

Report on BEREC International Mission to China

03 October, 2019

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1. Introduction and acknowledgements

BEREC Chair 2019 Mr Jeremy Godfrey (ComReg) and the Vice-Chairs Johannes Gungl (RTR), Mr Dan Sjöblom (PTS), Ms Tanja Muha (AKOS), Mr Konstantinos Masselos (EETT), Mr Marcin Cichy (UKE) accompanied by Ms Elisabeth Aarsæther (NKOM), Ms Elisabeth Dornetshumer (RTR) and Mr Tom Boyce, BEREC CN Chair 2019, travelled to China to meet institutional and industry stakeholders.

The meetings were held in Beijing, Shenzhen and Hong Kong and covered a wide range of topics. The delegation was particularly interested in the following topics: 5G rollout and use cases, ultra-fast broadband, IoT and spectrum assignment. Regarding 5G rollout, from the discussions with the different stakeholders, it appears that China is making big efforts to be in the leading countries in the race towards 5G deployment. Net neutrality issues were discussed with one stakeholder and while there is no legislation underpinning the OI principles, it appears that Chinese companies are monitoring the varying regional approaches on this subject across the world.

The delegation was also impressed by the Huawei campus in Shenzhen, where multiple actors from different sectors exchange and work together on common projects and experiments such as smart cities or artificial intelligence. Finally, the study trip was an occasion of the BEREC Chair and Vice-Chairs to engage in discussions with representatives from the China Academy of Information and Communications Technology (“CAICT”), a scientific research institute directly under the Ministry of Industry and Information Technology (MIIT) of China, which provides support for the telecoms industry’s major strategies, plans, policies, standards, testing and certification as well as representatives from the Office of the Communications Authority, the body responsible for telecommunications regulation in the Hong Kong Special Administrative Region of the Peoples Republic of China.

We would like to warmly thank all the people we met in China. RTR deserves special thanks for its involvement in the organisation of the trip.

About BEREC

The Body of European Regulators for Electronic Communications (BEREC) was initially established by Regulation (EC) No 1211/2009 as part of the Telecom Reform package. On 11 December 2018, the European Parliament and of the Council adopted Regulation (EU) 2018/1971, establishing BEREC and the Agency for Support for BEREC (BEREC Office), repealing Regulation (EC) No 1211/2009.

BEREC is an independent EU body composed of the National Regulatory Authorities (NRAs) for the electronic communications sector from the Member States and the European Commission, to which participation is open to NRAs from European Economic Area States and third countries, in particular candidate countries which facilitates the consistent application of the electronic communication framework throughout the European Union. BEREC’s mission is to contribute to the development and better functioning of the internal market for electronic communications networks and services. In particular, BEREC develops and disseminates among NRAs regulatory best practices, such as common approaches, methodologies or guidelines on the implementation of the EU regulatory framework. BEREC also assists the

European Commission and the national regulatory authorities (NRAs) in implementing the EU regulatory framework for electronic communications. It provides advice on request and on its own initiative to the European institutions, and complements at European level the regulatory tasks performed at national level by the NRAs.

BEREC has a system of rotating Chairmanship and the BEREC Chair of 2019 is from ComReg, the Irish NRA. The Board of BEREC, the Board of Regulators (BoR) is composed of one member per Member State, who is the head or a member of the collegial body, appointed by the NRA that has primary responsibility for overseeing the day-to-day operation of the markets for electronic communications networks and services

BEREC's annual study trip

Each year, BEREC organises a visit to a non-member country to gain insights from the local electronic communications markets and digital ecosystem. During a typical study trip, the BEREC delegation meets representatives of the NRA, the relevant ministries, as well as incumbent operators, new entrants and other stakeholders in the industry. Past destinations include Japan, the USA, Canada and India.

2. General information about China

The official name of the country is “The People’s Republic of China” and was declared a republic on September 21st, 1949. It covers an area of 9.388.211 km² and has a population of 1.39 billion people. The capital of the country is Beijing and the GDP in 2017 was recorded at USD 12237.70 billion (GDP per capita USD 7329.09). This places China economy as the world's second largest economy by GDP. Until 2015, China was the world's fastest-growing with growth rates averaging 6% over 30 years.

The currency is the Chinese yuan renminbi (CNY), with €1 = 7.8 CNY



2.1. Provinces

China is a vast country, with several provinces, municipalities, special administrative and autonomous regions as follows:

Municipalities: Beijing, Shanghai, Tianjin, Chongqing

Special administrative regions: Hong Kong and Macau (Maccao)

Autonomous regions: Guangxi, Inner Mongolia, Tibet, Xinjiang, Ningxia

Areas controlled by the Republic of China: Taiwan, small part of Fujian

Official languages: Standard Mandarin, Cantonese, Portuguese (Macau), English (Hong Kong), Mongolian (Inner Mongolia), Korean (Yanbian), Tibetan (Tibet), Uyghur (Xinjiang), Zhuang (Guangxi)

Despite the large geographic area, the population of China is relatively homogenous, with the Han Chinese (also called Han) ethnic group making up approximately 92% of the population.

As the Study Trip visited Beijing, Hong Kong and Shenzhen, so additional details about these areas are set out below.

2.2. Beijing

Area: 4.100 km² Population: 21.5 million people Density: 4.500/km²

2017 GDP: 2.6 trillion yuan (342.68 billion EUR)

GDP per capita: 128.927 yuan (16.994,79 EUR).

Beijing is large primarily because it is China's capital. It is actually China's largest city by area, as Shanghai's urban population is more concentrated. It is a political, educational, and cultural centre, with light industries (science, technology and research) dominating over mass manufacturing. Beijing has the world's largest airport, and an extensive, mostly new subway system, but ongoing traffic congestion issues.

The Forbidden City still features strongly in the core of its 6-ringroad concentric layout.

2.3. Hong Kong

Area: 1,106 km² Population: 7.4 million people Density: 6.630 people per km²

2017 GDP: 2.661,0 billion HK\$ (299,81 million EUR)

GDP per capita: 359.996 HK\$ (40.543,58 EUR)

Hong Kong is a Special Administrative Region of the People's Republic of China. Following British rule from 1842 to 1997, China assumed sovereignty under the 'one country, two systems' principle. The Hong Kong Special Administrative Region's constitutional document, the Basic Law, ensures that the current political situation will remain in effect for 50 years. The rights and freedoms of people in Hong Kong are based on the impartial rule of law and an independent judiciary. Hong Kong's economy is characterised by free trade, low taxation and minimum government intervention. It is the world's 7th largest trading economy, with the mainland of China as its most significant trading partner. Hong Kong is also a major service economy, with strong links to mainland China and the rest of the Asia-Pacific region.

2.4. Shenzhen

Area: 1.700 km² Population: 12.5 million people Density: 7,300/km²

2017 GDP: 2,2 trillion yuan (290 billion EUR)

GDP per capita: 193,338 yuan (25.485,27 EUR)

Shenzhen is located in between Guangzhou and Hong Kong. It is a huge manufacturing centre that developed in the 1980s out of a simple fishing village. Feeding off the success of its neighbours, it is ranked fourth in China for industrial output, manufacturing higher technology products than Guangzhou in general, and with several of its own successful sunrise companies. Companies like Tencent, ZTE, Huawei and many others were founded in Shenzhen and now retain research centres there.

3. China's communications market

3.1. Telecommunications market China

The total business revenue of the telecommunications industry in China reached 1.2 trillion yuan (about 174 billion U.S. dollars) in the period between January and November 2019, according to the Ministry of Industry and Information Technology (MIIT).

Telecommunications and Internet statistics

Internet Users (2018): 772 million (world's largest internet-using population)
Mobile phone penetration (2018): 97,5 %
Mobile internet users 1.39 billion
Mobile internet used by cell phone 1.26 billion
Mobile phone ownership: 1.56 billion
Internet speed (2017): 7583.32 KBps
International Bandwidth: 1,899,792Mbps
IP addresses (2017): 98.86 million
IPv4 Addresses: 331 million
WWW websites: 2.68 million
Domain names: 13.41million

Due to the particular political circumstances, the leading Chinese telecommunications operators are all partially owned by the state or its agencies. This creates a unique field of responsibilities, where competing companies co-operate in order to provide public telecommunications infrastructure: to cite an example, China Telecom, China Unicom and China Mobile (the three biggest telecommunications operators) established the China Iron Tower Company with the aim of facilitating the construction and sharing of basic telecoms facilities.

The Notice Concerning the Implementation of Mobile Communication Re-sales Business, however, led to the first MVNO trials and with the end of the trial period in 2018, commercial licenses were handed to 15 operators, amongst which were Suzhou Snail Digital Technology, Xiaomi, JD.com and Alibaba Cloud Computing. Together, MVNO operators held a market share of 3,5% by the beginning of 2018. The Government's MIIT publishes reports on market developments on a monthly, quarterly and annual basis.

The three leading telecommunications operators – China Telecom, China Unicom and China Mobile – also publish reports on their activities. As their activities are differently weighted, the focus of these reports differs, often significantly.

3.1.1. China Mobile Ltd.

China Mobile Ltd. is the biggest Chinese network operator and promotes itself as “a world-class telecommunications operator with the world's largest network and customer base”. Founded in 1997, its services focus on mobile telecommunications, in particular mobile voice and data, and wireline broadband, on a global level.

China Mobile has a mobile customer base of 887 million people (2017) and 113 million wireline broadband customer base (2017), in conjunction with 229 million IoT smart connections.

3.1.2. China Telecom Corp. Ltd.

China Telecom is a subsidiary of China Telecommunications Corporation Ltd. and was incorporated in 2002. It is the largest fixed-line and the third-largest mobile operator in China. Its narrow-band IoT network, launched in May 2017, is the first and largest in terms of scale in the world. It has subsidiaries in 27 countries and regions.

China Telecom has a mobile customer base of 250 million people (2017) and 133.5 million wireline broadband customer base (2017), in conjunction with 44.3 million IoT smart connections.

3.1.3. China Unicom Ltd.

China Unicom operates both fixed and mobile networks in the PRC as well as overseas and has subsidiaries in 14 countries. China Unicom provides integrated information services, also through its satellite-based services, and is the second-largest mobile network operator. In the course of its mixed-ownership reform, companies such as Alibaba, Tencent, Baidu and JD.com have invested in China Unicom and also taken part in joint initiatives to drive technology development for smart cities.

China Unicom has a mobile customer base of 284 million people (2017) and 75 million wireline broadband customer base (2016).

