CHAPTER 4 Snapshots of Internet around 2020

2020.3.8++/2026.3.12

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The Internet was 51 years old in 2020, with 7.8 billion users worldwide, more than half of whom are in Asia [InternetWorldStats 2020]. The coronavirus-19 pandemic has significantly changed the Internet landscape, with many activities now conducted online, such as work, education, and meetings. Zoom, a video communication platform, was the 14th most popular website in 2020 [Alexa 2020].

The USA and China dominate online activities. The top 10 sites include seven from the USA and three from China [Alexa 2020]. In terms of market value, these two countries lead among the top sites. Four US companies have a market value over one trillion dollars [CorporateInformation 2020]. E-commerce is also similarly dominated by China and the USA. Please see Chapter 6 E-commerce for details.

Short message services began with short texts sent through phones, the Internet, and mobile devices over the past 50 years [SMS 2020]. We are now experiencing a major new development with short video services called TikTok, following short text services like Twitter and short image services such as Instagram in the past.

Chapter 4, Snapshots of the Internet, explores various countries in Asia around 2020, consistent with all previous Asia Internet History publications for the 1980s, 1990s, and 2000s. In this chapter, we include snapshot articles from around 2020 on the following countries.

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4.1 Snapshot of the Internet in Bangladesh around 2020

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Internet in Bangladesh

Like many other developed and developing countries, Bangladesh's Internet has seen substantial growth in recent years. Despite numerous challenges in expanding Internet access and usage, the development of the Internet and information technology remains a top government priority. In April 2019, the number of Internet users in Bangladesh reached 96 million [Internet 2020]. Additionally, on February 19, 2018, Bangladesh launched 4G network service.

Although Internet speeds in Bangladesh might not be among the fastest globally, they have significantly improved in recent years [OpenNet 2012]. As of July 2015, Bangladesh ranked 90th out of 198 countries on the Household Download Index by Net Index [Okla 2016]. The completion of the Kuakata submarine cable (Regional Submarine Telecommunications Project, Bangladesh) by BSCCL has increased transmission capacity through the SEA-ME-WE 5 Cable and provided redundancy and low latency with PoP (Point of Presence) to PoP connectivity. This has resulted in greater Internet penetration at the grassroots level.

At the same time, the government views information and communication technologies (ICTs) as a crucial driver of socioeconomic development. This is reflected in the government's "Digital Bangladesh" plan and the National Information and Communication Technology Policy [OpenNet 2012]. Bangladesh is gradually improving its position in the global ICT rankings, moving from 130th in 2009 and 113th in 2012 on the "networked readiness index" to 101st in 2019 [Network Readiness Index 2019]. Although its ICT ranking has improved, Bangladesh still trails behind other low-income countries of similar stature. Progress remains limited due to weaknesses in the regulatory framework and infrastructure development. Additionally, ICT leaders are concerned that the annual budget does not adequately support the government's ICT objectives.

All Internet service providers (ISPs) and similar providers in Bangladesh route traffic through two systems: the National Internet Exchange (NIX) and International Internet Gateways (IIGs). The IIGs provide global Internet connectivity, while all local Internet traffic is routed through the NIX to reduce international bandwidth consumption. The NIX has two exchange points: the Bangladesh Internet Exchange (BDIX), founded in August 2004 and operated by the Sustainable Development Networking Programme and the Peering Society of Bangladesh, and the Bangladesh Society of Internet Exchange (BSIX), established in May 2004. In June 2012, the Bangladesh Telecommunication Regulatory Commission (BTRC) announced plans to issue an unlimited number of additional NIX licenses. Currently, two IIGs are in operation, managed by Mango Teleservices Limited and the state-owned Bangladesh Telecommunications Company Limited [Wikipedia 2020].

ICT has greatly transformed daily life for people worldwide. In this context, recent innovations and reforms in ICT are notable in modern society. Specifically, mobile phones and the Internet have revolutionized the lives of people in Bangladesh and millions elsewhere. BTRC plays a vital role in the country's economic development. Since its establishment through June 2017, BTRC has contributed a total of Bangladeshi Taka 470 billion to the government treasury in

pre-tax revenue [BTRC 2018]. Last year alone, the contribution was Bangladeshi Taka 42 billion [BTRC 2018]. In July 2020, Bangladesh ranked 131st worldwide for mobile speeds and 101st for fixed broadband speeds [Speedtest 2020].

The total number of Internet subscribers reached 80.89 million at the end of July 2018 [Dhaka Tribune 2018]. The total number of Internet users in the country increased to 90.05 million by the end of July 2018, according to statistics published on the Bangladesh Telecommunication Regulatory Commission's (BTRC) website. Of these users, 80.47 million are mobile phone Internet users, 570,000 are broadband Internet (ISP + PSTN) users, and the remaining 83,000 are WiMax users.

The number of Internet users in Bangladesh has surpassed 100 million for the first time, reaching 103.253 million, according to recently released data from the country's regulator, the Bangladesh Telecommunication Regulatory Commission (BTRC). Of the 103 million people accessing services in March, 95.16 million did so through the web or mobile phone networks. Therefore, in a country with a population of 161.4 million, the growth has been relatively rapid [Capacity Media 2020].

Coronavirus and Internet usage

During the coronavirus pandemic, people confined at home have been using 50 percent more data since the holidays began, which coincided with the outbreak starting on March 26, 2020. Users are not facing any issues because corporate internet usage has dropped to zero with all offices closed nationwide until April 4. A source provided this information after analyzing data from over 800 members of the ISP association. However, some ISPs, whose clients are mostly corporate users, face losses as many small firms canceled subscriptions for a month. Meanwhile, the number of broadband internet connections in the country exceeded 5.7 million as of February, according to the Bangladesh Telecommunications Regulatory Commission [Bdnews 2020].

According to an international study, mobile Internet speeds in Bangladesh are slowing down during the coronavirus pandemic, with the country's download speed being the lowest among the 42 markets it has surveyed. However, the country's mobile operators stated that Internet use has increased following the government-declared holiday, as people are using more mobile data than before, making it difficult for them to provide better Internet services with the existing spectrum. During the first week of February 2020 in Bangladesh, the mobile Internet download speed was 9.3 Mbps, dropping to 7.8 Mbps in the last week of March 2020, according to a study conducted by Opensignal, a Hong Kong-based international mobile analytics organization specializing in measuring mobile network experience [The Daily Star 2020].

Coronavirus and online learning

BioTED is a new training and research initiative for students from various universities across the country. When they finished their regular training activities in the second week of March and decided to continue with one training program online, they faced some challenges. Some students who had moved from Dhaka, the capital city, to their hometowns or villages could not

attend sessions due to poor internet connectivity and lack of access to devices. Additionally, some private universities started offering online classes and exams. This situation led them to conduct a survey of university students to understand their circumstances and readiness for online learning. Through their student network, BioTED quickly carried out a survey receiving responses from 42 public and private universities and affiliated colleges. Between May 9 and 11, 2020, 2038 students participated, answering simple questions. Students from science (55%), arts and humanities (12.1%), social sciences (11.2%), business studies (12%), and other fields (4.7%) responded from both public (58.8%) and private (41.2%) institutions. Among them, 34% are in rural areas, and 66% are in urban areas. Notably, only 23% of students supported taking online classes under these conditions, while 77% opposed [Tbsnews 2020]. However, it is expected that the situation will improve as more students become aware of online learning and its easy access.

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4.2 Snapshot of the Internet in Cambodia around 2020

Norbert KLEIN

Examining the recent history of the Internet worldwide clearly reveals an incredible rate of development. However, this is not only true for economically advanced countries, where Internet growth is part of a broader and longer tradition of technological modernization. Comparing Cambodia's situation is even more remarkable, given that the first Internet access there was in 1994 via UUCP.

Infrastructure

Looking back at the start of the Internet in Cambodia in 1994 helps us understand how much progress has been made since then. The ITU "KHMER INTERNET - CAMBODIA CASE STUDY" of 2002 emphasizes Cambodia's development as follows:

> Cambodia exemplifies how wireless technology can boost telecommunications growth. It was the first country worldwide where mobile phone users exceeded fixed-line subscribers, all the way back in 1993. Like much else in Cambodia, the international development community—bilateral and multilateral agencies and NGOs—has played a crucial role in introducing and supporting the Internet in the Kingdom. These low-profile organizations have contributed just as much, if not more, than anyone else in launching Cambodia into cyberspace.

A May 2020 report from the Telecommunication Regulator of Cambodia shows that many companies serve the country's population of over 16 million on the Internet.

20,481,054 registered users across 5 mobile phone operators: (some users have multiple SIM cards)

52,380 registered users with 4 wired phone line operators

10,950,000 Facebook users

This allows for the following population coverage:

2G Mobile Network Coverage 99.2%

3G Mobile Network Coverage 85.1%

4G Mobile Network Coverage 80.3%

This is based on the following fiber optic services' cable lengths:

2,292 km Telecom Cambodia (TC)

16,841 km Cambodia Fiber Optic Communication Network (CFOCN)

25,119 km Viettel (Cambodia)

There are many general information sites about Cambodia that offer guidance on Internet options, such as "(Recommended) Best Internet Providers in Cambodia," including technical details and instructions on how to set up connections, etc.

Cambodia is making progress toward establishing a national Internet exchange called a DIX (Domestic Internet Exchange) [TRC 2020]. Currently, the Cambodia Network Exchange (CNX) operates. Their services are described as follows: "By meeting all major ISPs and carriers at CNX, the chances are high you'll find multiple new peers to which you weren't connected before, meaning that network performance will increase. Internet exchanges also provide redundancy; by adding multiple routes to peers at several exchanges, you increase redundancy in your network, not just relying on one point of interconnect or your transit provider" [CNX 2020]. These IXPs are local, reducing costs by enabling local data exchanges among multiple external operators and enhancing speed. Finally, in February 2021, the Cambodian Prime Minister signed a sub-decree establishing a National Internet Gateway (NIG) "to direct and facilitate all of the nation's local and international internet traffic… It must also 'take immediate action to block or disconnect any network connection that affects national revenue, security [or] social order' in collaboration with the country's authorities. Cambodia's move to set up a NIG was first proposed in July 2020, but faced criticism from the Asia Internet Coalition (AIC), which claimed that the gateway could be used to restrict internet access for civilians, posing a threat to businesses, internet platforms, freedom of expression, and user privacy" [Barton 2021].

Emerging technological efforts

The easy access to the Internet has increased active participation in online activities among many people. Barcamps have played a significant role in this development. The first Barcamp in Cambodia was held in 2008 with just four leaders and four volunteers in Phnom Penh. After hosting Barcamps in 12 provinces with over 70,000 participants, supported by 25 universities and more than 1000 companies, Barcamps have become a foundation for many young Internet-related entrepreneurs. The goals of Barcamps are as follows;

- To join the network of tech and startup movement in Cambodia and ASEAN.
- To inspire youth across the nation on entrepreneurial mindset and career in digital economy era.
- To provide a platform for startups and talents to present and showcase their ideas and business.
- To build a better connection between talents, startups and corporates.
- To equip students with the understanding of significance of digital readiness.

● To bridge talent and knowledge on digital technology, innovation and business all across the nation.

● To introduce digital tools to help everyone achieve better lifestyle and sustainable family business and career development [Cambopedia 2020].

In the study "Startup Kingdom – Cambodia's Vibrant Tech Startup Ecosystem In 2018," the editor faced challenges because "digital data is extremely scarce in Cambodia as the country is still undergoing early stages of digital transformation," while the author estimates that there were over 300 active tech startups in 2018. However, there is general optimism that technology can fundamentally change consumers' behaviors and activities, leading to growth and social transformation. This belief remains despite the limited availability of high-skilled technical talent and the need for clearer policy and regulatory frameworks to provide certainty and incentives for both startups and investors domestically and internationally.

As of 2019, there were 23 co-working spaces in Phnom Penh where anyone could use an Internet-connected computer; these spaces are especially important for startup developers who do not yet have their own technical facilities.

In May 2020, a "Women in Tek Network: Cambodian First Co-working Space for Women-run Tech Start-ups" was opened with support from The Asia Foundation's Women in Tek Network (WTN) project, to enable "start-ups to operate their business and hold trainings, conduct meetings with partners and customers"; these spaces have already supported 18 women-led businesses.

There is still a long way to go in the future of the Cambodian economy, where the annual growth rate has been about 7% over many years (before the coronavirus pandemic). However, e-commerce accounts for only about 0.51% of the GDP, with domestic e-commerce at around 6% and cross-border e-commerce at 94%, or roughly US$106.4 million ("MSMEs in Cambodia Digital Economy" – a training session presentation).

To the general public in Phnom Penh, the most noticeable sign of an Internet-based business economy is the widespread personal transport services offered by tuk-tuks. Customers can call a vehicle using a mobile phone app; the driver's software can identify the caller through their app, which varies for each company, using GPS. It can also find any address in town. At the end of the ride, the customer receives a map of the route taken, the time spent, and the price, all delivered to their mobile phone.

While many educational opportunities are available, especially regarding different aspects of Internet use, the efforts of the Ministry of Education, Youth, and Sport, in cooperation with the NGO Open Institute, stand out. For at least five years, the Ministry has maintained a bilingual Krou Website offering "Materials for Classroom, Reference Documents for Teachers, Useful Links, and Support." The content can be filtered by Grade, Level, Subject, Main Topic, Document Type, and Keyword. To manage courseware, the Ministry implemented a Moodle course management system, which the Open Institute translated and updated into Khmer, making

it fully accessible in the national language and meeting the growing interest from teachers in course content. Developing e-learning courses, however, remains challenging because it requires a clear understanding of the value of content development and recognition that e-learning material is not just duplicating textbook content. Creating new media, such as videos, demands innovative pedagogical approaches that are engaging, and the methodology must be straightforward for teachers—the primary users of these materials. Even videos are only one aspect of e-learning; an additional pedagogical layer is needed to encourage students to think critically and reflect on the content.

KounSvaChhlat, translated as “The Clever Monkey Child," is a series of booklets funded by Manos Unidas, the Spanish Campaign Against Hunger. These booklets help children learn Khmer language and math more effectively, encouraging preschool learning in grades 1 and 2. Developed by the NGO Open Institute in close collaboration with the Ministry of Education, Youth, and Sport, they are also available online. Using KounSvaChhlat booklets, children easily learn how to hold a crayon, follow straight and curved lines, and eventually trace lines of the Cambodian script. This helps them learn to read and write Khmer. The booklets also offer extra math practice, helping children better understand concepts they will need later in their studies. Notably, Manos Unidas – Campaña contra el hambre is an initiative that raises awareness about hunger and malnutrition. This program shows that these problems are mainly caused by a lack of proper early childhood education.

Some problematic aspects of the Internet development

Since the Internet began expanding, the “digital divide” has become a problem: some geographic areas and certain groups of people, due to their economic disadvantages, are excluded from these new communication opportunities. While these issues still exist, there are also new aspects worth noting. They can be examined separately in terms of technical factors, social and economic status, or political environment.

There are still parts of the country with poor Internet access, although coverage has been steadily expanding. However, even where coverage has improved, access to public e-government services (such as receiving government information and doing online registrations) or online educational programs only becomes possible if you have the necessary tools. Access to these tools is a key part of quality of life in society. While those with the technical and economic abilities are becoming more advantaged, those who are less educated, less aware, or less motivated fall further behind in the 'digital divide.”

The Cambodian population was estimated in 2018 to be approximately 16,3 million, with over 50 % under the age of 25. At the same time, it is estimated that about 62 % of the population uses Facebook, and 15 % use YouTube (estimations vary). While YouTube tends to be more for passive consumption of information, the high number of Facebook users indicates an increasing flow of personal information and opinions. The Constitution of the Kingdom of Cambodia states that citizens “shall have freedom of expression, press, publication, and assembly. No one shall exercise this right to infringe upon the rights of others, to affect the good traditions of society, to violate public law and order, or threaten national security.” The increased use of these freedoms,

especially enabled by social media on the internet, has also led to more conflicts, as authorities interpret what "affect the good traditions of society" and what "violates public law and order and national security" differently from what some citizens consider their rights. Without the widespread use of social media, particularly Facebook, some of the conflicts mentioned below would not have become so serious.

As has occurred in other countries, the coronavirus crisis has also led to the spread of false and misleading information on social networks in Cambodia. This issue is part of a broader problem: unreliable, misleading, and sometimes dangerous medical or cosmetic ads are shared on social media without proper or clear measures to prevent them. Another increasing area of conflict involves punishing individuals for expressing personal opinions: citing certain expressions, declaring them to be defamation, incitement to public disorder, or social chaos. For example, in 2020, three people were arrested and "educated

The issue of Internet addiction in Cambodia has not been widely discussed so far. There is no available data on the extent of Internet addiction in Cambodia. This contrasts with China, where an estimated 24 million people aged 14 to 29 are classified as Internet addicts. In 2008, China's health officials became the first to officially recognize it as a clinical disorder. Although there isn't a universally accepted definition of Internet addiction, it is generally seen as a set of behaviors and symptoms that include excessive use, withdrawal, and effects on daily life.

- Information overload. Too much online surfing leads to decreased productivity at work and fewer interactions with family members.
- Compulsions. Excessive time spent in online activities
- Cybersex addiction possibility. Surfing of porn sites can affect real relationships.
- Cyber-relationship addiction. Excessive use of social networking sites to create relationships rather than spending time with family or friends may destroy real-life relationships.

It is, however, easy to recognize the level of Internet addiction in Cambodia—whether caused by parents replacing their parental role by handing their children a smartphone—often while they themselves are Internet addicted. It's not uncommon for parents to worry that their teenagers are spending too much time online. In 2019, the World Health Organization added Video Game Addiction to its official list of Mental Disorders. Although there isn't much systematic research available in Cambodia, some general information is accessible: "World health officials take a hard line on screen time for kids." "How much should parents resort to videos and online games to entertain, educate, or simply distract their young children?" According to the World Health Organization, it is never good for children in their first year of life and rarely in their second to spend excessive time in front of screens. Children aged two to four should spend no more than an hour a day in front of a screen," related to "one of the most anxiety-producing issues of 21st-century family life"—as the acquisition of language and social skills normally developed through interactions with parents and others who are crucial for cognitive development is at risk. What kind of future will society face? Although there are no research data available for Cambodia, the reality can be easily observed.

Final considerations

Reflecting on Cambodia's Internet from its early days in 2020 to now, the outcomes remain somewhat unclear or even conflicting. Infrastructure development has been remarkable for a less wealthy developing country. However, the rapid rise in Internet use, especially on social media platforms like Facebook and Twitter, has generated greater interest in using these new tools to express opinions, share ideas, and engage in discussions. It is understandable that authorities are concerned about the potential misuse of these constitutionally protected freedoms. The clearer and more transparent the legal boundaries are—rather than vague concerns labeled as "incitement" and "social disorder"—the more hope there is that current tensions will not hinder the ongoing development of Cambodian Internet society, moving toward the future outlined in the Preamble of the Constitution of the Kingdom of Cambodia.

"To restore Cambodia into an "Island of Peace" based on a multi-party liberal democratic regime guaranteeing human rights and the respect of law, and responsible for the destiny of the nation always evolving toward progress, development, prosperity, and glory."

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4.3 Snapshot of the Internet in China around 2020

Zhong, Rui

As of March 2020, Internet penetration in China was 64.5%. The number of Internet users in China reached 904 million, with mobile Internet users totaling 897 million. Rural Internet users comprised 28.2% of the country's total Internet population. By March 2020, China had a total of 5.094 billion domain names. As of December 2019, there were 4.97 million websites in China, of which 3.41 million used the domain name ".CN". Meanwhile, 85.4% of all broadband users (449

million) had speeds of 100 Mbps or higher, and Fiber-To-The-Home (FTTH) or Fiber-To-The-Office (FTTO) subscribers reached 417 million.

As the Internet enters an era of high traffic and widespread connectivity, business needs and technological innovations are driving the transformation of network architecture. Cloud computing services and networks work closely together. Developing cloud services depends on strong network capabilities, while optimizing network resources benefits from cloud computing concepts. China's cloud computing market reached 96.28 billion yuan in 2018 [State 2018]. In the public cloud industry segment, the Infrastructure-as-a-Service (IaaS) market size reached 27 billion yuan, the Platform-as-a-Service (PaaS) market was 2.2 billion yuan, the hardware market totaled 37.1 billion yuan, and the software market was 8.3 billion yuan in 2018.

The market size of China's big data industry was estimated at approximately 540.5 billion yuan in 2018 [ISC 2019]. To encourage practical exploration and improve regional big data initiatives, China established 8 comprehensive demonstration areas and 5 industrialization demonstration bases. These included China's first big data comprehensive pilot zone in Guizhou, two cross-regional pilots in Beijing-Tianjin-Hebei and the Pearl River Delta, four regional pilot zones in Shanghai, Henan, Chongqing, and Shenyang, and a pilot zone for big data infrastructure development in Inner Mongolia. The five bases are located in Chengde County (Hebei), Horinger New Area (Inner Mongolia), Jing'an District (Shanghai), Chongzhou Economic Development Zone (Sichuan), and Guian New Area (Guizhou). These regions and bases focus on research in big data system innovation, public data sharing, big data application and industry growth, data factor flow, data center integration and utilization, and international collaboration. Regarding enterprise services, big data mainly supports risk management, followed by operational optimization and management. Industry applications primarily target the Internet, government, finance, and transportation sectors, with significant activity in social governance and telecommunications.

In 2018, China's artificial intelligence (AI) market was about 33.9 billion yuan. By February 2019, there were 745 AI companies in China, mainly engaged in technology integration and solution services (15.7%) and key technology R&D and application platforms (10.5%), ranking among the top two in 18 application fields [Chinese 2019]. AI has integrated into every aspect of life in China and has further advanced areas like smart security, smart manufacturing, smart education, smart finance, and smart travel. It has also become a major driving force for the country's real economy. However, China's AI development remains in its early stages, with many key indicators—such as basic research, human resources, and microchip technologies—still lagging behind those of developed nations.

In 2018, the total industrial scale of the Internet of Things (IoT) in China reached 1.2 trillion yuan [China 2018]. From a sector perspective, IoT has been gradually and widely implemented in areas such as transportation, logistics, environmental protection, healthcare, security solutions, and electric power. The "IoT + Industry Application" market has begun to divide into four main segments: smart cities, industrial IoT, Internet of Vehicles, and connected homes. The ongoing development of new IoT technologies—such as chips, smart identification, sensors, blockchain,

and edge computing—has sped up the growth of IoT products, making them smarter, more convenient, energy-efficient, and smaller in size.

In 2018, China experienced rapid growth in investment and financing activities, with a total of 2,685 disclosed deals totaling $69.7 billion. These transactions mainly focused on Internet finance ($26.3 billion), e-commerce ($11.8 billion), tourism ($5.63 billion), and local life services ($4.58 billion). Additionally, there were 167 listed Internet companies in 2018, with a combined market value of approximately 8 trillion yuan.

In 2018, the cybersecurity product industry in China experienced significant growth, reaching a scale of 51.092 billion yuan [China 2019]. That year, China identified a total of 124.34 million cybersecurity threats, including 27.87 million malicious network resources (such as malicious IP addresses and domain names), 89.97 million malicious programs like Trojans, bots, and viruses, 210,000 hidden security risks such as network vulnerabilities, and 5.36 million security incidents like host control breaches, data leaks, and webpage tampering. To address these threats and challenges, the Chinese government, related organizations, and the private sector collaborated to develop cybersecurity threat sharing platforms and emergency response mechanisms. For example, to prevent and fight online fraud, government agencies, telecom operators, banks, and Internet companies worked together to establish effective mechanisms, cracking down on 131,000 telecom and online fraud cases and recovering direct economic losses of 2.03 billion yuan.

