will transform how we live our lives - similarly to how apps did with 4G. But it starts with the networks as they're the enabling platforms. But it's probably going to take three to five years for the networks to be effectively rolled out."

What impact and delay have the imposed sanctions caused?

"For the UK, the knock-on impact is substantial - particularly from a value creation perspective." The Huawei Assembly Economic Impact report revealed that more than GBP 100 billion of economic benefit and 350,000 potential new jobs outside of London and the South East may not be fully realized over the next decade. An independent Assembly report published 28 October 2021 stated that "a delay in Britain realizing its full 5G potential could condemn some parts of the country to the digital slow lane for years to come." A report commissioned by Huawei declared that "if 5G were delivered nationwide without delay, three-quarters of its expected economic benefit would likely come in regions outside of London and the South East, with potential to transform connectivity in areas such as the North East, North West and the West Midlands."

Risk to UK jobs and a widening of the digital divide

As a global leader in 5G, the UK could stand to benefit from more than 600,000 potential new jobs over the next decade, bringing with it the value of more than £6,000 per household on average by 2030. Critically, the jobs at risk are not limited to the tech sector or confined to tech hubs but spread across white-collar and blue-collar workforces.

- In the North-West, the region risks not fully realizing an economic uplift of £16.9 billion between 2020-2030 – and 59,000 new jobs.
- In London, the region risks not fully realizing an economic uplift of £39.7 billion between 2020-2030 – and 139,000 new jobs.
- In the West Midlands, the region risks not fully realizing an economic uplift of £13.0 billion between 2020-2030 – and 45,500 new jobs.

> *For the UK, the knock-on impact is substantial - particularly from a value creation perspective.*

Consumers could be left waiting

The UK mobile industry has already made significant progress in the roll-out of 5G, with more than 300 towns and cities having some degree of coverage. However, a delayed roll-out would mean consumers across the country would have to wait longer to enjoy the full benefits of next-generation connectivity on their devices – such as virtual reality video streaming, gaming, and the delivery of on-demand content.

Industries face losing out on 5G benefits

The report warns that a delay in the 5G roll-out threatens to slow advances in everything from next-generation remote healthcare and smart manufacturing to robotics and at-home schooling. Social equalizer entities such as high-quality remote learning and healthcare that helps to address GP or teacher shortages and advances in smart manufacturing and robotics are under threat. 5G has huge potential for streamlining processes and productivity, with a recent 5G trial in Worcestershire registering a marked rise in productivity after exploring the use of 5G in machinery fault detection and remote training.

Matthew Howett, Principal Analyst and Founder of Assembly said: "The Government's own expectation of its restrictions on Huawei is for up to a three-year delay in 5G roll-out. The risk is that this will be felt by operators being forced to focus their deployments in more profitable urban centers, which would inevitably mean it takes longer to reach - and fully cover - more rural and remote parts of Britain with 5G. If this plays out, there is a risk of a widened digital divide."

Victor Zhang, Vice President of Huawei, said: "The UK government has set ambitious targets for improved connectivity by 2025. This research reveals how a three-year delay in the 5G roll-out will have a significant economic impact on every part of the UK and highlights the consequences of failing to realize Britain's full potential. Without global 5G leadership, Britain faces relegation to the digital slow lane, a job creation black hole and a wider digital divide."

What is your opinion on the official removal of Huawei from the 5G network by 2027?

"In my opinion, the UK did everything right when it came to 5G - until they decided to remove Huawei from the network. By doing so, they effectively put the handbrake on 5G development, delayed rollout plans and slowed down innovation. It's extremely disappointing. The UK was the first large European country to introduce 5G, and we were well-positioned. The regulator's early release of the spectrum in the auction encouraged all carriers to invest - which not only got the network out and delivered a competitive advantage - but it also enabled the UK to become an early testbed for new technologies and reengineering. First movers can take their business processes engineering to other places, but now, due to the removal of Huawei, Germany has overtaken the UK and are enabling more test cases. This means that they can export their insights and ideas to the UK - who previously had the lead. Operators are now sadly more concerned with when and how to remove Huawei equipment - instead of focusing on the rollout and innovation."