3.1.4. Mobile virtual network operators (MVNOs)

Mobile virtual network operators (MVNOs) in China are in the rather peculiar situation, by European standards, of heavy government promotion. The Notice Concerning the Implementation of Mobile Communication Re-sales Business, however, led to the first MVNO trials and with the end of the trial period in 2018, commercial licenses were handed to 15 operators, amongst which were Suzhou Snail Digital Technology, Xiaomi, JD.com and Alibaba Cloud Computing. Together, MVNO operators held a market share of 4% by the beginning of 2018.

3.1.5. Social Media and digital service providers

Digital connectedness in China is ubiquitous. More people own mobile phones than bank accounts, although mobile payment services either complement or render obsolete many bank accounts. The digital landscape itself is quite different from others around the world due to Western platforms and providers (most notably Google, Facebook and Twitter) being blocked by the Great Firewall of China. Chinese services and platforms are not common in the Western world, although the Chinese diaspora does use them and global usage is increasing. The four competing grand companies are Tencent, Alibaba and Bytedance/Baidu (merger announced for 2019), and they have spread out investments through the market, thereby leading to diffused alliances and competition.

3.1.5.1. Competing platforms: Tencent's WeChat and Sina Corporations' Weibo

In terms of social media, two of the biggest competing platforms are Weibo by Sina Corporation (recipient of investments from Alibaba) and WeChat by Tencent. Another platform is QQ (also by Tencent), which with this year's 20th anniversary is the oldest social media platform in China and has been rebranding itself as an entertainment platform to avoid competition with WeChat.

Launched in 2009, Weibo is often compared to Twitter in that it allows users to post short blogs, as its name (literally: microblog) promises. However, it also offers features much like Pinterest and Tumblr in that it supports multiple media formats for posting. Its active user base has long surpassed that of Twitter, with 431 million daily active users as of the second quarter of 2018 and a net income of \$ 141 million (which represents an increase of 92% from the same quarter of 2017). Similar to QQ, Weibo is preferred by children and young adults, and the shift of daily usage from these apps to WeChat often coincides with becoming an adult.

WeChat on the other hand has increasingly become the mediator for life in China, despite having launched only in 2011. Offering messaging and group services (such as group chat, polls etc.), payment services, booking and shopping services, its popularity and widespread use have made it the ideal partner for the Chinese government to host official IDs and pilot projects such as the Deadbeat Map, a mini-app notifying users of the proximity of debtors and their total debt. All in all, it is easily feasible to use WeChat alone to access the same functions provided elsewhere by dozens of different apps. WeChat exists in two versions, the international WeChat and the Chinese WeiXin. It has drawn heavy criticism for, allegedly, repeated privacy violations (e.g. by blocking messages or notifying authorities of critical content), its monopolistic business practices (e.g. blocking competitors or disabling hyperlinking) and its sheer scope, which makes it difficult for consumers to resort to alternatives.

3.1.5.2. E-commerce platforms in China

Online marketplaces are very common in China and their force has driven innovations in finance, logistics and virtual reality. Their features and form are very well adapted to Chinese

understandings of business and often use cultural concepts, backed by big data insights, to draw and keep more customers. In turn, the technology developed by these companies advances the development of Smart Cities, making Alibaba's and JD.com's expertise vital to these projects.

Alibaba Group owns two of the biggest online e-commerce platforms in China – taobao.com and tmall.com – and in total about 60% of the Chinese e-commerce market, providing support infrastructure through its logistics companies, cloud sharing and marketing services, its UC Browser (improving download speed and saving up to 85% of data) as well as Alipay, an escrow service providing security to combat lack of trust. Its combined mobile monthly active user base on the Chinese online retail marketplaces has reached a staggering 666 million in the third quarter of 2018.

JD.com is a direct competitor of Alibaba and has received investments from Tencent. Apart from being the biggest online (and offline) retailer, it heavily invests in logistics in order to provide its signature 24-hour delivery service within China. It is currently developing smart supply chain and smart logistics solutions based on blockchain technology, using AI to power its operating fleet of autonomous delivery vehicles and working on augmented and virtual reality solutions. Its annual active user base as of the third quarter of 2018 is 305.2 million.

Pinduoduo is an online commerce platform available mostly through WeChat and enables group buying deals. This platform and many others like it try to find niches in the vibrant digital landscape by innovative consumer targeting, product development or both. Another Tencent-backed commercial service is Meituan-Dianping, a location-based social network offering the largest database of reviews for restaurants, hotels and other businesses as well as ticketing and booking services for them.

3.1.5.3. Baidu

The Great Firewall blocking access to Google in China made room for the unhindered growth of Baidu's search engine. Similarly to Google, Baidu has since expanded its services to maps, advertising, e-commerce, entertainment production and AI, amongst others, to become a veritable behemoth of the Chinese internet. AI development in particular has propelled it to the leading expert in AIs for cars and a recent deal with Volvo was signed to co-develop robotaxis. It counted 665 million monthly active users in the second quarter of 2018 for its Baidu App alone. Total revenues in 2017 amounted to RMB 84,8 billion (\$13.03 billion), increasing 20% from 2016. Mobile revenue represented 73% of total revenues, compared to 63% in 2016.

3.1.5.4. Other social media and digital services

Douyin, launched by Bytedance in 2016, has taken up many features formerly provided by Vine and provides features 15-second-videos and livestreaming capabilities merged with social functions. In September 2017, ByteDance created an international version named Tik Tok, which merged with musical.ly in September 2018. The apps are immensely popular with millennials, in part because other generations do not use them and they thus offer an exclusive space. Douyin and TikTok together have 500 million monthly active users globally, with China accounting for 150 million daily active users.

Another highly popular app is Momo, which started in 2011 as a Tinder-like platform offering dating services. It since evolved into a generalised friend-finding app and began to offer livestreaming and entertainment services, producing its own reality shows.

DiDi (formed by the merger of Didi Dache and Kuaidi Dache, backed by Tencent and Alibaba respectively), offers a range of transportation solutions like cab-hailing, private car-hailing, and ride-sharing but also food delivery. Its advances in autonomous driving make it an equally valuable expert for the Chinese government, especially in the framework of the Belt-and-Road Initiative.

Toutiao (launched by Bytedance in 2012) is the largest news platform in China, with about 240 million monthly active users. It uses an algorithm to recommend articles written by official accounts of news websites, individual content creators or publishing agencies to its users. It has been touted the world's highest-valued start-up and swiftly expanded to advertising, video content sharing (Douyin) and AI. The success of Toutiao quickly forced established technology giants Tencent and Baidu to react and establish similar features or products, but it retains its uniqueness by not offering more functions.

iQIYI (by Baidu) is one of China's major entertainment platform, offering streaming for movies and series much like Netflix, but also games and video streaming like YouTube. It is surpassed by Tencent Video, which offers the same functions including news, and in heavy competition with Alibaba's Youku Tudou, whose original productions have up to 20 million viewers per episode (to compare, House of Cards has reached about 3 million viewers per episode). For music streaming, China offers Kugou and Kuwo (which merged with QQ and thus Tencent in 2016), QQ Music and NetEase Cloud Music. Tencent's services also offer karaoke and music videos and make up roughly 75% of the total market.

Last but not least, the Chinese online gaming industry is growing each year: increased spending on mobile games even though the government froze game licenses in March 2018, which had a great negative impact on the domestic gaming industry. The biggest gaming company is Tencent with over half the market share, followed at a distance by NetEase with almost 15%.

Aside from these companies, network operators also provide services such as streaming, banking or messaging. However, the market share is for the most part insignificant.

3.2. Telecommunications market Hong Kong

Hong Kong's small size and high population density has enabled the country to extensively rollout fixed broadband infrastructure and provide almost all households with access to high-speed broadband connectivity. This has propelled Hong Kong to boast the highest peak average broadband speeds are the highest in the world. International internet connectivity continues to grow, driven by Hong Kong's status as an international financial hub and its location next to China.

Fixed line growth in Hong Kong has declined over the past five years as consumers migrate to wireless voice and data services. This trend is predicted to continue over the next five years to 2023. While current data centre sites are sufficient to support immediate demand, Hong

Kong needs cheaper land options for data centre usage and government support to achieve its long-term goal as a data centre hub and smart city.

The government has taken steps towards coordinated development of a smart city. The Hong Kong government announced a range of measures in six areas, including “Smart Mobility”, “Smart Living”, and “Smart Environment”, will be introduced over the few years to 2023.

Underpinning delivery of digital economy services is increasing affordability and sophistication of end user devices and IOT connected sensors as well as continual investment in network infrastructure to connect end-user devices as well as integration of new mobile related technologies designed to improve wireless broadband capacity and service quality.

TELECOMMUNICATIONS AND INTERNET STATISTICS QUANTITY	
Cellular mobile telephone subscribers	18.40 Million
Digital cellular subscribers	18.40 Million
Mobile subscriber penetration rate (%)	248%
Mobile Network Operators (February 2019)	4
Local Fixed Network Operators (February 2019)	27
External Fixed Telecommunications Services Providers (February 2019)	236
Residential fixed line penetration rate (October 2018)	89.03%
Mobile subscriber penetration rate (September 2018)	256.7%
Internet Service Providers (February 2019)	251
Household broadband penetration rate (October 2018)	92.8%
Fibre-to-the-home/building (FTTH/B) penetration rate (October 2018)	73.9%

3.2.1. Telecommunications providers Hong Kong

3.2.1.1. PCCW Limited

PCCW Limited is a Hong Kong-based information and communications technology (ICT) company which is best known as the majority owner of HKT Limited. PCCW also holds a majority interest in Pacific Century Premium Developments Limited. PCCW is headquartered in Hong Kong and operates in Europe, the Middle East, Africa, the Americas, mainland China, and other parts of Asia. The PCCW Commercial Group provides ICT services to small, medium and large enterprises. The group managed the installation of Asia's largest IP-enabled network for securities and derivatives markets, built for Hong Kong Exchanges and

Clearing Limited and known as SDNet. It includes an electronic passport system, known as e-PASS, and the Smart Identity Card system for the Hong Kong SAR Government.

3.2.1.2. HKT Hong Kong Telecommunications Limited (subsidiary of PCCW Limited)

HKT is Hong Kong's premier telecommunications service provider and leading operator in fixed-line, broadband and mobile communication services. It meets the needs of the Hong Kong public and local and international businesses with a wide range of services including local telephony, local data and broadband, international telecommunications, mobile, enterprise solutions, and other telecommunications businesses such as customer premises equipment sales, outsourcing, consulting, and contact centres. HKT offers a unique quadruple-play experience in Hong Kong delivering media content on its fixed-line, broadband Internet access and mobile platforms jointly with its parent company. HKT also provides a range of innovative and smart living services beyond connectivity to make the daily lives of customers smarter, whether they are at home, in the workplace, or on the go. Consumers and merchants alike may also enjoy HKT's financial-related services such as mobile payment, smart mobile point-of-sale solutions, and insurance. For enterprises, HKT delivers end-to-end integrated solutions employing emerging technologies such as cloud computing, Internet of Things (IoT) and Artificial Intelligence (AI) to accelerate their digital transformation, contributing to Hong Kong's development into a smart city.