China's e-commerce transactions in 2018 totaled 31.63 trillion yuan, with online retail sales reaching 9.01 trillion yuan. Of these, Business-to-Consumer (B2C) sales accounted for 62.8%. The top three online retail categories were clothing and knitwear, household appliances, and audio-visual equipment. The total import-export volume of cross-border e-commerce reached 134.7 billion yuan [Ministry 2019]. Besides physical goods, e-commerce platforms expanded into service goods. More platforms began offering supplementary services for physical products, like car maintenance, and also provided service-related offerings such as tourism and pet services. In 2019, Alibaba's T-mall recorded a gross merchandise volume of 268.4 billion yuan during Singles' Day, a 24-hour online shopping event. During this event, 15 brands, including Apple, Midea, Haier, and Huawei, each achieved sales over 1 billion yuan. Meanwhile, China's online payment transaction volume reached 2126.30 trillion yuan in 2018, and the mobile payment market size hit 170.75 trillion yuan. The use of mobile payments expanded into public transportation, healthcare, and other sectors, while also accelerating offline applications of the internet in commerce.

Three major Chinese telecom operators started offering 5G services in 2018, marking the final stage of 5G commercialization in China. China Telecom allocated 100 MHz of 5G spectrum between 3400 MHz and 3500 MHz. China Mobile provided 5G spectrum in the ranges of 2515 MHz to 2675 MHz and 4800 MHz to 4900 MHz. China Unicom offered a 100 MHz bandwidth of 5G spectrum from 3500 MHz to 3600 MHz. As 5G gained significant attention upon its launch, various application scenarios emerged. Notably, entertainment, home, transportation, and medical uses garnered high public interest and expectations. For example, the high reliability and low latency of 5G can enable real-time communication between vehicles, infrastructure, and

people, advancing vehicle-road cooperative autonomous driving. The main reason most users are eager for its adoption is the pursuit of ultimate entertainment and improved life experiences.

As of June 2019, over 758.77 million users accessed online videos, and 433.22 million users engaged in live streaming [CNNIC 2019]. The leading live streaming platforms (Douyin, YY, Kuaishou, etc.) explored the “live streaming plus” model and built the content ecosystem. E-commerce and short video platforms also used live streaming to boost their business growth. The e-commerce platform lowered barriers to attract hosts and fans, creating emotional connections between the platform and consumers, which sped up market growth.

As of February 2019, 973 million people in China used social networks. The installation penetration rate of Tencent's WeChat reached 85.8%, with its Monthly Active Users (MAU) reaching nearly 1 billion. QQ, another of Tencent's messaging services, had a MAU of 600 million. Sina's Weibo had an installation penetration rate of 32.6%, with a MAU of 300 million. While WeChat and QQ mainly focus on connecting with friends, Momo is designed for connecting with strangers based on interests and location. Momo's installation penetration rate is 5.33%, with a MAU of 50 million. In terms of online community/BBS services, Baidu's Post-Bar was the top platform, with a MAU of 40.47 million [Aurora 2019]. Social e-commerce is a rapidly growing sector in China. Asking for advice from friends, family, or other trusted sources before making important purchase decisions isn't new. In the digital age, social e-commerce is often described as turning strangers into friends, friends into customers, and customers into salespeople. Social e-commerce apps like PinDuoDuo and Suning Pinguo, which feature social elements such as bargaining or group buying, along with SNS apps like WeChat that enable selling products within friend groups, and internet personality bloggers and live streamers on platforms like Weibo, Douyin, and Kuaishou who promote products through content or live broadcasts, are common. The social e-commerce market size in 2019 was projected to reach 2060.58 billion yuan in China.

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4.4 Snapshot of the Internet in Japan around 2020

(1) Statistics

Shigeki Goto

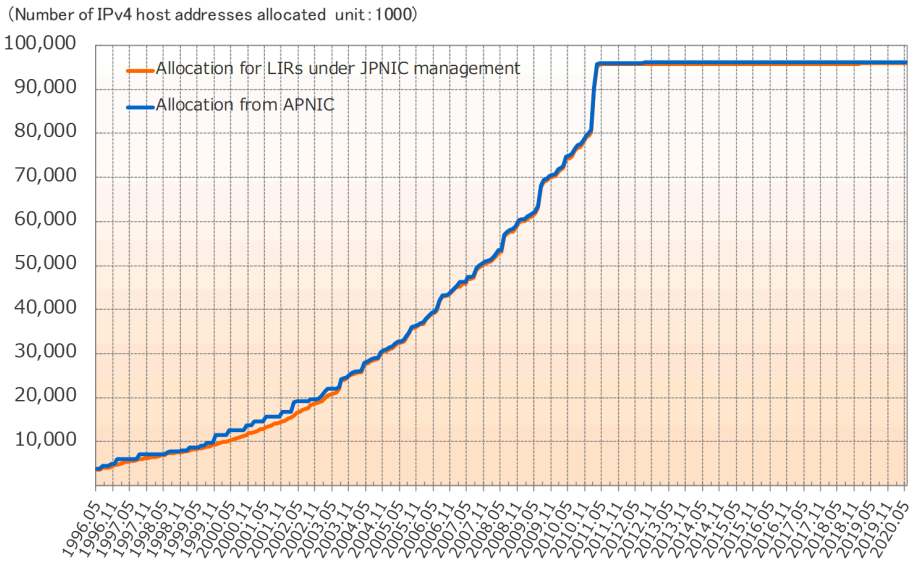
Internet penetration rate in Japan

The Ministry of Internal Affairs and Communications of the Japanese Government publishes a series of annual reports on the information and communication statistics database. According to the latest survey, the Internet penetration rate was 89.8% in 2019 [MIC 2019]. The English version of the report presents data through 2018 [MIC 2018].

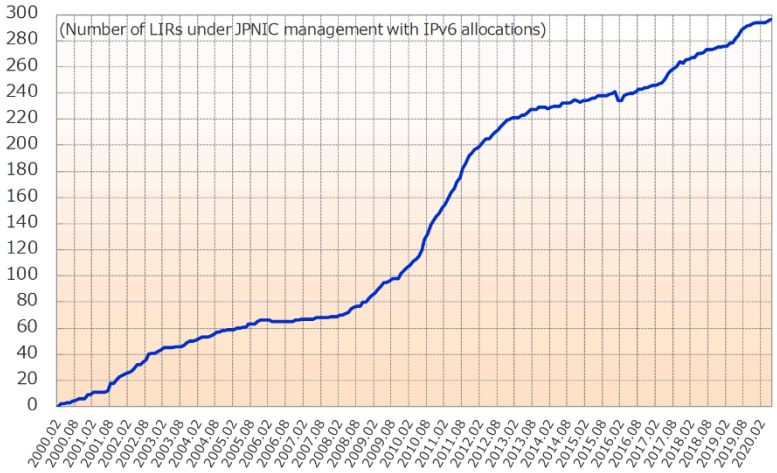
Year	Penetration rate
2015	83.0%
2016	83.5%
2017	80.9%
2018	79.8%
2019	89.8%

IPv4 and IPv6 addresses in Japan

The Japan Network Information Center (JPNIC) plots a graph of IPv4 allocations. The vertical axis indicates the number of hosts in thousands. After the IPv4 address pool was exhausted in April 2011, the curve becomes nearly flat, indicating that there were no significant allocations following the exhaustion [JPNIC 2020].



JPNIC also provides a graph of IPv6 addresses. The vertical axis displays the number of Local Internet Registries (LIRs) under JPNIC, which continues to grow [JPNIC 2020].



Domain names in Japan

Japan Registry Services Co., Ltd. (JPRS) regularly releases a report on the number of JP domain name registrations [JPRS 2020]. There are three categories of JP domain names: general-use, prefecture, and organizational or geographic types. Each category is thoroughly explained in the document "Guide to JP Domain Names" [JPRS 2020b].

The number of JP domain name registrations (2020/06/01 Total: 1,589,085)				
General-Use JP Domain Name (Total: 1,074,269)				
	ASCII	981,728		ASCII (Alpha-Numeric)
	Japanese	92,541		Japanese (Japanese Domain Names)
Prefecture Type JP Domain Name (Total: 11,298)				
	ASCII	9,575		ASCII (Alpha-Numeric)
	Japanese	1,723		Japanese (Japanese Domain Names)
Organizational Type and Geographic Type JP Domain Name (Total: 503,518)				
	AD	254		Members of JPNIC
	AC	3,684		Universities, Technical schools, Incorporated schools
	CO	433,117		Incorporated companies, Limited companies
	GO	581		Government organizations, Government-affiliated organizations
	OR	37,619		Foundation and Aggregate corporation
	NE	12,927		Network services
	GR	5,778		Arbitrary organization
	ED	5,505		Schools including primary, junior and senior high schools
	LG	1,891		Local Government
	GEO	2,162		Geographic Type

Domain survey

The latest domain survey is from January 2019 because the Internet Systems Consortium (ISC) believed their survey was misleading since it was based solely on IPv4 [ISC 2019]. The survey indicates that Japanese (JP) domains have numerous connected hosts. The table displays the top five domain names, each with many connected hosts.

Domain	#hosts	remarks
net	367,709,849	Networks
com	171,764,916	Commercial
jp	74,749,861	Japan
de	44,753,593	Germany
br	36,307,426	Brazil
--	--	other domains
TOTAL	1,012,695,272	connected hosts

(2) Topics in Domain Names

Takaharu Ui and Atsushi Endo

2011 -- Implemented DNSSEC to .jp

Domain Name System Security Extensions (DNSSEC) is a security feature for DNS that uses digital signatures with public key cryptography to enable Internet users to verify responses through their digital signatures. By detecting fraudulent DNS responses, DNSSEC effectively prevents security threats caused by false DNS replies.

Since DNS has a hierarchical structure that extends from the root, it is essential to implement DNSSEC at every level of DNS, from the top-level root DNS to the DNS server for each domain name. DNSSEC involves specific steps, such as signing DNS information and registering the signing key details on the DNS server for each domain.

In July 2010, the Internet Corporation for Assigned Names and Numbers (ICANN) introduced DNSSEC in Root DNS Servers, the top level of the DNS hierarchy. This helps promote the deployment of DNSSEC among TLDs. Based on these conditions, JPRS decided to implement DNSSEC in JP domain name services through the following steps.

July 9, 2010	Published a plan to implement DNSSEC into the JP domain name service. https://jprs.co.jp/en/topics/2010/100728.html
October 4, 2010	Conducted .jp DNSSEC Key Ceremony. Created a pair of keys to sign the JP zone.
October 18, 2010	Started signing JP zone with DNSSEC
December 10,2010	Registered the key information (DS resource record) of the JP zone in the root zone
January 14, 2011	Published DNSSEC Practice Statement for the JP Zone (JP DPS). https://jprs.co.jp/en/topics/2011/110114.html
January 16, 2011	Completed implementation of DNSSEC in the JP domain name service. https://jprs.co.jp/en/press/2011/110117.html

2012 - A large number of applications from Japan for the ICANN's new gTLD program

ICANN opened the application window for the new generic Top-Level Domain (gTLD) in 2012, and a total of 1,930 applications were submitted [New 2020]. There were 71 applications from Japan. Among the statistics by countries and territories, the number of applications from Japan ranked No. 5 (the United States ranked No. 1 with 884 applications), and Japan was ranked No. 1 in the Asia Pacific region (Hong Kong SAR ranked No. 2 with 42 applications). Roughly classifying those 71 applications, 54 were from prominent Japanese companies with their

company or service names (called “Brand TLDs”), 9 were geographic names within Japan, and 8 were generic strings or names.

After evaluating the applications, qualified TLDs started operating after 2014. This enabled new domain name registration services and the use of company or service names as TLDs (“Brand TLDs”). By 2020, .shop and .tokyo had more than 100,000 registrations from Japan [Shop 2020; Tokyo 2020]. Additionally, companies that effectively utilize “Brand TLDs" have emerged; for example, Canon Inc. adopted “.canon” for the email addresses of all employees worldwide [Canon 2018]. This has introduced diversity in domain name usage through the new gTLD program.

2016 - DNS operation went under the jurisdiction of Telecommunication Business Law

In Japan, telecommunications, including the Internet, are governed by the Telecommunications Business Law. This law guarantees the smooth delivery of telecommunications services and safeguards users' interests. By providing telecommunications services properly and fairly, user convenience and public welfare can be improved. Originally, the law mainly focused on telephone services; however, as the importance of the Internet grows, its scope extends to include Internet-related services.

Through the following process, DNS operation fell under the jurisdiction of the Law.

October 1, 2013	The Ministry of Internal Affairs and Communications submitted “Modalities of Information and Communication Policies Regarding Domain Names” to the Information and Communications Council
December 18, 2014	The Information and Communications Council submitted the report to the Ministry of Internal Affairs and Communications
April 3, 2015	The Ministry of Internal Affairs and Communications of submitted “Law for Partial Amendment to Telecommunications Business Law” to the Diet
May 15, 2015	“Law for Partial Amendment to Telecommunications Business Law” was established
May 22, 2015	“Law for Partial Amendment to Telecommunications Business Law” was issued
May 21, 2016	“Law for Partial Amendment to Telecommunications Business Law” came into effect

During the discussion at the Information and Communications Council, the operation of DNS servers is acknowledged as a crucial part of the Internet infrastructure, which was built through private-sector-led global cooperation and emphasizes that new regulations should not damage this aspect.

As a result, the amendment of the Telecommunication Law applied only to the Domain Name Resolution Services, which needed to be provided robustly and stably. The operation of DNS

was defined as a Telecommunications Business with Notification, and minimum requirements were established to ensure the reliability and transparency of its services as follows.

a. Domain name telecommunication services（more than 300K users）	
Obligations	notification of Telecommunications Business; documentation of administrative rules for the telecommunications facilities; notification, appointment of a general manager of telecommunication facilities; reporting of significant accidents with respect to telecommunications operations without delay

b. Specified domain name telecommunications services 1. ccTLD: .jp 2. geographic TLD: .nagoya, .tokyo, .okinawa, .yokohama, .osaka, .kyoto	
Obligations	In addition to the obligation for “a.”, continuous provision of its services without refusal and annual publication of the status of income and expenditure for its telecommunications services

2017 - The number of general-use JP domain names exceeded 1 million

The General-use JP Domain Name is the domain space that allows registration of second-level domains like "EXAMPLE.JP." Any individuals, groups, or organizations with postal addresses in Japan can apply for a second-level domain. Multiple domain names can be registered in both ASCII and Japanese. JPRS started offering registration services for the General-use JP Domain Name in February 2001. The service has been popular among internet users due to easy registration and use, resulting in over 1 million domain names registered after 16 years and 7 months.

The general-use JP domain name has five distinct features compared to the traditional organizational JP domain name, which usually limits each organization to registering only one domain.

- Registration of any string for second-level domains is permitted, such as “EXAMPLE.JP”
- Any number of domain names can be registered
- Any person or organization having a residential address in Japan can register any number of domain names
- The registration procedure is simple
- Domain names can be registered in both ASCII and Japanese Characters including *Hiragana*, *Katakana*, and *Kanji*

The name “General-use JP Domain Name” implies that using the service with these five features across different scenarios without restrictions encourages the growth of the Internet.

In the early stages of considering introducing a general-use JP domain name, some involved parties feared that Internet users in Japan would exclusively choose General-use JP over Organizational Type JP, such as “CO.JP” or "GO.JP," because of the convenient features of General-use JP; however, it has become common for many companies in Japan to operate websites not only for their company names with a "CO.JP" domain name but also for each of their products and services using multiple General-use JP domain names.

2018 – The number of JP domain names surpassed 1.5 million

On February 1, 2018, the total number of JP domain name registrations surpassed 1.5 million. Of 1,500,136 registrations, 1,014,301 (68%) are General-use JP domain names (e.g. EXAMPLE.JP), 473,903 (31%) are Organizational Type JP domain names (e.g. EXAMPLE.CO.JP), and 11,932 (1%) are Prefecture Type JP domain names (e.g. EXAMPLE.TOKYO.JP, EXAMPLE.北海道.JP).

The Organizational Type JP Domain Name, such as "EXAMPLE.CO.JP," was introduced in 1989 and has the longest history among JP Domain Names. It can only be registered by organizations or companies with postal addresses in Japan, and it allows them to indicate the type of organization through the second level (to the left of “.jp”). The CO.JP domain, which is the most registered category among the Organizational Type JP Domain Names, has been registered by 97% of the companies listed on the first section of Japanese stock exchanges, and most people feel that Japanese companies are synonymous with “CO.JP” [JPRS 2018].

The general-use JP domain name, which has the highest number of registrations, was introduced in 2001. Any individual, group, or organization with a postal address in Japan can apply for a second-level domain. A second-level domain can be registered using both ASCII and Japanese characters. General-use JP domain names have become popular among internet users in Japan due to their easy registration and use; therefore, this type of domain surpassed 1 million registrations as of September 2017.

The Prefecture Type JP Domain Name space was launched in 2012. It includes the names of Japan's 47 prefectures, with structures like "EXAMPLE.TOKYO.JP" and "EXAMPLE.NAGASAKI.JP" as examples. This allows website or email addresses to reflect the connection to the local community. Anyone or organization with a residential address in Japan can register multiple domain names. The third-level domain (the "EXAMPLE" part in the examples) can be registered in both ASCII and Japanese. Generally, the services and rules follow those of General-use JP Domain Names, such as "EXAMPLE.JP".

(3) Internet Timeline and History of Internet Resources Management in Japan

Shigeki Goto

JPNIC created an “Internet Timeline” in September 2013. The English version can be found at this URL: https://www.nic.ad.jp/timeline/en/. The most recent update was in March 2018. In the same month, JPNIC also published a booklet titled JPNIC's 20-Year History with the Japanese Internet, written in Japanese. Building on this booklet, JPNIC and JPRS collaboratively edited a

more detailed and revised document: History of Internet Resources Management in Japan, available in both Japanese and English. This document includes ten chapters and two appendices and was published online in April 2015 (https://www.nic.ad.jp/timeline/en/20th/). Originally authored in Japanese, the English version of the history document contains extra material to help international readers understand the Japanese context.

(4) Great East Japan Earthquake in 2011 and Anti-Disaster Activities

Dai Sato and Hideaki Sone

The Great East Japan Earthquake

The Great East Japan Earthquake and the massive tsunami on March 11, 2011, caused significant damage, especially in northeastern Japan. Mobile communication services were affected more by the power outage than by line and facility damage. Although 3G connections were becoming popular in Japan, coverage in the tsunami-affected coastal areas was inadequate. The use of smartphones and improved search skills to find essential information greatly enhanced the quality of life for affected people. Newspapers and TV broadcasts were not suitable for obtaining real-time regional information about food and daily necessities, whereas social media and web forums proved more reliable. As a result, data from the Internet and temporary disaster broadcasting stations (mini FM), which were licensed immediately after the earthquake, became the most helpful sources. Effective information transmission for requesting support, such as disaster volunteers, relief supplies, and donations, also played a crucial role in shaping the region's outcome.

Some network engineers and media experts on the Internet actively assisted affected people by providing information about the safety of relatives and residents, transportation status, and locations for obtaining daily necessities. Additionally, requests for help were shared online through social media and specialized websites. Volunteers also set up computers and network systems at support bases, such as "Netvol-Miyagi," "ICT Shien Ouen Tai," and "WIDE Project." Some of these groups organized roles based on their expertise or geographic area, including tasks like equipment collection, configuration, installation, and user support [Sato 2019].

Anti-disaster Activities and the Internet

The Great East Japan Earthquake marked the first opportunity for large-scale information volunteer activities in Japan. The initial response to a major disaster was shaped by experience. Information volunteers began sharing their experiences to prepare for future disasters. A series of nationwide conferences called "IT × Saigai" discussed systems for organizing information volunteer efforts, and one of the new support groups was "IT DART."[1]

[1] "IT DART" is an abbreviation for IT Disaster Assistance and Response Team. https://itdart.org/

Disaster volunteer systems in Japan were also reorganized after the earthquake. Many disaster support groups, including IT DART, established a new cooperation platform called "JVOAD." While the public sector provides consistent and fair support, NPOs and private supporters offer attentive help to those affected who have trouble receiving public assistance. The Japanese Cabinet Office has emphasized promoting such volunteer activities. It has become common for the government, NPOs, and volunteers to collaborate in supporting affected individuals until the 2016 Kumamoto Earthquake [COJ 2019]. In 2019, JVOAD signed a declaration with the Japanese government's Cabinet Office to work together on disaster support efforts. As a result, information volunteers have been integrated into Japan's disaster response system.

The rate of households with smartphones in Japan rose sharply from 9.7% to 79.2% between the end of 2010 and 2018 [MIC 2019b], and online information sharing has become vital for disaster response efforts. Disaster volunteer centers need network environments for recruiting volunteers, public relations, and coordinating with support groups. During disasters, a large volume of information floods in, and the signal-to-noise ratio drops. Information volunteers aim to extract useful pieces from the data, organize them, and re-transmit while considering their lifespan [Sato 2015]. IT DART developed information tools for volunteer groups. One such tool is the disaster information collection system, which shares real-time information about locations, short reports, and photos using messaging services and mapping systems [Kayama 2019]. In disaster medicine, Japan DMAT has significantly improved its web system and logistics team with the help of ICT. Smartphones and satellite data communication are now essential tools for them.

With the current spread of COVID-19, the Tokyo Metropolitan Government has adopted an open-source system made by "Code for Japan,"[2] which was established after the earthquake, for their information website of COVID-19 [STOPCOVID 2020]. This system represents the first large-scale use of open-source software for local government services. The source code of the site has been diverted to other prefectures. Meanwhile, the implementation of remote work and remote classes has become popular.

(5) Blocking Accesses to Pirated Manga (Cartoon) Sites and the Secrecy of Communications

Shigeki Goto

Telecommunication operators in Japan have consistently followed the rule for protecting secrecy, which is clearly stated in Article 4 of the Telecommunication Business Act.

> *Telecommunications Business Act*
>
> (Protection of Secrecy)

[2] "Code for Japan" https://www.code4japan.org/

Article 4 (1) The secrecy of communications handled by a telecommunications carrier must not be violated.

This article complies with the Constitution, which is the highest law of Japan.

The Constitution of Japan

Article 21. Freedom of assembly and association as well as speech, press, and all other forms of expression are guaranteed.

No censorship shall be maintained, nor shall *the secrecy of any means of communication* be violated.

There is only one exception to the protection of secrecy in communications. In April 2011, Internet Service Providers (ISPs) began blocking access to child pornography sites. This action was taken based on a new law concerning child pornography. A new organization, the Internet Content Safety Association, was established in March 2011 to compile a list of addresses of child pornography sites.

Act on Regulation and Punishment of Acts Relating to Child Prostitution and Child Pornography, and the Protection of Children

(The Endeavor of Business Operator Relating to the Use of Internet)

Article 16-3 (abbreviated by the editor of this snapshot)

Business operators providing telecommunication services should make efforts to cooperate with criminal investigation authorities and implement effective measures to prevent the transmission of child pornography-related information. This includes actions based on the supervisory authority of the business operators or other measures that help prevent such activities on the Internet.

Although the blocking of child pornography sites literally violates the protection of communication secrecy, it is interpreted as *an averting present danger* described in the Penal Code in Japan.

Penal Code

(Averting Present Danger)

Article 37 (1) An act unavoidably performed to prevent a present danger to the life, body, liberty, or property of oneself or another person is not punishable only when the harm caused by such an act does not exceed the harm being prevented, provided, however, that an act causing excessive harm may result in reduced punishment or may exonerate the offender given the circumstances.

Mangamura is a website that launched in 2016 and shut down in 2018. It offered a collection of pirated manga (comics), along with some journals, novels, and photography books. In Japanese, 'mura' means village. Since Mangamura was open to the public and free to use, it became a popular site in Japan. According to a survey, the number of monthly users was about 98,920,000, making it the 31st most popular website in Japan [Mangamura 2020]. Japanese publishers and manga artists were frustrated by pirated manga sites like Mangamura. They claimed that they suffered losses due to Mangamura, losing around 3 billion USD [Mangamura 2020].

On April 13, 2018, Japanese Government requested ISPs to block access to three sites: *Manga-mura*, *Anitube*, and *Miomio*. These sites were known as pirated manga sites. On April 23, the president of NTT (at that time) said that they would block accesses to three pirated manga sites in line with the government request. There were some organizations and experts who expressed their concern about site blocking because it is against the secrecy of communications.

