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HOW BIG A PROBLEM IS HUAWEI ?

SUMMARY

Huawei Technologies and its 5G network construction work around the world have created concern in many quarters. The chief cause for this concern is the perception that Huawei networks have a unique potential for exploitation by Chinese intelligence services.

A Wapack Labs review to determine the scale of this problem showed that Huawei is in fact involved in 5G infrastructure development in many countries.

Germany, Ireland, Switzerland, and Canada have been using Huawei equipment to set up their 5G networks. Huawei has been involved in 5G trials and test beds in **Estonia, Italy, Norway, Romania, UK, Bangladesh, Lebanon, and Thailand**, in some cases since 2017. Huawei also has contracts for future 5G work with **Hungary, Russia, Philippines, and Saudi Arabia**.

However, Huawei's fielding of 5G networks is not the key component of their worldwide presence. Huawei claims to have already provided network support to more than 170 countries. This initial survey did not catalogue their work in all countries, but **existing Huawei equipment and construction contracts were identified in 70 countries**, including 23 in Europe and 26 in Asia.

Some Huawei products being marketed worldwide raise particular concerns. Huawei claims to have sold its "**Smart City Solution**" to 40 countries. This integrated city management system puts all city data and Internet-of-Things systems under one command center. This includes a unified and extensive **video surveillance system supported by AI for facial recognition**.

In addition, the Huawei subsidiary **Huawei Marine** has been laying submarine communications cable for the past ten years and equipping these networks with Huawei switches and controllers. Huawei claims that its **cable systems are deployed in 68 countries**.

Several countries, especially in Europe, are now rethinking their relationships with Huawei. Still, Huawei equipment is already installed in so many countries, potential Chinese exploitation is indeed a worldwide problem.



Figure 1. Huawei logo

BACKGROUND

In early 2019, Huawei's name seems to be on everyone's lips. The US Secretary of State is traveling abroad warning other governments to keep Huawei out of their new 5G communications networks. Huawei is described as leading the effort to get ahead of the US in 5G technology and thus dominate the future market for China. Huawei is accused of being a tool of Chinese intelligence because its founder, Ren Zhengfei, was in the Chinese military.



Figure 2. Meng Wanzhou

Huawei's Chief Financial Officer Meng Wanzhou (Ren's daughter) is currently being held in Canada pending extradition to the US to answer charges against Huawei for fraud and intellectual property theft. The Chinese government has spoken publicly on the case, declaring Huawei's innocence and charging the US with using her arrest for leverage in trade talks. On 1 March 2019, Meng Wanzhou filed a civil suit in Canada alleging members of the Royal Canadian Mounted Police and Canada Border Services Agency breached her constitutional rights when she was arrested in Vancouver on 1 December 2018.¹

It is true that Huawei has been aggressively marketing its 5G equipment all across the world. However, the focus on 5G obscures the facts about Huawei's historical presence in the international telecoms market. The West often seems unaware that Huawei is the largest telecommunications-equipment manufacturer in the world and the second-largest manufacturer of smartphones, after Samsung and ahead of Apple. As for security concerns, phones are not the key issue; Huawei is a leader in building and equipping networks, and has done so in perhaps the majority of countries on the planet. This theoretically puts their equipment in good positions for exploitation and intelligence collection by the Chinese government.

To date, no firm evidence has been found of Huawei building back doors into its equipment, operating as an arm of Chinese intelligence services, or that Huawei has been forced to grant Chinese intelligence access to Huawei-built networks. However, none of that reduces the potential for the Chinese government to coerce Huawei to make its systems available at some later date. Given that, it is assumed for purposes of this report that the presence of Huawei-built networks in a country create an intelligence vulnerability for that country and the users of such networks.

¹ <https://www.theglobeandmail.com/canada/british-columbia/article-huawei-executive-meng-wanzhou-files-lawsuit-alleging-breach-of/>

This assumption is supported by the fact that China's new National Intelligence Law, released in June 2017, contains statements such as "All organizations and citizens shall, in accordance with the law, support, cooperate with, and collaborate in national intelligence work," and "The state will protect individuals and organizations that support, cooperate with, and collaborate in national intelligence work." Some analysts have pointed out that this likely puts an obligation on Huawei and other companies to support Chinese intelligence services when asked.²

In view of this, the size of the Huawei problem could be said to be proportional to the number of Huawei-built networks and the extent of coverage of those networks. Wapack Labs has conducted a review of Huawei's work abroad to document the extent of Huawei's presence in other countries. This report is a summary of the findings of this review.

HUAWEI AND 5G SYSTEMS

Most of the concern expressed in the last year has been about Huawei's 5G development and their role in installing it around the world. The year 2019 is a critical moment in the fielding of 5G systems, by Huawei and by other countries and companies: initial rollout of 5G service is expected in many countries. This section will review the definition of 5G systems, what 5G equipment Huawei is marketing, and what countries have a relationship with Huawei as they field 5G systems.

What is 5G Technology

What does it mean to be 5G? In a general sense, it means anything that could be called "fifth-generation" wireless technology. However, as standards have been refined and the technologies themselves have evolved, 5G wireless systems are becoming characterized by the following features:

- For 5G, new types of transmission towers with very large numbers of antenna elements on each must be installed. These will make use of new **massive multiple input/multiple output (MIMO) technology** allowing increased multiplexing capability for higher data rates.
- Because frequency bands below 3.5GHz have become crowded, 5G mobile wireless will use frequency bands from 3.5GHz up to perhaps 100GHz, putting them in **the millimeter wave (mmWave) spectrum**. To achieve **data rates of 1-10 Gigabits (Gbps)** to end points in the field, 5G systems must also be capable of hundreds of megahertz (MHz) of channel bandwidth.
- Millimeter-wave transmissions have much shorter range than 4G systems and are less capable of penetrating walls and other obstacles.

² www.aspistrategist.org.au/much-ado-huawei-part-2

To compensate, 5G antenna array will use **beamforming to steer narrow-beam transmissions to specific receivers**, thus extending coverage for each cell to the required range.

- 5G will also use **fixed wireless transmission**, signals from towers to fixed locations such as homes and businesses with data rates of 20Gbps or higher.
- A key requirement for 5G is a reduction in latency from the existing 4G standard of about 10 milliseconds to **end-to-end latency of one millisecond or less**. This will enable real-time connections for such activities as autonomous vehicles and augmented reality/virtual reality.
- Design and data rates for 5G are intended to **support the Internet of Things (IoT)** in completely different ways, capable of connecting vast numbers of devices machine-to-machine (M2M) with extremely low latency and low power use.^{3 4 5}

Huawei 5G Marketing

Huawei is currently aggressively marketing its "5G Solutions" to the world. Its website advertises the following as its primary solutions:

- **"Simplified 5G Site:** Huawei 5G full-band, full-scenario, and full-RAT [radio access technology] tech product solutions help customers efficiently build the best quality 5G network. The 5G massive MIMO AAU [active antenna unit] allows more simple deployment and operations and maintenance, and the simplified 5G network enables ultimate performance, helping achieve 5G ultimate service experience within reach.'
- **"5G Core Network:** Built on microservices-based software architecture, SBA network architecture, and enhanced computing platforms, Huawei's simplified 5G core network delivers real-time business agility, network autonomy, and a reduction in cost per bit that outpaces Moore's Law, helping carriers increase revenue and sustainably optimize TCO.'



Figure 3. Huawei 5G marketing illustration

³ www.qorvo.com/design-hub/blog/getting-to-5g-comparing-4g-and-5g-system-requirements.

⁴ www.electronics-notes.com/articles/connectivity/5g-mobile-wireless-cellular/requirements.php.

⁵ 5gmf.jp/en/about-5g.