HKT currently holds a market share of ca. 54% in the residential broadband market, and 29% in the mobile market. Approximately 13% of its mobile service revenue was generated through roaming in 2017.

3.2.1.3. Hutchison Telecommunications Hong Kong Holdings Limited

Hutchison Telecommunications Hong Kong Holdings Limited is a Hong-Kong based operator of GSM dual-band and 3G mobile telecommunications services in Hong Kong and Macau. It formerly also provided fixed line telecommunications services in Hong Kong, which were discontinued in 2017. It is actively involved in Smart City development in Macau and Hong Kong, and was the first operator to provide NB-IoT roaming solutions in 2018. Since 2018, Hutchison has conducting 5G trials in Hong Kong. Its 2017 revenues stand at 7,912 billion HKD, with net profits of 404 million HKD. HTHKH has a market share of about 21% of the mobile market and 7% of the residential broadband market through its brand 3. It generated about 18% of its mobile service revenue through roaming in 2017.

In Hong Kong, CK Hutchison holds a majority interest in Hutchison Telecommunications Hong Kong Holdings Limited (HTHKH). A listed company and an established telecommunications operator, HTHKH provides leading-edge mobile services in Hong Kong and Macau under the 3 brand. CK Hutchison's success is founded on a commitment to innovation and leading edge mobile technology. CK Hutchison is now serving approximately 112.8 million customers across the world.

3.2.1.4. HKBN Hong Kong Broadband Network Limited

HKBN Group is Hong Kong's second largest provider of residential high-speed fibre broadband service and a fast growing enterprise solutions provider. The company offers a wide range of telecommunications solutions for both the residential and enterprise markets,

including broadband and managed Wi-Fi services, voice communication, mobile services, OTT entertainment, data centre services, integrated cloud services, data connectivity and system integration. HKBN Group is part of HKBN Ltd., which is listed on the Main Board of the Stock Exchange of Hong Kong Limited.

HKBN owns an extensive fibre optic network in Hong Kong, which covers over 2.3 million residential homes passed and 2,400 commercial buildings. In 2004, HKBN successfully built the largest Metro Ethernet network in the world. In 2005, it became the first Internet Service Provider in Hong Kong to offer 1,000Mbps residential Fibre-to-the-Home service. In 2013, HKBN acquired Y5ZONE Limited and further extended its Wi-Fi business development. In 2016, the acquisition of New World Telephone Holdings Limited's telecommunications took place to further strengthen its Enterprise Solutions segment, and in 2018, HKBN acquired ICG to form a cloud system integration powerhouse.

HKBN currently maintains a market share of 33% of the residential broadband market. Its entry into the mobile market in 2017 enabled a 30% increase in MVNO subscriptions.

3.2.1.5. China Mobile Hong Kong Limited

China Mobile Hong Kong Company Limited ("CMHK") is the wholly-owned subsidiary of China Mobile Limited, which ranks 47th on the Fortune Global 500. CMHK was incepted in January 1997 and was the first mobile network operator to launch PCS services in Hong Kong. CMHK currently holds a market share of 20% in the mobile market.

CMHK's 4G LTE service covers two major standards LTE FDD and TD-LTE, and launched the world's first converged commercial LTE network in 2012 and in November 2016, CMHK has successfully launched 4.5G mobile network. The Company offers innovative and comprehensive communications services, including voice, data, IDD and international roaming through 4G LTE, 3G HSPA, GPRS, EDGE and other technologies. In 2016, CMHK became the first mobile operator to provide 4G network coverage in 16 tunnels throughout Hong Kong. In February 2017, CMHK became Hong Kong's first mobile operator to "cloudify" its core network; in August, it became world's first operator to launch commercial 2.3GHz TDD Massive MIMO technology and in September, it is the first operator to announce and activate NB-IoT commercial service.

In May 2014, CMHK became the first service provider in Hong Kong to provide 4G data roaming service in Mainland China, creating a new era for cross-border mobile services. In May 2016, CMHK launched "Supreme Greater China" Service Plan; customers can enjoy data roaming service in Mainland China, Hong Kong, Macau and Taiwan inclusive in one monthly fee, enabling the best advantages in Greater China communications. With focus on expanding international roaming services, CMHK unveiled "Supreme" service plan series in March 2017.

The "Supreme Global" and "Supreme Asia" Service Plans extensively cover the most frequented destinations of business and leisure travellers in Hong Kong, bringing added convenience to customers and allowing them to enjoy worry-free data roaming service with one single monthly fee. In September, 2017, CMHK 4G data roaming coverage covers over 120 destinations. In December, the "Supreme Greater Bay Area" service plan was launched

to empower customers with the advantages of cross-border communications between Guangdong, Hong Kong and Macau.

3.2.1.6. SmarTone Telecommunications Holdings Limited

SmarTone Telecommunications Holdings Limited (0315.HK) is a leading telecommunications company with operating subsidiaries in Hong Kong and Macau, providing voice, multimedia and mobile broadband services, as well as fixed fibre broadband services for the consumer and corporate markets. SMT currently has a market share of ca. 14% of the mobile market.

SmarTone is renowned for leading the industry in developing proprietary services. In 2002, SmartOne introduced HTML browser-enabled multimedia services to Hong Kong. In 2006, SmarTone revolutionised mobile broadband in Hong Kong with the world's first network-wide 1.8Mbps HSDPA network; as well as the first mobile broadband dongles, which enables customers to bring the Internet with them wherever they go. In collaboration with The Chinese University of Hong Kong in 2007, SmarTone developed ground-breaking cloud-based technologies making it possible for customers to enjoy popular Internet multimedia content in real-time, including a wide variety of standards on all 3G devices. This patented technology enables SmarTone customers to enjoy Flash videos even on devices that do not natively include Flash technology.

SmarTone leads the market in retail store design, and successive generations of retail stores have provided a superior shopping experience to its customers. In 2009, SmarTone introduced the first Android smartphone to Hong Kong, together with exclusive widgets, apps and entertainment services customized for its customers. Recently, SmarTone has developed applications for over-the-top distribution on application stores attached to the main smartphone operating systems, enabling mobile users on other mobile networks to subscribe to these services. SmarTone Telecommunications Holdings Limited (0315.HK) has been listed in Hong Kong since 1996. It is a subsidiary of Sun Hung Kai Properties Limited (0016.HK).

3.2.1.7. WTT HK Limited (subsidiary of HKBN)

Backed by the state-of-the-art fully fibre-optic network, WTT HK Limited (formerly known as Wharf T&T Limited) is the second largest business fixed line operator and the first and only comprehensive ICT service provider in Hong Kong focusing on the business sector. Licensed in 1995, WTT has invested over HK\$7 billion to build its own telecommunications network infrastructure in Hong Kong. Co-owned by MBK Partners, North Asia's largest independent buyout firm, and TPG, a leading global alternative asset firm, WTT is well positioned to serve enterprises with more best-of-breed ICT solutions and deliver enhanced value to enable their businesses.

As a leading ICT service provider, WTT strictly focuses on enabling customers' businesses using best-of-breed technologies via top-class service. Backed by the state-of-the-art "Fibre-to-the-Desk" (FTTD) ultra-high speed broadband network, WTT possesses strong system integration capabilities and offers a full suite of subscription-based public cloud solutions to meet the evolving business demands for ICT adoption. WTT has a rich ICT service portfolio ranging from fibre-based high-speed business broadband, sophisticated local and international data networking, advanced IP-based voice telephony, best-of-breed public cloud

services, to complex mission-critical systems integration solutions that are tailored to enable businesses of its customers.

3.2.1.8. i-CABLE Communications Limited

i-CABLE Communications Limited was incorporated under the laws of Hong Kong in May 1999 and was listed on both The Stock Exchange of Hong Kong Limited and the Nasdaq Stock Market in the U.S. on November 24, 1999. Founded by WTT HK Limited, i-CABLE became its division for services aimed at residential customers in 2006 and was acquired by Forever Top Asia in 2017. i-CABLE Communications Limited is an integrated communications services provider in Hong Kong, commanding a large and influential television viewer and communications service user base in town. It owns and operates a near universal wireline telecommunications network in Hong Kong to provide Television, Broadband, Telephony and multimedia services to over two million households. It is also one of the largest producers of television, film and multimedia content based in Hong Kong for distribution over conventional and new media, with a particular focus on news, information, sports and entertainment. Its share of the residential broadband market totals about 6%.

3.2.1.9. HGC Global Communications Limited

HGC owns an extensive fibre-optic network in Hong Kong and provides world-class telecoms services based on innovative application of the latest technologies and a strong customer-centric service ethic. Coupled with its four cross-border routes integrated with three of mainland China's tier-one telecommunications operators and a world-class international network, HGC provides a comprehensive range of fixed-line telecommunications services locally and overseas and its lines of business can be divided into four major categories: International and Carrier Business, Data Centre Business, Corporate Business, and Residential Broadband Service.

HGC meets the needs of commercial and public sectors at home and abroad, as well as Hong Kong households and also provides wholesale services on a one-stop-shop basis to support mobile service operators, international carriers, multinational corporations, Internet content providers and application service providers in Hong Kong, the Americas, Europe, the Middle East and Africa, along with the rest of Asia. With world-class data centre facilities, connectivity capability, a sophisticated billing system and the provision of 24x7 technical and hotline support service, HGC is well positioned to capture new cloud computing opportunities and provide leading-edge cloud services and enterprise solutions.

3.3. Telecommunications manufacturers China

3.3.1. ZTE

ZTE started out in Shenzhen in 1985 as a simple trade company processing raw materials on client demand or acting as local agents for foreign businesses. This changed when the founder, Hou Weigui invested in research and development of telecommunications switching equipment, which was an unusual move at that time. Its success however proved ZTE and its

direct competitor from the same city, Huawei, right and in 1996, the company made the move to include transmission, access and videoconferencing equipment in its portfolio while strengthening its local market position and entering foreign markets. Already in 2001-2002, ZTE had acquired the contracts to build the national backbone networks in Ecuador and Poland as well as in five western Chinese provinces (in cooperation with China Telecom). As a company, ZTE strives to develop its products, investing over 10% of its annual revenue in research and development. This has allowed it to make crucial contributions to China's 5G development: in particular, it recently unveiled CloudStudio, the first commercially ready AI-based 5G slice operation system at the MWC2019 Barcelona. Shenzhen is one of the first 5G pilot cities of China Unicom, and ZTE'S infrastructure contributions allowed China Unicom and ZTE to make the first phone call using 5G mid-January 2019.