On June 22, a committee was formed to discuss the issue of site blocking at the Intellectual Property Strategy Headquarters within the Prime Minister's Cabinet Office of the Japanese Government. This committee came to an extraordinary closing: they had no formal deliverables. Usually, a committee produces a report even if the members have divergent opinions. The committee consisted of 18 members. Nine members supported site blocking to pirated manga sites. Nine members were against site blocking. Below is a summary of the respective positions of supporters and opponents of site blocking to pirated manga sites.

> *Supporters:* It is hard to trace back the pirated manga sites on the Internet because they use anonymizing techniques. They cause major financial losses. Blocking access is a promising approach to depress their pirating activities.
>
> *Opponents:* Blocking assess apparently violates the constitution. We cannot interpret blocking access as averting a present danger. Pirated manga sites are different from child pornography. There are several countermeasures to pirated sites. Blocking access may not be effective. This committee should not make any report. A government agency may enact legislation for blocking based on a part of the report, even if there are divergent opinions within the committee.

On October 15, 2018, the committee concluded that they would not produce any report. After the committee was dissolved, the ex-manager of Mangamura was taken into custody in Manila, Philippines on July 7, 2019. He was deported from the Philippines and arrested in Japan on September 24, 2019.

Although one specific incident of Mangamura was closed, the fundamental issue of blocking has not been resolved yet. Masako Wakae described the discussion in detail at the committee under the Intellectual Property Strategy Headquarters [Wakae 2019]. She also drew a lesson from the pirated manga issue. The Internet community in Japan has not successfully persuaded that blocking access violates the spirit of fee and open Internet. They should explain to the people what are technology, philosophy, and the possible risks of the Internet.

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4.5 Snapshot of the Internet in North Korea around 2020

Chan-Mo Park

1. Recent Changes in North Korea

North Korea is one of the very few countries in the world with very strict restrictions in the use of the Internet by its citizens due to fear of political uprisings once the Internet is open to the public like in Middle East and North Africa. Also, DPRK is very reluctant to disclose national statistics such as population of the Internet users, domestic gross income, government budgets, and so on. Therefore, North Korea was called a Hermit country for many years.

But, since the death of Kim Il Sung in July, 1994, when Kim Jong Il took over, the country has been changing slowly and become slightly more internationalized or globalized. In September 2000 when the author went to Pyongyang for the first time, there was a placard hanging at the gate of Kim Chaek University of Technology (KUT) which said ‘Let us materialize the Science–centered ideology of the Great Leader Kim Jong Il to shine brilliantly!’ In early 2010’s, however, there was a huge board in the foyer of the e-library of Kim Il Sung University (KISU) with Kim Jong Il’s writing that began ‘Put your feet in your country but see the world with your eyes!’. These days this slogan is everywhere throughout North Korea. After Kim Jong Un took over following Kim Jong Il’s death in December, 2011 more changes were seen. For example, since March, 2013, any foreigner can use a mobile phone and access to the global Internet by subscribing a Koryolink phone number. Restrictions on taking photos and videos were relaxed,

especially compared to the early 2000's. Use of mobile phones by local people has also been increasing rapidly, and now close to 6 million units have been sold. Travel to North Korea is still difficult, however one can now check luggage directly to Pyongyang from Gimpo or Incheon airport in South Korea. In the old days you had to recheck in Beijing or Shenyang in China.

Benefits and preferences for scientists and engineers have improved remarkably after Kim Jong Un took over. A few examples are: 1) completion of the Unha Scientists' Street (Spetember, 2013) – around the Defense Research Center, 2) completion of residences for Satellite scientists (October, 2014) – location of headquarter of the State Academy of Sciences, 3) completion of Mirae Scientists Street (November, 2015) – around KUT, 4) completion of Sci-Tech Complex (January, 2016) – Ssuk island in Daedong River and 5) completion of Ryomyong Street (April, 2017) – around KISU.

There have been several efforts to promote globalization in North Korea's scientific and engineering sectors—three recent examples are described here. The first (January 2013) involved inviting Google Chairman Eric Schmidt and his colleagues to advise on North Korea's Internet situation. During a meeting with Korea Computer Center (KCC) scientists, it was noted that the scientists were very interested in Google Wallet for e-commerce, as they needed electronic settlement methods to sell their IT products outside North Korea. Schmidt recommended that North Korean officials open up the Internet to citizens to help boost the economy by enabling communication with advanced countries. Unfortunately, North Korea has not accepted this suggestion so far. The second (April 2016) involved inviting three Nobel Laureates in connection with KISU's 70th anniversary celebrations throughout 2016. Sir Richard Roberts (UK, Biomedicine, 1993), Dr. Finn Kydland (Norway, Economics, 2004), and Dr. Aaron Ciechanover (Israel, Chemistry, 2004) were invited to give special lectures at KISU, KUT, and Pyongyang University of Science and Technology (PUST). At a press conference in Beijing after visiting Pyongyang, Professor Roberts disclosed that while KISU and KUT students were using the Intranet, students at PUST were using the global Internet. The third (August 2018) marked the first time North Korean scientists published a research article in a South Korean (ROK) IT journal—'Improved Hybrid Symbolic Organism Search Task – Scheduling Algorithm for Cloud Computing' by Choe Song Il, Li Il Nam of KISU, and three others (ROK Transactions on Internet and Information Systems Vol. 12, No. 8).

2. Current Status of the Internet in North Korea

It is well known that there are two types of Internet in North Korea, namely domestic Intranet and global Internet. Researches related to the Internet started as early as 1990's such as developing Worluf Broadband Anti-virus program at Computing Center of KISU and researches on firewalls and Intranets by KCC.

Domestic Nationwide Intranet

The first version of the Intranet, called Kwangmyong, a network for science and technology information, started its service in 1997 managed by the Central Information Agency on Science & Technology (CIAST). Later, it was expanded to include other data sources such as e-libraries of KISU, KUT, and Grand People's Study House (GPSH) in the mid-2000s after the DPRK government established the Central Information Communication Bureau (중앙정보통신국), which was fully equipped with the infrastructure necessary for a national network system. Currently, optical fiber communication lines are installed in every province, city, and county, with ADSL communication using modems available at all lower levels. To support distance education, improve healthcare in rural areas, and facilitate smooth commercial activities, the Education Network (교육망), Public Health Network (보건망), and Trade Network (무역망) have been established and are operational on the Intranet. Users include members of central and local government organizations, factories, farms, and individuals.

The assignment of IP addresses and hierarchical structure of domain names on the Intranet is shown in the following picture (Fig. 1) which was hung on the wall of a computer room of KISU library in 2015.

Fig. 1 IP Addresses and Domain Names on Intranet

Recently North Korean Supreme People's Assembly adopted a law on distance education. This may be related to the Corona Virus pandemic since distance education has been increasingly become important worldwide. Details of the law are not available, though.

Distance learning in North Korea traces back to the Kim Il Sung era when the 'factory university' (공장대학) was first introduced to encourage factory workers nationwide to learn science and technology at their workplaces. Kim Jong Il established an Education Network for factory universities. In 2015, Kim Jong Un stated that all organizations should create well-equipped Sci-tech dissemination rooms (과학기술보급실). Since most ordinary North Koreans do not own personal PCs, they attend online classes in Sci-tech dissemination rooms at their workplaces (for example, Pyongyang Thermal Power Plant (평양화력발전연합기업소) in Pyongyang, Fig. 2) or visit an e-library in a nearby city (such as the Public Library of Hamgyong North Province (함경북도 도서관) in Chongjin, Fig. 3)

Fig. 2 Sci-tech Room of Thermal Power Plant in Pyongyang

Fig. 3 Hamgyong North Province Liabrary with computers connected to Intranet

It is noticed in Fig. 2 that was televised in North Korean Central TV in 2020 the workers were sitting widespread with masks on for protection from Corona Virus while Fig. 3 which was taken

in 2015 shows students working with computers in the library connected to the Intranet. Learning materials for online lessons are fed from major universities such as KUT, KISU, etc. Fig. 3 also shows organizations that can be accessed.

KUT, known as the MIT of North Korea, established the country's first Distance Education Center in 2006. This was expanded to the Distance Learning College (원격교육대학) in 2010. According to the university's website (www.kut.edu.kp), the online college offers more than 30 courses including computer science and engineering, control engineering, applied electronics, and mining machinery engineering. Workers across the country can enroll in these online courses and choose to earn a degree or certificate after completing the required years of study. Fig. 4 shows KUT's distance education network.

Fig. 4 KUT distance education network

Following KUT, other top universities such as KISU, Pyongyang University of Mechanical Engineering, and Pyongyang Jang Chol Gu University of Commerce also launched online courses. The KUT has over 24,000 students enrolled in its distance learning programs, according to the KUT website in 2020.

Recent technology development has made online courses available on tablet PCs and smart phones. North Korea developed WiFi network, Mirae (meaning future, Fig. 5) so that North Korea's tablet PC such as Daeyang and smart phone such as Pyongyang 2428 could be

connected to North Korea's nationwide Intranet. However, you need a WiFi sim card installed in your device. Students can use Daeyang tablet PCs to attend lectures and take exams, and download study materials in their tablets. The Mirae network, which is currently only available in Pyongyang, has been introduced to factories in the capital, which can "turn all factories into classrooms" and "enable the students to study anywhere in the factories," according to Naenara portal.

Fig. 5 The Mirae network app on a smart phone

The Mirae network is now available at various compounds in Pyongyang, including KISU. KUT and Sci-Tech complex, and major streets such as Mirae Scientists, Ryomyong, Yonggwang and Haebangsan streets. The network is scheduled to be introduced to the whole city.

North Korea is very much suffering from shortage of electricity and poor electric power lines in country side. Therefore, researches on alternative energy have been actively carried out and many solar energy panels are installed to light street lights, individual apartment and homes and to supply electricity to wireless communication towers (Fig. 6).

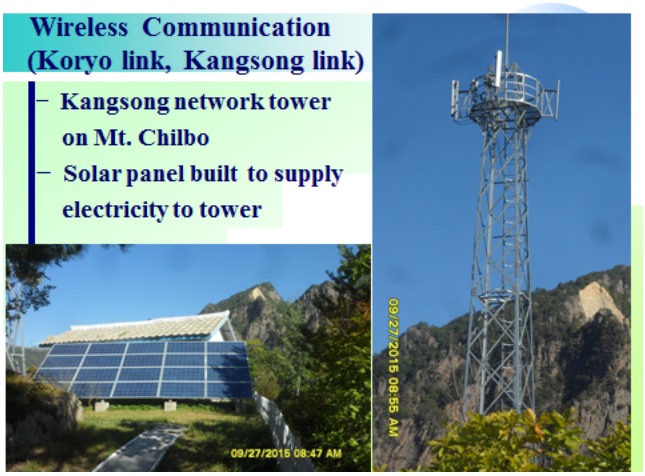

Fig. 6 A Kangsong Network Tower and Solar Panels in Mt. Chilbo

There are close to 200 websites connected to domestic Intranet including Naenara portal, Manmulsang online shopping site (Fig. 7), Korean Central TV, Rodong Newspaper and many universities and research institutes.

Fig. 7 Manmulsang Online Shopping Portal

Global Internet

North Korea's main connection to the global Internet is through a fiber-optic cable connecting Pyongyang with Dandong, China, crossing the China–North Korea border at Sinuiju. Internet access is provided by China Unicom. Before the fiber optics connection, global Internet access was limited to government-approved dial-up over land lines to China. In 2003 a joint venture between a German businessman in Berlin and the North Korean government was established and started the commercial Internet to North Korea called KCC Europe. The connection was established through an Intelsat satellite link from North Korea to servers located in Germany so there was no need to dial Internet Service Providers (ISPs) in China.

In 2007 North Korea successfully applied to ICANN for approval of the .kp, country code top-level domain (ccTLD). KCC Europe administered the domain from Berlin, and also

hosted a large number of websites. In 2009 Star Joint Venture Co., a joint venture, StarJV, between the North Korean government's Post and Telecommunications Corporation and Thailand-based Loxley Pacific was established as an ISP and took control of North Korea's Internet Protocol (IP) address allocation. The satellite link was phased out in favor of the fiber optics connection and is currently only used as a backup line.

In October 2017 a second Internet connection was taken into service. This connects North Korea through a fiber optic cable with Vladivostok, crossing the Russia-North Korea border at Tumangang. Internet access is provided by TransTelekom (TTK), a subsidiary of Russian national railway operator Russian Railways. Since March 2013, foreigners have been able to access the internet using the 3G phone network, Koryolink, a joint venture between North Korea and Orascom Telecom Holding of Egypt. According to a phone directory of foreign members published by Inter Agency Meeting (IAM) in Pyongyang in August, 2017 there were more than 280 foreigners in Pyongyang area who were using mobile phones and global Internet. This number does not include other foreigners who were not registered with IAM, for example more than 100 foreign professors and staff members at PUST.

Foreigners are not allowed to connect to domestic Intranet and mobile phones owned by the foreigners are blocked from calling North Korean people or North Korean organizations in North Korea and vice versa. A foreigner may use the global Internet service with Koryolink by subscribing connection to mobile network by paying 75 Euros for connection fee and 10 Euros per month up to 50 MB. If it exceeds 50 MB you have to pay 0.15 Euros per MB. International phone calls are very expensive, e.g., 5 US dollars per minute to USA and 2 US dollars to China. If your call time to US is 1 minute and 1 second the charge will be 10 US dollars. If you have an access to WiFi you can make free calls to any place in the world via Skype, Kakao talk, WeChat, etc. It was noticed that unprotected WiFi connections were available near foreign Emabssy buildings (e.g., Linksys, TP-Link near British Embassy) sometimes.

Here is a brief information on global Internet in North Korea described in Wikipedia.

- ccTLD: kp (the date of ccTLD delegation: 2007-09-24)
- Internet Population – 14,000 (2016)
- Broadband Population xxx (2010)
- IP Address Allocation (Year) :
  - Number of IPv4 addresses: 1,024 (2012)
  - Number of IPv6/48s: xxx
  - As of 2014 North Korea had one known block of 1,024 IPv4 addresses: 175.45.176.0 -175.45.179.225
- Border Gateway Protocol (BGP) to North Korea
  - StarJV AS131279 from China
  - TTK AS20458 from Russia

Although North Korean government tries very hard to limit access to free-world information for normal citizens it may be very difficult to stop completely since in many cities near the North Korea – China border a foreign smart phone with roaming could receive electronic messages from servers located in China. Fig. 8 shows text messages from South Korea received by a Samsung smart phone in North Korea near Mt. Paekdu as well as at a hotel in Samjiyon city that is located about 20 miles away from Mt. Paekdu.

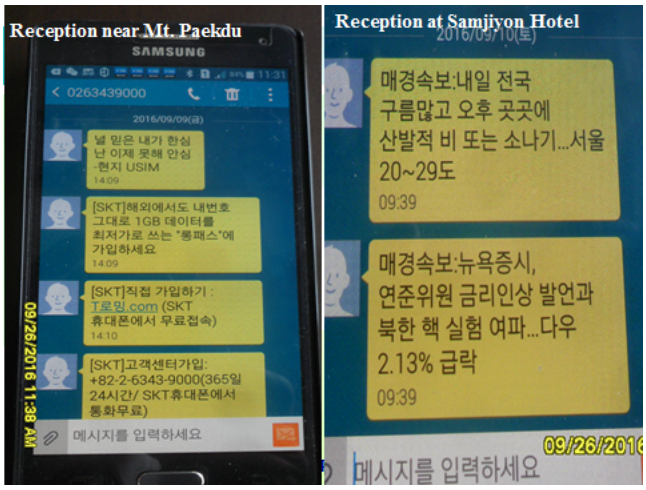

Fig. 8 Messages from South Korea received in North Korea

Recently Kim Jong Un emphasized the use of Virtual Reality in education for young people and to develop application programs for using VR such as automobile driving learning system. North Korea imported many sets of HTC VIVE hardware systems for which application software are developed in North Korea. With an era of Fourth Industrial Revolution approaching North Korea is trying to innovate their education system to cope with new paradigm (Fig. 9).

Fig. 9 Emphasizing use of VR in North Korea

3. Use of Global Internet at PUST

Brief Introduction to PUST

As mentioned earlier students at PUST are allowed to use global Internet inside the campus. It is an exceptional case in North Korea and it is worthwhile to understand background on PUST before actual usages of the Internet at PUST are described. PUST was established by South and North Korea to foster well trained scientists and engineers with good character and global mind-set who can contribute to boosting North Korea's economy and globalizing the nation.

It is a unique private and international university in North Korea in which all the courses are taught in English by foreign professors. About half the faculty members were US citizens until September 1, 2017 when the US State Department banned travel of US citizens to North Korea. PUST opened in September, 2009 and the first crop of students, 100 undergraduates and 50 graduates (all male) entered in October, 2010. Female students have been admitted since 2015 and now represent approximately 15% of the student body. Currently there are about 600 undergraduate and 100 graduate students. Until September, 2017 there were about 125 foreign faculty and staff members -- all volunteers coming from more than 15 countries including USA, UK, Canada, China, Australia, Albania, Netherlands, Germany, and others. They teach either technical English, Chinese, or subject courses in the various University colleges -- College of Agriculture and Life Sciences (ALS), College of International Finance and Management (IFM), College of Electrical and Computer Engineering (ECE), College of Dentistry (COD) and College of Medicine (COM). The colleges of Public Health, Nursing and Pharmacology will open in near future. There is a church connection; most faulty are Christians who self-identify as having high spirits and love toward world peace. Their perspectives can be summarized as follows: 1) efforts to foster talented young people in agriculture, business, science & technology, and medical areas for economic development of North Korea (teach how to catch fish rather than give fish), 2) teaching soft skills such as ethics, virtues, trust, appreciation, and patience in addition to hard skills, 3) exemplifying in showing love, sacrifice and service by working as volunteers without salary, 4) trying to bridge a gap between North Korea and the West by sending many students to universities in foreign countries as well as inviting many distinguished scholars such as Nobel laureates to PUST by holding international conferences every other year, and 5) guiding PUST graduates to contribute to the globalization of North Korea. Faculty are well aware of UN sanctions and never teach courses related to weapons (e;g;, nuclear and missile development). Cyberattack technologies are not included in PUST curriculum. Most of the male students at PUST are waived from serving military duty of 10 years so that they could pursue their studies to become top-notch scientists and engineers, businessmen and medical doctors.

Approximately 100 students per year graduate with Bachelor degree. Of these, about 35% advance to a graduate program at PUST; others go to work in research institutes, companies, or enter other North Korean graduate schools. Those who graduate with Master degree either pursue PhD at PUST or at a foreign university such as Uppsala, Sweden, or Oxford, UK; others find jobs as instructor or researcher at another university. Some graduates go to industry, banks,

or research institutes such as Pyongyang Informatics Center (PIC). Courses taught at PUST (both undergraduate and graduate) may be found at the PUST website, http://pust.com.kp.

Globalization Efforts

The vision of PUST is to globalize their students so that they can contribute to globalization of their country. To achieve this goal PUST initiated an International Conference on Science and Technology (ICoPUST) in October, 2011 and had been holding this on alternate years until US government banned travel of US citizens to North Korea in September, 2017. That resulted in the cancellation of the 4th ICoPUST originally scheduled for October, 2017 but rescheduled to hold in October, 2019 in conjunction with the 10th Anniversary celebration of the founding of PUST.

Another effort is to send many students abroad to study at foreign universities. These include Westminster, Cambridge, Surrey, and Oxford universities in UK, Uppsala University in Sweden, Zurich University of Applied Sciences in Switzerland, Sao Paulo University in Brazil and various universities in China. Thus far about 30 students received MS or MBA degrees and several students are currently working for their Master or Ph.D. degrees abroad.

For those who cannot pursue advanced study abroad PUST started a program to take 30 to 40 students to China for two weeks each summer for a study tour of academic institutions such as Dalian Polytechnic University and China Agricultural University in Beijing, as well as companies such as IBM, HP, SAP, GE, Dell, Liferay, etc.

Use of the Internet by PUST students and faculty

Foreign faculty and staff members started to use the Internet in Spring semester (March ~ June), 2011 but students began to use the Internet in Fall semester (September ~ December), 2011. PUST is the only university in North Korea where students can have access to the global Internet so that they can access websites such as Google, YouTube, Wikipedia, electronic libraries of foreign universities and Wall Street Journal, etc. for their research and course works. Since there is only one IP address allocated to all users of PUST due to a high price of about 900 US dollars per month per an IP address and there are approximately 700 students as well as 150 foreign faculty and staff members only graduate students are allowed to use the Internet freely at the computer room where 30 desktop computers are connected to the Internet via PUST LAN. There are two helpers in the computer room to assist users with their problems and probably monitoring purposes. Undergraduate students may use the Internet for their research works related to their graduation theses (approximately 3 months before graduation) but there are classrooms connected to the Internet where a lecturer can connect his/her laptop to demonstrate working with the Internet during a classroom lecture. Also, there are two remote conference rooms for Skype and distance education. PUST students are not allowed to use WiFi inside the campus.

However, Foreign faculty and staff members of PUST are allowed to use the Internet through a desktop or laptop computer connected to PUST LAN or via WiFi at their offices as well as apartments. Several routers are installed on the wall of each floor of the faculty apartment.

Private routers are also installed in the apartments with permissions from the Foreign Affairs Department of PUST.

Like South Korean government blocked websites of most of the North Korean organizations the websites of many of the South Korean organizations are blocked by North Korean government. Also, the websites of the US government and companies, especially high-tech related and financial organizations are blocked in the USA. If you try to access those websites, they reject your entry with a message saying that 'You are in a sanctioned area.' Fortunately, use of VPN (Virtual Private Network) in North Korea is not illegal so some of the blocked websites can be accessed.

Domestic faculty and staff members at PUST may use the Internet with a permission of North Korean Vice President for Academic Affairs at the computer room.

Students at other universities are still using an Intranet. However, it is known that KISU is technically ready for its students to use the Internet in 2015 according to Director of Foreign Affairs of KISU although implementation has not occurred yet.

The following tables show the activity records on Google gmail account at PUST in Spring semester, 2015.

Table 1. Activity Record (2015-3-20 8:40 a.m.)

Activity on this account

This feature provides information about the last activity on this mail account and any concurrent activity. Learn more

This account does not seem to be open in any other location. However, there may be sessions that have not been signed out.

Recent activity:

Access Type [?] (Browser, mobile, POP3, etc.)	**Location (IP address) [?]**	**Date/Time** (Displayed in your time zone)

Browser (Chrome) Hide details *"Mozilla/5.0 (Windows NT 5.1) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/39.0.2171.65 Safari/537.36,gzip(gfe),gzip(gfe)"*	* North Korea (175.45.177.143)	7:38 am (0 minutes ago)
Browser (Chrome) Show details	North Korea (175.45.177.143)	5:52 am (1.5 hours ago)
Browser (Chrome) Show details	North Korea (175.45.177.143)	10:25 pm (9 hours ago)
IMAP () Show details	North Korea (175.45.177.143)	9:19 pm (10 hours ago)
Browser (Chrome) Show details	North Korea (175.45.177.143)	Mar 19 (13 hours ago)
Browser (Chrome) Show details	* North Korea (175.45.177.143)	Mar 19 (14 hours ago)
Browser (Chrome) Show details	* North Korea (175.45.177.143)	Mar 19 (19 hours ago)
Browser (Chrome) Show details	* North Korea (175.45.177.143)	Mar 19 (20 hours ago)
Browser (Chrome) Show details	* North Korea (175.45.177.143)	Mar 19 (21 hours ago)
Browser (Chrome) Show details	* North Korea (175.45.177.143)	Mar 19 (23 hours ago)

Alert preference: Show an alert for unusual activity. change

* indicates activity from the current session.

This computer is using IP address 175.45.177.143. (North Korea)

Table 2. Activity Records (2015-5-1 3:30 p.m.)

Activity on this account

This feature provides information about the last activity on this mail account and any concurrent activity. Learn more

This account does not seem to be open in any other location. However, there may be sessions that have not been signed out.