- **“Global Services Enabling Best 5G:** Huawei provides end-to-end professional services throughout the planning, construction, and maintenance phases for 5G networks, in alignment with the customer's business and operation flows. This helps customers create competitive edges through efficient, cross-domain 5G network planning and fast, accurate 5G network build-out.’
- **“X-Haul:** Huawei X-Haul provides a full-coverage solution for backhaul and fronthaul. In the backhaul scenario, Huawei released the industry's first 5G router that supports cost-effective 50GE access ring networking and is compatible with 100GE.”⁶

Huawei is also highlighting its status as a lead developer of 5G technologies and the extent to which it is already installing that technology worldwide:

- **“Leading R&D Investment:** Between 2009 and 2013, Huawei invested more than US\$600 million into 5G technology research. Following this, in 2017 and 2018 Huawei invested almost US\$1.4 billion into 5G product development.’
- **“Leading Business Cooperation:** By 29 January 2019, Huawei was cooperating with 50+ partners, had 30 5G commercial contracts, and made 25,000 base station shipments.’
- **“Leader in 5G Technologies:** Huawei has completed inter-operability development testing (IODT) with mainstream chip, terminal, and network vendors. Huawei became the first company worldwide to launch the industry-first 5G commercial chip with the Balong 5G01 and 5G commercial CPE [customer premises equipment] compliant with 3GPP Release 15.”⁷



Figure 4. Huawei Headquarters in Shenzhen

Status Of 5G in China

The transition to 5G is taking place in China, and Huawei is part of that transition. As of mid-2018, China's three major telecom operators had all secured government approval for 5G deployment inside China and were all in the midst of 5G rollout plans. China Unicom planned for 5G pilot projects in 16 cities including Beijing, Nanjing, Chengdu, Shenzhen, and Shenyang. China

⁶ carrier.huawei.com/en/spotlight/5g.

⁷ carrier.huawei.com/en/spotlight/5g.

Telecom's 12 pilot cities include Shenzhen, Shanghai, Suzhou, and Lanzhou. China Mobile planned 5G field testing in five cities including Shanghai and Guangzhou.⁸ China Mobile reportedly plans to build 10,000 5G base stations by 2020, with 5G devices coming in the first half of 2019.⁹

Not all of these companies are using Huawei equipment; ZTE is also in the mix. However, in highlighting its recent achievements inside China, Huawei listed the following in the news section of their website:

- Huawei Launches World's First 5G Base Station Core Chip for Simplified 5G (24 Jan 2019)¹⁰
- Huawei Takes the Lead in Completing China 5G Technology R&D Trial using 2.6GHz Spectrum (17 Jan 2019)¹¹
- Shanghai Mobile and Huawei to Complete the World's First Real 4K UHD Live Broadcasting Through 5G Network Slicing (10 Dec 2018)¹²

5G Development by Other Countries

While China and Huawei are aggressively pursuing 5G technology development and the fielding of 5G systems, they are not necessarily ahead of 5G development by the US, Europe, or Asia. The rollout of 5G service is already under way in the United States. Verizon initiated its Home 5G service in Houston, Indianapolis, Los Angeles and Sacramento. AT&T started 5G wireless service in 12 cities in 2018: Atlanta, Charlotte, Dallas, Houston, Indianapolis, Jacksonville, Louisville, New Orleans, Oklahoma City, Raleigh, San Antonio and Waco. It has plans to add at least 7 more in 2019. Sprint will reportedly roll out 5G in nine markets in 2019, and T-Mobile is planning a 2019 launch with nationwide 5G coverage in 2020.¹³ To support these networks, Qualcomm and Intel are currently developing 5G modems for phones, cars, and smart-home devices.



The UK network operator EE will launch 5G in 2019 in London, Cardiff, Edinburgh, Belfast, Birmingham, and Manchester. Vodafone UK also plans to release 5G in the Lake District and Cornwall in 2019.

⁸ new.qq.com/omn/20180419/20180419A07DIL.html.

⁹ www.lifewire.com/china-5g-4178852.

¹⁰ www.huawei.com/en/press-events/news/2019/1/huawei-first-5g-base-station-core-chip-5g.

¹¹ www.huawei.com/en/press-events/news/2019/1/china-5g-technology-rd-trial-2dot6ghz-spectrum.

¹² www.huawei.com/en/press-events/news/2018/12/migu-china-mobile-4k-uhd-live-broadcasting-5g.

¹³ www.tomsguide.com/us/5g-release-date,review-5063.html.

South Korean companies SK Telecom, LG Uplus, and KT have initiated mobile 5G service, currently providing access with mobile 5G routers since no 5G phones are yet available. Japan's largest wireless carrier NTT DOCOMO plans to launch pre-commercial 5G services in September 2019, with an official launch in 2020.¹⁴

Huawei's Involvement in 5G Worldwide

Beyond these countries, however, the fielding of 5G systems around the world is being done at least in part with Huawei equipment and Huawei contracts. Telus Mobility in Canada, for instance, has said it will make 5G available by 2020, with customers in the Vancouver area potentially getting early access. Huawei has been working with Telus on deployment of small-cell high-speed equipment as part of this transition to 5G technology (2017).¹⁵

Deutsche Telekom started deploying 5G in parts of Berlin in 2018. Their planned deployments will start with 2,000 mobile base stations during 2019. Deutsche Telekom has been using Huawei 5G equipment, software, and terminals in its 5G rollout.¹⁶ For example, Deutsche Telekom's establishment of the first connection on a 5G network in 2017 used Huawei 5G New Radio equipment.¹⁷ Germany has still not decided if they are going forward on 5G in partnership with Huawei.



Telenor Norway will run a 5G pilot in the first half of 2019. They had families test in-home 5G and have planned their commercial launch in 2020. Huawei has also been involved here, having worked with Telenor Group on the successful demo of the first 5G MIMO-2 system in Norway in 2017.¹⁸

Many other companies have contracted with Huawei for equipment and construction of their 5G networks. Specific cases identified of Huawei involvement in Europe include the following:

- **Estonia:** Huawei working with Elisa on 5G speed tests using Huawei's 5G home router (2018).¹⁹
- **Hungary:** Huawei contract with Hungarian government for upgrade of broadband network to 5G technology (2018).²⁰

¹⁴ www.lifewire.com/5g-availability-world-4156244.

¹⁵ www.huawei.com/en/press-events/news/2017/11/TELUS-Canada-5G-Innovative-Small-cell.

¹⁶ www.telekom.com/en/media/media-information/archive/5g-rollout-in-germany-523636.

¹⁷ www.huawei.com/en/press-events/news/2017/9/Deutsche-Telekom-Europe-First-5G-Connection.

¹⁸ www.huawei.com/en/press-events/news/2017/3/Huawei-Telenor-First-5G-Demo-Norway.

¹⁹ www.zdnet.com/article/why-estonia-finds-itself-in-the-middle-of-a-5g-arms-race.

²⁰ emerging-europe.com/business/huawei-seals-hungarian-5g-partnership.

- **Ireland:** Telecom firm Eir using Huawei 5G systems for its experimental next-generation pilot system (2018).²¹
- **Italy:** Huawei activated first 5G antennas in Italian cities for 5G trials promoted by the Italian government (2018). Conducted first 5G trials in Turin in partnership with TIM and Fastweb (2018).²²
- **Romania:** Huawei cooperating with Orange Romania to conduct first live technology trial of “Massive MIMO” in Bucharest (2017).²³
- **Russia:** Huawei making preparations for construction of 5G network in Russia (2018).²⁴
- **Switzerland:** Huawei cooperation with Sunrise on putting Switzerland’s first 5G antenna into operation (2018).²⁵

Huawei involvement in fielding 5G systems in Asia includes:

- **Bangladesh:** Huawei conducted 5G technology demonstration with Bangladesh government (2018).²⁶
- **India:** Huawei invited by Indian government to participate in 5G trials (2018).²⁷
- **Lebanon:** Huawei cooperation with Touch on first commercial 5G trial in Lebanon (2018).²⁸
- **Malaysia:** Government declared that Huawei still in contention to set up 5G network in Malaysia despite Western nations accusing Huawei of espionage (2019).²⁹
- **Philippines:** Huawei cooperation with Globe Telecom to support planned rollout of 5G network as well as Narrow Band Internet-of-Things technology (2019).³⁰

²¹ www.rte.ie/news/2018/1210/1016373-huawei-telecom-ireland.

²² www.rcrwireless.com/20180305/5g/tim-huawei-5g-antenna-italy-tag23.

²³ www.romaniajournal.ro/orange-romania-huawei-trial-5g-in-bucharest.

²⁴ gbtimes.com/huawei-to-construct-5g-network-in-russia.

²⁵ www.huawei.com/ch-en/about-huawei/corporate-information/milestone.

²⁶ www.huawei.com/en/press-events/news/2018/7/Huawei-5G-Technology-Bangladesh.

²⁷ [economictimes.indiatimes.com/articleshow/66085621.cms?](http://economictimes.indiatimes.com/articleshow/66085621.cms?from=mdr&utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst)

[from=mdr&utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst](http://economictimes.indiatimes.com/articleshow/66085621.cms?from=mdr&utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst).

²⁸ www.huawei.com/en/press-events/news/2018/11/huawei-state-of-the-art-5g-lebanon.

²⁹ www.malaymail.com/news/malaysia/2019/02/13/communications-ministry-huawei-still-contender-to-set-up-first-5g-network-i/1722645.