While ZTE headquarters were moved to Nanshan, Shenzhen remains the seat of its research and development department. It currently operates in the segments Carrier Networks (54%), Terminals (29%), and Telecommunication (17%), manufacturing equipment for network operators, network access equipment and services (software). Its 2017 annual revenue amounted to 108,8 billion yuan and 4,55 billion yuan net profits.

3.3.2. Huawei

Founded in 1987 in Shenzhen by Ren Zhengfei as a sales agent for a Hong Kong manufacturer of PBX switches, Huawei began investing in research and development of communications solutions in 1990, which by 1998 allowed it to expand its operations from rural China to the metropolitan areas. The first significant contract (over 25 million USD) with the Dutch operator Telfort in 2004; by the end of 2007, it was a partner to all major European network operators. It accounted for 10% of LTE patents worldwide in 2008 and remained a driving force of LTE deployment globally. Huawei has been actively researching 5G since 2013, when it released a White Paper, and launched the first SDN-based IoT solution in 2015.

In 2016, it provided the networks serving over a third of the global population in more than 170 countries and actively contributed to Smart City development in over 40 countries. Its cloud computing solutions remain vital to industries globally since Huawei first offered the world's largest desktop cloud in 2012, allowing it to now work on developing the world's first All-Cloud networks.

Similarly to ZTE, Huawei retains its facilities in Shenzhen as its Chinese headquarter for its research and development operations. Huawei's 2017 annual revenue amounted to 92,55 billion USD and 7,28 billion USD net profits.

4. Institutional and regulatory context

4.1. Institutions China

4.1.1. Ministry of Industry and Information Technology

The Ministry of Industry and Information Technology (MIIT) of the People's Republic of China was established in 2008 as a department under the authority of the State Council. It determines China's industrial planning, policies and standards and monitors the daily operation of industrial branches in addition to promoting the development of major technological equipment and innovation concerning the communication sector. The regulation agencies on the provincial and regional level report to the MIIT and monitor the local telecommunications industry on its behalf. The MIIT is further tasked with guiding the construction and development of information systems and safeguarding China's information security. In practice, it distributes licenses for operators, it authorises access for end-user devices to telecommunication networks and manages the distribution of frequencies.

4.1.2. Economic and Information Technology Commission

The Economic and Information Technology Commission (EITC) acts as the support body to the MIIT at the provincial and municipal level, aiding with specific and localised terms as well as the implementation of the nationwide policies published by the MIIT.

4.1.3. State Administration for Market Regulation

The State Administration for Market Regulation (SAMR) was recently created in August 2018, replacing amongst others the State Administration for Industry and Commerce (SAIC), the Anti-Monopoly and Anti-Unfair Competition Bureau of SAIC, the Price Supervision and Anti-Monopoly Bureau of the NDRC, the Anti-Monopoly Bureau of MOFCOM, and the Anti-Monopoly Commission of the State Council. The merger is part of current reform efforts aiming at streamlining administration and consolidating power structures. Its duties now encompass market supervision, management and reform (including price supervision and credit supervision), regulation (drafting guidelines for price charges, anti-unfair competition, anti-monopoly guidelines and law enforcement) and business registration for small and medium enterprises.

4.1.4. Cyberspace Administration of China

The Cyberspace Administration of China (CAC) was created in 2014 to oversee the internet and technology sector. The CAC has three main tasks, namely safeguarding internet security, promoting digitisation (also on an international level) and managing online content. It has played an instrumental role in coordinating with EU institutions and on a European level to further the Digital Silk Road initiative, a side project of the Belt-and-Road Initiative. The National Information Security Standardization Technical Committee operates under the

direction of the Cyberspace Administration and is commonly tasked with reviewing the privacy terms and data collection practices of businesses operating in China.

4.2. Telecommunications regulations in China

Telecommunications in the People's Republic of China is legally defined as the use of wire-based or wireless electromagnetic or optoelectric systems for the transmission, sending or receiving of speech, text, data, pictures and other information. The PRC sports several internets with varying degrees of connection to international servers.

4.2.1. PRC Telecom Regulation

The PRC Telecom Regulation was issued on 25 September 2000 and revised on 29 July 2014 and 6 February 2016. It contains the definition of telecommunication and the distribution of competences for telecommunications in China: the separation of state and business operators; the obligation of operators to provide immediate, exact, secure, comfortable and cost-efficient services to consumers; and the prohibition of the use of telecommunications for activities which endanger national security, public interest or legitimate rights and interests of others. Furthermore, it stipulates laws for licensing, network connection, tariffs for telecommunications and the handling of telecommunications resources (such as frequencies, satellite positions, network code numbers etc.). Obligations for telecommunications operators towards users of telecommunications (regarding provision, quality, neutrality and maintenance of services as well as information) and vice versa (regarding payments) are laid out, wherein universal service alongside free-of-charge service are assured for public uses (fire alarms, medical and other emergencies et al.). The construction of telecommunications infrastructure and subsequently the authorisation of access for end-user devices are placed within firm state limits, and a series of strict rules are stipulated regarding information security. Finally, legal penalties are defined in case of transgressions and an exemption is made for foreign organisations or persons investing in China and operating telecommunications services as well as mainland Chinese telecommunications services operating in Hong Kong, Macau and Taiwan.

The well-developed system of licensing divides operators into:

- Basic telecom services (BTS), which are defined as the provision of public network infrastructure, public data transmission and basic voice communications services.
- Value-added telecommunications services (VATS), which are defined as telecommunications and information services provided through public network infrastructure.

BTS operator require basic telecoms operation licencing while VATS (divided into Type I and Type II) operators may apply for either a value-added telecoms operation license or a cross-regional value-added telecoms operation license. All telecommunications operators must have a permanent establishment in China in order to commence operations, and shareholding

restrictions previously applied to foreign investors (equity interest capped at 49 % for BTS and 50% for VATS¹) but were lifted in 2015.

Regarding network connection, the PRC Telecom Regulation states that market-dominating operators may not refuse applications for connection from other operators. The market-dominating operator is defined as that operator who:

- controls the necessary telecommunications infrastructure
- has a major share in the telecommunications service market,
- and may have a considerable effect on operators entering the market.

The MIIT identifies the leading telecommunications companies, which are obliged to provide interconnection services and to develop procedures for interconnection, including procedures for the interconnection of networks, timelines for unbundling and catalogues of unbundled elements.

In terms of neutrality of service, the Regulation prohibits the limitation of users' use of services, specification or limitation of end-user devices, interference with the service provided without legitimate reason, non-fulfilment of publically specified duties or misinformation, limitation of users in terms of telecommunications services provided by other operators, unacceptable cross-subsidisation or other unfair business practices.

As to information security, the Regulation prohibits the use of telecommunications to create, copy, publish or distribute information which:

- contradicts the principles of the constitution
- endangers national security, publicizes state secrets, undermines state law or national unity,
- damages national honour and interests
- incites national hatred, ethnic discrimination, and the undermining of national unity,
- destroys the state's religious policy and promotes cults and feudal superstition,
- spreads rumours, upsets social order and undermines social stability,
- spreads obscenity, pornography, games of chance, violence, murder, terror or abuse,
- insults or defames others and infringes upon the law and the legitimate interests of third parties,
- contains other content, which is prohibited by other laws and administrative directives.

¹ Telecoms business activities in China are divided into BTS and VATS. BTS refers to the business of providing public network infrastructure, public data transmission and basic voice communications services. VATS refers to the telecoms and information services provided through public network infrastructure. The Telecom Catalogue sets out the detailed types of BTS and VATS.

Prohibited activities include deleting or changing of the functionality of the telecommunications network or the data and applications it saves, processes and transmits; using the telecoms network for the theft or destruction of information; and creating, copying or distributing malware or other attacks on telecoms-related devices. Users of telecommunications are liable for the content and its consequences. Public security agencies, state security agencies and the prosecution must check the content of communication according to the legally stipulated procedures, except in cases of danger to national security or the prosecution of crimes.

4.2.2. PRC Law on the Protection of Consumer Rights and Interests

As the PRC Telecom Regulation itself does not distinguish between business and private consumers, the obligations of telecommunications operators towards consumers arise from the obligations and requirements set out in the PRC Law on the Protection of Consumer Rights and Interests (from 1 January 1994, revised 31 May 2013). Amongst these is the obligation for business operators to disclose all information related to the services provided, while the consumer's right to protection of their personal information when receiving a service and their right to privacy is defined here.

4.2.3. Provisions on Administration of Foreign-Invested Telecommunications Enterprises

The Administrative Regulation contains restrictions and criteria for foreign investment in BTS and VATS. The PRC's efforts to open its economy to global investment in accordance with the WTO's specifications were the main driver for these efforts.

4.2.4. Cyber Security Law

With the Cyber Security Law from June 2017, the government of the PRC has strengthened control over possible risk factors (e.g. by defining requirements and obligations for operators of critical information infrastructure, which are networks used by public services or those the failure of which could be harmful to national security, national economy or public interest), by expanding personal data protection requirements, by introducing obligations for network operators (a loose term applying equally to owners or administrators of computer networks and also network service providers), and simultaneously promoted the development of cyber security technology.

With the coming into effect of the Cyber Security Law, an increase of cybersecurity inspections and the development of security standards for devices, software, mobile applications and for data transmission and storage can be expected. In addition, the prohibition for operators of critical information infrastructure to store data collected in China outside of China will require identification of the scope of and protective measures for critical information infrastructure, and further prosecution of the illegal use of VPN or proxy servers is foreseeable. As the Cyberspace Administration recently announced, drafting and implementing standards for personal information protection and data security, the security of critical information infrastructure, industrial control systems security, vehicle network security, cybersecurity testing platforms, and smart lock security.

In the wake of the Cyber Security Law, the Chinese government has created new obligations for social media platform operators, which are now required to review content posted by users, block illegal content and those accounts which routinely post illegal content, and to obtain a license for transmitting audio and video products (failing that, to block the channels by which such content can be uploaded). Throughout the past century, the PRC has often been accused of serious censoring of content and form of communication or art if they are considered harmful for or in opposition to the Communist Party's line. Often called the "Great Firewall of China", the government has constructed a system of filters and blocks of content and in some cases even internet access to "manage" cyberspace.