Recent activity:

Access Type [?] (Browser, mobile, POP3, etc.)	**Location (IP address) [?]**	**Date/Time** (Displayed in your time zone)
Browser (Chrome) Hide details *"Mozilla/5.0 (Windows NT 6.1) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/42.0.2311.135 Safari/537.36,gzip(gfe),gzip(gfe)"*	* North Korea (175.45.177.159)	3:22 pm (0 minutes ago)
Browser (Chrome) Show details	North Korea (175.45.177.159)	5:39 am (9 hours ago)
Browser (Chrome) Hide details *"Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36*	United States (175.45.177.149)	May 13 (1 day ago)

(KHTML, like Gecko) Chrome/42.0.2311.135 Safari/537.36,gzip(gfe),gzip(gfe)"		
Browser (Chrome) Show details	* United States (175.45.177.149)	May 13 (1 day ago)
Browser (Chrome) Show details	United States (175.45.177.149)	May 13 (1 day ago)
Browser (Chrome) Show details	United States (175.45.177.149)	May 12 (2 days ago)
Browser (Chrome) Show details	United States (175.45.177.149)	May 12 (2 days ago)
Browser (Chrome) Show details	* United States (175.45.177.149)	May 12 (2 days ago)
Browser (Chrome) Show details	United States (175.45.177.149)	May 12 (2 days ago)
Browser (Chrome) Show details	United States (175.45.177.149)	May 12 (2 days ago)

Alert preference: Show an alert for unusual activity. change

* indicates activity from the current session.

This computer is using IP address 175.45.177.159 (North Korea)

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4.6 Snapshot of the Internet in South Korea around 2020

DaeYoung Kim

Taxi and Ridesharing

Services like Uber X are illegal in South Korea. This is not just because of opposition from existing businesses but also due to certain unique aspects of the local taxi industry. Hailing a cab on city streets is quite straightforward, and fares are among the lowest worldwide; therefore, there is little room for new competitors. Additionally, the public transportation system, which includes subways and buses, is very convenient and affordable, providing users with a comfortable alternative. The only Uber service allowed in South Korea is Uber Black, a luxury vehicle option.

A service that appears similar but is actually different is Kakao T Taxi, officially called Kakao T Taxi. It is part of Kakao's transportation services, operated by the major Internet company

Kakao under the group brand Kakao T. This group includes services for luxury vehicles (Black), bikes, parking, carpooling, shuttles, navigation, and proxy driving—where a customer can hire a professional designated driver when they are intoxicated and cannot drive. Kakao T Taxi is legal because it does not hire new drivers without taxi-driving licenses but instead provides call services to existing licensed taxi drivers; thus, business conflicts are avoided. As a result, Kakao T Taxi is currently running a very successful business.

A recent controversial issue involved banning TADA, a short-term rental car service spun off from SOCAR. SOCAR is a legal rental company that operates eleven-passenger minivans as six-passenger rental cars. The main difference between TADA and SOCAR is the service terms: TADA offers hourly rentals, while SOCAR provides daily rentals. This makes TADA similar to a regular taxi service. When TADA launched in 2018, there was significant opposition from the taxi industry, which claimed that TADA was basically a disguised taxi operation without proper licensing. Although a related lawsuit cleared TADA of these allegations, the South Korean Parliament recently passed a law banning TADA's business model. Public opinion remains divided. Some see TADA as a futuristic service that offers better working conditions for drivers, while others argue that such a business model is taking jobs away from already struggling taxi drivers.

Network Neutrality

The common dispute over net neutrality involves content providers' alleged free riding on network providers' infrastructure. A somewhat more convincing argument that domestic content providers have recently raised is that they face unfair and unbalanced taxes compared to locally registered branches of global competitors. Local branches of global companies like Facebook and Google, among others, are nearly exempt from many types of domestic business restrictions and local taxes. However, proving this claim is difficult because these companies' business reports to tax authorities are said to lack transparency. The complaints and allegations made by domestic companies have not yet been fully addressed in market practice, but it remains a contentious issue that warrants close attention for future developments.

Another aspect of neutrality has recently become a point of contention. Specifically, the rapid expansion of major portal companies like Naver and Kakao into online shopping, banking, insurance, and even transportation has raised concerns in society. They have now taken on a big brother role, and complaints about unfair business practices are frequently reported. They are also suspected of distorting public opinion by strategically posting news articles that favor a particular political group. They may face increasing antitrust legal challenges, just as the big brothers of the previous generation did.

Bye to Windows 7 and Active X

As support for Windows 7 and Internet Explorer (IE) ended on January 14, 2020, South Korea is finally forced to abandon Active X. Against the image of the IT-strong country, South Korea has made perhaps one of the worst 'soaked and locked in Active X' cases across practically all public Internet services for the last 20 years.

The story began when the government launched the E-Government project around 2003. Although there were serious considerations for open-source alternatives, the final platform choice was Microsoft Windows with IE, which offers extended features through plugins implemented with proprietary Active X. As E-Government set a leading example, all public services, especially banking services, followed the same approach; however, the result was that the entire nation became effectively monopolized by MS Windows/IE/Active X. No other operating systems, browsers, or plugin methods could work with public Internet services. A specific policy introduced was the enforcement of a Korean-made authentication method called ‘Authorized Authentication,’ which accelerated the widespread adoption of Active X into every aspect of South Korea’s daily online activities.

As the world rapidly moved toward platform-independent HTML5, South Korea couldn't take any steps forward because the entire country was deeply entrenched in Windows/IE/Active X, with established business interests blocking any attempts to escape the trap. An alternative at the time was downloading .exe files, but this was merely another form of evasion; downloading itself is a poor practice, and those files still contained Active X elements, keeping the trap firmly in place. Some sites offered services that were OS- and browser-independent, only to then switch to NPAPI (the outdated Netscape plugin technology), which is an even older and increasingly problematic plugin method.

After nearly a decade of struggle to escape, relief was achieved with the final suspension of IE along with Windows 7. South Korea is left with no options but to switch to the global web standard, thereby entering the cross-OS and cross-browser Internet world.

The transition that the South Korean Internet community will face will be very painful and expensive, highlighting how a single wrong decision and hesitant corrective measures can cause widespread social and economic disaster, similar to the COVID-19 pandemic.

As of Nov. 10, 2020, the exclusive status of ‘Authorized Authentication’ aka ‘Official Certificate’ has ended and will only be an option in the new law-enforced system of ‘open authorization infrastructure’.

Internet Service

In search engines, Naver accounts for about 70% of all queries, followed by Daum (part of Kakao's business sectors) with 16%, and Google with 12%. In the instant messaging market, KakaoTalk handles roughly 80% of the total traffic, followed by Facebook Messenger at around 7%, Snapchat at about 3%, and others. In social networking, the main platforms are BAND by Naver, Instagram, Facebook, and Kakao Story in that order, with Twitter holding a smaller share. For email services, Naver and Google are the two leading providers.

Internet-only Banks

Two direct banks launched in 2017: K-bank and Kakao Bank. K-bank is owned by a consortium of 21 fairly balanced shareholders and offers services on both mobile phones and desktops. Kakao Bank has two large shareholders and nine smaller ones, with Kakao holding the largest share at 30%. It provides only mobile services, meaning only on smartphones. Of the two, Kakao

Bank has experienced impressive growth, with over 10 million customers—about 20% of the Korean population—including total deposits of roughly 20 trillion KRW and total loans of 14 trillion KRW as of November 2019.

Infrastructure

Regarding the number of IPv4 addresses and IPv6 /32 blocks, there has been little change since 2014, with approximately 112 million (6th globally for IPv4) and around 5,000 (13th globally for IPv6), respectively.

Regarding subscriber links, a significant portion of South Korean homes now have Gbps connections per household, using IEEE 802.3ah EPON (Ethernet Passive Optical Network) and ITU-T G.984 GPON (Gigabit Passive Optical Network). 10 Gbps connections were introduced in 2018, reaching 10% of all households by the end of 2019. The government's plan aims to provide 10 Gbps connections to 50% of households by 2022.

Regarding WiFi, IEEE 802.11ac Wave2, with a maximum speed of 1.73 Gbps, has been widely available nationwide since 2016, while IEEE 802.11ax (WiFi 6), with a top speed of 4.8 Gbps, began commercial service in April 2019. Additionally, about 30% of Seoul's area currently has free public WiFi access, which is expected to reach 100% coverage by 2022.

COVID-19 and Online Education

After a five-week delay in opening the spring semester due to COVID-19, South Korea started online schooling on April 9, beginning with grades 9-12. Grades 4-6, 8 and 9, and 10 and 11 started school a week later, with all grades from 1 to 12 finally going online on April 20. All South Korean universities provided online education for the Spring 2020 semester, but kindergartens remained closed.

Although there was a lot of chaotic confusion in the first few days, the system, including students and teachers, seemed to adapt to the abrupt transition more smoothly than many feared. Online schooling took place in three modes: real-time interactive, Q&A with recorded content, and self-directed projects. Two platforms were used: Online Class by Educational Broadcasting System (EBS) and e-Learning by Korea Education and Research Information Service (KERIS), an agency of the Ministry of Education. The former is provided by Microsoft, while the latter is run by a consortium led by Naver, which demonstrated a smoother start.

It is unclear how long this online schooling will continue, as COVID-19 appears to be fairly under control in South Korea, with fewer than 30 confirmed cases per day as of April 10. This has sparked optimism that on-site schools might fully reopen in the fall semester. However, it is clear that, through this experience, Korea will need to rethink and redesign its entire educational system to be fully online ready.

The shift to being online-ready might extend beyond education. Given the widespread pessimistic view that a pandemic like Corona could hit the world at any time in the future, we

might need to reengineer every aspect of our society to be online-ready, including smart work, smart offices, smart manufacturing, and more.

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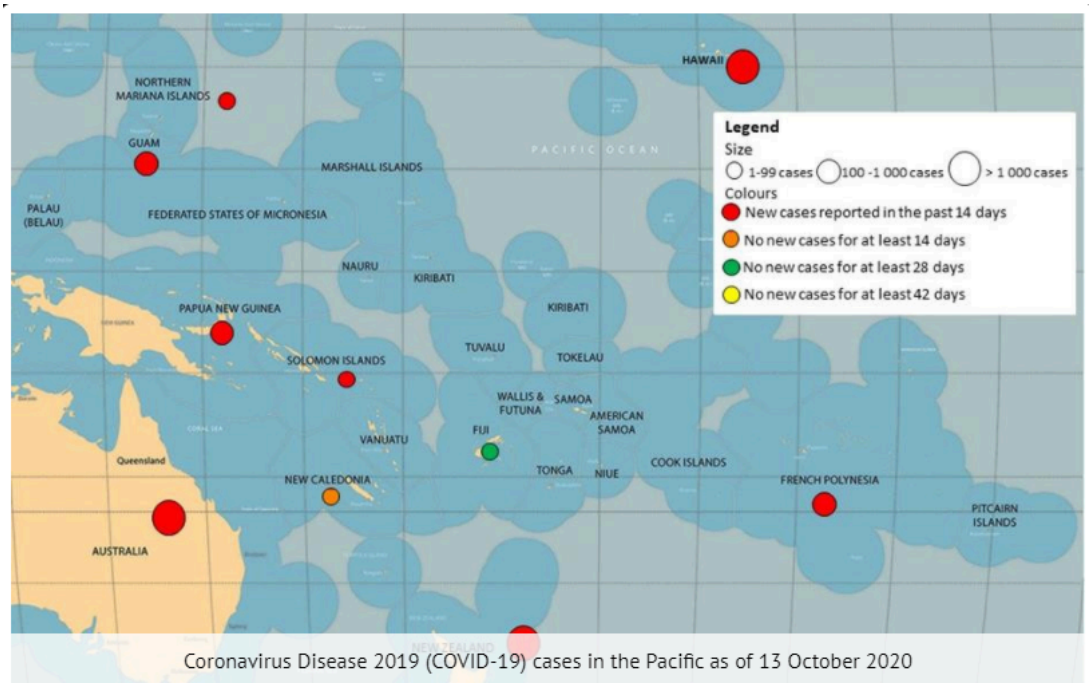
4.7 Snapshot of the Internet in the Pacific around 2020

Maureen Hilyard

INTRODUCTION

2020 will be remembered in history as the year when the world's populations struggled under the weight of COVID-19 – the coronavirus. The impact of the virus on populations, especially in developed countries with the highest rates of active cases and deaths, was devastating. Reporting on the COVID-19 situation in the Pacific was often incomplete and sometimes unreliable [BBCNews 2020; BusinessInsider 2020; SydneyMorningHerald 2020]. Even the World Health Organization (WHO) only reported on Pacific countries that are UN members, which meant excluding the Cook Islands, Niue, and Tokelau [WHOCOVID 2020; Filho 2020].



Coronavirus Disease 2019 (COVID-19) cases in the Pacific as of 13 October 2020

The most accurate and regularly updated information comes from the Secretariat of the South Pacific Community (SPC) site (above), which reported that only seven of the 22 Pacific countries and territories—Fiji, French Polynesia, Guam, New Caledonia, Northern Marianas, Solomons, and Papua New Guinea—were not successful in avoiding the pandemic, with some experiencing fatalities [Wikipedia 2020; SPC 2020]. While isolation may have helped the smaller island nations to keep themselves safe from some of the harsh effects of COVID-19, border closures and lockdowns had an equally devastating impact on their economies [IMF 2020]. Governments deployed available financial resources to safeguard and support their citizens during the lockdowns, ensuring continued non-COVID-19 contact, but income from tourism came to a halt [CIMFEM 2020; CITravel 2020]. Strict border restrictions, aimed at preventing the virus's unpredictability, banned entry to tourists and visitors, causing a drain on the lifeblood of many small island developing states [RNZ 2020]. Meanwhile, island communities united to ensure that families—especially the elderly and children—were cared for during a time when government and private resources continued to run low amid ongoing border closures. In the Cook Islands, social media was used extensively in the first months of the pandemic to keep residents informed and aware of all safety precautions, despite the islands being COVID-free [CITravel 2020]. However, due to the economic crisis, New Zealand and the Cook Islands are still working on strategies to address their economic development and health safety issues [Stuff 2020].

IT professionals around the world have been working to help us cope with the fallout of the coronavirus (COVID-19) pandemic. The lack of warning meant that there was no real opportunity to test the infrastructure for adapting to the widespread online communication activities that were to take place, which was less than ideal for some. Meanwhile, an organization within the Pacific region has taken advantage of the pandemic and the increased use of the internet by its members to utilize its main communication channel to develop opportunities that can improve the lives of people within the Pacific. The Pacific Islands Chapter of the Internet Society (PICISOC) has connected with its members through its picisoc@picisoc.org mailing list for nearly 25 years, and the activity among Pacific members since the beginning of 2020 has truly proven its worth during the course of the pandemic [PICISOC 2020a]. Its primary purpose is to facilitate discussions among members on issues of interest or concern to the region. Usually, these matters are raised by the members themselves, and they can come from any part of the Pacific because the Chapter, which has nearly 400 members, is unique [ISOC 2020] within the Internet Society (ISOC) in that its members are not from one city or even one country but from the 22 Pacific Islands Countries and Territories (PICTs) that are members of the Pacific Island Forum, including American Samoa, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Marianas,

Palau, Papua New Guinea, Pitcairn, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna PIFS 2020.

PICISOC was founded in 1994 when two IT managers from the Forum Fisheries Agency (FFA) and SOPAC decided to hold a formal meeting for Pacific IT administrators and managers. The IT-PacNet was established and held annual meetings until 1999, when the formation of a Pacific Islands Chapter of the Internet Society (PICISOC) was proposed. This finally took place in 2002, allowing the IT-PacNet to become a CROP (Council of Regional Organisations of the Pacific) ICT Working Group, focusing more on CROP policies. PICISOC grew, and its annual general meetings gained increasing popularity, leading to the creation of PacINET, which over the years evolved into the leading ICT conference for the Pacific region. It features discussions on Pacific-related internet governance issues and provides training opportunities for those with technical expertise, courtesy of the Asia Pacific Network Information Centre [APNIC2020]. PICISOC concentrates on internet issues relevant to the Pacific Islands and collaborates with various organizations and governments to promote ICT development in the region. Its most valuable asset is its mailing list, which has served as the primary communication channel connecting members of the ISOC Chapter across the Pacific, including countries in the Pacific Forum. The chapter grew to nearly 700 members from across the Pan-Pacific. Changes in Board personnel caused a brief pause, but experienced leaders, many of whom are former Board Chairs, decided to take action to rekindle interest in developments occurring in the Pacific, re-engage members more actively, and restore the chapter to its former role as the ICT activity hub in the region.

In 2018, a new Board of PICISOC was elected with a key goal during the pandemic: to revive the use of the PICISOC mailing list as the main platform for raising concerns and discussions across the Pacific, and developing solutions from within the Pacific, for the Pacific. These included:

Emani Fakaotimanava-Lui (PICISOC Chair 2019-20) who had established what was said to be the first WiFi system in the world, on his island of Niue when he managed Niue's internet to ensure that everyone on his small island was connected. After gaining more experience with large telecom companies in New Zealand as well as working with Kacific Broadband Satellites [Kacific 2020], he set up his own network [MakaNet 2020), and now connects Pacific Island families to the internet in the Auckland region. A major initiative that he established during the pandemic was ***FamilyNet*** where he collaborated with other sponsors to provide six-months Fibre Unlimited internet connection to the homes of Pacific Island families who had children who needed to do their schoolwork online during national lockdowns. Through his connections with Kacific and his return during 2019-20, his home country of Niue is now upgraded to the Kacific satellite and fully connected to a faster and more affordable internet service. His company, MakaNet (NZ) operates out of the Pacific Business Hub, which is a Manukau-City-based centre for Pacific business start-ups to rent space and work together to test the market for their products. A great innovation to support Pacific initiatives.

Maureen Hilyard (PICISOC Chair 2011-14) returned to the PICISOC Board with more organisational experience since she was in the Board 4 years earlier, now as the Chair of the At-Large Advisory Council (ALAC) of **ICANN** (the Internet Corporation of Names and Numbers), a member of DNS Women in ICANN, the Chair of the Board of DotAsia, and a member of the Advisory Council of the Public Interest Registry [PIR 2020]. She is also the founder of the **Cook Islands Internet Action Group** which is a member organisation of ICANN [CIIAG 2020]. In collaboration with the Tracy Hackshaw of ISOC Trinidad and Tobago in the Caribbean, she is a co-founder of the UN Internet Governance Forum's (UNIGF) **Dynamic Coalition of Small Island Developing States** in the Internet Economy (DC-SIDS). Her association with PICISOC and organising regional PacINET events were driven by an interest in **capacity building development** and raising awareness about ICANN and ISOC Internet issues that relate to Pacific Island internet users. During 2020, 14 PICISOC members participated in a **Pacific ICANN Learn programme** to understand how ICANN works – on topics such as Cybersecurity, and Introduction to ICANN, DNS and Policy Fundamentals, as well as introductions to various sections of the ICANN community. About 20 PICISOC members enlisted in the first global cohort of students for the first **Virtual School of Internet Governance** [VSIG 2020]. While Maureen's IT engagements are all volunteer positions, as a day job she is a strategic development consultant working mainly for government agencies. She is also keeping a watching brief over developments related to the fibre optic cable that was landed on Rarotonga, Cook Islands in January 2020, yet in October, was still awaiting connection of the cable network due to the government's lack of preparedness to ensure that the required infrastructure was in place to facilitate the last mile connection into users' homes. Redirection of funding to support safekeeping of citizens during the pandemic mean that this activity is now in the hands of the private sector which does not bode well for future affordability expectations of Cook Islands internet users.

Andrew Molivurae (PICISOC Chair 2009-2011) is Ni-Vanuatu works as an Internet Governance & Child Online Protection Officer with the Telecommunications & Radiocommunications Regulator (TRR). He is also engaged in Cyber-security awareness around Vanuatu under the TRR Consumer Protection Regulation. Prior to that he was IT Billing Engineer for Digicel Vanuatu Ltd, IT Manager for Vanuatu SDA Mission, Internet Technician for Telecom Vanuatu Ltd and Systems Administrator for Vanuatu Financial Services Commission. Apart from his full-time jobs, he was also founding Chair of **Vanuatu IT Users Society** (VITUS) which is a legal ICT Charitable Association in Vanuatu and an ICANN At-Large organisational member (with over 200 members) that was formed in 2005 [VITUS 2020]. As a member of the Vanuatu ICT Development Committee, Andrew has been an advocate for ICT development in Vanuatu for over 10 years. During 2020, Vanuatu Internet users have benefited from the introduction of **the Kacific network** to previously unconnected areas of Vanuatu, particularly the rural areas.

Anju Mangal (PICISOC Vice Chair 2019-20) spent many years with the Secretariat of the Pacific Community (SPC) a regional inter-governmental organisation providing technical assistance to the 22 PICTs [SPC 2020]. She worked on **cross-sectoral ICT projects** such as e-Agriculture, e-Health, before

joining SPC's digital transformation team. She is an alumna of the Internet Governance (IG) Capacity Building Programme, an ISOC ambassador as well as a former Fellow of the Commonwealth IGF, ICANN, APRIGF, APNOG and the UN IGF Secretariat in Geneva. All of which she maintains contact with to strengthen Pacific links. In 2020 she moved to the World Wide Web Foundation to work as their Asia and Pacific Regional Lead, coordinating activities in the Pacific Region. While on the PICISOC Board, Anju has been a strong advocate for the interests **of women and youth in ICT**, as well as ICT for disability. She has launched a **social media campaign** to increase engagement via the PICISOC Facebook page which in turn has led to an increase of PICISOC mailing list subscribers. **PICISOC website** and social media pages are regularly updated with ICT news, announcements, and capacity building efforts from the region. ICANN and ISOC events and newsletters are also included. She was a former member of the UN IGF **Multistakeholder Advisory Group** (MAG) and continues to maintain contact with former MAG members to support the interests of the people of the Pacific.

Cherie Lagakali (Board Member 2017-2019, PICISOC Chair – 2020+) started her ICT career in the private sector as a webmaster for FijiLive Group of companies, then as a programmer - part of a team that developed an in-house Bank Management System at the Fiji Development Bank. Later she developed Internet-related applications for resorts and SMEs in the Fiji Tourism industry, eventually becoming an increasingly active member of the Pacific Internet community. As an alumna of the ICANN Fellowship programme she keeps the region up to date on At-Large engagement and outreach programmes as well as ISOC activities.

PICISOC INITIATIVES AND PARTNERSHIPS

During the APTLD meeting in Melbourne in February 2020, Cherie signed an **MOU with APTLD** to formalise strategic partnership to explore possible areas of cooperation in the field of outreach and engagement of, and capacity building for, ccTLD managers across the PICTs. This was in preparation for a collaborative event with InternetNZ to be held in Fiji in September 2021. As PICISOC is also a member of At-Large of ICANN, Leonid Todorov, APTLD General Manager said "*PICISOC has been a key player in the Pacific region and we believe this partnership will allow us to collaborate in holding public activities, as well as aim at education and awareness raising among the At-Large community and ccTLD managers in the Pacific*." Also, while in Melbourne, Cherie attended the 2020 **Global Cyber Security Capacity Building Conference** (GSCCC) where she and other Pacific participants made presentations on cybersecurity in the Pacific region as well as engaged in panel discussions on future national capacity building and international collaboration. Alongside that meeting, the Global Forum on Cyber Expertise (GFCE) organized a Pacific Regional Forum to discuss the way forward on cyber capacity building across the region. Cherie was later appointed to the Advisory Board of the GFCE [GFCE 2020].

PACIFIC WOMEN IN ICT

During 2020, Cherie has been a strong advocate for the formation of the **Pacific Women in ICT,** and in September held an inaugural meeting of Pacific women at which nearly 40 women participated,

including two who were later elected to the PICISOC Board [PICISOC 2020c]. As a follow-up, the ITU Regional Office for Asia and the Pacific, DTC-PNG and APCICT of United Nation's ESCAP jointly co-organised virtual training sessions on "Leveraging ICTs for Women Entrepreneurship in Papua New Guinea" [UNESCAP 2020]. Pacific Women are also discussing the World Wide Web Foundation report "Closing the Gender Gap for a more equal world"(2020) which illustrates the barriers that prevent women globally from accessing and using the internet and the challenges limiting their experiences [WWWF 2020]. The findings of the report reflected many of the experiences in the Pacific relating to access, privacy issues and employment opportunities.