³⁰ www.prnewswire.com/news-releases/globe-telecom-brings-5g-technology-to-the-philippines-300661639.html.

- **Saudi Arabia:** Huawei signed Memorandum of Understanding with Mobily on deployment of future 5G networks (2018).³¹
- **Thailand:** Huawei 5G test bed facility opened in Chonburi (2019).³²

Reaction to Huawei Risk

The US government spent most of 2018 warning other countries that using Huawei equipment for their 5G rollouts creates a security risk in those countries and future problems in their relations with the US. These warnings have been taken to heart by several countries. The blowback against Huawei has been most severe in Europe. Specific cases include:

- **United Kingdom:** British Telecom (BT) is struggling with a situation in which their acquisition of telecom EE included taking ownership of Huawei 3G and 4G networks. Huawei had been heavily involved in EE's provision of the new Emergency Services Network in the UK.³³ The British government's center for Huawei equipment testing identified "shortcomings in Huawei's engineering processes that have exposed new risks" in UK networks. In Dec 2018, a spokesperson for BT made the following statement:

"In 2016, following the acquisition of EE, we began a process to remove Huawei equipment from the core of our 3G and 4G networks, as part of network architecture principles in place since 2006. We're applying these same principles to our current RFP for 5G core infrastructure. As a result, Huawei have not been included in vendor selection for our 5G core. Huawei remains an important equipment provider outside the core network, and a valued innovation partner."³⁴

- **Germany:** As of early 2019, Deutsche Telekom was still in the process of deciding its way forward. It said it "takes the global discussion about the security of network elements from Chinese manufacturers very seriously." The German government now debating whether to block Huawei from building up Germany's 5G network out of data security concerns (2019).³⁵ Deutsche Telekom has most recently proposed a new security certification process for network equipment so that

³¹ www.rcrwireless.com/20181017/5g/huawei-mobily-ink-5g-agreement-saudi-arabia.

³² www.totaltele.com/502119/Huawei-launches-5G-test-bed-in-Thailand.

³³ www.theguardian.com/technology/2018/dec/05/bt-removing-huawei-equipment-from-parts-of-4g-network.

³⁴ www.ispreview.co.uk/index.php/2018/12/security-bt-and-ee-to-remove-huawei-kit-from-uk-mobile-network.html

³⁵ www.dw.com/en/german-government-debates-huawei-access-to-5g-network/a-47392437.

companies in Germany could continue to use Huawei products for their 5G rollout.³⁶

- **France:** The CEO of Orange said his company would not use Huawei gear for sensitive parts of its network because of “messages of prudence” from French authorities.
- **Belgium:** The nation’s cybersecurity agency said it was considering a ban on Huawei.
- **Czech Republic:** Their cybersecurity agency warned that products by Huawei and ZTE pose “a security threat.” The prime minister ordered his government office to stop using Huawei phones.
- **Turkey:** As of February 2019, Turkcell was defending its partner Huawei against “uncorroborated” security allegations and calling for authorities to work with Huawei on 5G network security.³⁷
- **European Union:** The head of technology policies said “we have to be worried” about Huawei when asked about the company’s role in European 5G projects.³⁸

Several other countries are also listening to the warnings from the US government about the risks associated with having Huawei 5G equipment installed:

- **Australia:** Government banned Huawei from participation in its 5G mobile network (2018).³⁹
- **Canada:** Since the arrest of the Huawei CFO in Vancouver in Dec 2018, the Canadian government is considering accepting the US request to ban Huawei 5G altogether (2019).⁴⁰
- **Japan:** The top three telecom operators announced their plan not to use current equipment and upcoming fifth-generation (5G) gear from China’s Huawei (2018).⁴¹

³⁶ www.totaltele.com/502045/DT-proposes-action-plan-to-keep-Huawei-involved-in-Germanys-5G-rollout.

³⁷ www.totaltele.com/502089/Turkcell-defends-Huawei-against-uncorroborated-security-allegations.

³⁸ www.scmp.com/business/companies/article/2179291/huaweis-troubles-grow-europe-more-countries-follow-us-shunning-it.

³⁹ www.wsj.com/articles/australia-bans-chinas-huawei-from-5g-network-rollout-1534992631.

⁴⁰ www.theglobeandmail.com/politics/article-china-threatens-reprisals-if-canada-bans-huawei-from-its-5g-networks.

⁴¹ www.reuters.com/article/us-usa-china-huawei-japan/japans-top-three-telcos-to-exclude-huawei-zte-network-equipment-kyodo-idUSKBN1090JW.

- **Republic of Korea:** SK Telecom announced preferred bidders for 5G equipment, excluding Huawei (2018).⁴²

Huawei's Response

In response to the crisis over security risks associated with Huawei, the Huawei Europe office in Jan 2019 published its pitch for "Why Europe and Huawei need to stick together." Besides claiming that cybersecurity was Huawei's top priority, they argued that their long-standing business relationships in Europe meant that they should not be turned away:

"Over the past 18 years, Huawei has invested over US\$1 billion in European R&D, local procurement reached over US\$37 billion between 2009 and 2018, and we established strong partnerships with more than 140 European universities and research and consulting institutes. We now have 12,200 employees here and over 70 percent of them are hired locally. To date, 47 European companies of the Fortune Global 500 have chosen Huawei as their partner to go digital."⁴³

In December 2018, Huawei had touted its continuing plans for 5G rollout in a variety of countries. They stated:

"Huawei Technologies said it has secured more than 25 commercial contracts for 5G and gave an upbeat forecast of surpassing US\$100 billion in revenue this year, despite the swirling legal drama surrounding its chief financial officer who was arrested in Canada and is currently out on bail. Huawei currently has 5G equipment deals in place that have resulted in its shipment of more than 10,000 base stations for the next-generation mobile technology."⁴⁴

HUAWEI'S EXISTING WORLDWIDE PRESENCE

Huawei deployment of 5G worldwide is a topic of increasing concern, but the focus on 5G ignores the fact that Huawei has already been building networks across the planet for many years. The deployment of 5G technology is just the latest wave of Huawei's work in other countries.

Concerning their historical work, Huawei makes several claims, including that they have:

- Supported the operations of over 1,500 networks in more than **170 countries.**

⁴² www.zdnet.com/article/sk-telecom-snubs-huawei-in-5g-equipment-selection.

⁴³ huawei.eu/blog/why-europe-and-huawei-need-stick-together.

⁴⁴ www.scmp.com/tech/gear/article/2178563/huawei-lands-more-25-contracts-5g-forecasts-revenue-exceed-us100-billion.

- Provided cloud computing solutions to customers across more than **130 countries**.
- Deployed over 190 mobile backhaul networks in over **100 countries**.
- Deployed their Smart Grid Solution in the electricity sector in **65 countries**.
- Deployed Smart City solutions in more than 100 cities in over **40 countries**.⁴⁵



Figure 5. Meng Wanzhou speaking on Huawei's worldwide presence

Research on these statements did not validate all count claims but did find evidence of deep Huawei presence in all regions of the world. In many countries, Huawei has been constructing networks for 10-15 years. Specific countries where Huawei was found working abroad are listed below.

Europe:

Austria: Partner with T-Mobile to install Huawei Optical Transport Network devices with wavelength-division multiplexing (WDM) to modernize metro and backbone networks (2017).⁴⁶

Belarus: Huawei training center opened (2011). Plans under way for Huawei equipment to support Smart Home, Safe City, and health care projects (2018).

⁴⁵ www.huawei.com/en/about-huawei/corporate-information/milestone.

⁴⁶ www.smartcitiesworldforums.com/news/smart-cities-europe/smart-mobility-deployments-eu/449-t-mobile-austria-selects-huawei-s-otn-solution-for-high-capacity-transport-network.

Huawei claims to have implemented \$400 million worth of joint projects with Belarusian enterprises.⁴⁷

Belgium: Huawei speed testing with Proximus conducted for 4.5G network (2016)⁴⁸ and 5G network (2018).⁴⁹ However, Belgium Centre for Cybersecurity was considering the possibility of banning Huawei from Belgium (2018).⁵⁰

Bulgaria: Huawei operating in Bulgaria since 2004. Partner with Vivacom for installation of LTE network (2016). Contract with Vivacom for Cloud project (2017).⁵¹

Croatia: Huawei contract with Croatian Telecom for installation of LTE equipment (2010).⁵²

Czech Republic: Government cybersecurity agency issued directive warning that Huawei represented a potential national security threat (2018).⁵³

Denmark: Huawei Denmark opened in 2007.⁵⁴ Contract with Denmark's TDC Group to upgrade coaxial network to "Giga COAX" technology (2016).⁵⁵ Two Huawei employees expelled from Denmark for Immigration Law violations (2019).⁵⁶

Finland: Huawei began selling GSM and UMTS equipment to TeliaSonera in 2009.⁵⁷ Conducted speed testing of Huawei 4G equipment with Elisa (2016).⁵⁸

France: Contract with Financial Group BPCE for Huawei Agile Network as their Network Management System (2017).⁵⁹ Contract with SFR France to build 4.5G Network (2017).⁶⁰

⁴⁷ eng.belta.by/society/view/belarus-huawei-planning-joint-project-to-supply-network-solutions-for-healthcare-108948-2018.