4.2.5. Anti-Monopoly Law of the PRC

The Anti-Monopoly Law was passed 30 August 2007 and came into effect on 1 August 2008 and focuses on the control of mergers and the prohibition of market abuses and monopolistic agreements. In the telecommunications and media sectors, only four cases were made until March 2017, the first dating to September 2016.

4.2.6. Measures for the Administration of Internet Information Services

Providing the legal basis for all profit-generating and non-profit activities via online services, the Measures for the Administration of Internet Information Services were first released on 25 September 2000 by the State Council. They define Internet Information Service (IIS) as the service of providing information to internet users through the Internet.

It stipulates that all commercial IIS providers (those who provide information or webpage creation services to internet users for profit) must apply for an ICP license from the MIIT or the relevant local telecoms administration authorities prior to conducting business registration. In addition, any investments from or cooperation with foreign investors must be approved in advance by the MIIT. Non-commercial IIS providers who share information free of charge only need to file their records with the MIIT or the local telecoms administration authorities. Both commercial and non-commercial IIS providers should display their ICP license or filing codes at a conspicuous place on their homepage.

4.2.7. Provisions on Regulating the Order of the Internet Information Services Market

The Provisions on Regulating the Order of the Internet Information Services Market were promulgated by the MIIT in 2011 and came into force 15 March 2012. They provide the basis for net neutrality discussions in the PRC. They prohibit:

- maliciously disrupting other IISPs' services or the downloading, installation, operation, or upgrading of products related to IIS;
- maliciously making products or services incompatible with those of other IISPs;
- disparaging services and products of other IISPs or infringing upon their rights through fabrication of facts or dissemination of such fabrications; and

- deceiving, misleading, or forcing users to use or to give up other IISPs' services or products, or to modify the parameters of other IISPs' services or products.

These provisions also require assessors of IISPs to publish information pertaining to the assessment (e.g. data sources, assessing environment and methods) and allow assessed IISPs to take action against their assessments. The first definition of “user’s personal information” is set out here along with the duties of IISPs in case they collect this information.

Lastly, the provisions also contain a definition of those actions considered to encroach on the rights of users, namely:

- refusing, postponing, or ceasing to provide services or products without legitimate reason;
- providing services and products by means of deceit, misleading information, or compulsion;
- improperly tying users to certain designated services and products;
- providing services and products that are inconsistent with their publicity or commitments;
- unilaterally lowering service quality, increasing users' liability, or changing agreed-upon services or business rules;
- failing to give proactive notification and explanation to users of incompatibility of the IISP's services or products with other IIS or related products; or
- modifying browser configuration or other settings or downloading, installing, operating, upgrading, or uninstalling software at a user's terminal without prior notice and users' informed consent.

4.2.8. Measures for the Protection of Information of Telecoms Users and Internet Users

Issued by the MIIT and effective on 1 September 2013, these Measures specify business operators' obligations in terms of user data protection. These include the following:

- to seek informed consent by the users to the collection and use of their data;
- to limit the collection and retention of data to that which is strictly necessary to provide services;
- to adopt technical and managerial measures to protect the safety of personal data;
- to provide channels for data-privacy- and data leakage-related concerns; and
- to report any incidents resulting in data leakage to the regulator and affected individuals.

They partially draw on and reinforce the Provisions on Regulating the Order of the IIS Market (see above). The Measures are intended to provide specific implementation rules for the earlier Decision of the Standing Committee of the National People's Congress on Strengthening Online Information Protection from 28 December 2012.

4.3. Institutions Hong Kong

4.3.1. Communications Authority in Hong Kong (CA)

The Communications Authority (CA) is an independent statutory body established under the Communications Authority Ordinance (Cap. 616) on 1 April 2012, comprising 10 non-officials from various sectors of the community and two public officers. The CA is a unified regulatory body for the broadcasting and telecommunications industries in Hong Kong. It regulates the broadcasting and telecommunications industries in accordance with the Broadcasting Ordinance, Telecommunications Ordinance, Communications Authority Ordinance, Broadcasting (Miscellaneous Provisions) Ordinance, Trade Descriptions Ordinance and Competition Ordinance. It also enforces the Unsolicited Electronic Messages Ordinance. The Telecommunications Affairs Committee is set up under the CA to offer advice and report to the CA on relevant telecommunications matters. The Office of the Communications Authority (), the CA's executive arm and secretariat, helps the CA administer and enforce the relevant ordinances governing the broadcasting and telecommunications industries.

4.4. Telecommunications regulations in Hong Kong

According to the stipulations of the PRC Telecommunications Regulation, network operators in the special administrative regions Hong Kong and Macau as well as Taiwan are treated as international communication services and have to be approved by a special department within MIIT. Moreover, special rules and exemptions apply to municipalities, e.g. the Shanghai Free Trade Zone Regulation on foreign investment in the telecommunication sector or the Mainland and Hong Kong Closer Economic Partnership Agreement (CEPA) specifying limitations for VATS and the distribution of telephone cards in Guangdong Province. Pilot projects such as Smart Cities, are also handled on a regional, municipal or local level, generating diversity and ambivalence on a national level.

4.4.1. Fair Usage Policy Guidelines

Fixed and mobile broadband service providers offer a variety of service plans to consumers, including plans with "unlimited usage". However, certain "unlimited usage" service plans are in fact subject to usage restrictions imposed by service providers in the name of Fair Usage Policy ("FUP"). The FUP is intended to prevent excessive usage of network resources by individual customers, which may adversely affect the network performance and hamper other customers' use of the service. For example, service providers may impose restrictions by lowering the network service priority or reducing the access speed for customers whose data usage has exceeded certain threshold. Nevertheless, consumers may not be aware of the existence of the FUP or understand the relevant terms and conditions. Customers of "unlimited

service” plans in particular feel aggrieved when their data usage is subject to restriction because of the FUP. In order to protect consumer interests and enhance the transparency of service information, the CA issued a set of FUP guidelines in November 2011, governing the way service providers should implement their FUP. The mandatory guidelines have been in effect since February 2012. In 2017/18, OFCA assisted the CA in handling nine FUP-related complaint cases. None of them was found to be in contravention of the FUP guidelines.

4.4.2. Industry Code of Practice for Telecommunications Service Contracts

In order to provide guidelines for the industry in drawing up telecommunications service contracts with a view to improving transparency in the contracting process and increasing customer satisfaction, the CAHK, an industry association, promulgated a self-regulatory Industry Code in December 2010, which was implemented by all major fixed and mobile network operators starting from July 2011. Having regard to the implementation experience and consumers’ feedback, OFCA made a number of suggestions to CAHK to further enhance the Industry Code. CAHK revised the Industry Code in October 2014 following discussions with participating operators. The revised Industry Code took effect on 1 May 2015. Since the implementation of the Industry Code in July 2011, the number of complaints related to service contract disputes has been decreasing continuously, from 1 277 cases in 2011 to 419 cases in 2017, representing a drop of 67% in six years.

4.4.3. Publications of the Service Termination Arrangements of Residential Broadband Service Providers

To enhance service information transparency and to better inform consumers, OFCA has since November 2016 published on its website details of the arrangements adopted by major residential broadband service providers to handle service termination requests from consumers. Information published covers the advance notice requirement, channels for accepting service termination requests and their relevant formats, arrangements to acknowledge and to confirm receipt of service termination requests, and channels for the return of customer equipment to service providers.

The information will enable consumers to better understand existing practices of different service providers, which should help reduce disputes over service termination matters. The information would also go some way towards facilitating consumers in making informed decisions on service plans that best suit their needs, by comparing the existing termination arrangements of different service providers, thereby encouraging operators to introduce improvements on an on-going basis. OFCA updates the published information periodically, and when changes are introduced by service providers. OFCA will continue to encourage service providers to review their service termination arrangements with a view to making further improvements.

4.4.4. Code for the Provision of Chargeable Mobile Content Services

To safeguard consumer interests and to increase the transparency of the pricing information related to Mobile Content Services (“MCS”), OFCA has worked closely with the industry to

draw up the voluntary “Code for the Provision of Chargeable Mobile Content Services”. Promulgated and put into effect by CAHK in January 2010, the code governs the practices of third-party Content Service Providers (“CSPs”) in providing MCS and the establishment of an industry self-regulatory scheme. Under the code, all third-party CSPs are required to indicate clearly to their customers the chargeable nature of the services and to obtain their clear consent before initiating the delivery and provision of MCS. They are also required to set out clearly the unsubscribing mechanism, which should be simple and convenient.

Since the adoption of the code in January 2010, OFCA has been closely monitoring its effectiveness, and noted a continued decrease in the number of related complaints, which has remained at a low level. In light of past experiences and latest market situation, as well as the persistently low level of complaints in recent years, CAHK, in consultation with the industry and OFCA, streamlined the self-regulatory arrangements under the code from 1 April 2017 such that mobile network operators would take up a more prominent role to ensure continued compliance with the code requirements by CSPs, and the Administrative Agency set up under CAHK for handling matters related to the code ceased operation from 1 April 2017. Despite the adoption of the streamlined arrangements under the revised code, all the measures in respect of safeguarding consumer interests and provision of transparent pricing information related to MCS by CSPs remain the same in the revised code. In 2017/18, only two complaints about MCS were received, reflecting the general compliance of CSPs with the voluntary code and satisfaction of customers with the MCS.

4.4.5. Code of Practice in Relation to Billing Information and Payment Collection for Telecommunications Services

In October 2011, the CA issued a voluntary code of practice entitled “Code of Practice in Relation to Billing and Payment Collection for Telecommunications Services”, with a view to reducing billing disputes and enhancing the transparency of billing information. This code of practice provides guidance to telecommunications operators on chargeable items to be included in their bills, and arrangements for payment collection. As at March 2018, seven local fixed network operators and four mobile network operators had pledged compliance with the code. The CA published a consumer alert as well as a summary of the compliance status of all operators for the information of consumers on its website and has undertaken to continue to closely monitor the implementation and effectiveness of this code of practice.

4.4.6. Customer Complaint Settlement Scheme

The voluntary Customer Complaint Settlement Scheme (“CCSS”) helps resolve billing disputes in deadlock between telecommunications service providers and their residential / personal customers by means of mediation. The mediation service is provided by an independent mediation service centre (“CCSS Centre”) set up under CAHK with voluntary participation of all major telecommunications service providers in Hong Kong. OFCA supports the CCSS by contributing the necessary funding, vetting the CCSS applications against the acceptance criteria, and monitoring the performance and the governance of the scheme.