"I strongly believe the key challenges for the Pacific women in ICT today is keeping up with the current and trending technologies, and constantly upgrading your skillset as technology evolves… and reversing the whole mentality and perception that women only belong in administration and documentation field." Bandana Elisha Devi (Fiji)

"*I have a BSc in Computer Science and been in the industry for almost seven years after graduating in 2013. The challenge I face, is trying to fit into the industry. Women lack opportunities to further our careers and be certified in specific fields and a lack of mentorship for young women and girls in the ICT space. I would like to see more government support towards the growth of women and girls in this industry."* Samanaia Ned (Papua New Guinea)

"*Women in rural areas have limited access to basic resources and literacy. Lack of access to information makes digital inclusion a major challenge, as it impedes their growth and well-being in many facets of their lives*." Swaran Ravindra (Fiji)

"*The Papua New Guinea ICT Cluster has had several successes this year as more females are starting to work in the fields of Computer Science, ICT, Engineering, Life and Social Sciences, Maths and Physics; one of their women has recently been appointed to a major company as their Technical Solutions Specialist PNG; four of their top female Computer Science & Communication Engineering students from PNG University of Technology have been selected for a three month technical training course, where if they pass the end of training exam, they will be awarded a 2 year contract to work on global, regional and domestic software engineering projects; six of their female youth have been invited to join the Get Safe Online Ambassador program; and finally, PNG women have been invited to sign up to the recent Women in ICT Frontier Initiative (WiFI) training by ITU DTC in October 2020.*" From Priscilla Kevin (PNG ICT Cluster)

Georgina Sakimi-Naigulevu (2020 Board member) brings a strong background in banking for her role as Board Treasurer. Georgina is a strong advocate for the regional Pacific Disability Forum [PDF 2020] in Fiji. She is pictured speaking in March

2020 at the Fiji National University's conference "Leveraging Technology for Productivity Growth and Sustainability" about a community engagement project that promotes digital inclusion for persons with disabilities. She attended the APRICOT meeting in Melbourne [PICISOC 2020d] and brought the perspective of the disabled into many of her interventions. She has since established links with ISOC's Accessibility SIG [A11YSIG 2020] and Gunela Astbrink (Vice President of the SIG in Australia) who has had a long association with PICISOC. "When PICISOC ran annual PacINETs, I was invited to hold workshops and presentations on accessibility for persons with disability over several years. Maureen was a champion in ensuring that the disability voice was heard at these events". Now, PICISOC, the PDF team, ISOC's Accessibility SIG and the IGF Dynamic Coalition on Accessibility and Disability (DCAD) [IGF, 2020a], are collaborating to develop ways to meaningfully dialogue online with audiences that include people with disabilities. The inclusion of captioning and sign language interpretation, using interpreters from the PDF team, are being proposed to ensure that all virtual meetings are accessible for people with disabilities.

Kanaan Ngutu is the Senior ICT Officer at the Ministry of Information, Communication, Transport and Tourism Development, Government of Kiribati. His background brings Cybersecurity and e-Government initiatives and experience to the Board, but he is also involved in the buildup of e-Commerce environment for Kiribati, ICT in Education, and the improvement of the Government Finance Management Information System. He also serves as the correspondent on Cybersecurity works with regional and global bodies such as Oceania Cybersecurity Center (OSCS) and Get Safe Online (GSO) [OSCS 2020; GSO 2020]. He has attended various ICANN and Internet Society meetings as well as actively represented the Pacific at the DC-SIDS sessions of the Global IGF.

e-TALANOA

Supported by the Board, PICISOC member and former Board member, **Will Tibben** from the University of Wollongong organised an e-Talanoa which is a traditional discussion forum (but online) discuss "FOSS: it's free, its open but how does it work?" His speakers came from Tonga, Fiji, and Australia, and discussed issues raised by the 16 participants in true talanoa tradition. **Edwin Liava'a** (Former PICISOC Board Chair, 2014), from Tonga works for Kacific Broadband Satellites as Regional Director for the Pacific and collaborates with a number of regional agencies in the Pacific in project delivery and capacity building. **Kenneth Katafono** (PICISOC member, from Fiji) founded a Fijian traceability tech start-up, TraSeable Solutions, which supports global food sustainability by providing a blockchain-ready software-as-a-service (SaaS) platform for fisheries and agriculture traceability. Both Kenneth and Edwin believe that accessibility and affordability in the Pacific, are connected to "bigger picture" issues about wholesale and retail availability of broadband, and more particularly by government regulation. **Ashley Maher,** a Director to the Australian Computer Society, concluded that with regards to the uptake of FOSS in the Pacific, "*It takes time for new ideas to emerge, be communicated and then be accepted. One factor that constrains FOSS is the reality that many IT specialists who have*

developed their careers on Windows are not going to voluntarily make their store of knowledge redundant by introducing new concepts. Learning new concepts takes time and effort - it's much easier to stick with the familiar."

ASIA FOUNDATION – PICISOC MISINFORMATION PROJECT

Online misinformation and harmful rumours related to the COVID-19 pandemic have spread quickly within Pacific Island nations, threatening citizens' health and safety and encumbering health authorities' efforts to protect against the virus. To better understand and respond to this challenge, The Asia Foundation worked with PICISOC to convene a group of local stakeholders to conduct a regional study and support public information-sharing efforts focused on how false and harmful COVID-related information is being created, shared, and consumed online in the Pacific. Activities implemented under the project include research and policy analysis, data collection, and support for information-sharing and dialogue related to the COVID-19 pandemic and the problem of online misinformation more generally. The project also established a partnership with the University of California, San Francisco COVID-19 Fact Check project to share validated COVID-19 information in three Pacific languages: Tongan, Bislama, and Tok Pisin.

PICISOC EDUCATION SPECIAL INTEREST GROUP

The PICISOC Education SIG was established in May 2020 and currently has 21 members from 11 Pacific SIDS [PICISOC 2020b]. The discussions will centre around key topics relevant to ICT in Education including:

- Access and Infrastructure – Networks/Devices/Phones/Tablets/Electrification
- Human Resources – Digital Literacy and ICT Competency for Educators and Leaders
- Information Systems – Software, Databases and Learning Management Systems
- Policy and Planning – Short, medium and long term planning and financial considerations

Members of the SIG have contributed examples from their own countries and discussed common challenges drawing on examples of education technology adoption from other parts of the world. Discussions are underpinned by international standards and aim to support informed decisions in terms of education technology investments, recognising that the SIDS face unique challenges in terms of geography and infrastructure that need well considered solutions involving Governments and Ministries of Education around the Pacific.

ACRONYMS

ALAC	At-Large Advisory Committee
APNOG	Asia Pacific Network Operators' Group
APNIC	Asia Pacific Network Information Centre
APRIGF	Asia Pacific Regional Internet Governance Forum
APTLD	Asia Pacific Top Level Domains
ccTLD	Country Code Top Level Domains
CIIAG	Cook Islands Internet Action Group
CROP	Council of Regional Organisations of the Pacific
DCAD	Dynamic Coalition on Accessibility and Disability

DC-SIDS	Dynamic Coalition of Small Island Developing States
DNS	Domain Name System
DTC	Digital Transformation Centre
FFA	Forum Fisheries Agency
FOSS	Free and Open Source Software
GFCE	GLOBAL Forum on Cyber Expertise
GSCCC	Global Cyber Security Capacity-Building Conference
ICANN	Internet Corporation of Assigned Names and Numbers
ICT	Information and Communication Technology
IGF	Internet Governance Forum
ISOC	Internet Society
IT	Internet Technology
ITU	Internet Telecommunications Union
MAG	Multistakeholder Advisory Group
MIS	Management Information Systems
MOU	Memorandum of Understanding
NZ	New Zealand
PDF	Pacific Disability Forum
PICISOC	Pacific Islands Chapter of the Internet Society
PICTs	Pacific Island Countries and Territories
PIR	Public Interest Registry
PNG	Papua New Guinea
SDA	Seventh Day Adventist
SIG (ISOC)	Internet Society Special Interest Group
SIG (Virtual)	Virtual School of Internet Governance
SOPAC	Pacific Islands Applied Geoscience Commission
SPC	Secretariat of the Pacific Community
TRR	Telecommunications & Radiocommunications Regulator
UN	United Nations
VITUS	Vanuatu Internet Technology Users Society
WiFI	Women in ICT Frontier Initiative

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Closing the Digital Gender Gap for a More Equal World

4.8 Snapshot of the Internet in Pakistan around 2020

Waqas Hassan

The decade from 2010 to 2020 was truly transformative for Internet development in Pakistan. In June 2010, there were 0.9 million broadband subscribers in the country compared to 82 million subscribers by the end of May 2020 [PTA 2020]. The broadband subscription rate increased from 0.5% in 2010 to 39% as of May 2020. This significant rise in Internet adoption results from various technical, policy, regulatory, and market factors, most of which occurred after mid-2014.

The introduction of mobile broadband through the 3G and 4G LTE spectrum auctions in 2014 became a game-changer for broadband growth in Pakistan. This significant step enabled broadband access for the existing 140 million 2G cellular subscribers and opened the broadband market to effective competition [PTA 2010]. Despite being the dominant technology since the early 2000s, the fixed broadband infrastructure failed to fully capitalize on Internet opportunities. This is clear because, by the end of May 2020, 97.5% of broadband subscribers had subscribed to mobile broadband (3G, 4G LTE). Pakistan connects to the rest of the world via six undersea cable systems with a combined Internet bandwidth of 3.12 Tbps, of which 1.76 Tbps is in use by operators. Over 90,000 km of backhaul fiber optics had been deployed across the country as of 2020. Internet Exchange Points are established in Islamabad and Karachi, with a third one being established in Lahore [PTA 2020]. The government also introduced the Telecom Policy 2015, the Digital Pakistan Policy 2018, and legislation to build user confidence and trust in the online space. Mobile broadband has also spurred other socioeconomic activities such as digital financial services, e-commerce, smartphone adoption, entrepreneurship, and e-governance.

Despite the rapid increase in Internet adoption, several factors hindered the ideal growth of the Internet over the last decade. Taxation on the Internet and data services in Pakistan is among the highest in the world [GSMA 2019]. The affordability of Internet services and device costs remains relatively high compared to the rest of the region. Extrinsic factors include a lack of local content, low literacy rates, language barriers, sociocultural taboos, and electricity shortages.

Looking ahead, Pakistan's plans appear promising, as it became the first country in South Asia to test 5G in 2019 [CMPAK 2019]. The E-commerce Policy was recently approved, and a draft

of the Data Protection Bill is currently in the consultation phase [MoC 2020; MoITT 2010]. Key challenges that all stakeholders must address through constructive dialogue include issues related to privacy, freedom of speech, fake news, internet shutdowns and restrictions, consumer protection, surveillance, and cyber fraud.

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4.9 Snapshot of the Telecommunication in Palestine around 2020

Nadira AL-Araj

Background

After the 1967 war, the Israeli military authority took control of both the West Bank and Gaza Strip and assumed responsibility for Palestinian civil affairs. Bezeq, the Israeli government telecommunications company, gained management of an existing, outdated, and scattered telephone network and controlled the international gateways for both the West Bank and Gaza Strip.

The turning point in the telecommunication and information technology (T&IT) sector toward Palestinian autonomy occurred after signing the Israeli-Palestinian Interim Agreement on the West Bank and Gaza Strip (also known as "Oslo II") on September 28, 1995. At that time, the Palestinians gained some very limited freedom in managing the telecom sector.

To understand the restricted environment in which the Palestinian T&IT sector was allowed to operate, it is helpful to consider how Oslo II classified the West Bank into three different areas. The map included here offers visual clarification [ARIJ 2020]. Area A makes up approximately 18% of the West Bank and is theoretically under the jurisdiction of the Palestinian Authority (PA). It includes the major cities in Gaza and the West Bank. Area B accounts for 22% of the West Bank, where the PA manages the civil affairs of the Palestinians living there, while Israel controls its security. Area C covers about 60% of the West Bank, where Israel retains full control. Regarding Jerusalem, Israel seized it and established a permanent status as part of Israel. On a

side note, Palestinians living in any of these areas are not allowed to travel without passing through Israeli military checkpoints.

Readings in Article 36 – "Telecommunications of Oslo II"

Article 36 of "Telecommunications from Oslo II Annex III: The Protocol Concerning Civil Affairs" provides the legal basis for challenging ongoing negotiations between the Palestinian and Israeli sides to develop the Palestinian T&IT sector.

The first principle of Article 36 clearly states, "Israel recognizes that the Palestinian side has the right to build and operate separate and independent communication systems and infrastructures including telecommunication networks, a television network, and a radio network." This sounds promising, but restrictions are outlined in the following sections. The General Section Item A.2.a does not permit Palestinians to dig, build, or install any telecommunication equipment in Area C without prior approval from Israel, thus imposing significant limits on developing and installing a Palestinian telecommunications network.

As we can see from the map, the overlap of Areas A, B, and C makes it difficult to build equipment between cities in Area A or between Area A and the villages in Area B, because doing so requires approval from the Israeli side. Often, gaining approval takes several years, and on many occasions, pressure from the international community accelerates the process. Usually, to complete network connections, the Israelis will only accept if the Palestinians use the Israeli telecoms backbone.

The other item in the General Section addresses the Israeli settlements in Area C, even though these settlements were built illegally under international law. Item A.2.b provides the full telecommunication services for the settlement to Israel.

When mobile operators started and became common in Israel because they controlled the frequencies, Palestinians used the Israeli mobile networks as the only ones available. However, in 1999, when the first mobile operator, Jawwal, started, along with more Israeli restrictions on people commuting and working in Israel, the Palestinian network quickly became more popular among Palestinians despite the fact that the allocated frequencies only supported basic G2 functions. Therefore, Israeli mobile operators operating in Area C can easily cover Palestinian areas without authorization, since they have more advanced telecommunications technologies than their Palestinian counterparts.

The principles in Article 36 facilitate Palestinians in developing their T&IT sector, but there are limitations. For example, Principle 2 grants Palestinians the right to establish satellite networks for various purposes, but it excludes international services. Palestinians are also given the "right to choose any and all kinds of communication systems (including broadcasting systems) and technologies, suitable for its future," which is the positive side. The problematic part is that Israel is responsible for providing the necessary spectrum of frequencies and approving the standards for advanced equipment required by Palestinian telecommunication companies. Additionally, any equipment ordered by a Palestinian company or the Ministry of Telecoms and Information Technology (MTIT) must be approved by Israel. As a result, Israel can easily block the import of telecom gear that might improve Palestinian networks if it does

not align with Israeli policies aimed at keeping Palestinian networks inferior in technology, speed, broadband, access, and other services.

Principle 5 requires both sides to avoid behavior "that interferes with the communication and broadcasting systems and infrastructures of the other side," assuming the two parties are on equal footing. However, in this case, Israel has the advantage in terms of infrastructure. Since all Palestinian information traffic must pass through Israeli network operators, continued surveillance by Israel is possible, was, and remains the norm.

The negotiators also anticipated the contentious issues of the Principles. Article 36 includes a provision to establish a Joint Technical Committee (JTC) consisting of members from both sides to meet regularly and address urgent problems. However, history has shown that many decisions made by the JTC required approval from the Israeli government. Additionally, for the JTC to convene, both sides must agree. The Israeli side rarely agreed to meet despite numerous official requests. As a result, nothing was done to resolve the numerous issues and problems that such technology and requirements demand. The JTC agreed on the necessary frequency for 3G and the frequency-sharing model, but it took ten years to assign this frequency to the two Palestinian operators.

Article 36 addressed the electromagnetic spectrum and allocated frequencies or sections of frequencies to technologies that existed at that time, while also limiting the coverage areas. The JTC is responsible for decisions regarding future frequency needs, but these decisions must be confirmed by Israel. Section D under Telecommunications explains how Palestinians must govern their T&IT sector, but only under certain conditions.

To establish an independent Palestinian telephone network, they must enter a commercial agreement with Bezeq or any other licensed Israeli companies. The Palestinian must be in full technical compliance with the standards adopted by the Israeli "ministry of communications and will coordinate with the Israeli side any changes to the structure and form of telephone exchanges and transmission equipment."

To continue providing Bezeq services to the Settlements and military installations, as well as maintaining any infrastructure passing through Palestinian jurisdiction areas. In the meantime, Palestinian connections between the West Bank and Gaza Strip and the operation of an international gateway shall remain under Israel's responsibility. The final comment in this section pertains to taxes, which prohibit Palestinians from collecting taxes on telecommunications services from Israeli operators operating in Area A without a license.

Milestones of the T&IT sector development in Palestine

Each event on the timeline listed below stands as a case worth documenting on its own. Nothing comes easily to Palestinians. Through consultations and support from international bodies and the Israelis themselves, there were successful steps forward despite the difficulties. When the PA initially took over the telecommunication network in Gaza and Jericho, then from the remaining main West Bank cities, the total number of fixed lines was only 82,000 for a population of many millions. The Palestinian Authority set a condition on Paltel, the company that was awarded the contract to establish the Palestinian network, to reach 250,000 lines in three years. They achieved

this goal before the deadline because it used to take a Palestinian family almost 10 years to wait for Israelis to permit them a fixed telephone line.

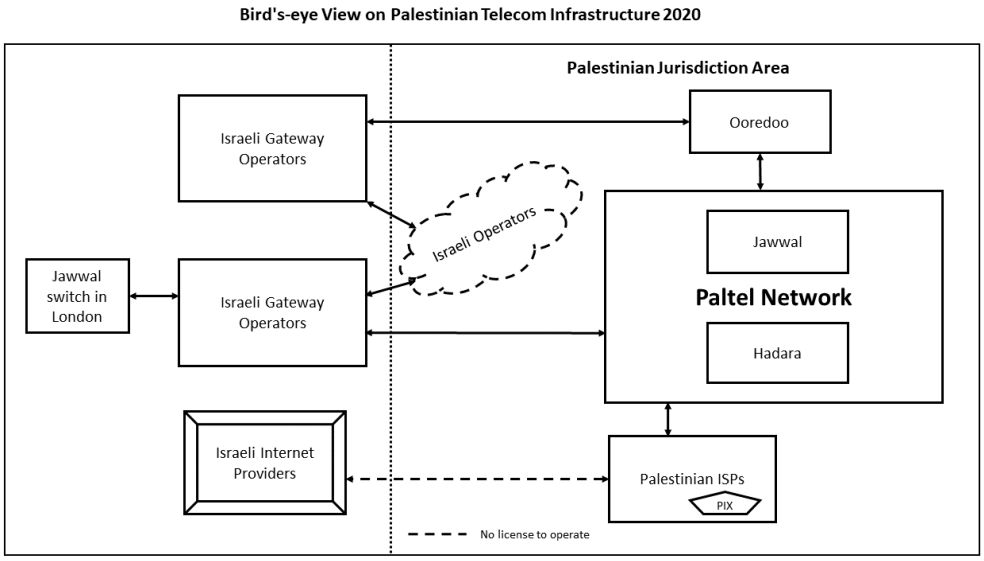
Starting in 1995, from a rundown telephone network with 82,000 fixed landlines to 2019, when 467,000 fixed telephone lines provided service and 3,381,787 users accessed the Internet among a total population of 5,101,414 in the West Bank and Gaza Strip, representing a 66.3% penetration rate.

Regarding 2G mobile lines, there are 4.304 million subscribers in total, with 1.294 million using Ooredoo (formerly Wataniya) and 3.01 million with Jawwal. Additionally, Jawwal has 363,000 3G lines.

1995	Israel handed the PA the telephone network after 28 years of control occupation and only 82K fixed landlines subscribers.
1996	The PA granted an exclusive 20-year license to the Palestine Telecommunications Company (Paltel) group to build and manage the telecommunications infrastructure in the West Bank and Gaza Strip.
1999	Paltel group launch Jawwal mobile network operators after Israel released the 2G frequency to the Palestinian. This frequency shared with Israeli operators in accordance with Article 36. (970) assigned as the Palestinian international dialling country code.
2000	The International Organization for Standardization officially designated the code .PS for Palestine.
2003	The Palestinian National Internet Naming Authority became the official domain registry for the Palestinian country code Top-Level-Domain.
2005	Paltel Group launched Hadara Internet service provider. The PA, through the JTC, requested the following from Israel: - Frequencies for building 3G networks - Microwaves on several bands to use to a link between sites and cities. - Frequencies for building a WiMAX network - Frequencies for building a trunking System
2009	A second mobile operator, Wataniya Mobile launched its commercial services in the West Bank only.
2015	After 10 years of request, Israel allocated the frequency of 10MHz to both Jawwal and Wataniya shared with Israeli operators. Launching of the Palestinian Internet Exchange Point as a community initiative from small ISPs.
2016	The MTIT renewed the licenses for Paltel and Jawwal for another 20 years.

2017	Wataniya launched its business in the Gaza Strip.
2018	Jawwal and Ooredoo launches their 3G services in the West Bank.

The following figure broadly summarizes the current infrastructure in Palestine. It complies with Article 36 conditions by not allowing access to international networks without passing through an Israeli network switch. It limits companies to providing their services within the Palestinian jurisdiction area. At the same time, Israeli operators are capturing some of the Palestinian market share with their advanced 4G services and cheaper data plans, all without paying license fees or taxes to the Palestinians. It is likely that individuals who buy Israeli SIM cards are those who travel daily to work and do business in Israel, as well as others whose jobs require faster data streaming.



Moving forward

The year 2020 presented a new challenge to the Palestinians, as ongoing negotiations and unfulfilled agreements of the Oslo Accords came to a halt for reasons beyond the scope of this chapter. The JTC will be unable to discuss the specifications of 4G/5G networks or other Palestinian requests. While negotiations are paused, Palestinians can continue developing their T&IT sector within their jurisdiction. They can establish an independent telecommunication regulatory body to promote market competition and fair service pricing. The Ministry of Telecoms and Information Technology can permit additional companies to provide telecommunication infrastructure, such as fiber-optic networks owned by electricity companies. This would attract entrepreneurs with more innovative communication solutions. New entrants could gain some market share by targeting the 33.7% of citizens still without internet access. Under the current circumstances, Palestinians have no choice but to continue engaging with international bodies like the International Telecommunication Union (ITU). This remains the only viable way to press for Israel to grant Palestinians their rights to frequencies. A better solution, of course, would be for Israel to end its occupation of Palestinian territory, and

meanwhile, for the Quartet to support a new Israeli-Palestinian peace agreement that includes a fair new article on telecommunication, allowing Palestinians to manage their T&IT sector both nationally and internationally.

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4.10 Snapshot of Internet in Sri Lanka around 2020

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Sri Lanka, a democratic socialist republic and island nation in the Indian Ocean with a population of 21 million, continues to experience the impact of the Internet across all spheres of socio-economic activities. The major areas affected include education and research, commerce and banking, health, agriculture, environment, industry and innovation, social media, and politics. The state sector's education and research are primarily managed by LEARN, the Sri Lankan National Research and Education Network (NREN), while the demand in both the public and private sectors is largely met by private sector Internet initiatives.

2015 marked twenty years of the Internet in Sri Lanka. ISOC Sri Lanka Chapter hosted INET 2015 in Colombo [INETColombo 2015] to celebrate this milestone. An award ceremony was also held in June 2015 to honor the pioneers of the Internet in Sri Lanka [Biyagamage 2015].

This article documents how the Internet infrastructure services as well as access have grown and supported during the decade 2010 – 2020.

(1) Connectivity Aspects

To sustain the steady growth of web access, use of email, and most of all the increased use of social media, it has become essential to provide suitable local and international connectivity both in terms of speed (or bandwidth) and spatial spread. During this decade therefore, major investments on infrastructure development have been made by the government and the private sector. In particular, the government has identified eight thematic areas including connectivity, security, legislation and digital content under its digitalisation programme and the Information and Communication Technology Agency (ICTA) has been allocated Rs. 15 billion from the 2017 national budget [CBSL 2017]. In terms of spatial spread, albeit at a lower bandwidth, mobile Internet continues to play a major role.