⁴⁸ www.huawei.com/en/press-events/news/2016/5/Successful-trial-of-1point1-Gbps.

⁴⁹ www.proximus.com/en/news/proximus-and-huawei-team-first-successful-5g-outdoor-trial-belgium-speeds-294-gbps-reached-end.

⁵⁰ www.brusselstimes.com/belgium/13384/the-belgian-subsiidiary-of-huawei-confirms-we-have-nothing-to-fear.

⁵¹ huawei.eu/blog/infrastructure-champion-bulgaria.

⁵² www.t.ht.hr/en/Press/press-releases/570/Croatian-Telecom-and-Huawei-announce-cooperation-on-the-occasion-of-bringing-the-state-of-the-art-LTE-technology-to-Croatia.html.

⁵³ www.nytimes.com/2019/02/12/world/europe/czech-republic-huawei.html.

⁵⁴ huawei.eu/blog/glimpse-future-denmark.

⁵⁵ carrier.huawei.com/en/relevant-information/maxmizing-network-value/huawei-and-tdc-group.

⁵⁶ cphpost.dk/news/huawei-employees-expelled-from-denmark.html.

⁵⁷ www.investinfinland.fi/-/huawei-makes-successful-entry-to-the-finnish-telecom-market.

⁵⁸ halberdbastion.com/intelligence/news/elisa-huawei-achieve-worlds-first-19-gbps-4g-lte-network-finland.

⁵⁹ e.huawei.com/topic/leading-new-ict-en/index.html?utm_campaign=lni17-minisiteen&utm_medium=hwdc&utm_source=ebghome-en&source=eebghq175155l.

⁶⁰ www.huawei.com/us/press-events/news/2017/6/huawei-sfr-french-4x4-mimo.

Germany: Deutsche Telekom and Huawei implement world's first live Narrowband IoT network (2016).⁶¹

Greece: Contract with OTE Group to upgrade broadband network with Huawei Fiber-to-the-Cabinet (FTTC) equipment (2018).⁶² Contract with Piraeus Port Authority for the modernization of their network infrastructure (2018).⁶³

Hungary: Huawei began operations in Hungary in 2005 and claims to have invested US\$1.2 billion since then. Contract to develop the LTE mobile network for government-owned MVM NET (2015).⁶⁴

Ireland: Contract with SIRO for Huawei equipment for a new fiber-optic network (2017).

Italy: Huawei contract with TIM for development of Internet of Things for mobile networks (2016).⁶⁵

Lithuania: Huawei began operating in Lithuania in 2005. Cooperation with LRTC for modernization of legacy WiMAX to LTE (2015). Huawei Cloud launched in Lithuania (2017).⁶⁶

Netherlands: Huawei contract to build third-generation network for Telfort (2005). Cooperation with T-Mobile Netherlands for implementation of complete new nationwide mobile network based on Huawei Radio Access Network (2014). Contract with T-Mobile to implement unlimited data package (2017).⁶⁷

Poland: Huawei established headquarters for central and eastern Europe and the Nordic region in Poland (2008). Opened a joint innovation center for supercomputing with the Poznan Supercomputing and Networking Center (2016).⁶⁸ Poland arrested Huawei sales director in Poland on suspicion of espionage (2019).⁶⁹

⁶¹ www.telekom.com/en/media/media-information/archive/first-narrowband-iot-end-to-end-system-is-live-44072.

⁶² www.telecomlead.com/telecom-equipment/ote-selects-huawei-to-upgrade-broadband-network-in-greece-84841.

⁶³ safety4sea.com/huawei-to-modernize-network-infrastructure-in-port-of-piraeus.

⁶⁴ huawei.eu/blog/european-hub-hungary.

⁶⁵ www.telecomitalia.com/tit/en/archivio/media/note-stampa/market/2016/TIM-Huawei-MoU-21-02-2016.html.

⁶⁶ huawei.eu/blog/loyal-partner-telcos-lithuania.

⁶⁷ huawei.eu/blog/strong-commitment-netherlands.

⁶⁸ huawei.eu/blog/high-powered-innovator-poland-0.

⁶⁹ www.washingtonpost.com/world/asia_pacific/huawei-fires-chinese-employee-arrested-in-poland-on-spying-allegations/2019/01/12/60e4681a-167d-11e9-a896-f104373c7ffd_story.html?utm_term=.c729d23d8e57.

Romania: Huawei contract with UPC Romania for maintenance services for land-based public communications networks (2017).⁷⁰

Russia: Huawei contract with Central Bank of Russia to build national system of payment cards (2016).⁷¹ Cooperation with Rostelecom on deployment of wifi network in Moscow as exclusive supplier to Rostelecom for its central branch (2017).⁷²

Spain: Huawei operating in Spain since 2002. Networks infrastructure supplier for Telefónica, Vodafone, Orange and MásMóvil.⁷³

Sweden: Huawei contracts with Tele2 and Telenor Sweden to deploy LTE network (2009).⁷⁴

Switzerland: Huawei contract with Swisscom for implementation of FTTH (Fiber to the Home) network (2009). Contract with Swisscom for new transport core network (2018). Memorandum of Understanding with Swisscom on NetCity project (2018).⁷⁵

Ukraine: Huawei contract with Ukrtelecom for three-year network modernization project (2016).⁷⁶

United Kingdom: Huawei claims it has been working with British Telecom (BT) since 2004. "Heavily involved" in installation of telecom EE's (now BT subsidiary) new 4G-capable emergency services network (ESN) for police, ambulance and fire brigade radios. However, BT confirms it is now removing Huawei equipment from key areas of its 4G network (2018).⁷⁷

Asia:

Afghanistan: Contract with Optimus to expand Huawei channel network and for enterprise products including cloud computing, enterprise networking, and wireless (2013).⁷⁸

⁷⁰ www.broadbandtvnews.com/2017/10/13/upc-romania-huawei-deal-wins-approval.

⁷¹ e.huawei.com/us/case-studies/global/2016/201609070919.

⁷² www.news18.com/news/tech/huawei-collaborates-with-russias-rostelecom-1562119.html.

⁷³ huawei.eu/blog/model-company-work-spain.

⁷⁴ www.telegeography.com/products/commsupdate/articles/2009/12/18/tele2-and-telenor-sweden-choose-huawei-to-deploy-lte-network.

⁷⁵ www.infoworld.com/article/3259846/networking/swisscom-and-huawei-sign-mou-on-netcity-project.html.

⁷⁶ www.telegeography.com/products/commsupdate/articles/2016/04/12/ukrtelecom-begins-three-year-modernisation-project-with-huawei.

⁷⁷ www.theguardian.com/technology/2018/dec/05/bt-removing-huawei-equipment-from-parts-of-4g-network.

⁷⁸ channeleye.co.uk/huawei-expands-into-pakistan-afghanistan-and-iraq.

Armenia: Huawei contract with Russia's MTS to provide base stations and controllers for Armenian 3G network (2009).⁷⁹

Azerbaijan: Huawei operating in Azerbaijan since 2002. Contract for Fiber-To-The-Home project to reach rural customers (2014).⁸⁰ Contract for construction of 4G mobile network in Nakhchivan (2016).⁸¹

Bahrain: Huawei contract with VIVA Bahrain for upgrade of recently acquired Menatelecom network (2018).⁸² Contract to construction of Tier III data center for Batelco (2018).⁸³

Cambodia: Huawei contract with MobiTel for expansion of its network coverage (2010).⁸⁴ Partner with Smart Axiata for launch of Cambodia's first 4.5G network (2017).