There were 82 eligible applications in 2017/18, 42 of which were resolved before referral to the CCSS Centre, 36 were satisfactorily settled upon referral to the CCSS Centre, and four

cases were not settled after mediation. To raise public awareness of the CCSS, a series of publicity activities were conducted, including publication of comic strips on newspapers, featured posts on social media platform and website banner advertisements, as well as roving exhibitions and public seminars. OFCA has undertaken to continue to support the CCSS and monitor its effectiveness.

4.5. Regulatory contexts in China

4.5.1. Artificial Intelligence and Big Data

Artificial Intelligence (AI) has often been touted the future of technology: algorithms are believed able to improve production (and consumption), environmental protection, manufacturing and supply chain processes, logistics, urban living and design, healthcare, security, warfare and a multitude of other fields. AI is based on the principle of Deep Learning, where a program is trained to recognise patterns and improve itself through evaluation of its errors. The “simplest” programs evaluate data sets, such as photographs, improving their method of evaluation to achieve higher accuracy. More complex AIs interact with humans, like voice-controlled assistants, and some of the most complex are able to play games (and, in an increasing number of cases, win against human champions).

In the PRC itself, AI is used by various parties for different reasons: the government seeks to improve surveillance AI like facial recognition to maintain tight control of movement in public, while banks and digital financial platforms (often called fintech providers) use the same technology for user verification and fraud prevention; recommendation algorithms drive the growth of applications and e-commerce platforms; autonomous vehicles use AI to navigate the streets safely; industrial AI linked to sensors through the IoT improves agricultural and manufacturing production, thereby reducing costs and increasing productivity. Baidu, Tencent and Alibaba are leading Chinese AI development through their investments in start-ups in China and elsewhere, securing an edge in patents for autonomous driving, voice assistants, facial recognition, healthcare and Smart Cities.

The sheer population size alone and the almost total mobile penetration automatically assure major Chinese mobile network and platform providers a clear advantage when it comes to using Big Data to feed and train AIs. This allows rapid advances in technologies such as facial recognition, but may come at the cost of increased surveillance and intrusion. As of 2017, Big Data is not regulated by specific legislation: instead, policies issued by –amongst others – the State Council in 2015 and by MIIT in 2017 aim to encourage the development of big data technology and applications, boost the development of big-data-related business, and encourage information-sharing between business sectors. According to these policies, the regulation of big data should be based on public security and national sovereignty considerations. Big Data developments also tie in with data protection concerns, and the management of the latter in the light of the former was discussed at a forum in November 2018.

4.5.2. Data protection and social credit scoring

With the Administrative Measures from 2013, the MIIT expanded previously legally determined data protection measures. The concern of data protection also led to the publication of a White Paper by the Chinese Institute for Information and Communication in November 2018, summarising the current situation and containing findings that 95% of Android applications are not consistent with the licenses obtained (e.g. include advertisements or use personal information without the required permission). On the same day, the China Consumers Association published the findings of a study of 100 apps in Beijing, showing that 91 of the tested apps collect more information than permissible – some of which were developed by organisations and institutions such as the Industrial and Commercial Bank of China. In reaction, the government announced a joint initiative by the MIIT, the Cyberspace Administration, the Ministry of Public Security, and the State Administration for Market Regulation to combat these illegal data collection practices.

Also, apps such as the one developed by the Higher People’s Court of Hebei Province, notifying the users of any debtors in the vicinity (500m) and which can be accessed through the near-ubiquitous WeChat, pose a different privacy problem. Social credit scoring is the technological approximation of everyday social evaluation processes – of merit, of competence, of suitability etc. – by way of electronically collected and generated data. Information that previously had been classified as “restricted” for the general public becomes available to anyone, and in some cases, it may result in advantages or disadvantages for the person in question. As several pilot schemes started from 2014 on a regional level, and participation is as of now voluntary, the outcomes cannot yet be fully evaluated. These pilots are conducted by local government offices on the one hand and companies on the other hand, meaning that entirely different types of data may be collected and evaluated for different purposes and interests.

One of the primary concerns voiced by Western institutions is of course the infringement on personal data privacy on an individual level. Chinese institutions however greet the possibilities these types of systems offer: since the Chinese legal context does not differentiate between private persons and companies, consumers can feel safer regarding their consumption choices. More developments are expected in the run-up to the end of the planning phase in 2020.

4.5.3. Fraud and cryptocurrency

As in many countries, there have been incidents of fraud in China and perpetrators have increasingly begun to use telecommunications services to commit their crimes. Telephone and e-mail scams capitalise on the incredible mobile penetration of 98% and convince their victims to transfer money to accounts on bogus grounds. Banks and other institutions are trying to develop tech-based solutions to this problem, e.g. improving facial recognition programs to detect micro-expressions that might be indicators of fraud attempts. Even mini apps have become the target of elaborate scams, as the hype for these programs is met with little to no knowledge about their processes and companies seek to enter into the new field.

Another area of concern for the authorities is the cryptocurrency sector. Cryptocurrencies were greeted with enthusiasm in China, as they presented an alternative form of investment. In the

beginning, the government even introduced incentives such as tax deductions for cryptocurrency mining facilities, nurturing the industry until China's bitcoin hash power (the rate of mathematical operations necessary for completing transactions) reached nearly 70% of the global total. Starting from 2017, the financial instability generated by cryptocurrency trading (and instances of fraud cases in the industry, as well as online gambling rings) led the government to change its stance and begin a crackdown on initial coin offerings (ICOs), followed by private exchanges via over-the-counter accounts and finally trading platforms. Notwithstanding these restrictions and bans, the Chinese government is not opposed to cryptocurrencies per se and considers them to have high potential as an international monetary reserve.

4.5.4. The Next Generation and 5G

5G research – guided by MIIT – has been conducted in China since 2013, with technical trials starting in September 2016. In 2018, the three leading telecommunications providers began testing 5G in 16 Chinese cities, among them Beijing, Tianjin, Qingdao, Hangzhou, Nanjing, Wuhan, Guiyang, Chengdu, Shenzhen, Fuzhou, Zhengzhou, Shanghai, Guangzhou, Suzhou, Xiong'an, Lanzhou and Shenyang. In January 2019, the MIIT announced it would begin granting temporary 5G licenses to mobile network operators, with China Mobile expected to sell 5G-enabled devices as early as July 2019.

This move is part of an effort to boost Chinese technology development, in particular in the IoT field, and the China Academy of Information and Communications Technology predicts that 5G will lead to 8 million jobs created in China alone by 2030.

China's Next Generation Internet (CNGI) programme from 2003 created the basis for the swift advancements currently underway. The Chinese Education and Research Network (CERNET) was established by the Ministry of Education and with the funding provided by CNGI, CERNET began to develop the IPv6-only network and testing it internally at universities.

The China Internet Network Information Centre, an organisation connected to the Chinese Academy of Sciences, was heavily involved in this research and is the operator of the China Science and Technology Network, which was the first internationally connected internet in China.

China Telecom was the first to begin testing this IPv6-based network: in 2005, it was launched under the name of CN2. According to their website, "CN2 is an IPv6-capable backbone network leveraging new softswitches and protocols like DiffServ and MPLS, which boost performance. Five classes of service and QoS help CN2 guarantee reliability and performance of mission-critical and high-priority applications. Its MPLS-optimized architecture also enables Frame Relay and ATM traffic to be transported over a Layer 2 VPN, which promotes network efficiency and scalability".

4.5.5. Smart Cities

Although the foundations of China's current Smart City policies can be found in the "Eight Gold Plan" of the 1990s, the first set of concrete policies in this field stem from the 12th Five-Year-Plan of 2010 and the Notice of Implementing the National Smart City Pilots, the National

Interim Measures for Smart City Pilots, and the Guidance on Promoting Healthy Smart City Development from the following years. This was further stimulated by IBM's intense engagement in China during the global financial crisis, starting with a co-operation in 2008 with the Shanghai World Expo Bureau and subsequent discussions with over 200 mayors in the course of 22 forums.

Where 90 cities across China were first approved for pilot projects in 2012, these projects already numbered over 500 in 2018. These pilot cities followed the “new concept and model which utilizes the next generation of information technology, such as the Internet of Things (IoT), cloud computing and big data, to promote smart urban planning, construction, management and services for cities” (Guidance on Promoting Healthy Smart City Development, issued by the NDRC in 2014). The New-Type Urbanisation Plan of 2014 identifies the following critical applications for smart technologies in cities:

- broadband information networks;
- informatisation of planning and management, including building public information platforms;
- intelligent infrastructure in transportation, power, water and sewage, and pipeline networks;
- convenient public services;
- industrial development; and
- social governance

These were re-confirmed in the 13th Five-Year-Plan of 2015 and to this end, the government created the PATH to Smart Cities Initiative in 2018, involving Ping An (P), Alibaba (A), Tencent (T), and Huawei (H) in the development of measures to manage urban phenomena such as traffic, environmental pollution (China Unicom's Smart River Chief), or changing the ways people interact with cities and businesses through the wide-scale implementation of QR codes.

Xiong'an is the first city in China constructed from scratch following the principles of the government's Smart City vision. Located 129km southwest of Beijing, it features 5G test networks constructed by China Mobile and China Telecom, enabling autonomous vehicles and virtual reality live-streaming.

4.5.6. Internet of Things

By connecting AI with cloud computing and advanced analytic programs, and enabling such connections with high speed internet capabilities, companies and governments are attempting to increase efficiency, productivity and more detailed insight into industrial and other processes. China's production and manufacturing capabilities have created a keen interest in inventing and developing cutting-edge technology “at home”: not only do Chinese companies manufacture and develop most of the chips required for IoT, but also the demand for these chips for industrial purposes largely comes from the Chinese market. The applications are

numerous, with active pilot projects in areas such as agriculture, logistics, environmental protection and industrial manufacturing. These projects are more often than not devised and implemented or supervised by the leading telecommunications providers (China Telecom, China Mobile and China Unicom). Meanwhile, since 2015 the government has set up institutions, e.g. the National IoT Centre in Shanghai, and funding programs within the framework of the Made in China 2025 strategy to support the manufacturing sector or the Internet Plus Action Plan to improve the digital integration of Chinese companies.