It is evident from Figure 1 [Hootsuite 2020] that while only 18% of the 21 million people account for urban population, the Internet penetration is 47% (10 million). It follows from this that more than 30% of the Internet users are semi-urban and rural. Similarly, 30% of the population are active social media users of which 12% accounts for semi-urban and rural users. For a developing country this is an important indicator and the high level of Internet penetration within rural and semi-urban population can be attributed to the reasonably widespread 3G/4G mobile communication and telecom infrastructure, low ownership cost of devices, and low tariffs. In this respect it is important to note that Sri Lanka launched the first 3G mobile network in 2006 and 4G/4G-LTE adoption started in 2013 thus creating a bubble in the Internet market place. As the cost of 4G enabled devices drops the ownership of a device with Internet connectivity becomes easily affordable thereby contributing to a higher Internet penetration.

Another major factor is the intense competition among mobile communication service providers in Sri Lanka, which has led to lower subscription fees for fixed and mobile broadband access, thereby removing another potential barrier to Internet growth. Galpaya provides an account of the development of broadband communication in Sri Lanka around 2011[Galpaya 2011]. Currently, Dialog and Sri Lanka Telecom (SLT) are the leading owners of telecom infrastructure networks in Sri Lanka. Dialog dominates mobile coverage in the country, while SLT leads in fixed line coverage with the largest fiber optic cable network. As shown in Figures 2 and 3 [SLT 2018], Sri Lanka, compared to other developing, developed, and least developed countries, has continued to operate for many years with low fixed broadband and mobile subscription fees.

Figure 4 illustrates the continued growth of fixed and mobile Internet subscriptions, as compiled by the Telecommunications Regulatory Commission of Sri Lanka [SLT 2018]. Although the number of subscriptions keeps rising, Hutch CEO states that "Even though 4G has been around in Sri Lanka since 2014, mass adoption of 4G has not yet occurred with only 40% of mobile subscribers on 4G networks today. There were multiple reasons for this slow uptake, including expensive 4G handsets and perceived high costs of using 4G services" [MENAFN 2020].

This leads to the observation that full utilization of available technology remains far from reality. Although this could be a positive sign for future infrastructure investors, it is a negative signal for the nation. Additionally, no distinction is made between owners of multiple devices and facilities, and it is assumed that approximately 30% of the population has access.

The table and chart in Figure 5 show how Internet penetration was affected by the introduction of mobile broadband around 2009-10 [TRCSL 2020]. As seen here, aided by decreasing device costs and connection fees, there has been an exponential growth in mobile broadband subscriptions from 2010 to 20. Additionally, Internet tariffs are lower compared to other developing countries, resulting in 30 million mobile subscriptions for a population of about 20 million. The Telecom Regulatory Commission (TRC) of Sri Lanka reported 5.5 million mobile broadband connections by the end of 2019. At the same time, a major retailer in the country recorded a 35% increase in sales of smartphones and tablet PCs in 2018. This shift toward smart devices with mobile connectivity has been linked to a decline in computer literacy but an increase in digital literacy during the first half of 2018 [ECONOMYNEXT 2020].

LIRNEasia in their AfterAccess report presented following findings [LIRNEasia 2019]:

- Out of a population of about 21.4 million in Sri Lanka, 13.5 million use mobile phones equipped with 17.9 million active SIM cards. (Number of SIM cards is higher because of multiple SIM use)
- Nearly half of Sri Lanka's mobile phone users' own smartphones
- Sri Lanka's internet users are more urban men

In 2010, ITU and UNESCO launched the Broadband Commission for Digital Development to promote broadband as an international policy, aiming to expand access and accelerate progress [BroadbandCommission 2020]. Sri Lanka became the first South Asian country to launch 3G in 2006, and although technology and devices are now available at lower costs, mobile coverage in the country remains unsatisfactory. Coverage maps of two major mobile broadband providers are shown in Figure 6 [NPERF 2020]. It is clear that coverage outside the main cities is minimal.

(2) Mobile App based Internet Services

During this decade, the growth of traditional Internet-based services has continued in both the public and private sectors. Many public services have created portals for public use, such as E-Revenue Licence, Lanka Government Network (LGN), EPF / ETF, and Gov.lk. In the private sector, hotel booking systems, transport booking systems, banking systems, and others have moved online. The Central Bank of Sri Lanka (CBSL) reports a volume of 26.9 million Internet banking transactions with a total value of Rs. 2940 billion in 2018 [CBSL 2019]. During the same year, mobile phone banking transactions amounted to 8.16 million, with a value of Rs. 142 billion.

The growth of Internet based Mobile Apps has made people to glue in to mobile solutions such as mobile banking for easing their day-to-day life. Internet based shopping has become a very familiar feature during the decade and many consumers have shown a preference to do online shopping for less expensive products.

Internet banking in Sri Lanka was introduced in 1999, but by 2010, less than 1% of banking customers used it. Figure 7, an excerpt from the Payment Bulletin of the Central Bank of Sri Lanka [CBSL 2019], shows the volume of Internet-based payments in Sri Lanka and the percentage increase from 2018Q1 to 2019Q1, which is 32%. This rise was driven by lower device and Internet access costs, along with a boom in ICT literacy in the country. However, there is a 39% decrease in the total value of Internet banking transactions, indicating a shift toward more low-value transactions. Kariyawasam examines the level of Internet banking usage among banking customers in Sri Lanka [Kariyawasam 2016].

As with many developing nations, the use and availability of credit cards in Sri Lanka is below average. Online payments via credit card for the purchase of goods and services is only possible for a small percentage of the population. However, an alternate payment mechanism exists through mobile cash enabling the transfer of money to anyone, anywhere in Sri Lanka via mobile or CDMA network based on which Cash on Delivery was introduced. Going further Sampath Bank PLC has introduced an innovative cash delivery system by entering into a ground breaking partnership with PickMe Digital Mobility Solutions Lanka (PVT) Ltd enabling the delivery of the cash withdrawn from an ATM directly to the doorstep of a customer [DailyNews 2020].

(3) Internet Entrepreneurship

The period from 2010 to 2020 has seen a surge in Internet-based entrepreneurs in Sri Lanka, especially freelancers with specialized skills. It has become a key area to explore during this decade, with around 20,000 freelancers [Fiverr 2020] involved in the sector, bringing in foreign projects through platforms like Fiverr, described as "the world's largest marketplace for digital services" and the most popular locally [Echelon 2017]. Freelancing is considered an old practice that has received a new boost with the rollout of broadband Internet, which allows freelancers to access opportunities worldwide [Echelon 2017].

There is also 'micro work' that can be done by new and low-skilled workers. Based on a nationally representative survey conducted among 16- to 40-year-olds, LIRNEasia estimates [Echelon 2017] that there could be 17,000 to 22,000 freelancers in Sri Lanka registered with various platforms and selling their skills online. With an average monthly earning of $200, and with 7800 active freelancers [Galpaya 2017] estimates that the revenue per year from online freelancing is around $18.7 million. In [Echelon 2017], Nalaka Gunawardene identifies the absence of fully developed international micropayment services like PayPal accounts to conveniently receive remittances as the main barrier for Internet entrepreneurship to flourish in Sri Lanka. Although the Sri Lankan government is keen, it appears that PayPal is not very eager. Additionally, uneven quality of broadband Internet and frequent disruptions to electricity supply are major issues when working under tight deadlines. Otherwise, this could be a higher revenue model for Sri Lanka.

IT/BPO (Business Process Outsourcing) Sector (Knowledge) also boomed during the 2010-2018. Sri Lanka's knowledge services industry was the fifth largest export earner for Sri Lanka in 2018 and is currently estimated to be USD 1.2 billion. There are over 300 IT / BPM (Business Process Management) companies, mostly small and medium companies and few large global players that operate in Sri Lanka with an estimated 80,000 fulltime workforce contributing $10,625 per employee annually.

(4) Internet of Things (IoT)

The concept of the Internet of Things (IoT) is that the Internet allows digital devices – the so-called "Things" – to connect in order to communicate and exchange information involuntarily for various purposes. IoT can be defined as "the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data." The IoT revolution would make transforming new and innovative business ideas into reality much easier [Induruwa 2016].

IoT has created new market opportunities for Sri Lankan developers of industrial automation solutions, embedded systems, etc [Induruwa 2019a]. It has been identified that to deliver seamless IoT, connectivity is a crucial element. The demand thus created has prompted network operators to launch new services such as low power wide area (LPWA) networks, and use NB-IoT and LTE-M technologies to create added value and ensure sustainable growth.

To support the development of new network infrastructure, the Sri Lanka government's Board of Investment formally approved a significant investment in 2018 for the expansion and upgrade of 4G mobile and fixed broadband services [DevelopingTelecoms 2018]. The market is

now shifting from 4G towards 5G mobile services. Dialog Axiata has conducted a 5G network capability trial in Colombo with technology partners Ericsson and Huawei. The demonstration showcased a range of 5G solutions, including Massive MIMO, cloud radio, IoT-based smart parking, and real-time 4K video streaming. Dialog Axiata has claimed the first launch of a South Asian NB-IoT-enabled network supporting IoT solutions in the region [DevelopingTelecoms 2018]. Mobitel has completed another round of proof-of-concept (PoC) tests for LTE-Advanced Pro (LTE-A Pro) technology in Colombo [Businesswire 2018].

IoT initiatives led by government and private organizations have generated significant momentum. Start-up incubators are also supporting the growth of IoT development within Sri Lanka, along with technology facilitators. The Ministry of Digital Infrastructure led a project to raise awareness of the Internet of Things (IoT) through the use of basic hardware, distributing 1,930 IoT kits and 7,720 micro:bit kits. Other institutions, such as the University of Moratuwa, have organized and conducted training workshops.

McKinsey forecasts that IoT will generate up to $11trillion a year in economic value by 2025, i.e. 15% of the current global GDP [McKinsey 2015]. This translates to substantial growth potential for Sri Lanka too. According to McKinsey predictive maintenance using IIoT (Industrial IoT) is estimated to reduce maintenance costs by 10-40% and reduce downtime by 50% in industries.

Now leading IoT operators and ISPs are building on this and leveraging their reputation as trusted industry partners by offering value-added services beyond connectivity. These innovative solutions include services across IoT, IIoT, big data, machine learning, analytics, edge computing, and enablement platforms.

Although IoT has immense potential in creating new innovative business opportunities for creating intelligent infrastructure, such as building smart cities for example, the security threats emanating from vulnerabilities in IoT infrastructure is a major concern [Hussain 2020a].

(5) Internet and Health

eHealth in Sri Lanka started with the formation of the National eHealth Steering Committee within the Ministry of Health in June 2010. Since then, the Sri Lankan health sector has developed the following national eHealth base documents.

- National eHealth Policy;
- National eHealth Standards and Guidelines;
- National eHealth Strategy.

Ministry of Health has also transformed its paper based Indoor Morbidity and Mortality Record system into a web-based system eIMMR [eIMMR 2009] to form an integral part of their health information system which supports management of healthcare, monitoring of disease patterns and evaluation of treatment and prevention [Kariyawasam 2011]. Important eIMMR milestones up to 2016 are show in Figure 8.

Due to the farsightedness of the Ministry of Health, Sri Lanka became the first country to successfully deploy a DHIS2 (District Health Information Software 2) [DHIS2 2020] tracker instance specifically designed for Covid-19 surveillance within just two days after the first suspected coronavirus case was registered in the country on January 27, 2020. The DHIS2 instance was operational at the country's airports—thanks to the support and training provided by HISP (Health Information System Programme) Sri Lanka—to register and track incoming travelers from areas with a high risk of Covid-19 infection.

Later, in May 2020, TraceMe [TraceMe 2020], an Android based tracing app developed by Redot Pvt Ltd [Redot 2020a] as a social project to support the government efforts in tracing was released. TraceMe claims that it is the first contact tracing platform built in Sri Lanka to help stop the spread of COVID-19. An iOS version for Apple iPhones is promised in the near future. Around the same time, eWIS (e-w Information Systems Ltd) as part of their corporate social responsibility during Covid-19 [eWIS 2020] has supported the government efforts by launching the following initiatives:

- A video conferencing facility for Health Ministry officials;
- 24/7 uninterrupted support in ensuring the availability of medical supplies across the country;
- Technical and Engineering support to telecast the "National Corona Awareness Programme" in all the local TV channels simultaneously.

(6) Internet and Education

One of the key pillars of sustainable development in any country is education. The deployment of the Internet in a country has tremendous potential to enhance the quality of modern education there.

The Internet has affected all types of education: formal, informal and non-formal. During the period after 2010 there is a noticeable improvement in the education content online and many formal institutes, both in the public and private sectors, have started offering online education and certifications. In the state sector, Open University of Sri Lanka (OUSL) has been operating distance education nodes for many years now. Private sector engagement in online education has also created a hype in Internet based education during the period.

The impact of online education became evident with the onset of the Covid-19 pandemic. As a safety measure, all schools were closed, but the government made efforts to provide

education through online channels more frequently [Hussain 2020b]. The Internet has created an opportunity to assist educators and students. Teachers set up YouTube channels, Facebook pages and groups, and shared educational material via social media such as WhatsApp. These efforts were highly supportive for students and parents who were unable to participate in face-to-face education for months. Now, most schools have implemented online education systems using popular Learning Management Systems (LMSs).

The online program is being implemented by the Ministry of Education in Sri Lanka, in collaboration with Microsoft Sri Lanka and EWIS. The program has been phenomenally successful, growing from just 1 student to 100,000 students, 1 school to 330 more schools, and just 1 teacher to 2800 more teachers within 03 months, with high rates of retention and satisfaction.

In the Sri Lankan Higher Education sector online education was a feature even before Covid-19 but the delivery and consumption of online content, and the conduct of assessment and examinations, have seen a dramatic increase during 2020. The 15 state sector Universities were fully supported by LEARN – the Sri Lankan NREN – (see next section) and those in the private sector were supported by the fixed-line and mobile communication service providers such as Sri Lanka Telecom, Mobitel, Dialog, etc. In doing so they have introduced many subsidies for students accessing an institutional LMS for their learning.

(7) Further development of LEARN and its role in online education

In 2019, Lanka Education And Research Network (LEARN) celebrated 30 years since its conceptualization in 1989 [Hussain, 2019]. LEARN's goal is not only to offer comprehensive network-related services to the academic and research community but also to unite the community [Ragel 2019]. The pioneers of LEARN—those who worked on implementing the concept over the years—have identified its development into five phases, namely:

Phase I - the mid to late 90s when the Government funded the project via University Grants Commission (UGC);

Phase II - the late 90s to early 2000s when LEARN was able to secure funding from the Swedish International Development Agency (SIDA);

Phase III - during the mid-2000s when the institutions were connected using IP-VPN over MPLS network;

Phase IV - during late 2000s to early 2010 when the member institutions got connected through fibre and LEARN was formed into a company limited by guarantee in 2009; and

Phase V - 2010 onwards where LEARN is now owned by 16 of its members (15 State Universities and the UGC). As of 2020, LEARN also has 15 associate and 18 affiliate member institutions.

Since its formation into a company, LEARN has made significant progress. In 2010, LEARN connected to the Trans-Eurasia Information Network (TEIN) with a 45 Mbps link. Later, in 2011, LEARN was registered as an Internet Service Provider (ISP) in Sri Lanka and has maintained this status ever since. In 2012, an additional 20 member sites were connected to LEARN, and in 2013, the total commodity Internet bandwidth was increased to 1.65 Gbps.

The year 2015 was significant because LEARN established a presence (point of presence, PoP) outside Sri Lanka by purchasing a 2.5 Gbps link to Singapore Global Switch and connecting the TEIN network, SingAREN, Internet2, and Google through this link. In 2016, LEARN upgraded its commodity Internet bandwidth to 7 Gbps, raising the total LEARN backbone bandwidth to 9.5 Gbps. That same year, LEARN joined eduroam, the global educational roaming service. Since then, LEARN has promoted eduroam among its members, making both local and global mobility easier for users of the member institutions.

In 2017, LEARN launched the Asi@Connect project as a successor to the TEIN4 project, beginning with a local event in Sri Lanka. In subsequent years, LEARN strengthened its engagement with regional and international NRENs, exchanging knowledge through more advanced training and workshops. LEARN is part of the European Union-funded Asi@Connect project, in which Sri Lanka manages two sub-projects focused on education and training for engineers in the region. Additionally, Sri Lanka/LEARN is listed as a direct beneficiary in several other Asi@Connect sub-projects. The current TEIN network diagram, now called the Asi@Connect network, is shown in Figure 9.

In the year 2018, LEARN got connected to India's National Knowledge Network (NKN) via a 1 Gbps link. In the same year, LEARN also formed its Identity Federation, known as LEARN Identity Access Federation (LIAF) and later, in the following year, joined eduGAIN, an international inter-federation service interconnecting research and education identity federations. The same year, LEARN upgraded its commodity Internet bandwidth to 14 Gbps and its Singapore link to 5 Gbps.

Figure 10 depicts the LEARN network diagram as of 2019. The LEARN backbone is also connected to the Lanka Government Network (LGN2) and India's NKN (National Knowledge Network) via separate 1 Gbps links. LEARN maintains two main routers at Dialog and SLT IDCs. The members are connected to the network via Primary and Backup VPLS (Virtual Private Line Service) links as shown in Figure 10.

In the year 2019, LEARN celebrated its 30th anniversary since inception [Induruwa 2019b] and also the 10th anniversary of its formation into a company. In the same year, LEARN has hosted two international workshops (one in Sri Lanka and one overseas), one local seminar and a local workshop and has supported about 25 foreign training and engagement opportunities for our members. Technical topics covered included hosting video conference solutions and building the campus area networks based on community best practices. In 2020, LEARN hosted its first workshop abroad in Laos extending LEARN technical assistance to the region. This workshop helped the deployment of IPv6 in Laos and Bhutan NRENs. By introducing our own Identity Access Federation (LIAF), LEARN plans to support its members with their applications and research.

In recognizing that sharing network operation technical expertise and knowledge can serve a very important role in community building and engagement in Asia, the South Asian Network Operators Group (SANOG) [SANOG 2020] has been formed as a sub-regional, community-led initiative in 2003 [Choudhury 2019]. Realizing the benefits of bringing network operators and networking professionals in Sri Lanka together in terms of educational, knowledge sharing and collaborative aspects, the LKNOG (Lanka Network Operators Group) was formed in 2017 with the objective of providing a local and regional platform to discuss operational issues and technologies that interest network operators in Sri Lanka [LKNOG 2020]. LEARN has actively supported and promoted the work of SANOG and LKNOG. During the decade 2010-20, LEARN has hosted two SANOG meetings in Sri Lanka, one in 2011 (SANOG 17) and the other in 2015 (SANOG 25). LEARN is planning to host the next SANOG meeting in Sri Lanka in July 2021.

The year 2020 has brought more challenges than before for both the Higher Education and Research sector and therefore for LEARN. COVID-19 pandemic forced all physical interaction of the sector on hold and LEARN with its local and international connectivity was able to come for the rescue of its member institutions at these trying times. Before the COVID-19 pandemic, the majority of the State Universities practised blended learning using Learning Management Systems (LMS, such as Moodle). LEARN connects these LMS servers through high-speed Internet. State University members had access to these servers on the LEARN network through public Internet facilities by using paid services offered by Internet Service Providers (ISPs) in Sri Lanka. Under the guidance of the President of the country, and in collaboration with Telecommunication Regulatory Commission (TRC) and the ISPs, the UGC was able to obtain free data access to those servers in the LEARN network of Universities. This initiative motivated the Study From Home (SFH) practices of staff and students of the State Universities in the current situation. The foregoing highlights the progress made in 21 weeks since the resumption of online learning activities on the 23rd of March 2020. The UGC decided to go back to "normalcy" on the 17th of August 2020.

Accessing the Learning Management System (LMS) with free data provided has become the norm for asynchronous teaching and learning within the State University sector now. The last 21 weeks usage statistics are in Figure 11. This Figure presents two types of data, namely:

1. **#Participants**: The number of users (teachers/students) who access the University LMSs on a daily basis, aggregated to a week;
2. **#Online Activities:** The number of online activities performed by the users weekly; an activity could be accessing a reading material, following a lecture slide, attending an online quiz, etc.

It is seen from Figure 11 that both the total number of users accessing the system and the total number of LMS activities carried out by users have increased during the first three weeks, then dropped a little during the New Year week and again picked up in the next few weeks. In week eight numbers reached a peak of *13 million* activities and the following weeks have recorded more than *10 million* activities each. The statistics show a gradual decrease in the last 5 weeks and numbers have dropped down to *5 million* activities. The total number of activities performed

by the LMS users from the State Universities is about *186 million* during the said 21 week period with nearly *4.5 million* aggregated user logins.

For synchronous teaching and learning at State Universities, LEARN offered a video conferencing solution (LEARN.zoom.us). During the present situation, LEARN set up its own media servers with its member network and provided a faster and cheaper solution to its members (teachers and students). As a result, it was possible to keep the video conferencing data traffic within the LEARN network saving international data bandwidth. The solution has become a livewire of the synchronous teaching method for the State Universities. The video conferencing activities illustrated here for the last 21 weeks is the evidence for the claim.

Figure 12 presents two types of data, namely:

1. #**Sessions:** the number of online sessions (lectures, discussions, meetings, etc.) weekly;
2. **#Participants:** the number of participants attended such sessions weekly.

As per Figure 12, both the total number of sessions per week and also the total number of weekly participants for such sessions has increased during the last 21 weeks although it shows a little decrease in 20th week due to election vacations. The numbers have again increased vastly week by week and recorded the peak number of participants in the eighteenth week with about *540,000* participants (more than 27x since week 1). During these 21 weeks, the State University users had about *160,000* sessions with a total of nearly *6.7 million* participants.

LEARN official blog gives more complete analysis of the online teaching and learning activities of state universities under the UGC during the Covid 19 lockdown in Sri Lanka [LEARN 2020].

In Phase V, LEARN not only tries to maintain and improve on the initial vision of the establishment but also work on providing economically viable and state-of-the-art network connectivity and services to its members. At present, LEARN's backbone accounts for more than 20 Gbps bandwidth including 3 Gbps access to the regional and global NREN network. LEARN member connections stand at about 80 with around one-third of them having separate backup links through secondary physical circuits for redundancy. LEARN's directions for the next decade is to go beyond the connectivity provider and be the ICT infrastructure and service provider for the research and education community. Such services will include state-of-the-art video conferencing facilities, in-house learning management system, other media servers and services, digital learning environment, student management system, digital assessment, learning analytics, etc., [Ragel 2019].

(8) Internet Governance Activities

Among the main policy decisions in the period is acceding to the Budapest Convention in 2015 which is the Convention on Cybercrime of the Council of Europe (CETS No. 185). This is the only binding international instrument on Cybercrime in Sri Lanka. It serves as a guideline for

any country developing comprehensive national legislation against Cybercrime and as a framework for international cooperation between state parties to this treaty. This augments the portfolio of previously enacted cybercrime prevention Acts namely: Computer Crime Act of 2007; Intellectual Property Act of 2003 and subsequent Penal Code Amendment in 2006; Information Communication and Technology Act of 2003; Payment Devices Frauds Act of 2006; and Electronic Transactions Act of 2006.

In the period 2016 -2017 Sri Lanka had inaugurated the Internet Governance Forum and the School on Internet Governance has been a beneficial new experience for the local community.

In 2018 the government accused the Internet for amplifying hate speech and allowing groups to coordinate attacks against Muslim residents during riots in district of Kandy. As a controlling measure the Government then decided to restrict the Internet within the country. It is estimated that the blockage of Social Media and messenger apps by the Government had resulted in an economic loss around 30 million dollars [Gross 2018]. Internet rights activists had taken action against this decision of the Government to shutdown Internet and it is claimed that the advocacy campaigns organised by them were responsible for being able to lift the ban.

In 2019 the government, with the aim to create a trusted and resilient cybersecurity ecosystem, prepared "Cyber Security Act" for adoption in the parliament and invited public comments. The Internet Society and Internet community engaged with draft bill [ISOCSriLanka 2019] and, while identifying and supporting the need of an act to protect critical infrastructure in the country, informed the authorities of issues that the proposed bill had. It was found that the bill was aiming to protect the Critical Infrastructures through establishing a National Cybersecurity Agency (NCA) as an independent apex authority for cyber security, but the definitions of some of the main terms were too open, for example the definition for Critical Infrastructure given in the bill. Commenting on the proposed bill, the Meta Defence Labs [Vithana 2019] have felt that the "Agency have such a vast portfolio of responsibilities that it can't possibly give the attention and resources required to achieve cyber resilience". The discussion and advocacy on such issues had delayed the process of adopting the bill.