Hong Kong: Contract with government for 190 sets of Huawei products including network switches, routers and accessories (2016).⁸⁵

Indonesia: Huawei contract with mobile operator XL to build a cloud infrastructure network (2016).⁸⁶ Contract with ISP Biznet to upgrade its metro network capabilities via equipment from Huawei (2018).⁸⁷

Iran: Huawei operating in Iran since 1999. Western press reported that Huawei installing technology that lets Iranian police track callers based on the locations of their cell phones (2011).⁸⁸ Contract with Telecommunication Company of Iran to upgrade fixed telephone and mobile telecommunications networks (2017).⁸⁹

⁷⁹ www.reuters.com/article/idUSLG46594520090116.

⁸⁰ www.azernews.az/business/69791.ht.

⁸¹ www.chinadaily.com.cn/business/tech/2016-10/27/content_27190471.htm.

⁸² www.bizbahrain.com/viva-bahrain-huawei-sign-major-transformation-upgrade-agreement-menatelecom-network.

⁸³ www.datacenterdynamics.com/news/huawei-to-build-tier-iii-data-center-for-bahrains-batelco.

⁸⁴ www.reuters.com/article/cambodia-china-telecoms/chinas-huawei-signs-200-mln-deal-with-cambodias-mobitel-idUSSGE62H0F720100318.

⁸⁵ www.atimes.com/article/huawei-purged-in-taiwan-but-everywhere-in-hong-kong.

⁸⁶ www.huawei.com/en/press-events/news/2016/2/indonesias-xl-launches-cloud-network-transformation-with-huawei.

⁸⁷ www.lightwaveonline.com/articles/2019/01/biznet-upgrades-metro-network-in-indonesia-via-huawei.html.

⁸⁸ www.techzone360.com/topics/techzone/articles/234546-huawei-technology-being-used-track-dissidents-iran-news.htm#.

⁸⁹ www.chinatechnews.com/2017/05/16/25043-chinas-huawei-gains-network-upgrade-contract-in-iran.

Iraq: Huawei contract with Kalimat Telecom for base stations and creation of full-scale fixed wireless network (2007).⁹⁰ Completed network modernization in Kurdistan in partnership with Zain Group (2018).⁹²

Israel: Huawei acquired Israel HexaTier, whose technology secures databases in the cloud, and also IT research firm Toga Networks (2016).⁹³

Jordan: Huawei contract with Umniah Mobile for GSM/GPRS/EDGE network in Jordan (2005).⁹⁴ Contract with Zain Jordan to supply equipment to build 4G network in Jordan (2014).⁹⁵



Figure 6. Huawei billboard in Jordan

Kazakhstan: Huawei contract with Kazakhtelecom/Altel for construction of 4G network to cover all cities in Kazakhstan (2013).⁹⁶ Contract with KTZ for data center for Kazakhstan Railways (2016).⁹⁷ Successful test of NB Internet-of-Things data system for Beeline Kazakhstan, providing equipment and setting up network (2017).⁹⁸

Kuwait: Huawei contract with Zain Kuwait to build an all-IP mobile backbone network (2013).⁹⁹ Cooperation with Viva Kuwait on testing 4.5G commercial network, including GigaRadi, eMIM, NB IoT solutions (2016).¹⁰⁰

Lebanon: Huawei contract with Touch Lebanon to upgrade 4G network to 4.5G technology (2016).¹⁰¹

⁹⁰ www.khaleejtimes.com/article/20070724/ARTICLE/307249972/1036.

⁹¹ www.arabianbusiness.com/iraq-wll-operator-awards-contract-huawei-199702.html.

⁹² www.iq.zain.com/en/web/iraq/media-coverage/-/asset_publisher/Fhj9gj3BjGKH/content/-zain-partners-with-huawei-to-modernize-its-network-in-kurdistan-to-provide-the-latest-communication-technology-to-more-than-one-million-subscribers-i.

⁹³ www.cnbc.com/2019/01/09/reuters-america-u-s-israel-air-concerns-over-china-telecom-companies-u-s-official.html.

⁹⁴ www.rcrwireless.com/20050407/archived-articles/huawei-to-build-gsm-network-in-jordan.

⁹⁵ www.jo.zain.com/english/media/pr/Pages/Zain-selects-Huawei-to-build-the-first-4G-Network-across-the-Kingdom.aspx.

⁹⁶ www.thebusinessyear.com/kazakhstan-2017/being-smart/interview.

⁹⁷ e-file.huawei.com/en-PL/news/global/2016/201610131750.

⁹⁸ halberdbastion.com/intelligence/news/beeline-huawei-successfully-demonstrate-nb-iot-kazakhstan.

⁹⁹ www.telegeography.com/products/commsupdate/articles/2013/08/01/zain-and-huawei-to-build-all-ip-network-in-kuwait.

¹⁰⁰ www.huawei.com/en/press-events/news/2016/2/viva-kuwait-and-huawei-cooperate-on-testing-45g.

¹⁰¹ www.telegeography.com/products/commsupdate/articles/2016/03/29/touch-lebanon-signs-4-5g-contracts-5g-agreements-with-huawei-nokia.

Malaysia: Huawei contract with Axiata for planning and construction of 4G network (2016).¹⁰²

Mongolia: Contract with Unitel for "Ger Internet" wireless home broadband network to connect rural population (2017).¹⁰³

Oman: Huawei contract with Omantel for deployment of Smart Street wifi small-cell networks (2016).¹⁰⁴ Contract with Omantel for deployment of first G.fast network in the Middle East (2017).¹⁰⁵

Pakistan: Huawei contract with Ufone to expand GSM wireless network to 1,550 cities and villages (2006).¹⁰⁶ Contract with Telenor Pakistan to build nationwide IP-based Dense Wavelength Division Multiplexing (DWDM) network (2007).¹⁰⁷

Philippines: Huawei contract with Globe Telecom for expansion of existing 3G and 4G networks (2015).¹⁰⁸

Qatar: Huawei contract with Qatar Telecommunications for construction of telecom infrastructure to support Asian Games in Doha (2007).¹⁰⁹ Contract with Qatar Telecom to implement fiber-to-the-home (FTTH) high speed broadband network infrastructure (2012).¹¹⁰ Huawei becomes one of first fully-owned tech firms in Qatar (2018).¹¹¹

Republic of Korea: Huawei contract with Korea Telecom to install 100G multi-service optical transport network (2016).¹¹²

Singapore: Huawei cooperation with mobile carrier M1 on launch of Singapore's first cloud-based virtual core network (2017).¹¹³ Cooperation with

¹⁰² www.telegeography.com/products/commsupdate/articles/2016/04/27/celcom-axiata-partnering-with-ericsson-and-huawei-for-4g-network-upgrade.

¹⁰³ www.huawei.com/us/industry-insights/outlook/mobile-broadband/wireless-for-sustainability/cases/connecting-herdsmans-yurts-s-in-mongolia.

¹⁰⁴ www.omantel.om/About%20us/Media%20Center/Details/omantel%20partners%20with%20huawei%20to%20install%20smart%20cities%20lampposts.

¹⁰⁵ www.huawei.com/en/press-events/news/2017/7/middleeast-first-gfast-network.

¹⁰⁶ www.arabianbusiness.com/huawei-s-energ-expand-gsm-across-pakistan-219829.html.

¹⁰⁷ www.telegeography.com/products/commsupdate/articles/2007/02/15/huawei-to-build-telenors-network-across-pakistan.

¹⁰⁸ www.rappler.com/business/industries/172-telecommunications-media/114012-globe-telecom-huawei-technologies-partnership

¹⁰⁹ callcenterinfo.tmcnet.com/news/2007/01/17/2250182.htm.

¹¹⁰ www.telegeography.com/products/commsupdate/articles/2012/05/24/qtel-extends-ftth-contract-with-huawei.

¹¹¹ www.xinhuanet.com/english/2018-09/19/c_137479605.htm.

¹¹² www.huawei.com/en/press-events/news/2016/9/huawei-korea-flexible-efficient-transport-network.

¹¹³

www.m1.com.sg/AboutM1/NewsReleases/2017/M1%20partners%20Huawei%20to%20roll%20out%20Singapore%20first%20cloud%20based%20virtual%20core%20network.aspx

M1 network tests for an end-to-end live broadcast of virtual reality over a 5G network (2018).¹¹⁴

Taiwan: Government reinforces its five-year-old ban on network equipment produced by Huawei (2018).¹¹⁵ Taiwan's Institute for Information Industry bans Huawei devices on its network (2019).¹¹⁶

Tajikistan: Huawei contract with Tacom to supply mobile equipment for the expansion of its 2G network and the launch of 3G services (2006). Contract to plan and implement Safe City network for Dushanbe, including transportation management and citywide video surveillance system (2015).¹¹⁷

Thailand: Huawei contract for campus network including data center network and 100G radio network design (RND) network (2018).¹¹⁸ Thai Board of Investment granted Huawei license to operate cloud services in Thailand (2018).¹¹⁹

Turkey: Huawei contract with Vodafone to supply infrastructure equipment for 3G network in Turkey (2008).¹²⁰ Contract with Turkish State Railways to install railway operational communications system (2017).¹²¹

United Arab Emirates: Huawei contract with Etisalat to supply equipment including 1,000 Node-B base stations for the construction of Universal Mobile Telecommunications System (UTMS) network (2006).