Two mobile technologies – Narrowband-IoT (NB-IoT, also known as LTE-M2) and LTE-M (Long term evolution category M1) – are key to developing the systems and programs required to realise these plans and have been standardised by 3GPP. NB-IoT uses the low spectrum of 200 kHz, which is otherwise unused, consumes less battery power and does not require gateways to connect to the base station. LTE-M on the other hand uses the 4G LTE spectrum and likewise does not require a gateway for connectivity, while LTE devices offer power saving modes like extended discontinuous reception (eDRX). The LTE-M was first and mostly developed by the French start-up SigFox and later with the assistance of LoRa. NB-IoT was largely developed by Huawei after acquiring Neul (UK), with the co-operation of Qualcomm, Vodafone, and Ericsson. Both standards are similar in terms of battery life and scope-potential, but differ in terms of data transfer capabilities and required base infrastructure. Where LTE-M needs to connect to LTE antennas, NB-IoT devices simply use the existing spectrum, eliminating the costs associated with installing new infrastructure.

The latter is the reason why the PRC has focused more on developing and deploying NB-IoT technology: with the deployment of 5G infrastructure underway, the government and companies in China are more willing to work with existing infrastructure suitable for immediate use. Immediate use is considered to be a guarantee for swifter technological progress, which is believed vital for success in the many ambitious projects of the government.

4.5.7. One Belt One Road Initiative and the Digital Silk Road

The Belt-and-Road Initiative has shaped and defined China's foreign policy like none other in the recent years. Often cited in the context of large-scale infrastructure projects in Central Asia and the Middle East, it has also driven investment in a wide range of telecommunications projects on a global scale. These may take the shape of satellite infrastructure projects or increasing the number of international branch offices to promote ICT cooperation with local businesses, in particular in Europe. In part, this initiative is an attempt to shift the economy in the PRC from heavily manufacturing-dependent (and thus dependent on low production costs) to an industry based on services and consumption.

The Digital Silk Road Initiative was first announced at the China-EU Digital Cooperation Round Table in July 2015. Under the auspices of the Cyberspace Administration, infrastructure projects such as transcontinental cable networks – from Europe through Russia to China – would be advanced while co-operation between Chinese and European companies would be fostered in order to promote development of 5G, cloud computing, IoT and Smart Cities. The Belt-and-Road Initiative and the projects it encompasses may therefore be understood as the foreign policy reflection of Chinese internal strategy.

4.6. Regulatory contexts in Hong Kong

4.6.1. 5G

To better prepare Hong Kong for the timely launch of the 5G services, there was deemed to be a need for additional spectrum for public mobile services towards 2020 and beyond. To implement the work plan issued by the CA in March 2017 for making available additional spectrum for public mobile services, OFCA served notice in April 2017 to spectrum assignees of the 26 GHz band, notifying them that their frequency assignments in the 26 GHz band would be withdrawn on 1 April 2019 with a view to re-allocating the 26 GHz band for 5G services. In December 2017, OFCA assisted the CA in issuing an invitation for expression of interest (“EOI”) in using the 4,100 MHz of spectrum in the 26 GHz and 28 GHz bands for the provision of 5G services. After reviewing the information received in the EOI, OFCA supported the CA in preparing a joint public consultation with the Secretary for Commerce and Economic Development (“SCED”) on the proposed allocation of the 26/28 GHz bands to mobile service and the associated arrangements for spectrum assignment, as well as the related Spectrum Utilization Fees (“SUF”). From July to September 2017, OFCA assisted the CA to conduct a public consultation on the proposal to change the frequency allocation of the 3.4 – 3.7 GHz band from fixed satellite service (space-to-Earth) to mobile service, to assign 200 MHz of spectrum in the 3.4 – 3.6 GHz band for the provision of public mobile services, and to reserve 100 MHz of spectrum in the 3.6 – 3.7 GHz band as a guard band. Having duly considered the views and comments received during the consultation, findings of the consultancy study and feedback from the industry, the CA decided on 28 March 2018 to effect the aforesaid re-allocation from 1 April 2020, thereby giving an advance notice period of two years to the affected licensees and parties.

As the next step, OFCA also assisted the CA during the year to make preparations for launching a joint public consultation with SCED on the proposed arrangements for assignment of the spectrum in the 3.4 – 3.6 GHz band for the provision of public mobile services and the related SUF. OFCA has committed to continue its efforts in identifying more spectrum to support the development of 5G services in Hong Kong. OFCA has been encouraging and facilitating the industry to conduct trials of 5G technologies and applications to better prepare for the launch of 5G mobile services. As of 31 March 2018, the CA issued a total of seven trial permits, with temporary, free-of-charge spectrum assignment for test purposes, to equipment vendors and mobile network operators, while OFCA welcomes applications from other interested parties for conducting further 5G trials.

4.6.2. MVNOs

The mobile market in Hong Kong is very vibrant, and apart from the well-established major telecommunications providers, about 20% of the market is shared by MVNOs – Mobile Virtual Network Operators – and other minor providers.

To ensure satisfactory provision of service by MVNOs for the protection of consumer welfare, OFCA provided support to the CA to introduce measures to strengthen the licensing and regulation of the MVNOs. In September 2017, after taking into account views and comments received from the industry and relevant stakeholders, the CA issued a Code of Practice on the

Cessation Arrangements for MVNO Services to provide practical guidance to the licensees in the event of cessation of MVNO services in order to better protect consumer interest. The Code of Practice sets out the requirements to ensure that MVNOs and their hosting mobile network operators would manage the service cessation arrangements in a better coordinated manner and that a reasonable advance notice would be given to the affected service subscribers and the general public before any service cessation of an MVNO. This would enable affected service subscribers to make timely arrangements to reduce adverse impacts caused.

4.6.3. Infrastructure development

4.6.3.1. Development of Fixed Broadband Services

Broadband access to various applications and content services has become an integral part of people's lives in Hong Kong. With the continuous network rollout of fixed network operators, the Hong Kong community is able to enjoy nearly ubiquitous coverage of broadband networks deploying various technologies. As at March 2018 there were around 2.66 million residential and commercial fixed-broadband subscribers, with a household penetration rate of 93%.

Broadband services are now available at speeds of up to 10 Gbps. Around 83% of fixed broadband subscribers use broadband services with a speed of 10 Mbps or above. According to a report issued by the Fibre to the Home Council Europe in February 2018, Hong Kong ranked the fifth worldwide in fibre to home/building household penetration among the 65 economies under comparison. According to the World Competitiveness Yearbook 2018 published by the International Institute for Management Development in May 2018, Hong Kong was ranked the fourth out of 63 economies in terms of average Internet bandwidth speed.

4.6.3.2. Landing of New Submarine Cable Systems in Hong Kong

With the support of OFCA's single-point-of-contact service, a new transcontinental submarine cable system (namely, Asia Africa Europe-1) and a new domestic submarine cable system (namely, Tseung Kwan O Express) have been brought into service in Hong Kong from December and June 2017 respectively. In addition, four regional and transcontinental systems (namely, Pacific Light Cable Network, Hong Kong-Guam Cable System, Hong Kong-Americas Cable System and South East Asia-Japan 2 Cable System), as well as two domestic systems, (namely, Ultra Express Link and TKO Connect) are being constructed and planned for putting into service between 2018 and 2020. OFCA is committed to assisting operators in applying for the necessary statutory approvals for construction of new submarine cable systems in Hong Kong

4.6.3.3. Development of the Hong Kong Satellite Networks

Satellite spectrum and orbital positions are scarce natural resources and use of these resources by communications satellites registered in Hong Kong are required to comply with the coordination and notification requirements of the International Telecommunications Union ("ITU"). OFCA supports the licensed satellite operators of Hong Kong to attend satellite

network coordination meetings with foreign administrations from time to time and assists in the processing of licences for the launching and operation of satellites in space orbits. In 2017/18, OFCA participated in three satellite network coordination meetings with the administrations of Russia, the United Kingdom and France respectively. Following the launch of two new satellites, AsiaSat 9 in September 2017 and APSTAR 6C in May 2018 recently, there are now twelve satellites in orbit operated by two Hong Kong companies licensed to provide satellite communications services.

5. Key insights from meetings with Stakeholders in the ECS and IT sectors

During the study trip, the BEREC delegation met with a range of stakeholders representing ECS operators, equipment manufacturers, e-commerce and social media companies as representatives from regulatory authorities and relevant government ministries.

This chapter provides a summary of the key insights and facts about the Chinese ECS market.

The Chinese ECS market has two discrete geographical areas; “mainland” China and the Hong Kong Special Administrative Region of the People's Republic of China. In China, excluding Hong Kong, the market is highly concentrated, with three nationwide operators (China Mobile, China Telecom and China Unicom), which all have fixed as well as mobile operations. The relative market share of these operators is set out below.

Company	Mobile subscriber share (2018)	Fixed-line broadband subscriber share (2018)
China Mobile	60%	41%
China Telecom	20%	38%
China Unicom	20%	21%

However, these figures themselves do not convey how dynamic the telecoms market is. China has adopted a policy that could loosely be described as “planned competition”, whereby each of the ECS operators is treated equitably in matters such as the assignment of spectrum, for example, but are expected to compete with each other and innovate for the benefit of consumers and wider society. For example in 2018, China Mobile, the leading operator, total subscriber share fell by 2.5% year-on-year, while China Telecom has increased its customer base with a cumulative incremental 53.04 million mobile subscribers in the year.

Another indication of how the state promotes competition was at the end of 2013 when MIIT canceled existing restrictions on China Mobile’s fixed-line business and allowed it to enter the fixed broadband market. As a result, since 2014 China Mobile has continued to promote fixed-line broadband services nationwide with a more aggressive price strategy. As a result, China Mobile’s subscriber share surpassed China Unicom at the end of 2016 and surpassed China Telecom in October 2018.

Competition in the ECS sector is also promoted through the emergence of MVNOs in the last five years. MVNOs currently have a customer growth of 10 million subscribers per half year and as of the end of December 2018 the number of mobile resale subscribers reached 83.2 million representing 5% of the total mobile subscribers in the country.

In Hong Kong, the ECS sector is regulated through OFCA, which favours a market-based pro-competition approach to regulating the ECS sector. The ECS market has been fully liberalised since 2003, with no pre-set limit on the number of licences issued. In addition there are no

foreign ownership restrictions and, with minimum government intervention, OFCA's can be described as a light-handed regulatory approach to provide a competitive environment.

The result of this regulatory approach is that under the heading "Local Fixed Operators" there are 27 facility-based internal fixed carriers and 21 service-based operators authorized to provide IP voice telephony services. In addition there are 4 MNOs and 26 MVNO active in the Hong Kong market, with 19.4 mobile subscriptions representing a 260% penetration rate.