Will the sanctions slow down 5G technology innovation? What are the unforeseen consequences for the 5G world moving forward?

"Yes - as far as the UK is concerned. The platform will not be there, and by taking out one of the biggest players in the game, you slow down innovation. Huawei outspends Ericsson and Nokia combined on research and development - and that's where innovation originates. Testbeds, R & D, cash, engineers, businesspeople from different sectors all working together forms innovation - and the UK has just made themselves unattractive. Huawei has always enticed top talent resources to the UK by being early adopters of 5G. Talented engineers - by definition - like to go to where the new, cool things are. Now, there are more 5G base stations in a city in Shenzhen than there is in the whole of Europe. There are big sites, smaller sites and over 500,000 base stations in China - they have the technology, so they have the innovation, and now they're attracting the best talent. At the other end of the spectrum, the most disadvantaged cities, and towns - especially rural areas - will have to wait even longer for 5G - and may never benefit from it at all. This completely defies the UK's level up agenda. There are still towns in the UK where 4G has only just been implemented!"

> *"The UK government has set ambitious targets for improved connectivity by 2025. This research reveals how a three-year delay in the 5G roll-out will have a significant economic impact on every part of the UK*

"We've seen the greatest shock to the technology global supply chain in the last 34 years - and when I say we, I'm not talking about Huawei specifically. Every technology product involves multiple countries and companies, and there is a whole generation of people in this business who have grown up expecting to source any part, from every continent, to build their product. Now, some parts are no longer available to be freely purchased, and the restrictions around them managed to damage Huawei and the Chinese - but also entire industries and companies. BMW, Toyota, and Ford can't get chips either, so the ripple effect and further consequences have caused a big shock to the system - far greater than the original target. The reality is that Huawei spent $12 billion on US components last year - and the year before that - and, ultimately, that money will go elsewhere. Once an alternative supply chain is identified, the original US suppliers will have an even bigger competitor - or set of competitors they would not have had otherwise. Now, there is a whole new raft of diversity being developed to mitigate the risk from an unpredictable US administration."

Huawei has assured us that the security concerns are not valid. What motivations do you think are driving these sanctions?

"The motivations for the sanctions are purely economic. Through a huge amount of R&D development over the years, the US has led the technology field in almost every sector. When they were not leading, it was because they didn't consider it to be too important. Historically, wireless has not been considered important, so they under-invested, but wireless - and 5G specifically - will soon be the economic backbone. Now that the US has realized that they're nowhere in this space; they've got no R&D capability, no productivity, and no industrial capability of any scale, they're playing catch up and investing huge amounts, like $17 billion into a chip manufacturing plant in Texas for Samsung. Huawei works in 170 countries worldwide, with 96 of the top 100 carriers. The company has been present in the UK for 20 years, and through that loyalty and trusted experience of working with our resilient products, customers repeatedly come back. They believe in the stability of our supply chain in terms of fuel supply, good stock of raw materials and components. We've proven safe for deployment and reassured our customers through a clear understanding of our management of the supply chain and business continuity management - which is why our customers have stuck with us."

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HUAWEI

Founded in 1987, Huawei is a leading global provider of information and communications technology (ICT) infrastructure and smart devices. Huawei's mission is to bring digital to every person, home and organization for a fully connected, intelligent world.

To this end, we will: drive ubiquitous connectivity and promote equal access to networks to lay the foundation for the intelligent world; provide the ultimate computing power to deliver ubiquitous cloud and intelligence; build powerful digital platforms to help all industries and organizations become more agile, efficient, and dynamic; redefine user experience with AI, offering consumers more personalized and intelligent experiences across all scenarios, including home, travel, office, entertainment, and fitness & health.

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