Vietnam: Huawei contract with EVN Telecom to deploy end-to-end 3G network in Vietnam (2009).¹²²

Africa:

Algeria: Huawei contract for eLTE broadband network at Boumediene Airport (2016).¹²³

Ethiopia: Huawei contract with Ethiopian Electrical Power Corporation to create nationwide fiber-optic switching network to support new Smart Grid

¹¹⁴ www.zdnet.com/article/huawei-conducts-5g-trials-in-singapore-with-m1.

¹¹⁵ www.voanews.com/a/taiwan-reinforces-ban-on-huawei-network-equipment/4695576.html.

¹¹⁶ www.taiwannews.com.tw/en/news/3618542.

¹¹⁷ e.huawei.com/en/case-studies/global/2015/201504031050.

¹¹⁸ e.huawei.com/us/publications/global/ict_insights/201801221604/education-research/201801241417

¹¹⁹ intl.huaweicloud.com/news/huawei-launches-public-cloud-services-in-thailand.html.

¹²⁰ www.reuters.com/article/vodafone-huawei-turkey-idUSLC1926220081212.

¹²¹ e.huawei.com/topic/leading-new-ict-en/turkish-ekb-railline-case.html.

¹²² www.lightreading.com/mobile/3g-hspa/huawei-wins-in-vietnam/d/d-id/672865.

¹²³ www.huawei.com/en/press-events/news/2016/7/Huawei-Wins-Algeria-Houari-Boumediene-Airport-Bid.

technologies.¹²⁴ Contract to build LTE network for rail services, with video surveillance system included (2017).¹²⁵

Kenya: Cooperation with Vodaphone Achieve to implement Huawei Mobile Money Platform for financial services (2012).¹²⁶ Contract with Safaricom to deploy a Fiber-To-The-Home (FTTH) network (2017).¹²⁷

Mali: Huawei contract with Alpha Telecom Mali for construction of national broadband network plus data center in Bamako (2014).^{128 129}

Morocco: Huawei contract with rail operator ONCF to build a unified GSM-R dispatching network (2014).¹³⁰

Mozambique: Huawei contract with Vodaphone Mozambique for expansion and modernization of its network, including Huawei construction of 400 2G base transceiver stations and 200 3G cell towers (2011).¹³¹

Namibia: Huawei entered the Namibian market in 2005. Huawei claims that continued network construction means Huawei products now serve more than 80% of the country's population. Cooperation with local operators on first 4.5G network application demonstration in Africa (2016).¹³²

Nigeria: Huawei contract with Suburban Telecom for supply of Suburban's national optic backbone networks, equipment and services (2018).¹³³ MTN Nigeria and Huawei completed deployment of RuralStar 2.0 low-cost long-distance voice and mobile broadband service (2018).¹³⁴

¹²⁴ e.huawei.com/ca/videos/global/2015/201509301437.

¹²⁵ e.huawei.com/ae/case-studies/global/2017/201704221522.

¹²⁶ carrier.huawei.com/en/success-stories/carrier-software/solutiontopic01/safaricomkenya.

¹²⁷ www.huawei.com/en/press-events/news/2017/8/Kenya-Safaricom-FTTH-Network.

¹²⁸ www.ecofinagency.com/telecom/2210-32579-mali-huawei-awarded-national-broadband-network-contract-worth-fcfa-34-billion.

¹²⁹ www.telegeography.com/products/commsupdate/articles/2017/05/09/alpha-telecom-mali-receives-hardware-from-huawei-as-it-targets-launch-by-end-2017.

¹³⁰ e.huawei.com/en/case-studies/global/2017/201704221416.

¹³¹ www.telegeography.com/products/commsupdate/articles/2011/11/22/vodacom-taps-huawei-for-usd16-million-network-upgrade.

¹³² economist.com.na/34019/technology/huawei-namibia-to-expand-cooperation-on-enhancing-public-security.

¹³³ www.balancingact-africa.com/news/telecoms-en/6997/nigerias-suburban-picks-atc-and-huawei-to-build-3500-kms-fibre-network.

¹³⁴ www.huawei.com/en/press-events/news/2018/4/MTN-Nigeria-Commercial-Deployment-RuralStar2.

Senegal: Huawei contract to deploy more than 3000 km of fiber-optic cable in Senegal (2015).¹³⁵ Huawei and Orange open Global Network Operations Center in Dakar (2016).¹³⁶

Sierra Leone: Huawei contract for responsibility for day-to-day operations of Airtel Sierra Leone network (2015).¹³⁷

South Africa: Huawei contract for equipment in upgrade of MTN network reaches 50% of all equipment in network.¹³⁸ Contract for construction of data centers in Capetown and Johannesburg (2019).¹³⁹

Tanzania: Huawei contract with Tanzania Telecommunications Company Limited (TTCL) to upgrade network to 4G LTE technology (2015).¹⁴⁰ Contract with TTCL for construction of 4.5G network (2018). Huawei named as official ICT advisor to Tanzanian government (2018).¹⁴¹

Uganda: Huawei contract with government for e-government network and national backbone transport network, including data communications, fiber transmission, IP telephony, video conferencing, security, and data storage (2011).¹⁴² Contract to install 5,500 CCTV Cameras for police surveillance network (2018).¹⁴³

Zambia: Huawei contract for construction of telecommunications tower network (2014).¹⁴⁴ Contract for equipment to set up Zambia National Data Center (2016).¹⁴⁵

Zimbabwe: Huawei contract with TelOne for two data centers and cloud facilities (2017).¹⁴⁶ Government subsidiary NetOne signs US\$71 million

¹³⁵ www.telegeography.com/products/commsupdate/articles/2015/10/26/adie-official-says-huawei-to-deploy-more-than-3000km-of-fibre-in-senegal.

¹³⁶ www.balancingact-africa.com/news/telecoms-en/39138/huawei-and-orange-open-network-operation-centers-in-africa/

¹³⁷ www.telegeography.com/products/commsupdate/articles/2015/07/16/airtel-sl-taps-huawei-ericsson-for-network-upgrade.

¹³⁸ mybroadband.co.za/news/telecoms/259281-mtns-network-in-south-africa-is-50-huawei.html.

¹³⁹ www.oann.com/huawei-to-build-data-centers-in-south-africa.

¹⁴⁰ extensia-ltd.com/tanzania-ttcl-huawei-ink-usd182-million-network-improvement-deal.

¹⁴¹ www.corporate-digest.com/index.php/huawei-partners-with-ttcl-to-launch-45g.

¹⁴² www.huawei.com/en/about-huawei/publications/winwin-magazine/04/HW_072297.

¹⁴³ dailynews.co.ug/huawei-installing-5552-cctv-cameras-under-the-uganda-police-national-cctv-network-expansion-project.

¹⁴⁴ www.techrends.co.zm/press-release-huawei-zamtel-zicta-launch-phase-2-communication-towers-project.

¹⁴⁵ e.huawei.com/en/case-studies/global/2017/201710091443.

¹⁴⁶ www.datacenterdynamics.com/news/zimbabwe-launches-two-data-centers-in-partnership-with-huawei.

financing agreement with Huawei for network extension and modernization (2018).¹⁴⁷

Americas:

Argentina: Huawei contract with Telecom Argentina for construction of new cloud core network as upgrade to existing 3G and 4G networks (2016).¹⁴⁸

Brazil: Huawei contract with Embratel for construction of new-generation network (NGN) (2004).¹⁴⁹

Chile: Huawei contract with Spanish telco Telefónica for deployment of NB Internet-of-Things network in Chile (2017).¹⁵⁰

Colombia: Huawei contract with Colombia Movil for GSM core network expansion (2006).¹⁵¹

Mexico: Huawei contract for construction of largest public wifi network in Latin America for México Conectado project (2014). Contract with Altan Redes to construct 4G network infrastructure in central and southern Mexico (2017).¹⁵² Contract for deployment of NetCity solution for Mexico City power grid (2017).¹⁵³

Peru: Huawei contract with Entel for 10,000 antenna sets for Nextel Peru's 4G network (2014).¹⁵⁴ Contract with Telefonica de Peru to build ultra broadband (UBB) network with both coaxial and fiber-to-the-home (FTTH) access (2016).¹⁵⁵

HUAWEI PROGRAMS OF CONCERN

In addition to the extensive reach of Huawei networks around the world, there are some specific aspects of the Huawei presence that spark concerns about the vulnerabilities that Huawei could create. For one, Huawei is actively marketing its "Smart City Solution" as a unified city management system. This includes a very intrusive video monitoring system backed by facial-recognition

¹⁴⁷ extensia-ltd.com/zimbabwe-netone-signs-71-million-financing-agreement-huawei-improve-network.