In terms of promoting 5G rollout, OFCA has assigned a total of 4,500 MHz (approx.) of spectrum, which is 8-times the amount of spectrum assigned for the provision of 2G, 3G, and 4G mobile services in Hong Kong. In addition further spectrum awards in the 600 & 700 MHz bands are planned once the process to switch off analogue broadcast TV has been completed. OFCA has taken a varied approach to its spectrum assignments by auctioning 380 MHz of spectrum in the 3.3, 3.5 and 4.9 GHz bands, while making 4,100 MHz of spectrum available through an administrative assignment process in the 26/28 GHz bands, which included both shared and non-shared spectrum. These administrative assignments in the mmWave bands involve binding roll-out commitments, which presents a challenge for those MNOs that participated in the award.

OFCA also facilitates 5G technology trials, having issued 25 trial permits since early 2017. Wireless IoT applications are regulated under a new licensing regime since December 2017 and has seen the emergence of a new generation of wireless and major technologies such as Sigfox and LoRa.

The BEREC delegation met with one of the largest social media platforms, Tencent, which gave an insight into how ubiquitous mobile usage is among Chinese citizens. What was also noticeable is the absence of bank cards (debit/credit cards) terminals and the Chinese seemed to have leap-frogged this technology cycle in favour of mobile payments. It is in this context that Tencent's provided the BEREC delegation with insights on its businesses.

Tencent Holdings Limited is a Chinese multinational investment holding conglomerate founded in 1998, whose subsidiaries specialise in various Internet-related services and products, entertainment, artificial intelligence and technology both in China and globally. Its headquarters, Tencent Seafront Towers are based in Nanshan District, Shenzhen.

Tencent is the world's largest gaming company, one of the world's most valuable technology companies, one of the world's largest social media companies, and one of the world's largest venture capital firms and investment corporations. Its many services include social network, music, web portals, e-commerce, mobile games, internet services, payment systems, smartphones, and multiplayer online games, which are all among the world's biggest and most successful in their respective categories. Offerings in China include the instant messenger Tencent QQ and one of the largest web portals, QQ.com. It also owns the majority of China's music services (Tencent Music Entertainment), with more than 700 million active users and 120 million paying subscribers. The company surpassed the market value of US\$500 billion in 2018, becoming the first Asian technology company to cross the valuation mark. It has since then emerged as one of Asia's most valuable companies, and among the world's top technology companies by market value. Tencent has been credited as one of the world's most

innovative companies by numerous media and firms. As of 2018, Tencent has the 5th highest global brand value

During its visit to TenCent's HQ, the BEREC's delegation was given a practical demonstration of how TenCents social media platform could be used to book a doctor's appointment, leave a rating of the doctor's performance, hail a taxi or order a take-away meal as well as pay utility bills or parking fines. Representatives from TenCent also gave some insights into a trial that the company is involved in with the Chinese Government pilot/trial programme to assign social credit scores to member of the population. TenCent's platform is being used to assign merit or de-merit points, which affects the individual citizen's overall social credit score. It is not clear what action would be taken if a person's social credit score dropped below a certain threshold.

Such pilot schemes could raise concerns about data protection. The representatives from TenCent gave a presentation to the BEREC delegation, which clearly demonstrated that they are aware of Europe's GDPR regime and asserted that their company policies are very similar, for example:

- Data processing practices should be fair and transparent notice to users
- Data policies should be compliant with applicable laws
- Data processing practices should have a clear purpose and never excessive
- Personal data should only for the duration necessary
- End-user control – user determines what to share and how much they share

TenCent representatives also presented on the company's approach to Net Neutrality. They were cognisant of the different approaches to net neutrality in the USA and Europe and explained that there is no law in China which stipulates net neutrality rules but, in theory, telecom operators should treat all content and applications equally and fairly.

The BEREC delegation also met with the equipment manufacturers ZTE & Huawei at their Shenzhen headquarters. Both companies are greatly focused on 5G deployment and use cases.

Huawei provided the BEREC delegation with a tour of its impressive campus in Shenzhen and highlighted its involvement and contribution to the development off 5G architecture standards. Huawei also gave demonstrations and presentation on the tests it has been proactively conducting on the 5G networks and trials on 5G business applications, working towards the goal of 5G commercialization. Huawei informed the delegation that it had accelerated the development of NFV (Network Function Virtualization) and SDN (Software Defined Networking) and had already put its virtualized NB-IoT core network into commercial use.

The issue of cybersecurity was addressed and Huawei's stated approach is that security algorithms/protocol/architecture must be standardised, which requires joint efforts by academic, ICT manufacturers, mobile carriers, etc. Huawei also maintains that 3GPP has defined a clear standards framework of 5G Security, to which Huawei subscribes.

6. Overview and brief summary of meetings held by the BEREC delegation

6.1. EU Delegation to China

The European Union is represented in China by the Delegation in Beijing. The Delegation was established in Beijing in October 1988. The Delegation is responsible for the conduct of official relations between China and the European Union. In all matters pertaining to the European Union, the Delegation works closely with the diplomatic missions of the EU Member States, particularly the one representing the EU Presidency, which changes every six months.



The Delegation is a natural point of contact between the EU and the Chinese authorities as well as others in China. It does not, however, deal with trade promotion, consular matters or other issues which have traditionally been handled by the Member State embassies, consulates or national tourism offices. The EU Delegation keeps abreast the European External Action Service, the Commission and other EU institutions on significant political, economic and other developments in China and facilitates the operation and development of bilateral co - operation agreements.

Ambassador Nicolas Chapuis and the Head of Information Society Media Section, Mr Philipp Barth met with the BEREC delegation and provided information on the ECS landscape in China.

6.2. China Mobile



China Mobile Limited is one of the leading telecommunications services provider in Mainland China and the China Mobile Group provides full communications services in all 31 provinces, autonomous regions and directly-administered municipalities throughout Mainland China and in Hong Kong Special Administrative Region. China Mobile boasts a world-class telecommunications operator with the world's largest network and customer base, a leading position in profitability and market value ranking. Its businesses primarily consist

of mobile voice and data business, wireline broadband and other information and communications services. As of 31 December 2018, the Group had a total of 459,152

employees, and a total connection of 1.633 billion, with its annual revenue totalling RMB736.8 billion.

Representatives from China Mobile informed the BEREC delegation about its operations, including network upgrades and rollout and services.

6.3. EU Chambers of Commerce - Beijing

The European Union Chamber of Commerce in China was founded in 2000 by 51 member companies that shared a goal of establishing a common voice for the various business sectors of the European Union and European businesses operating in China. It is a members-driven, non-profit, fee-based organisation with a core structure of 25 Working Groups and 7 Fora representing European business in China

The Chamber is recognised by the European Commission and the Chinese Authorities as the official voice of European business in China. It is recognised as a Foreign Chamber of Commerce with the Ministry of Commerce and China Council for the Promotion of International Trade.



Representatives from the Chamber briefed the BEREC delegation on its activities, role and insights to the Chinese ECS market.

6.4. CAICT

Founded in 1957, the China Academy of Information and Communications Technology (hereinafter referred to as “CAICT”) is a scientific research institute directly under the Ministry of Industry and Information Technology (MIIT) of China. CAICT adheres to the position of “a specialized think-tank for the government, and an innovation and development platform for the industry” and embraces a cultural philosophy of “boosting prosperity with virtues and expertise”. CAICT aims to provide support for the industry’s major strategies, plans, policies, standards, testing and certification, thereby proving itself an important facilitator in the development and innovation of China’s information and communications industry.



Representatives from CAICT provided the BEREC delegation with an overview of China's ICT market, the competitive landscape of the telecoms market, development of an MVNO market and progress of the 5G market.

6.5. OFCA

The Office of the Communications Authority (OFCA) is an executive arm of Communications Authority in Hong Kong. It is the body responsible for telecommunications regulation, antitrust enforcement and allocation of the radio spectrum.



OFCA provided the BEREC delegation with an overview of the regulatory regime in Hong Kong, the fixed and mobile markets. OFCA also provided information on the evolution of mobile technologies and the steps it has taken/planned to facilitate the rollout of 5G networks, including spectrum assignments.

6.6. Hong Kong Operators – PCCW & Hutchinson

The BEREC delegation met with PCCW and Hutchinson, which provided details and insights on their operations and outlook in China/Hong Kong.

PCCW is the parent company of Hong Kong Telecom (HKT), one of Hong Kong's telecommunications service providers, which includes a wide range of services including local telephony, local data and broadband, international telecommunications, mobile, enterprise solutions, and other telecommunications businesses such as customer premises equipment sales, outsourcing, consulting, and contact centers. HKT offers a quadruple-play service in Hong Kong delivering media content on its fixed-line, broadband Internet access and mobile platforms jointly with its parent company, PCCW Limited.

Hutchison Telecommunications Hong Kong Holdings Limited (HTHKH) is also a telecommunications operator providing advanced mobile communications in Hong Kong and Macau under the "3" brand. HTHKH is a member of the CK Hutchison Holdings and offers a range of mobile telecommunications services and products with increasing focus on data-centric services that converge with Internet and PC services.

6.7. TenCent



Tencent is an internet-based technology and cultural enterprise headquartered in Shenzhen, China. IT has a wide range of internet-based products and services, through the company's two principal business operations, 'social platforms' and 'digital content'. Such products include social communication platforms 'Weixin/WeChat' and 'QQ', comics, videos, games and animation, music, literature, films and news, Tencent also offers digital content and multi-media services to over 1 billion users

across the globe. Tencent also provides financial technology and mobile payment solutions that are intended to support the development of smart cities, smart transport and smart retail.

TenCent representatives provided the BEREK delegation with a practical demonstration of its communications platforms along with some information on some government pilot projects it is involved in, which involves the deployment of newer technologies, including cloud computing, big data, and artificial intelligence (AI).

6.8. ZTE

ZTE Corporation is a global manufacturer of telecommunications and information technology. Founded in 1985 and listed on both the Hong Kong and Shenzhen Stock Exchanges, the company provides integrated end-to-end solutions to consumers, carriers, businesses and public sector customers from over 160 countries to enable increased connectivity and productivity.

ZTE provided the BEREK delegation with an overview of its equipment portfolio and development plans. Of particular interest was the information on 5G equipment deployment with partner MNOs.



6.9. Huawei



Founded in 1987, Huawei is a leading global provider of information and communications technology (ICT) infrastructure and smart devices. It produces consumer devices including mobile phones, laptops, tablets, wearables and “Smart Home” devices.

Among its carriers products, it provides switches, routers, WLAN, storage as well as enterprise solutions such as Cloud Data Centers, Enterprise Networking and Intelligent Computing.

Huawei representatives provided the BEREC delegation with an tour of its impressive Shenzhen campus, which is a key R&D hub for its 80,000 employees involved in R&D.

Of particular interest were Huawei’s push to roll-out 5G networks and services.