Sri Lanka held its first ever Internet Governance Forum (IGF) in March 2016, supported by ISOC Sri Lanka Chapter, the IGFSA (Internet Governance Forum Support Association), the Sri Lanka Ministry of Telecommunication and Digital Infrastructure, and many more stakeholders. The main goal has been to allow the voice of people to be heard by policy makers on issues related to Internet Governance and to help citizens to take an active part in decision-making processes. Particular attention has been paid to the participation of people from vulnerable groups and those with fewer opportunities for better social inclusion [IGFLK 2016]. The second IGFLK was held in May 2017 focusing on Cyber Security and Safer Internet [IGFLK 2017].

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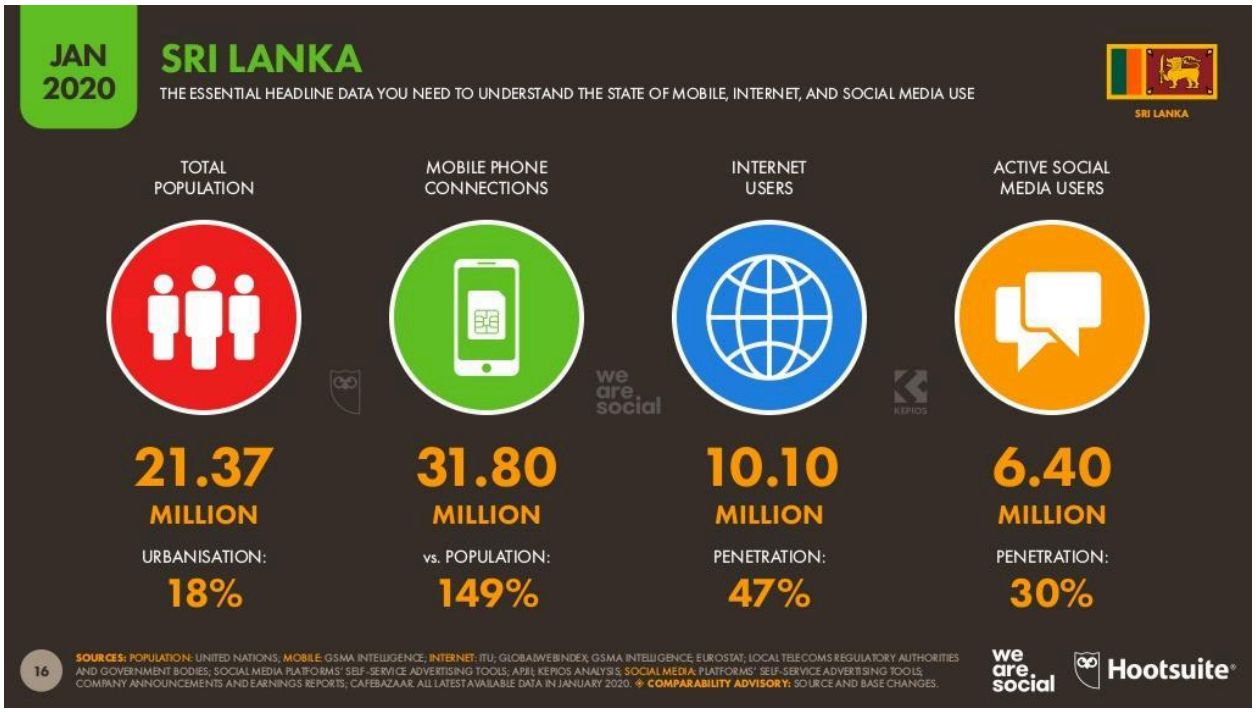


Figure 1. Mobile, Internet & Social Media use in Sri Lanka in January 2020

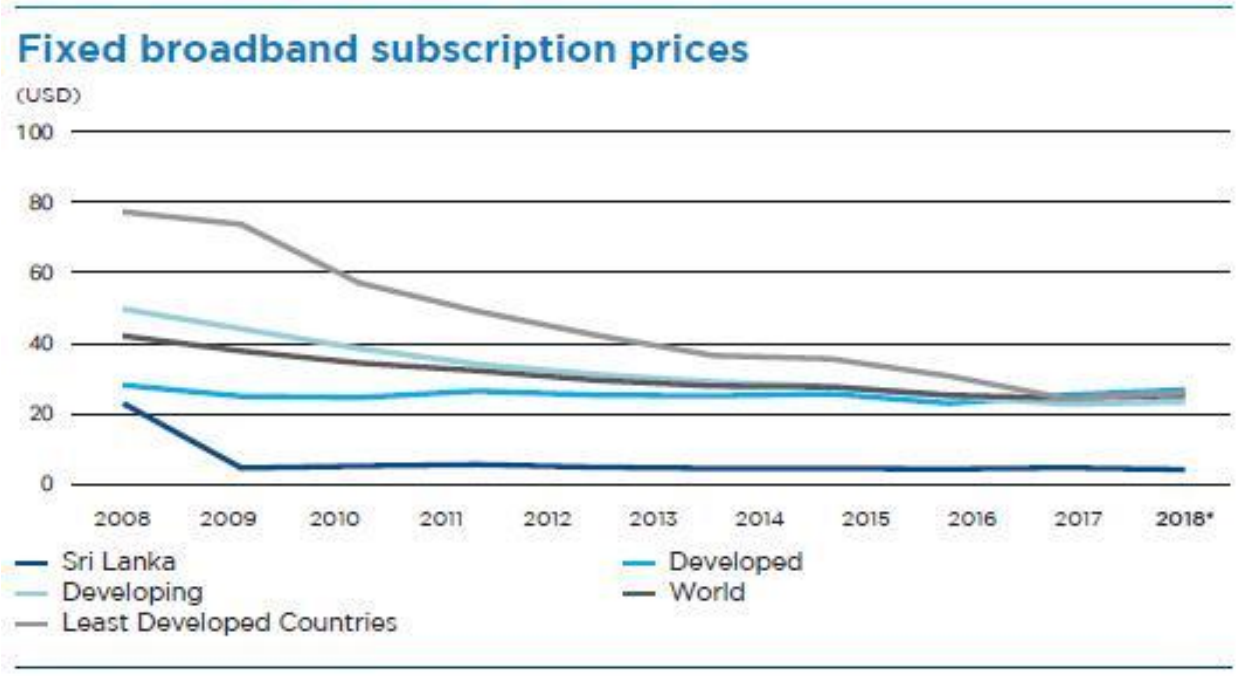


Figure 2. Comparison of fixed broadband subscription prices

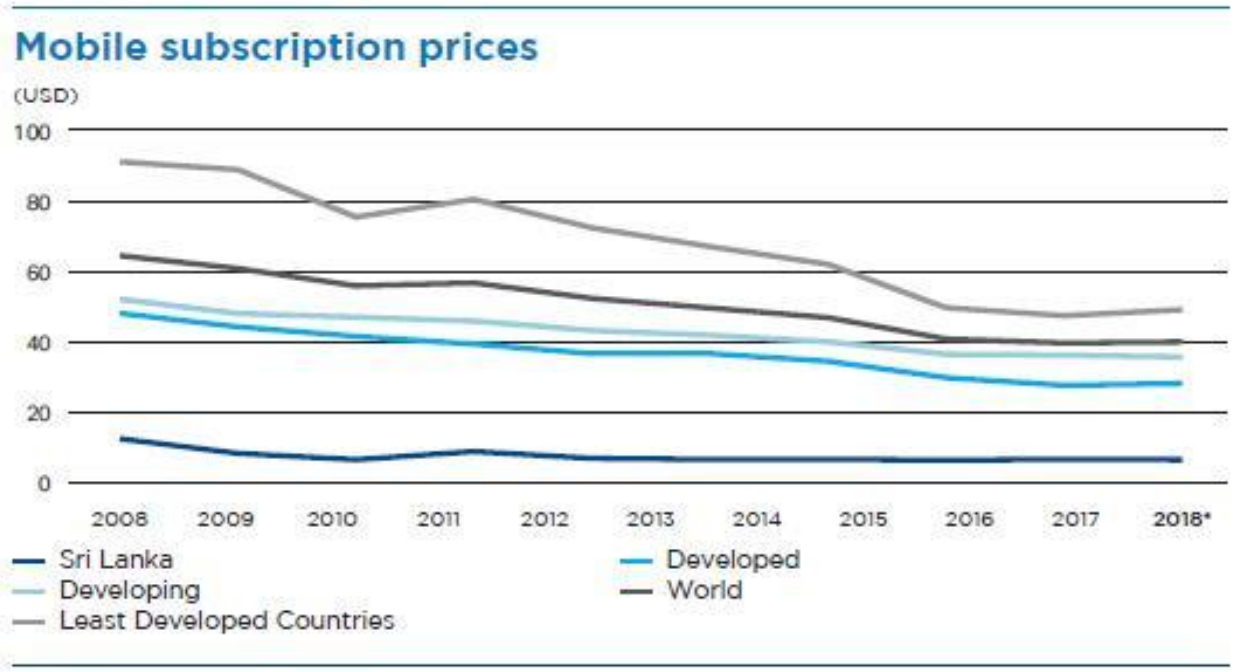


Figure 3. Comparison of mobile subscription prices

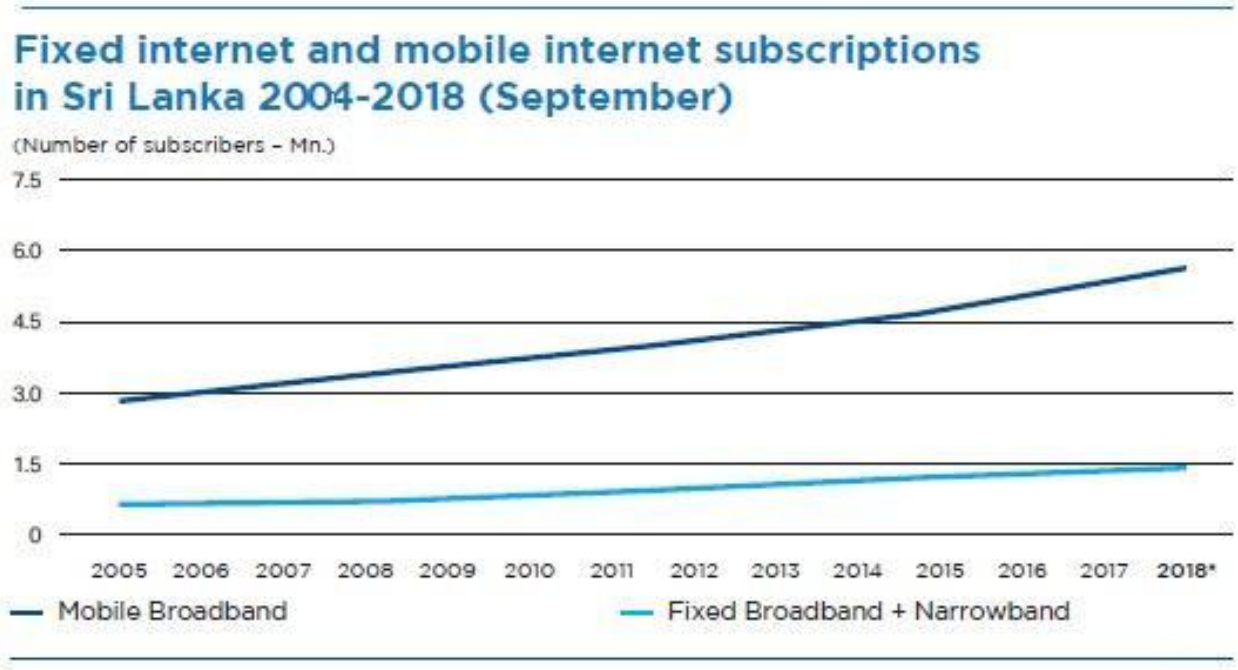
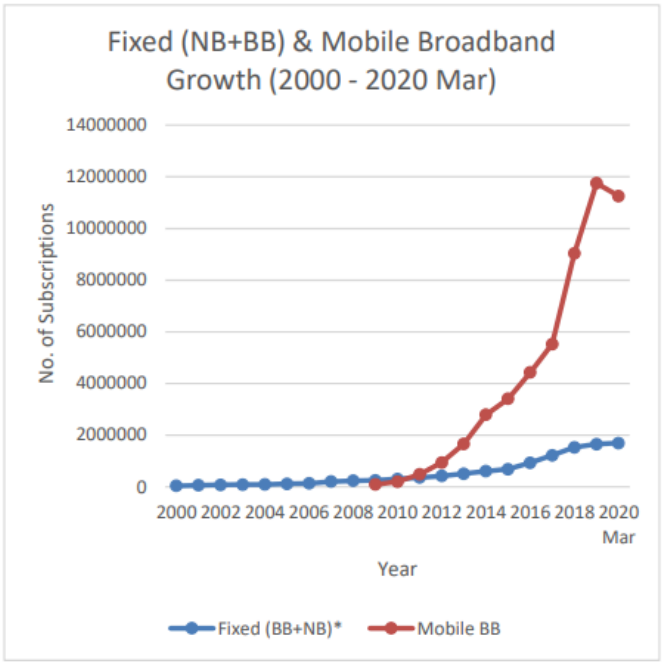


Figure 4. Growth of Internet subscriptions

Year	Fixed (BB+NB)	Mobile BB
2000	40,497	
2001	61,532	
2002	73,468	
2003	85,500	
2004	93,444	
2005	115,000	
2006	130,000	
2007	202,348	
2008	234,000	
2009	249,756	91,359
2010	302,000	200,000
2011	359,000	485,000
2012	423,194	942,461
2013	507,845	1,664,003
2014	606,100	2,790,195
2015	682,512	3,408,408
2016	929,089	4,429,344*
2017	1,221,960	5,525,194*
2018	1,530,099	9,032,576*
2019	1,654,237*	11,754,166*
2020 Mar	1,686,824*	11,392,156**

** - estimated, * - Provisional



Note: BB – Broadband, NB – Narrow Band

Figure 5. Impact of introducing mobile broadband subscriptions, March 2000-2020

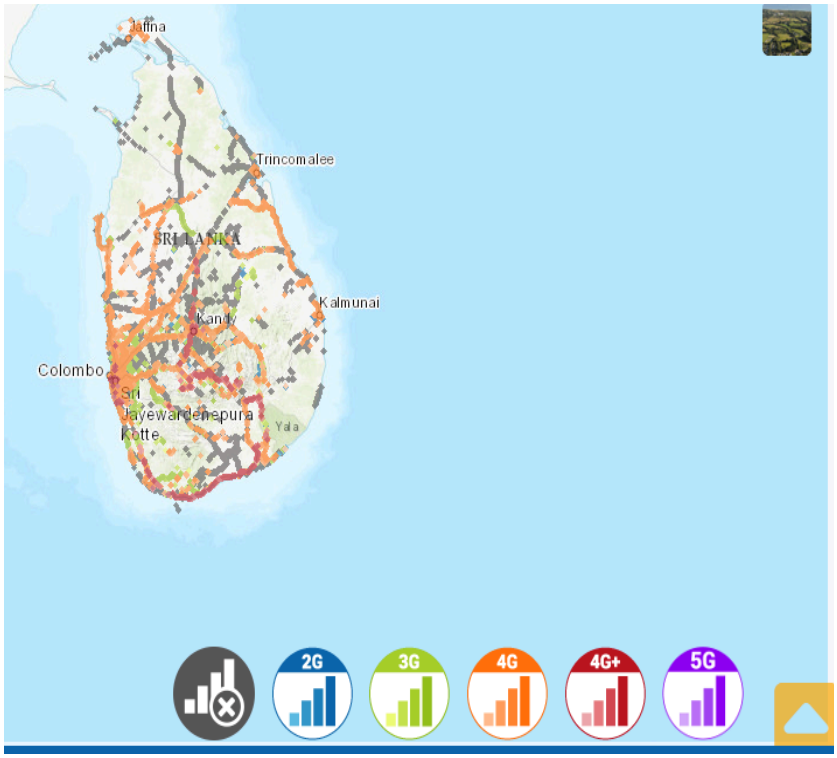


Figure 6. Mobile coverage (of two mobile providers)

- *Internet banking which allows bank customers to access banking services in a convenient and efficient manner through Internet was introduced in Sri Lanka in 1999.*
- *Financial institutions offer facilities through Internet banking, for customers mainly to obtain account information, apply or subscribe for financial products/services, perform own account/ third party fund transfers and pay utility bills.*

Table: 16 **Internet based Payment Systems**

Description	Volume ('000)				Value (Rs. billion)			
	2018	Q1 2018	Q1 2019 (a)	Percentage Change Q1 19/18	2018	Q1 2018	Q1 2019 (a)	Percentage Change Q1 19/18
Total financial transactions (during the period)	26,930.4	5,987.8	7,959.4	32.9	2,939.3	1,106.5	674.0	-39.1

(a) Provisional

Sources: Licensed Commercial Banks
Licensed Specialised Banks
Finance Companies

Figure 7. Comparison of volume and value of Internet based payments in Sri Lanka between 2018Q1 and 2019Q1

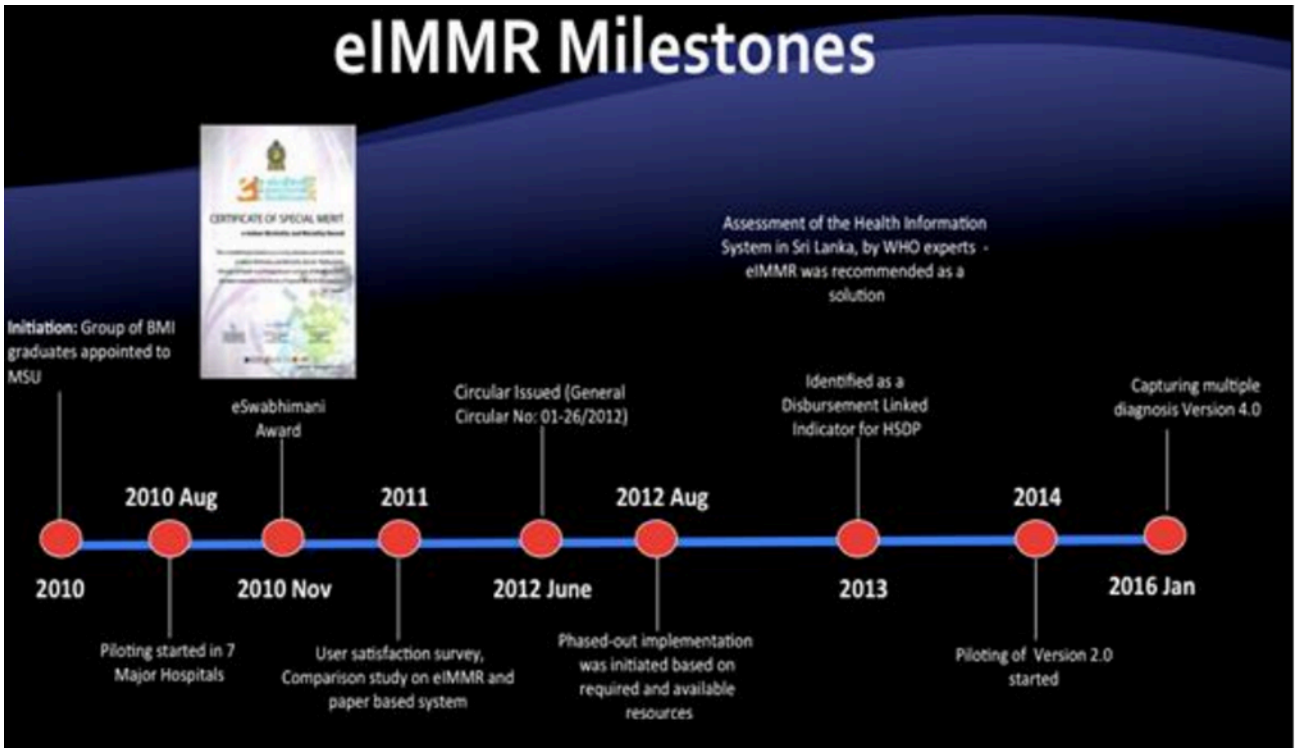


Figure 8. eIMMR milestones

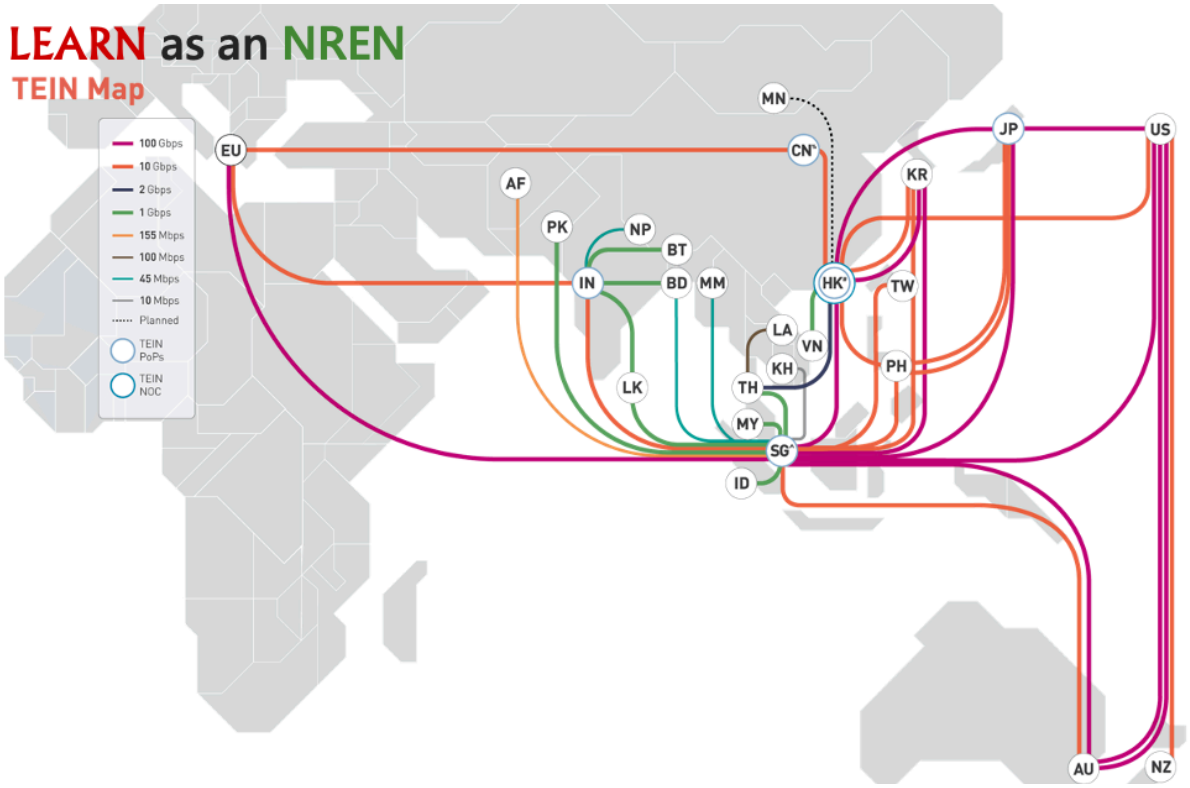


Figure 9. Present TEIN network diagram

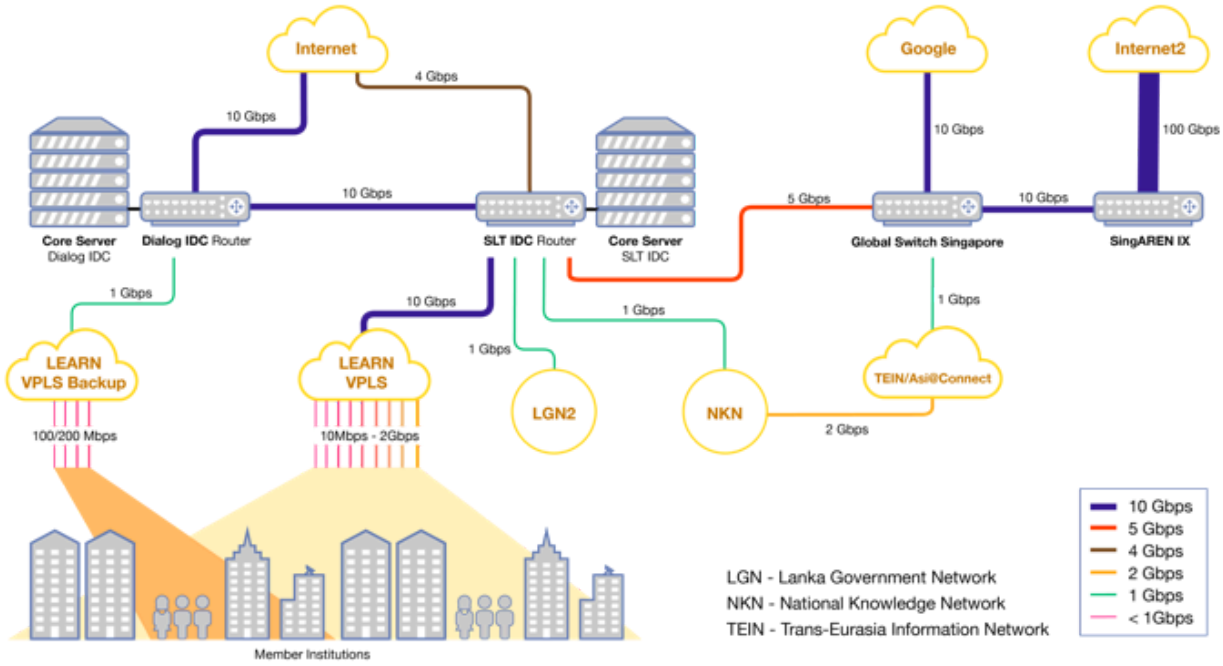


Figure 10. LEARN network diagram showing both local and international backbone connectivity as of 2019