¹⁴⁸ www.huawei.com/en/press-events/news/2017/11/network-transformation-initiative-award.

¹⁴⁹ www.lightreading.com/ethernet-ip/huawei-wins-ngn-deal-in-brazil/d/d-id/601241.

¹⁵⁰ enterpriseiotinsights.com/20170216/channels/news/telefonica-huawei-deploy-nb-iot-project-chile.

¹⁵¹ www.albawaba.com/news/huawei-wins-gsm-expansion-contract-colombia-movil.

¹⁵² www.rcrwireless.com/20170404/carriers/nokia-huawei-win-contracts-deploy-wholesale-4g-network-mexico.

¹⁵³ e.huawei.com/en-sa/case-studies/global/2018/201807060944.

¹⁵⁴ www.capacitymedia.com/articles/3310213/Entel-selects-Huawei-for-Peru-4G-roll-out.

¹⁵⁵ www.marketwired.com/press-release/huawei-works-with-telefonica-de-peru-build-latin-america-first-docsis-31-compliant-2162281.

AI support which would be attractive to autocratic states and potentially vulnerable to Chinese compromise. Second, a look at Huawei marketing materials showed that it has spent the last ten years laying undersea communications cables and selling switching and control equipment for undersea networks. This opens another set of points where Chinese services could theoretically gain access to communications. Finally, Huawei is working actively in the international 5G standards definition effort, meaning that standards choices made in Huawei's favor could increase their competitiveness and hence their presence in worldwide networks.

Huawei Smart Cities

Some network systems raise particular concerns if Huawei were considered vulnerable to access by Chinese intelligence services. A primary example of this is the Huawei "Smart City Solution." This is a network intended to bring city management into the digital age by integrating data systems and Internet-of-Things (IoT) devices across the full spectrum of city functions. This means that a city's complete management system of systems would be on Huawei networks. One key danger of this is that a key component of the Smart City is full coverage by video surveillance devices networked to a central command center with processing and analysis using artificial intelligence (AI) support systems.



Figure 7. Huawei image for video surveillance camera

Huawei's marketing description of the Smart City Solution reads as follows:

"The development of Smart Cities is characterized by an evolution not a revolution, it has a starting point and no end. To date there have been three distinct phases and advanced cities have now entered phase 3.0.'

"In phase 1.0, e-Government services enabled residents and organizations to access information and services online. In phase 2.0, citizens embraced mobile Internet applications to manage their government affairs and social activities. This phase empowered governments/city municipalities to interact with citizens more frequently.'

"Now in phase 3.0, the Internet of Things (IoT) is the foundation of Smart Cities, and digital technologies are integrated with city governance to improve management capabilities through **mass data mining**. This phase will enable sustainable city development.'

“The data of physical city activities is collected by sensors, cameras, and other front-end devices in real time, and then transmitted to cloud data centers through ubiquitous networks. The data centers then perform calculations and analysis using technologies such as **Big Data analytics and Artificial Intelligence** — and respond quickly by collaborating across functional areas. These are the city nervous systems that Huawei hopes to build to power Smart Cities.”¹⁵⁶

Smart City Development in China

A key component of the Smart City concept is fielding an extensive network of video surveillance devices and connecting them to a central command center. Huawei has been pioneering this surveillance technology augmented with AI processes and deploying it inside China, most notably in Xinjiang Province. Western reporting has indicated that Huawei has been working with China’s Public Security Bureau, the national police, in their operations in Xinjiang to maintain control over the Muslim Uighur population.



Figure 8. Image from facial recognition demo in Beijing

Huawei’s reported role has been deploying new systems for **“facial recognition, digital monitoring, and artificial intelligence in policing.”** In 2018 they reportedly established a partnership with an “intelligent security industry” innovation lab in the provincial capital, Urumqi, as the government sought to build up expertise in new surveillance technologies. A Huawei director was quoted in local media as saying, “Together with the Public Security Bureau, Huawei will unlock a new era of smart policing and help build a safer, smarter society.”¹⁵⁷

As an example of how all this works, Huawei described its Smart Cities AI partnership with the Binhai District in Tianjin, with “one center, four platforms, and additional innovative applications.” The description continues:

“The center is Huawei's Intelligent Operations Center, which processes data collected from the government, businesses, and citizens through

¹⁵⁶ e.huawei.com/en/publications/global/ict_insights/201806041630/commentary/201807131639.

¹⁵⁷ www.theglobeandmail.com/world/article-huaweis-partnership-with-china-on-surveillance-raises-concerns-for.

IoT applications and internet access. The four AI platforms are then **Resident Voices, which has voice recognition for all citizens of Tianjin; Sensing the City, which uses image recognition across people, places, vehicles, and things 'for the purpose of fostering harmony for all;'** Resident Care, which involves deep learning and correlation for personalized services for citizens; and Enterprise Services, which ensures services availability match their need by applying "multi-dimensional and correlation analysis to clarify the internal relationships of industries in the district."¹⁵⁸

As another example, Huawei also highlighted its deployment in Shenzhen's Longgang District:

"In the Longgang District, it set out to improve public safety by collecting, aggregating and converging data, and using innovating apps. **Huawei deployed 7,000 HD cameras and connected 34,000 legacy cameras** across shopping malls, parks, petrol stations and communities, **used facial recognition** for people and license plates, and equipped almost 7,500 officers with smart phones with specific apps for identity and vehicle checks, live camera feeds and the ability to issue summonses. As a result, theft and robbery decreased by 53%, and case solvency increased by 45% in the first half of 2017, as compared to 2016."¹⁵⁹

Smart City Worldwide Marketing

At the Smart City Expo World Congress in Nov 2018, Huawei made public its new "Smart City Digital Platform." Huawei claimed the Digital Platform will help governments bring together AI, hybrid cloud, and IoT technologies. According to coverage of the event, the Smart City Digital Platform "includes a central Intelligent Operations Centre (IOC) which can allow officials to bring together a variety of different feeds such as video and data sensors, to create real-time live 3D maps to spot potential problems such as traffic build-up or pollution hotspots."¹⁶⁰

Huawei is now advertising its "+AI Digital Platform," calling it a fourth stage in its Smart Cities program. This is the stage where "cities are improving their management capabilities through **AI-enabled data mining,**" and that the "+AI Digital Platform connects the command centre, network, and sensors, enabling the deployment of smart cities solutions utilizing artificial intelligence."¹⁶¹

¹⁵⁸ www.zdnet.com/article/huawei-unveils-artificial-intelligence-smart-cities-platform.

¹⁵⁹ medium.com/life-on-the-other-planets-whats-new/a-city-that-recognises-your-voice-huawei-presents-new-smart-city-platform-f2f7bec435ba

¹⁶⁰ www.techradar.com/news/huawei-launches-full-smart-city-platform.

¹⁶¹ www.zdnet.com/article/huawei-unveils-artificial-intelligence-smart-cities-platform.



Figure 9. Image from Huawei Smart City online marketing

Huawei has been very successful in gaining contracts for Smart City deployment worldwide. Their website makes these claims:

“Our Smart City solutions have been in use in more than 120 cities in over 40 countries. Huawei took the lead in drafting nine national standards for smart cities in China, and Huawei's Safe City solutions [a component of Smart City] have served more than 800 million people in over **200 cities across more than 80 countries** and regions.”¹⁶²

Huawei's Safe City solutions were first deployed in a number of authoritarian regimes with close ties to China, including Russia, Pakistan, Venezuela, Laos, and Angola.¹⁶³ In Jan 2019, Huawei signed a partnership agreement with the Talaat Moustafa Group for Smart City services in two cities in Egypt.¹⁶⁴ Valenciennes, France; Gelsenkirchen, Germany;¹⁶⁵ and Duisburg, Germany have also entered into agreements with Huawei for installation of Smart City technology for city management.¹⁶⁶ Other projects that Huawei has claimed include Smart Cities in Spain, South Africa, Zambia, and the Philippines.¹⁶⁷

¹⁶² www.huawei.com/en/about-huawei/corporate-information/milestone.

¹⁶³ jamestown.org/program/huaweis-smart-cities-and-ccp-influence-at-home-and-abroad.

¹⁶⁴ ifpinfo.com/huawei-partners-with-talaat-moustafa-group-for-smart-city-services-in-egypt.

¹⁶⁵ jamestown.org/program/huaweis-smart-cities-and-ccp-influence-at-home-and-abroad.

¹⁶⁶ smartmycity.com/smart-city-solutions-tech-giants.

¹⁶⁷ e.huawei.com/en/case-studies?industry=Smart-city.

Huawei Marine

Huawei has also created a major presence in the world through the laying of submarine communications cable and providing the connecting equipment. Huawei Marine has described itself online this way:



Figure 10. Huawei Marine logo

“Huawei Marine Networks Co., Limited (Huawei Marine) is a joint venture established by Huawei Technologies Co., Ltd. and the British company Global Marine Systems Limited, established in Tianjin, China, in 2009 to provide international submarine cable network installation, solutions, services, and products services. Huawei Marine solutions cover the entire project development, including business plan, design, integration and installation of systems, route study, training and maintenance, construction, and commissioning; as well as technical support and system upgrades (wave length, dark fiber, and SLTE), among others.”¹⁶⁸
¹⁶⁹

Huawei Marine claims that since its formation it has completed 90 cable projects and has made **cable connections to 68 countries**.¹⁷⁰ The map in Figure 11 from the Huawei Marine website shows its completed and ongoing projects. One of Huawei Marine’s most recent projects, completed in Feb 2019, was an upgrade of the West Africa Cable System, which it described as the longest 100G submarine cable system in Africa.¹⁷¹

For the most part, there are only limited connections in European countries and few with North America. In recent years, some proposed cable projects that Huawei was to build have been cancelled due to security concerns. For example, Huawei Marine signed a construction contract in 2012 to build the Project Express segment of Hibernia Atlantic’s Global Financial Network (GFN), a 2,800-mile submarine cable from the UK to Halifax, Canada.¹⁷² This contract raised some concerns since it would be a link in the connection between London and New York via an intermediate stop near Boston.¹⁷³ In 2015, security

¹⁶⁸ www.bnamericas.com/company-profile/en/huawei-marine-networks-co-ltd-huawei-marine.

¹⁶⁹ www.huaweimarine.com/en/Company.

¹⁷⁰ <http://www.huaweimarine.com/en/News/2018/press-releases/pr20180606>.

¹⁷¹ www.huawei.com/en/press-events/news/2019/2/huawei-marine-wacs-upgrade.

¹⁷² www.lightwaveonline.com/articles/2012/01/huawei-marine-to-build-hibernia-atlantics-project-express-137477213.html.

¹⁷³ www.jsa.net/blog/huawei-marine-begins-manufacturing-phase-for-hibernias-gfn-project-express/6694.

concerns from potential customers in the US about the use of Huawei equipment caused Hibernia to drop Huawei in favor of TE Subcom.¹⁷⁴



Figure 11. Huawei Marine online map showing current and completed cable projects

Similarly, a report by the US Director of National Intelligence in 2017 entitled “Threats to Undersea Cable Communications” highlighted the case of Australia’s concerns about construction of an undersea cable from the Solomon Islands to Sydney, Australia. The Director of Australia’s Secret Intelligence Service objected to the project in 2016 when the Solomons began negotiating with Huawei Marine for the contract. In the end, Australia determined to pay much of the contract itself and use an Australian company.^{175 176}

China and 5G Standards

This final effort, gaining influence over 5G technical standards, is more China’s work than Huawei specifically, although the company does play a role. The official process of standards-setting is centered on the 3rd Generation Partnership Project (3GPP), a group of national telecommunications standards associations that is establishing the guidelines for 5G wireless connectivity. It wrote its first specification for 5G in 2017, and its most recent update is Release 15.

A Jun 2018 report by Elsa Kania, a prominent writer on Chinese cyber issues working at the Center for a New American Security, outlined how China is working to shape 5G standards in their favor. In her view, China sees this

¹⁷⁴ www.lightwaveonline.com/articles/2015/09/hibernia-express-transatlantic-submarine-cable-network-ready-for-service.html

¹⁷⁵ www.dni.gov/files/PE/Documents/1---2017-AEP-Threats-to-Undersea-Cable-Communications.pdf.

¹⁷⁶ www.smh.com.au/politics/federal/australia-refuses-to-connect-to-undersea-cable-built-by-chinese-company-20170726-gxj9bf.html.

moment of emerging technical standards for 5G as a “golden opportunity” for China to seize through their promotion of their “Digital Silk Road.”

In 2012, the International Telecommunications Union started to define future standards for international mobile telecommunication (IMT) systems, aiming for 2020 and beyond. To shape the new standards for 5G, China established its own IMT-2020 (5G) Promotion Group in February 2013. The Promotion Group’s mission was to “organize and coordinate Chinese participants” in the standard-setting process. The China Communications Standards Association is a partner to 3GPP. At 3GPP, representatives from Chinese companies and institutions hold 10 of 57 chair and vice-chair positions. A Huawei executive born in Germany is currently serving as chairman of the group responsible for 5G core network equipment and network terminals.¹⁷⁷



Figure 12. IMT-2020 logo

To a certain extent, a country can have a greater voice in the standards process if they own the rights to the key technologies being fielded. A New York Times report in Mar 2018 showed that in the previous year Chinese firms (Huawei, ZTE, and others) already had 10 percent of the 1,450 patents essential for 5G networks, and that figure was expected to rise. The Western firm Qualcomm owned 15 percent and Nokia 11 percent of patents for 5G.¹⁷⁸

Kania highlighted that China’s engagement in 3GPP has been criticized for being too aggressive. For example, Huawei has been pushing a Polar Code standard for 5G control channels that China has developed independently. This is an alternative approach to encoding data proposed over the US-proposed low-density parity check (LDPC).¹⁷⁹

In addition, Kania noted that the Standardization Administration of China has released the “China Unicom Joint Construction Standards Action Plan For One Belt, One Road (2018-2020),” which promotes the implementation of national standards for 5G in Belt and Road Initiative countries. This plan also pushed the expansion of infrastructure of China Unicom, a state-owned telecoms company that partners with Huawei.

Kania’s concern in the end was that China’s leadership in 5G and its “global agenda” raise real questions of risk that China’s 5G infrastructure work in other countries could prove to be a modern-day Trojan horse.¹⁸⁰

¹⁷⁷ www.nytimes.com/2018/03/07/technology/china-huawei-5g-standards.html.

¹⁷⁸ www.nytimes.com/2018/03/07/technology/china-huawei-5g-standards.html.

¹⁷⁹ 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/#4ec73549222b.

¹⁸⁰ www.aspistrategist.org.au/chinas-play-for-global-5g-dominance-standards-and-the-digital-silk-road.

CONCLUSION

None of the Huawei operations enumerated in this report indicate that Huawei is preparing a worldwide intelligence collection network. For this report, the technical vulnerability of Huawei equipment to exploitation was not explored. Likewise, no attempt was made to define the nature of the current relationship between Huawei and Chinese intelligence services. However, based on the character of the Chinese government now, in the era of Xi Jinping, it seems reasonable to assume that government attempts to use Huawei networks out in the world for exploitation and information collection could not be resisted or thwarted by Huawei as a company.

Huawei's claims of being just another giant telecoms equipment manufacturer may be genuine, but that is probably beside the point. The lack of relationship with Chinese intelligence services up to now does not change the potential for Huawei to be exploited in the future. Furthermore, what the data collected for this report indicate is that the US effort to block Huawei participation in the development of 5G networks in select counties, even if successful, will not remove Huawei-built networks from the world. Huawei is, more or less, everywhere already.

Huawei's worldwide telecoms infrastructure has to be of great interest to Chinese intelligence. The mere fact that Huawei has installed networks in 100+ countries would necessarily make them interesting to Chinese intelligence services. The marketing of systems like Smart Cities, deeply embedding Huawei into digital city management that includes city-wide video monitoring and AI-driven facial recognition, should make Huawei networks even more attractive. The fact that they have equipment at the undersea cable connection points in 60+ countries would likely be a plus for Chinese intelligence collection as well. All of the above seems to reinforce the concern being expressed by the US and other nations that Huawei equipment presence, 5G or otherwise, opens up a country to potential exploitation and intelligence loss.

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