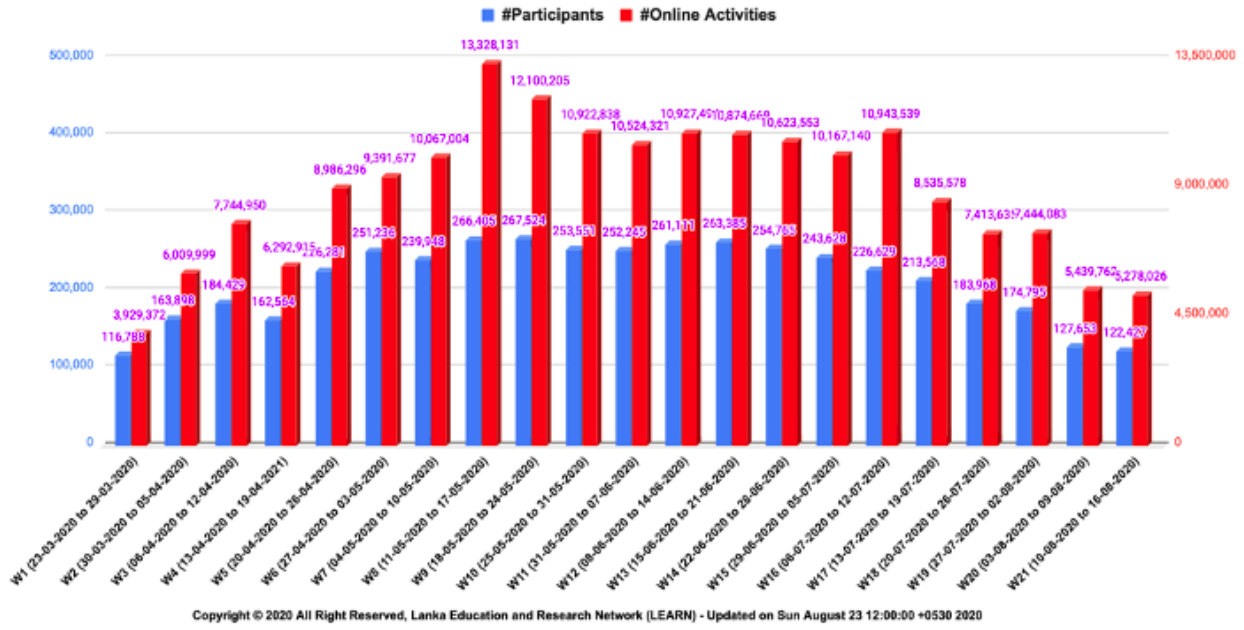


Figure 11. State Universities: Weekly Asynchronous Activities (LMS)

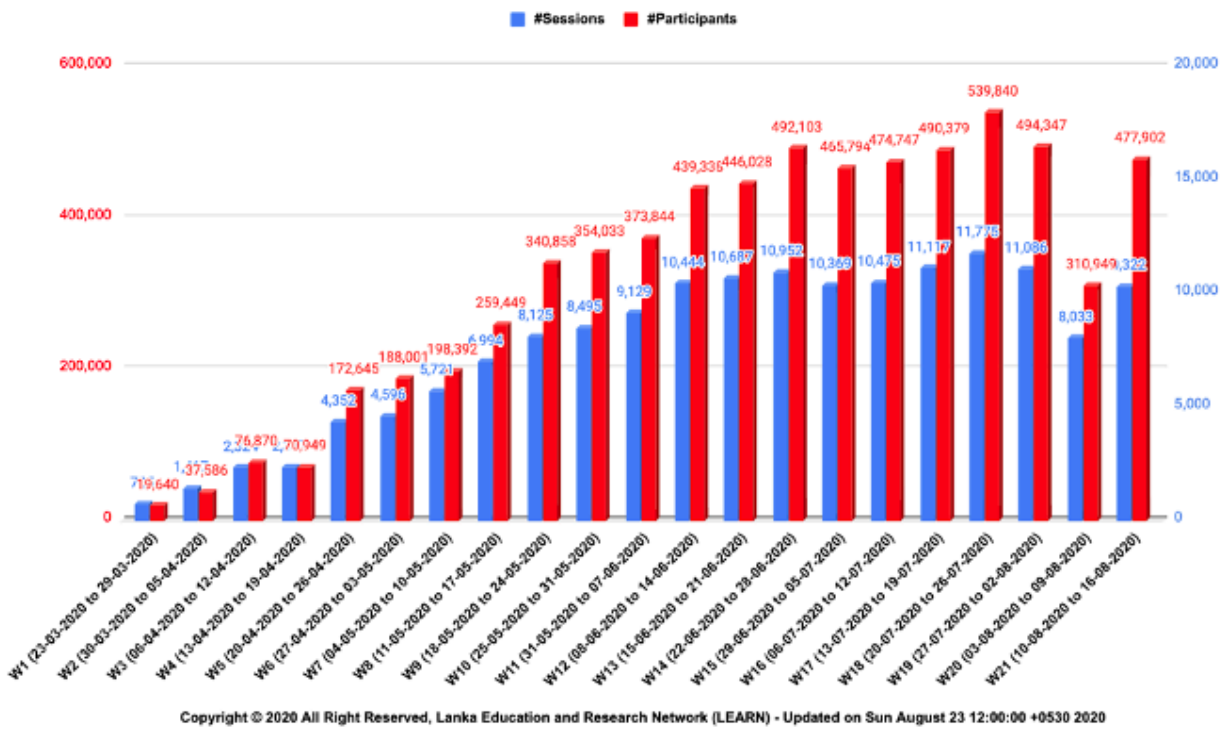


Figure 12. State Universities: Weekly Synchronous Activities (LEARN.Zoom.US)

4.11 Snapshot of Internet in Uzbekistan around 2020

Sang Chul Shin

Information

* ccTLD: UZ (the date of ccTLD delegation: 1995-04-29)
* Population (Year)
  1,288,307,100 (2000) / 1,330,141,295 (2010) / 33,376,000 (2019)
* Internet Population (Year)
  2,250,000 (2000) / 4,200,000 (2010) / 15,500,000 (2018)
* Broadband Population (Year)
  126,337,000 (2010) / 22,700,000 (2018)
* IP Address Allocation (Year):
  Number of IPv4 addresses: 81 blocks with 301,351 IPv4 addresses assigned (2019)
  Number of IPv6/48s: 27 blocks (2019)
* 5 Popular Websites [from alexa.com]:
  Портал Mail.Ru : mail.ru
  google : google.com

Яндекс : yandex.ru
Одноклассники.ru : odnoklassniki.ru
google.co.uz : google.co.uz

Overview

Since the country's independence in 1991, the development of the Internet sector has been one of the Government priorities. Private Internet services began in the late 1990s, and the number of Internet users increased from 855,000 as of February 2006 to 7.7 million in 2011 and 9.5 million in 2012, and 15.5 million (48%) as of 2018.

As of June 2018, the international circuit gate has a capacity of 140Gbps (54.9Gbps/2015), and the backbone was completed with the construction of an optical cable of 22,350km nationwide (1,800km/2015). As of September 2018, the total length of the optical cable was 35,000 Km, the number of Internet users was 20 million, and the international network gate speed was 140 Gbps.

According to the president's special order, in November 2018, efforts were made to dramatically increase bandwidth by 10 times and reduce rates by 2-3 times. As of September 2019, the Internet speed is 129th with 11Mbps for mobile and 116th with 19.9Mbps for wired. There are almost no optical cables to the house, and 40Mbps is the physical limit as A/VDSL using telephone lines is the mainstream. In order to provide a bandwidth of 100M and 1Gbps, it is expected that it will take about 10 years to build GPON and optical cables.

However, the telecommunications (internet), computer, and software sector is a growing trend, and the current Internet and telecommunications market is over 30% per year, and the growth rate of computer and software services is 12.2%, which is very noteworthy.

At the beginning of 2018, the number of Small and Medium Enterprises (SMEs) totaled 230,000, of which 149 companies related to information and communication were.

Key indicators for Uzbekistan (2017)		CIS	World
Fixed-telephone sub. per 100 inhab.	10.8	19.8	13.0
Mobile-cellular sub. per 100 inhab.	76.0	138.3	103.6
Active mobile-broadband sub. per 100 inhab.	59.4	72.0	61.9
3G coverage (% of population)	75.0	80.3	87.9
LTE/WiMAX coverage (% of population)	43.0	61.1	76.3
Individuals using the Internet (%)	*52.3*	68.6	48.6
Households with a computer (%)	38.5	68.1	47.1
Households with Internet access (%)	79.9	73.6	54.7
International bandwidth per Internet user (kbit/s)	9.6	66.8	76.6
Fixed-broadband sub. per 100 inhab.	10.4	17.8	13.6
Fixed-broadband sub. by speed tiers, % distribution			
-256 kbit/s to 2 Mbit/s	56.0	12.2	4.2
-2 to 10 Mbit/s	35.1	25.1	13.2
-equal to or above 10 Mbit/s	8.9	62.7	82.6

Note: Data in italics are ITU estimates. Source: ITU (as of June 2018).

The status of Internet Infrastructure

Rates of internet penetration continue to rise in Uzbekistan. Internet access is based primarily on asymmetric digital subscriber line (ADSL) technology. The International Telecommunication Union (ITU) estimates that internet access was available to 79.9 percent of households as of 2018, though only 52.3 percent of the population uses the internet. Users increasingly access the internet through their mobile devices, with the number of mobile internet users reaching 20 million in April 2018 (in a country of 32.9 million people). That year, the ITU estimated Uzbekistan's mobile broadband penetration rate at 62.4 percent, while the country's fixed broadband penetration rate was just 12.7 percent. Internet connection speeds remain relatively slow. Subscribers experience poor connection quality and frequent disconnections. According to Speedtest, as of May 2019, the average fixed broadband download speed was 14.37 Mbps (putting Uzbekistan in 131st place globally), while the average mobile broadband download speed was 9.77 Mbps (129th globally). In 2018, Uztelecom, the state-run telecommunications monopoly, completed a modernization plan to expand the capacity of Uzbekistan's two international internet traffic nodes, which increased the capacity tenfold, to 1.2 Tbps. In 2018, Uztelecom launched a project called Transformation 2020, which aims to expand and improve internet access throughout the country, as well as make it more affordable. Uztelecom and at least two private mobile service providers offer public Wi-Fi hotspots in limited locations. In February 2018, President Mirziyoyev signed a decree that introduced tax relief and advertisement rights for businesses investing in Wi-Fi hotspots. In December 2018, SOLA, a private company working in partnership with state authorities, reported that 1,200 hotspots were available in Tashkent, with another 3,000 on the way. SOLA also outlined its plans to set up 45,000 Wi-Fi hotspots in the regions, as part of a plan to boost international tourism. Public access points are popular, particularly among young internet users.

In general, access to the internet remains expensive relative to household income in Uzbekistan. Prices for communications services including internet subscriptions increased slightly during the coverage period, according to government statistics. The government reported in July 2018 that the average monthly income was about $190. The average monthly cost of a fixed-line broadband connection in 2018 was $21.26, while 1 GB of mobile data cost $3.27 on average. According to the ITU, Uzbekistan has the second most expensive mobile internet in the Commonwealth of Independent States, after Tajikistan. Internet penetration rates are significantly lower outside of Tashkent. Tashkent has the highest rate of internet penetration and fiber to the building (FTTB) broadband connectivity in Uzbekistan, significantly higher than the country's 12 regions and the autonomous Republic of Karakalpakstan.

According to the latest data available, Uztelecom's FTTB broadband service reaches 4,500 buildings in Tashkent, compared to just four in Termez, a city in the remote Surkhandariya region on the border with Afghanistan, with a population of 136,000. Information and communication technology (ICT) facilities also depend on a stable electricity supply, which further disadvantages rural areas.

Uztelecom runs the International Packet Switching Center to aggregate international internet traffic at a single point within its infrastructure. Uztelecom is also an upstream internet service provider (ISP) and sells internet traffic to domestic ISPs at wholesale prices. Private ISPs are prohibited by law from bypassing Uztelecom's infrastructure to connect to the international internet, and from installing and maintaining their own satellite stations to establish internet connectivity. However, the government reportedly plans to permit private ISPs to establish their

own gateways to the international internet in 2020. The TAS-IX peering center and content delivery network, established in 2004, interconnects the networks of private ISPs to enable traffic conveyance and exchange at no mutual charge, and without the need to establish international internet connections via Uztelecom. Private ISPs provide no traffic limitations to websites hosted within the TAS-IX networks but filter and block other websites to the same extent as Uztelecom.

Uztelecom enjoys a monopoly in the fixed broadband market. Five mobile service providers operate in the mobile market, including three state-owned firms: Ucell, UMS (Mobiuz), and UzMobile, as well as two privately owned operators: Perfectum Mobile (owned by the Uzbek company Rubicon Wireless Communication) and Beeline (owned by VEON, which is based in the Netherlands but is primarily owned by a Russian investment group). Ucell, one of the largest mobile service providers (along with Beeline), was acquired by the government in November 2018 after its former owner, Sweden's Telia Company, announced in 2015 that it would exit Uzbekistan.

The total IPv4 addresses in Uzbekistan is 285,533 in 2020 [IP2Location 2020]. Its global ranking is 127 in 2019. There are 72 hosting companies in Uzbekistan, and the number of websites in Uzebekistan is 2,834, which ranks 61st globally.

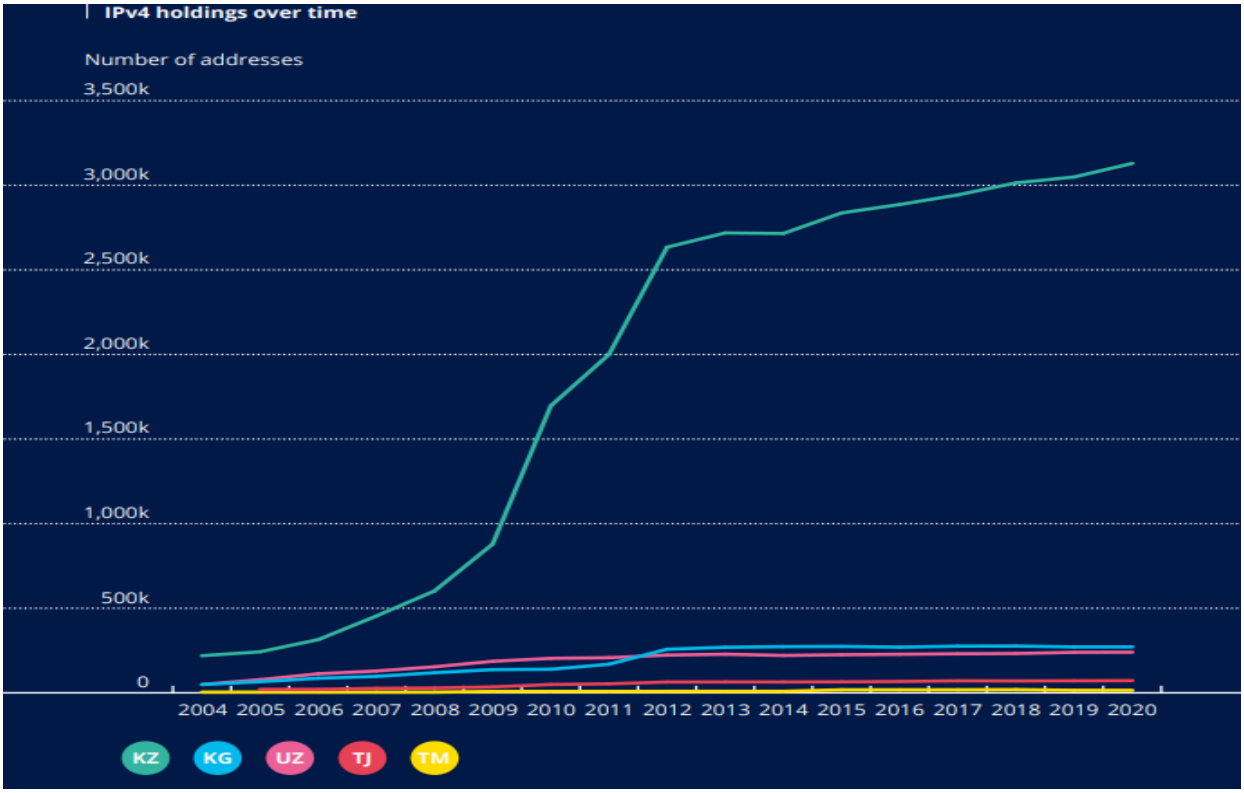


Figure 1 RIPE NCC Internet Country Report: Central Asia – IPv4

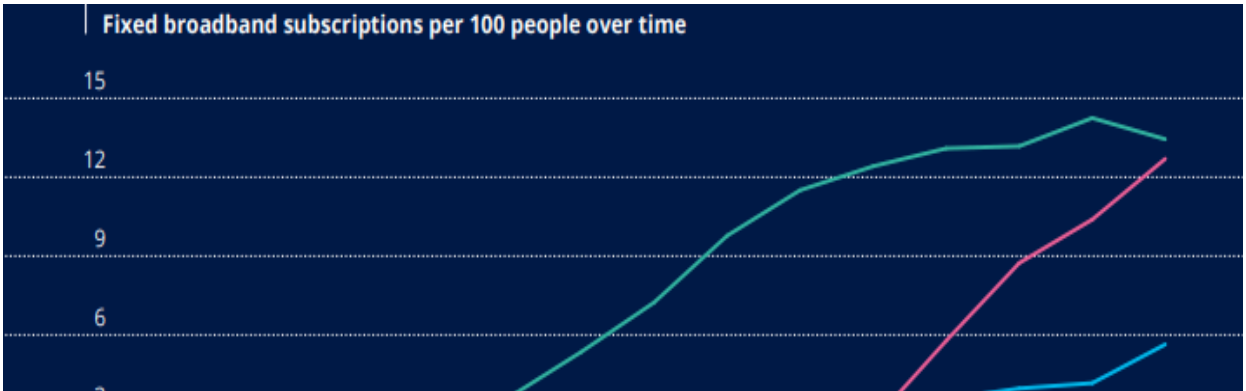


Figure 2 World Bank: Fixed broadband subscriptions per 100

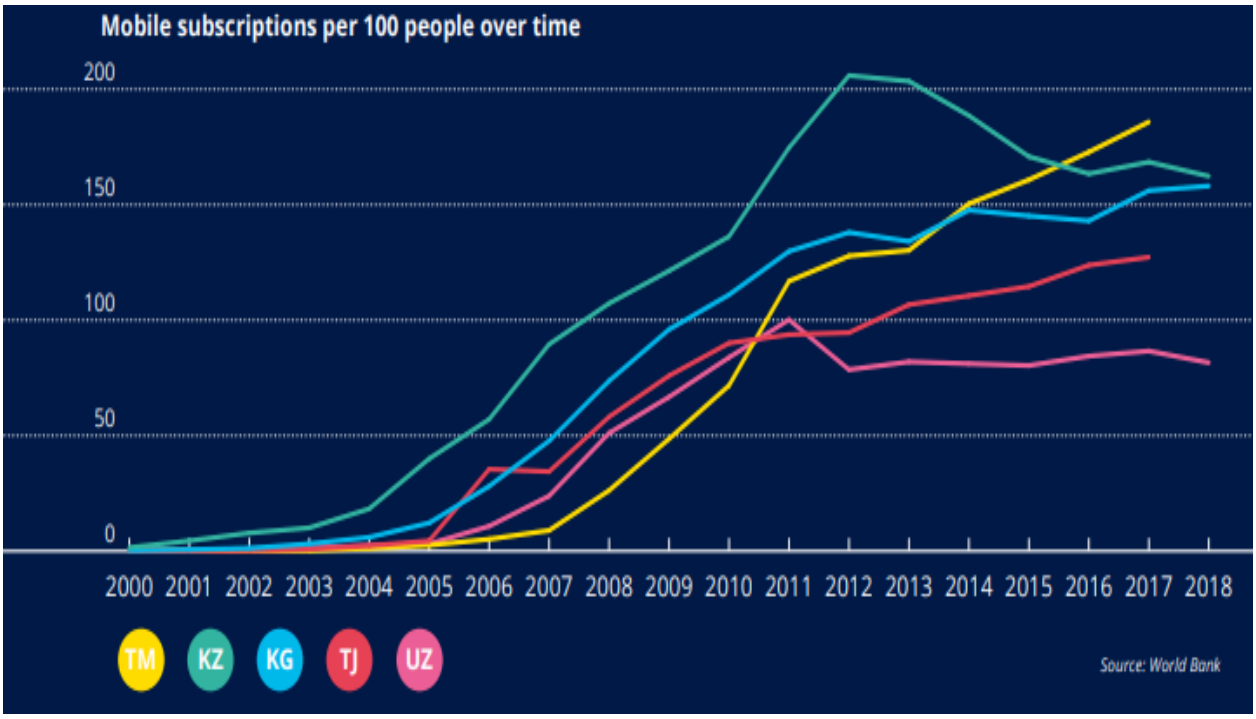


Figure 3 World Bank: Mobile subscriptions per 100 people

Table 1 History of Internet in Uzbekistan [Uzbekistan 2020]

	2014	2016	2017	2018
Speed External Internet (Gbps)	13	29		165
Coverage of population with Digital TV	45%	(60%)		100%
Internet Penetration (ITU)	35.5%	46.8%		-
Mobile Penetration (ITU)	73%	77%		-
Internet Subscribers	36.5%/100 households	14 mil.		15.5 mil.
Internet Domains	-	29,000		52,000
Fixed (Wired) Phones	8.2%/100 households 2.5 mil.	10.9%/100 households 3.4 mil.	10.8%/100 households 3.4 mil.	
Mobile Subscribers	66%/100 N/A	74%/100 20.8 mil.	76%/100 22.7 mil.	
Fixed Broadband Subscribers	2.7%/100 0.8 mil.	8.7%/100 2.7 mil.	10.4%/100 3.3 mil.	
Mobile Internet Subscribers	-	-		9.5 mil.
eGov Development Index	N/A	80th		81st
eGov online participation Index	N/A	47th		59th

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